INEXTECH

3RD International Next-Generation Innovation & Technology Exposition 2026

BOOK OF EXTENDED ABSTRACT

Bridging Ideas and Technology For A Resilient Future

Organized by:
Faculty of Plantation and Agrotechnology
Universiti Teknologi MARA (UiTM)

EVOLUSI DEKAD

UNIVERSITI TEKNOLOGI MARA

in Collaboration with
Jabatan Pendidikan Negeri Melaka (JPNM)
Sekolah Menengah Kebangsaan Agama Sharifah Rodziah

KEMENTERIAN PENDIDIKAN
JABATAN PENDIDIKAN NEGERI MELAKA

International Next-Generation Innovation and Technology Exposition (iNEXTECH) 2026

Book of Extended Abstract

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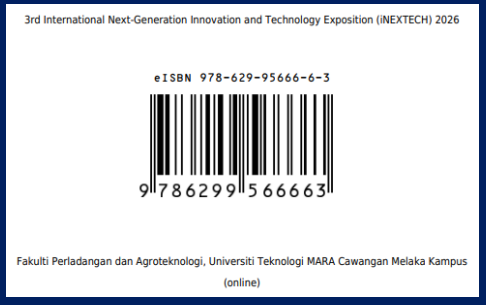


TABLE OF CONTENT

	Page
Foreword *Dean, Faculty of Plantation and Agrotechnology*	4
Foreword *Director, Malacca State Education Department (JPNM)*	5
Foreword *Chairman, i-NEXTECH 2026*	6
List of Extended Abstract *Category A1 (Professional & Industry Inventor-Group)*	7
List of Extended Abstract *Category A2 (Professional & Industry Inventor-Individual)*	8
List of Extended Abstract *Category B1 (Higher Education Student-Group)*	9
List of Extended Abstract *Category B2 (Higher Education Young Inventor-Individual)*	10
List of Extended Abstract *Category C1 (Primary School)*	11
List of Extended Abstract *Category C2 (Secondary School)*	12
Extended Abstract *Category A1 (Professional & Industry Inventor-Group)*	13
Extended Abstract *Category A2 (Professional & Industry Inventor-Individual)*	51
Extended Abstract *Category B1 (Higher Education Student-Group)*	58
Extended Abstract *Category B2 (Higher Education Young Inventor-Individual)*	141
Extended Abstract *Category C1 (Primary School)*	155
Extended Abstract *Category C2 (Secondary School)*	227

FOREWORD

Dean, Faculty of Plantation & Agrotechnology



Assalamualaikum Warahmatullahi Wabarakatuh and warm greetings.

On behalf of the Faculty of Plantation & Agrotechnology (FPA), Universiti Teknologi MARA (UiTM), it is my great honour and privilege to extend the warmest welcome to all participants, judges, collaborators, and distinguished guests to the Awards Ceremony of the 3rd International Next-Generation Innovation & Technology Exposition (i-NEXTECH 2026). i-NEXTECH was born from a simple but powerful conviction that the next generation of innovators deserves a global stage. Since its inaugural edition, this platform has grown from a local showcase into a truly international exposition that today brings together over 227 innovative projects from five nations including Malaysia, Indonesia, Thailand, Japan and Sri Lank**a.** This remarkable achievement is a testament to the trust, enthusiasm, and creativity of every participant who chose i-NEXTECH as the arena for their ideas. This year's theme, 'Bridging Ideas and Technology for a Resilient Future', could not be more fitting. The world we inhabit is changing at an unprecedented pace, shaped by technology, sustainability imperatives, and an ever-deeper need for human ingenuity. The projects presented in i-NEXTECH 2026 reflect exactly this spirit, the young minds and seasoned professionals alike daring to imagine solutions to the challenges of our time.To our award recipients today, your achievements represent the very best of what human creativity and determination can accomplish. Your innovations, whether they tackle food security, environmental sustainability, digital inclusion, or healthcare, carry the potential to transform lives. We celebrate not only your success today, but the countless hours of dedication, iteration, and perseverance that made it possible. To every participant who did not reach the podium, innovation is a marathon, not a sprint. The act of creating, presenting, and defending your work before an international panel is itself a victory. We encourage you to carry forward the lessons of this experience and return stronger.

I wish to express my deepest gratitude to *Jabatan Pendidikan Negeri Melaka* (JPNM) and SMKA Sharifah Rodziah for their steadfast partnership and collaboration. My heartfelt appreciation also goes to the entire organising committee of i-NEXTECH 2026, the judges who gave their expertise and time with great professionalism, and the sponsors and industry partners who believe in the mission of this exposition. Finally, I invite every participant, educator, and industry partner present today to join us in making i-NEXTECH an enduring legacy, a platform that continues to inspire, connect, and launch the innovators of tomorrow.

Thank you.

Assoc. Prof. Ts. Dr. Shamsiah Abdullah
Patron, i-NEXTECH 2026
Dean,
Faculty of Plantation and Agrotechnology

FOREWORD

Director, Malacca State Education Department (JPNM)



Assalamualaikum Warahmatullahi Wabarakatuh and warm greetings.

It is with great pleasure and a profound sense of pride that I convey this message on behalf of the Jabatan Pendidikan Negeri Melaka (JPNM) at the Awards Ceremony of the 3rd International Next-Generation Innovation & Technology Exposition (i-NEXTECH 2026), themed 'Bridging Ideas and Technology for a Resilient Future'. JPNM expresses its deepest appreciation and gratitude to the Faculty of Plantation & Agrotechnology (FPA), Universiti Teknologi MARA (UiTM), Cawangan Melaka Kampus Jasin, for their outstanding initiative and leadership in organising this prestigious international innovation platform. The strategic partnership between JPNM and UiTM represents the finest model of collaboration between higher education institutions and state education departments in cultivating an ecosystem of innovation among school students.I am immensely proud to witness primary and secondary school students from Melaka and across Malaysia stepping forward with bold and fresh ideas. These are the very individuals who will lead our nation into the future. Their participation in an internationally recognised platform such as i-NEXTECH 2026 is an invaluable experience and not merely for sharpening critical and creative thinking skills, but for building the self-confidence and resilience that will serve them throughout their lives. JPNM warmly welcomes the recognition from the Ministry of Education Malaysia (KPM) that affords school participants the opportunity to gain international co-curricular recognition through the i-NEXTECH platform. This is perfectly aligned with the aspirations of KPM to produce learners who are competitive, innovative, and prepared to navigate the challenges of the 21st century.

To our award recipients, heartiest congratulations on your outstanding achievements. Your success today is the fruit of dedication, creativity, and the unwavering support of your teachers and mentors. Let this recognition serve as a springboard to continue creating innovations that are meaningful to society and the nation. To the supervising teachers who have dedicated their time and energy to guide their students, your contribution is immeasurable. Behind every winner stands a teacher who believed. In closing, I pray that the i-NEXTECH platform will continue to grow and evolve, becoming an ever wider and more impactful arena for the nation's future innovators.

Thank you.

Puan Mahfudzah Mohamed Noor
Director
Jabatan Pendidikan Negeri Melaka (JPNM)

FOREWORD

Chairman, iNEXTECH2026



Assalamualaikum Warahmatullahi Wabarakatuh and warm greetings.

Alhamdulillah, all praise be to Allah SWT for His infinite blessings that have enabled us to successfully organise the 3rd International Next-Generation Innovation & Technology Exposition (i-NEXTECH 2026). The third edition of this exposition is not merely a continuation of tradition; it is a living testament to the enduring commitment of the Faculty of Plantation & Agrotechnology (FPA), Universiti Teknologi MARA (UiTM), to nurturing a culture of innovation, creativity, and excellence among the next generation. i-NEXTECH 2026 has attracted an outstanding response where over 227 innovation projects from five nations, encompassing Malaysia, Indonesia, Thailand, Japan and Sri Lanka. This achievement affirms that i-NEXTECH has transcended borders to become a truly international arena for the recognition of innovative talent.Our theme this year, 'Bridging Ideas and Technology for a Resilient Future', reflects our collective aspiration: that innovation is not merely an idea, but a bridge connecting dreams to reality, knowledge to practice, and the present generation to a more resilient tomorrow. I am deeply proud to witness projects from the most diverse backgrounds, from primary school pupils as young as seven years old to experienced researchers and industry practitioners, all united by the same spirit of inquiry and creation. To all award recipients, my heartiest congratulations. Your achievement today is not only a recognition of your hard work and creativity; it is an inspiration to the thousands of innovators who will follow in your footsteps. To those who did not reach the podium this time, do not be discouraged. Innovation is a journey, not a destination. Every attempt, every iteration, and every failure overcome is a step closer to a breakthrough.

I would like to extend my heartfelt gratitude to Jabatan Pendidikan Negeri Melaka (JPNM) and SMKA Sharifah Rodziah for their steadfast collaboration and unwavering support. My deepest appreciation also goes to the entire i-NEXTECH 2026 Organising Committee, who have given their time and energy without reservation, and to our distinguished judges who carried out their evaluation duties with the highest integrity and professionalism. As we celebrate today's achievements, let us carry forward this spirit of innovation and make it a way of life. For it is from curious, courageous, and tenacious minds that competitive innovations are born.

Congratulations to all, and may this be the beginning of many more remarkable journeys ahead.

Assoc. Prof. Ts. Dr. Fazleen Abdul Fatah
Chairman
International Next-Generation Innovation & Technology Exposition 2026 (i-NEXTech 2026)

PROJECT ID	TITLE
IN15	BioBidara Functional Tea: Science-Validated Herbal Infusion
IN33	Think GHG2.0: A Bilingual Offline-Capable Progressive Web Application (PWA) for Greenhouse Gas Emission Tracking in Malaysian Plantation Estates
IN45	BioRhizo Duo: An Integrated Dual-Phase Biofertilizer System from Spent Mushroom Waste and Agricultural Residues Inoculated with Rhizobium for Complete Crop-Cycle Nutrition
IN76	AeroPod: AI And IoT Smart Hydroponic Farming System for Sustainable Urban Food Growing
IN89	ESALAB-PORTAL
IN99	IrradiX-Tricho: Engineered by Mutation, Powered by Nature
IN118	EduPredictAI
IN131	INSECTA-X Smart Trap System
IN147	HypaBase: Mycelium - Structural Decorative Trays from Malaysian Agricultural Waste
IN225	PalmSphere: A Structured Board Game Approach to Enhance Understanding Among Estate Management Students
IN227	SMARTAERO - Smart Aerated Composting Technology
IN159	Smart Trek AI Band
IN176	SME-FIRI (SME Financial Inclusion Readiness Index)
IN228	ProctorX GreenVision

PROJECT ID	TITLE
IN88	LCC004:Mastering The Product Review
IN150	Q-LEARN iME: A One-Stop Learning Hub for Islamic and Moral Education for Young Learners
IN161	Administrative Law: Terminologies Series Two

PROJECT ID	TITLE
IN10	Heritage Guardian: The Preservation of Malaysia's Cultural Heritage Through Video Game
IN25	Optical World
IN36	Aspuri I'stay
IN43	AttendLog
IN59	PP-CST Ecosystem ©: A Translation of PP-CST (Parent's Practices-Children Screen Time) Questionnaire© into a Digital Parenting Screening and Behavioural Support Innovation for Healthier Children's Screen Habit
IN71	Performance of Modular Bamboo-Based Infiltration Wells in Enhancing Soil Infiltration for Urban Flood Mitigation in Pontianak
IN82	Eco-Friendly Pest Patch for Home Gardening: Bioguard Patch
IN84	A Scalable Live-Attenuated Bacterial DNA Vaccine Platform for Rapid Response to Emerging Infectious Diseases
IN94	EBIZCLASS
IN95	PALMDETECT AI: FFB Detection System for Assisting New Plantation Workers
IN101	SMARTPV-NET+: An Intelligent Ai-Based System for Interactive Thermal Hotspot Localization in Solar Pv Systems
IN111	DURIYANKRAKER: Converting Durian Seed Waste into Value-Added Crackers
IN117	Development Of an Eco-Friendly Smart Rodent Repeller Using Ultrasonic Sound and Natural Scent Dispersion Technology
IN119	CAMOUVISION: An Attention-Guided Deep Learning Framework for Military Camouflage Segmentation
IN130	RESOLVEX KIT
IN136	Labsera Courseware: Safety-Integrated Teaching Aid for Laboratory Experiments.
IN160	Mobile Apps Digital Tool Compliance Assessment for Rice Check Padi Guidelines in Malaysia
IN184	Islamixedu
IN197	Eco Batting Tee
IN203	Regreen Patch
IN212	HistoBox: Hijrah Detik Bersejarah
IN216	SMARTGROW: IoT-Based Automated Plant Care System with AI Plant Health Monitoring
IN218	Brave Little Botanists
IN219	AgroSense: AI Decision Intelligence System
IN220	Solar-Powered Agitation-Airflow Drum for Safe and High-Quality White Pepper Processing
IN223	Home-Made Liquid Detergent from Several Varieties of Pineapple Waste for Eco-Friendly Household Products
IN237	Gama-Caya
IN240	Development of an Inventory and Mapping System for Oil Palm Fresh Fruit Bunch
IN148	Sport.My: A One-Click Smart Solution for Seamless Sports Facility Booking
IN154	WahanaGo Apps
IN241	3 Phase Wifi Distribution Box Using Telegram

PROJECT ID	TITLE
IN7	Automatic Alternating Drip Irrigation Control System for Different Agriculture Plot
IN34	EMES (Electromagnetic Electrostatic Segregation System)
IN70	TruScope: Development of Real Time Credibility Score Indicator for Online Content.
IN106	OutPay - Offline E-Wallet Ecosystem for Disconnected Environments
IN134	Non-Destructive Testing (NDT) Inspection Simulator
IN135	GrowEM Fertilizer
IN162	iCourt: An Interactive Online Courtroom Learning Environment

Category C1 (Primary School: Ages 7–12)
List of Extended Abstract

PROJECT ID	TITLE
IN17	Ecotherm Solution: Save Energy by Reusing Heat
IN20	Natural Fire Extinguisher Ball
IN22	Biogas Production from Rotten Fruits
IN27	ECOVEND
IN28	Green Stick Grab and Wipe
IN29	e-Canteen: Online Food Ordering System
IN30	DIY Cooler Box
IN48	The Proton Bob
IN60	Smart Rainwater Saver System for Sustainable Water Management
IN63	Grease To Glow
IN64	Eco Moribite - Pelet Ikan Lestari
IN68	SolarSnack
IN75	Prompt Hacker Academy: Teaching Children How to Communicate with Artificial Intelligence
IN78	Smart PAJSK Advisor: A Smart Digital Solution for PAJSK Performance Monitoring, Strategic Planning, and AI-Guided Student Achievement Enhancement
IN96	KiddoGuard
IN100	Solar Grow Junior
IN128	The Zero Waste Hero
IN140	EcoHero: Rise of Renewal
IN142	Starsek Biofly
IN146	Smart Roof for Drying Clothes Area
IN153	Measure Monster: Interactive Educational Game for Year 3 Primary School (Measurement)
IN179	Equity
IN206	Mushroom House Observation & Control (MHOC)
IN210	EDUQUEST: A Gamified Web-Based Learning Adventure for Primary School Students
IN213	Kit Boba M: An Interactive Learning Aid for Mastering Basic Number Words
IN215	Smart Management Classroom System
IN217	KECAMBA
IN224	Laman Ajaib: Pengembaraan Cilik – An Interactive Agricultural Learning e-Book for Young Learners
IN226	One Stop PSS 2.0: A Digital Library and Reading Engagement Portal for Enhancing School-Wide Literacy
IN232	Future Tense Hot Wheel
IN233	Mathstorm Legends
IN6	Res-Q-Ride
IN51	The Flux Desk System: The Future of Learning
IN92	Agrisun Solar Tracker Arduino-based Intelligent Solar Irrigation System
IN97	Remote Control Cleaning Boat
IN107	Automated Book Organizer (ABO)
IN126	VYRO
IN170	StudyBuddy Homework Planner
IN193	Nadi Pulse: Her Pulse. Her Power.
IN204	Ecochill Junior: Investigating the Cooling Power of Unglazed Clay Pots for Off-Grid Food Preservation

PROJECT ID	TITLE
IN13	Wirelab
IN14	Electrolearn
IN16	Lumeera
IN18	Microbit Battle War Robot for Stem Education
IN23	Teddy Safety Alert
IN24	Smart Flood Monitoring and Alert System
IN46	Sistem Amaran Haba Berpusat Untuk Keselamatan Pelajar Sekolah
IN54	Natural Flavoring by Solanaceae
IN57	Ecobin Genius
IN61	Play-Based Learning Kit (English Grammar)
IN62	Ventinova
IN81	Care Card: Student Preparedness for Megathrust Earthquake Mitigation
IN103	D'-Rope-Let
IN104	The Octet Quest
IN108	Hang-It-Dry
IN109	Alge-Pack
IN110	Algebrik
IN112	Sensaride
IN116	Fish Catappa
IN124	Brainboost: Bridging Education and Motivation Through Digital Applications and Personalized Study Goals
IN125	Patrol Wasp
IN129	D-Tender
IN132	CHITIZ
IN133	Enhancing Breast Cancer Classification from Mammography Images with Alpha Cut-Paste Augmentation (Acpa)
IN141	Attendify: An Ai-Driven Automated Attendance System Using Group Image Capture
IN145	Kikiwa: Turning Stem Learning into a Confidence Building Adventure
IN164	Green Quest
IN165	Guppygrow: Aquaponic Solution
IN177	LIFER
IN180	Visionvoice
IN185	Hydroguard: An Ai-Enabled Autonomous River Cleaning and Flood Prevention System for Sustainable Waterway Management
IN186	Eco-Brick: A Step Towards a Greener Community
IN188	Evaluating The Efficacy of Cymbopogon Nardus, Carica Papaya, And Allium Sativum Extracts Against Gryllus Sp. On Capsicum Cultivars
IN192	Limo-Wax: Where Botanical Science Blossoms in the Circular Economy
IN194	Intellinex Edu
IN209	Nextgen Career: Ai-Powered Career Discovery System
IN236	Sustain
IN8	Forest Saver With IoT System
IN9	Smart IoT Based Bank Security System
IN11	Sporkinson
IN173	OneCore

EXTENDED ABSTRACT

Category A1 (Professional & Industry Inventor-Group)

PROJECT ID: IN15

BIOBIDARA FUNCTIONAL TEA: SCIENCE-VALIDATED HERBAL INFUSION

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ABSTRACT
The growing demand for natural functional beverages necessitates scientifically validated products aligned with real consumption practices. Most studies on Ziziphus mauritiana rely on solvent extracts, which do not reflect actual usage as tea infusions. This study introduces BioBidara, a functional herbal tea developed and validated using water-based infusion methods. Bidara leaves were evaluated based on maturity and processing methods. Processed samples demonstrated significantly higher total phenolic content (up to 18.86 mg GAE/g) and antioxidant activity (up to 60.20% DPPH scavenging). Sensory evaluation indicated processed matured leaves achieved the highest acceptability. These findings position BioBidara as a science-backed, consumer-relevant functional beverage bridging traditional use and scientific validation.
Keywords: Bidara tea, antioxidant activity, functional beverage, phenolic content

1.0 INTRODUCTION
Herbal infusions are popular caffeine-free beverages with health benefits. *Ziziphus mauritiana* (Bidara) is traditionally used for its antioxidant properties, but scientific studies mainly focus on extracts rather than tea infusions. Problem Statement: This creates a gap between research and real consumption, as existing studies do not reflect how consumers actually prepare and drink bidara tea. Significance of the Study: This study validates bidara in its actual infusion form, improving the credibility of functional claims and supporting the development of practical, plant-based functional beverages.

2.0 OBJECTIVES
The main objectives of this innovation/project are:
a. To evaluate the functional properties of bidara (Ziziphus mauritiana) tea infusion by analyzing antioxidant activity (TPC and DPPH) and comparing the effects of leaf maturity (shoot vs matured) and processing methods (fresh vs processed).
b. To assess the overall consumer acceptability of bidara tea infusion using sensory evaluation with a 9-point hedonic scale among 30 panelists.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: BioBidara is unique because it validates bidara in its actual consumed form as a tea infusion, instead of using solvent-based extracts. This ensures that the functional benefits are directly relevant to real consumer use.
Key Innovative Features: Consumer-relevant validation where it was tested in water-based tea, not extracts; Process optimization where drying and grinding improve bioactive extraction; and Dual performance where the study combines antioxidant functionality with sensory acceptability.
Comparison with Existing Solutions. Refer Table 1.
Intellectual Property Potential: BioBidara has potential for process and formulation-based innovation, particularly in infusion validation and processing optimization. Further development may support future patent opportunities. At present, no intellectual property has been filed.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Innovation
Validation	Extract-based	Real infusion-based
Relevance	Low	High
Positioning	Herbal tea	Functional beverage

4.0 PRACTICALITY & USEFULNESS

BioBidara can be applied as a functional beverage, nutraceutical product, and wellness tea. It targets health-conscious consumers and herbal users. The product is technically simple, cost- effective, scalable, and environmentally sustainable.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: BioBidara was developed using bidara leaves (shoot and matured), processed by drying (60°C) and grinding, then formulated into 1 g tea sachets and infused in hot water (30 min) to simulate real consumption. The system integrates selection, drying, grinding, and infusion to enhance phenolic and antioxidant extraction.
Technical Architecture/System Design: The system involves raw material selection, drying, grinding, sachet formulation, and infusion, designed to maximize extraction of phenolic compounds and antioxidants.

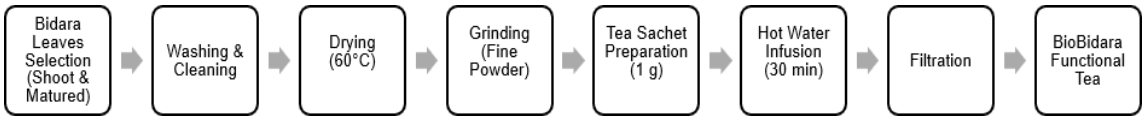


Figure 1: Development process flowchart

Materials and Methods: Analyses included pH measurement, total phenolic content (TPC), DPPH antioxidant activity, phytochemical screening, and sensory evaluation with 30 panelists. All tests were conducted in triplicate with ANOVA ($p < 0.05$). Testing and Validation: Functional properties were evaluated using TPC and DPPH assays, while pH assessed stability. Sensory evaluation measured acceptability using 30 panelists.
Results and Performance: Results showed higher performance, with TPC up to 18.86 mg GAE/g and antioxidant activity up to 60.20%. Flavonoids and saponins were present, with processed mature leaves most preferred.
Technical Explanation: Drying and grinding increase surface area and break down plant structure, enhancing bioactive extraction during infusion and ensuring functional benefits in the consumed form.

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Bidara leaves	Shoot & matured leaves	Source of bioactive compounds
Drying process	60°C tray drying	Reduce moisture & stabilize compounds
Grinding process	Fine powder	Increase surface area for extraction
Tea sachet	1 g per serving	Standardized dosage
Hot water infusion	30 minutes	Extract phenolics & antioxidants

6.0 CONCLUSION

Summary of Achievement: BioBidara was successfully developed as a functional tea validated in its actual consumed form. The study demonstrated improved antioxidant activity, phenolic content, and consumer acceptability, especially in processed samples. Contributions and Impact: This innovation bridges the gap between research and real consumption, enhancing the credibility of herbal products. It supports the development of affordable, plant-based functional beverages and promotes sustainable use of natural resources. Limitations and Challenges: The study is limited to laboratory-scale analysis. Future Work and Recommendations: Future work includes clinical studies, product optimization, and scaling up for commercialization. Closing Statement: BioBidara transforms traditional knowledge into a science-based functional beverage, contributing to bridging ideas and technology for a resilient future.

ACKNOWLEDGMENTS

Universiti Teknologi MARA

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PROJECT ID: IN33

THINK GHG 2.0: A BILINGUAL OFFLINE-CAPABLE PROGRESSIVE WEB APPLICATION (PWA) FOR GREENHOUSE GAS EMISSION TRACKING IN MALAYSIAN PLANTATION ESTATES

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Supervisor: Assoc. Prof. Ts. Dr. Abdul Rahman Saili

ABSTRACT
Greenhouse gas (GHG) emissions by the plantation industry are also a source of significant greenhouse gase emission in Malaysia, but smallholders and students do not have available necessary tools to measure the emission levels. The current calculators are overly complicated, restricted to desktop applications, or they are not in Bahasa Malaysia. This project is a presentation of Think GHG 2.0, a Progressive Web Application (PWA) which is bilingual (in English and in Bahasa Malaysia), and created as a significant addition to our 2023 workbook-based calculator. The application allows one to trace CO_2, CH_4, and N_2O emission across seven plantation activities such as diesel and petrol burning, lubricants, electricity, fertilizer, peat soil cultivation, and livestock in addition to carbon uptake by the oil palm, rubber and forest cover. The app is based on IPCC 2006 Guidelines with AR6 Global Warming Potential factors, calculates CO_2 -equivalent totals, facilitates multi-year comparison, scenario modelling (e.g. diesel-to-biodiesel substitution) and compares the results with Malaysian Palm Oil Board (MPOB) industry averages. It was validated in a dataset of 100 hectares of estates, which showed correct operation of computation of emissions and absorption. PWA can be installed on Android, iOS, and desktop, is offline, and exports professional PDF reports. Think GHG 2.0 is a practical decision-support tool and a practical decision in relation to MSPO and RSPO sustainability frameworks since it compares to its 2023 version of 1 to 6 features and access in English to bilingual and allows access to 6 features compared to 1.
Keywords: greenhouse gas calculator, progressive web app, plantation sustainability, IPCC methodology, palm oil industry

1.0 INTRODUCTION
Background. The plantation industry whose oil palm (solitary 5.65 million hectares) alone emits 274 tonnes/ha of GHGs, is also a major contributor to the GHG emissions in Malaysia because of fuel burning, fertilizer, livestock, and the decomposition of peat soils. Emissions must be monitored and reported on estates under the MSPO and RSPO certification. Problem Statement. Other GHG calculators are owned corporate (Sime Darby) or by complex international (UNFCCC) tool, or are in fixed spreadsheet format that only uses desktop computers and access to the English language. Smallholders who control 73% of the plantation land in Malaysia do not have a free, mobile, and bilingual tool. Significance. A convenient bilingual application will enable smallholders, students and field officers to calculate real-time emissions and helps to meet the goals of the New Industrial Master Plan 2030 and National Energy Transition Roadmap (NETR) in Malaysia.

2.0 OBJECTIVES
a. To develop a bilingual (English/Bahasa Malaysia) Progressive Web Application that calculates CO_2, CH_4, and N_2O emissions from seven plantation activities and converts them to CO_2-equivalents using IPCC AR6 GWP factors.
b. To enable multi-year tracking, scenario comparison, and benchmarking against Malaysian palm oil industry averages.
c. To provide an installable, offline-capable solution accessible to estate managers, smallholders, and students without requiring internet connectivity in remote field locations.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: Think GHG 2.0 evolves our 2023 IPO-certified Excel calculator into a full Progressive Web App. Key innovative features: (i) full bilingual interface (EN/BM) with one-tap toggle,

the first GHG calculator localized for Malaysian field workers; (ii) offline-first architecture using a service worker, allowing data entry in remote estates without connectivity; (iii) automated CO_2-equivalent conversion using AR6 GWP values (CH_4 = 28, N_2O = 265); (iv) multi-year trend analysis and what-if scenario modelling; (v) integrated MPOB/MSPO benchmarking with custom user targets; and (vi) one-click PDF report generation in user's chosen language. Intellectual Property: The 2023 Think GHG predecessor received an IPO certificate; this upgraded version extends the protected innovation.

Table 1: Comparison of Think GHG 2.0 with existing solutions

Feature	Think GHG 2.0 (2026)	Think GHG (2023)	UNFCCC Calculator
Platform	PWA (mobile/desktop)	Excel only	Web only
Bilingual (EN/BM)	✓	✗	✗
Offline use	✓	✓ (file)	✗
CO_2-eq + AR6 GWP	✓	✗	✓
Multi-year + benchmark	✓	✗	Partial
PDF report export	✓ (auto)	✗	✗

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: The app supports daily emission tracking in oil palm, rubber, and mixed plantations. Estate managers can prepare MSPO/RSPO compliance reports in minutes; lecturers can demonstrate IPCC methodology using the built-in Learn module; smallholders can quantify their carbon footprint to access carbon-credit programmes. Target Users: Plantation smallholders, estate sustainability officers, agriculture students, MPOB extension officers, and researchers.
Feasibility: Built on standard web technologies; no backend server required. Free to use, with optional paid consultancy. Scalable to other crops by extending emission-factor tables. Expected Impact: Enables 450,000 Malaysian palm oil smallholders to self-assess emissions, reduces reporting time by 30% versus manual spreadsheets, and contributes to NETR's 2050 net-zero target.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Development Process: Built using HTML5, CSS3, and vanilla JavaScript with Chart.js for visualization and is PDF for report generation. The app follows a four-stage workflow: (1) Data Entry — monthly activity logging across seven categories; (2) Dashboard — real-time CO_2-eq calculation; (3) Analysis — multi-year trends, scenarios, and benchmarking; (4) Report — PDF export aligned with MSPO format. Architecture: PWA architecture with Web App Manifest for install ability and Service Worker for offline caching. Data is stored locally via local Storage. Emission factors sourced from MPOB and IPCC 2006 Guidelines with AR6 GWP. Validation: Tested on a 100-hectare reference estate; cross-checked against the 2023 Excel calculator (deviation < 0.1%).

Table 2: Key technical components

Component	Specification	Purpose
Service Worker	Cache API v4	Offline functionality
Web App Manifest	JSON, 192/512px icons	Install on home screen
Chart.js 4.4	Doughnut, line, bar	Emissions visualization
jsPDF 2.5	With AutoTable plugin	Bilingual PDF reports
Emission factors	IPCC 2006 + AR6 GWP	Scientific accuracy

6.0 CONCLUSION

Summary: Think GHG 2.0 will turn our 2023 IPO-qualified Excel calculator into a two-language Progressive Web Application that can be deployed on 2-3 devices (online and offline). Contributions. The first Malaysian plantation GHG calculator that supports naive Bahasa Malaysian, works offline, multi-year analytics, and built in MPOB benchmarking - bridging the digital divide between small holders and corporate sustainability (tools). Limitations & Future Work. It is now optimized with oil palm, rubber, and mixed crops, and will soon support cocoa/coconut and multi-user support with cloud-syncing, Android APK distribution, and cloud-based emission predictions, which uses ML. Closing. By making world-class GHG accounting available to all the workers in their individual lingo in the plantations, Think GHG 2.0 directly contributes to "Bridging Ideas and Technology for a Resilient Future".

ACKNOWLEDGMENTS
The authors thank the Faculty of Plantation and Agrotechnology, UiTM, for academic and technical support; the Malaysian Palm Oil Board (MPOB) for emission factor references; and IPO Malaysia for recognizing the original 2023 Think GHG calculator.

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PROJECT ID: IN45

BIORHIZO DUO: AN INTEGRATED DUAL-PHASE BIOFERTILIZER SYSTEM FROM SPENT MUSHROOM WASTE AND AGRICULTURAL RESIDUES INOCULATED WITH *RHIZOBIUM* FOR COMPLETE CROP-CYCLE NUTRITION

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ABSTRACT
Excessive chemical fertilizer use and accumulation of agro-industrial waste are detrimental to soil health, and existing biofertilizers i.e., liquid (short shelf life) or solid (poor peak-demand response) continue to be inadequate for comprehensive supply of crop-cycle nutrition. We introduce BioRhizo Duo, a full integration dual-phase biofertilizer composed of compressed solid brick (slow-release basal) and fermented liquid concentrate (fast-acting boost) produced using spent mushroom waste (SMW) plus agricultural residues inoculated with *Rhizobium* spp. A stage-based protocol (Brick at Day 0 + Liquid at Days 14 & 28) was a verified in a 35-day mung bean (*Vigna radiata*) pot trial. The Duo treatment resulted in significantly increased plant height (+88%) and root biomass (+150%) and shoot dry weight (+133%) compared with controls, comparable NPK 15:15:15 rate of efficacy, and rhizosphere *Rhizobium* (5.2×10^6 CFU/g) remained that chemical fertilizer reduced. Converted to a marketplace ready kit with an organized commercialization process targeting smallholder, organic cultivation, rural-based entrepreneurs, BioRhizo Duo transforms waste streams into a total crop-nutrition solution, supporting circular economy and SDGs 2, 8, 12, 13 and 15.
Keywords: Dual-phase biofertilizer, Spent mushroom waste, Rhizobium, Circular agriculture, Agri-entrepreneurship

1.0 INTRODUCTION
Modern agriculture faces a convergence of two pressures: the increasing use of chemical fertilizers that degrades soil and water systems; and waste accruing from agro-industrial land use with no way out for disposal. As of 2023, Malaysia's fertilizer consumption was 2,926 kg per hectare of arable land, representing nearly 19 times the global average of 154 kg/ha and over 90% of which was synthetic mineral products [1]. Prolonged reliance on such inputs results in soil acidification, nutrient leaching, loss of microbial biodiversity, and greenhouse gas emissions [2]. In parallel, a global production of mushroom contributes to around 5 kg of spent mushroom waste (SMW) per kilogram of mushroom yield; the production is projected to reach over 100 million tonnes per year by 2026 [3]. These wastes are usually incinerated, disposed of or allowed to decay, releasing methane and contaminating waterways. Biofertilizers containing Plant Growth-Promoting Rhizobacteria such as *Rhizobium* provide a successful method for soil restoration, but use is still stifled by formulation limitations. Existing biofertilizers are nearly exclusively single format. Liquid concentrates are fast-acting, but at the cost of short shelf-life (1 to 3 months), need frequent reapplication, and introduce high contamination; solid formulations also store well and release gradually, but do not respond well to demand for vegetative nutrients at peak nutrient demand [4]. Neither category of fertilizer alone can support the performance of chemical fertilizers for the complete crop cycle. Our previous products, BioRhizo Brick (Gold, 2nd SDG Innovation@IBSD 2025) and SMartGro BioBoost (Silver, same event) demonstrated the SMW biofertilizer viability as products, but the independent products could not achieve full performance of chemical fertilizers and did not have market-oriented deployment plan. However, no Malaysian biofertilizer combines phases (solid and liquid) and feed elements in an integrated stepwise, stage-based feed with a good commercialization profile. BioRhizo Duo bridges the gap in this area by combining both in an innovative and attractive combination format and by presenting with delivery as a farmer-ready kit with an organized application procedure. Smallholder farmers receive a biofertilizer equivalent in potency to the chemical fertilizer performance at 30-40% lower lifecycle cost; mushroom producers can turn a waste burden into profit; organic and urban growers can use certified waste-

derived sources of inputs; and rural communities develop self-efficacy and entrepreneurship solutions. We contribute to Malaysia's national food security and circular-economy agendas and contribute toward the achievement of SDG 2 (Zero Hunger), SDG 8 (Decent Work), SDG 12 (Responsible Consumption), SDG 13 (Climate Action) and SDG 15 (Life on Land).

2.0 OBJECTIVES

The major aims of this innovation are to incorporate a compressed solid biofertilizer brick with a fermented liquid biofertilizer concentrate (derived from SMW and agricultural residues inoculated with *Rhizobium*) into a holistic dual-phased system, develop and validate a stage-based application protocol (Brick at Day 0 + Liquid at Days 14 & 28) to produce plant growth comparable to that produced by chemical NPK fertilizer while at the same time conserving soil microbial populations and to develop a commercialization and entrepreneurship pathway, including marketing strategy, cost structure and scale-up roadmap, which, in 12 months' time, will take the innovation to a deployable rural enterprise.

3.0 NOVELTY & INVENTIVENESS

Innovations: BioRhizo Duo is an innovative new concept, the first Malaysian dual-phase biofertilizer that combines a solid slow-release brick with a fast-acting liquid concentrate produced from the same waste-derived fermentation base. Key innovative features are: (i) Synchronized dual-format delivery engineered for synergistic, not merely additive, crop response; (ii) Stage-based application protocol aligning product format to plant growth phase; (iii) Complete waste valorization converting two underutilized waste streams (SMW + crop residues) into a single marketable product; (iv) Market-ready kit design with built-in application calendar for farmer adoption. Intellectual Property Potential: The formulation and protocol are suitable for filing under the MyIPO Utility Innovation scheme, with potential trademark registration for the "BioRhizo Duo" brand.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	BioRhizo Duo (Our Innovation)
Product format	Single format only (liquid OR solid)	Integrated dual-phase (solid + liquid) kit
Nutrient release	Fast but short-lived, or slow but unresponsive	Slow-release base + on-demand foliar boost
Raw material & cost	Imported/synthetic carriers; higher cost	100% local SMW + crop residues; ~near-zero cost
Farmer guidance	Generic dosage only	Stage-based calendar protocol included

4.0 PRACTICALITY & USEFULNESS

Applications: BioRhizo Duo is viable in (i) smallholder farmers, (ii) certified organic growers, (iii) urban/home gardeners, and (iv) landscaping and nursery SMEs. Technical feasibility: the production of it is on low-cost equipment (wooden mold, fermentation vessels, and muslin filters), which has a scalable community level without required infrastructure. Economic Feasibility: Costs of production were estimated at RM 8–10 per kit; retail target was RM 18–25—30–40% savings over NPK fertilizers. Breakeven at 500 kits/month within 6–8 months. Scalability: 3-tier (1) community cooperative hub (RM 10–20k), (2) a registered SME registered in MyIPO filed, Halal/organic certification, (3) national brand via partnerships with MARDI/MTDC/Agrobank licensing. Sustainability & Anticipated Impact: 100% waste-derived with zero synthetic inputs; 1,000 kits deployment: Approximately 2.5 tonnes worth of waste valorized and predicted improvement of ~25–35% yield over untreated plots.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development: 5 parts: raw materials, Rhizobium isolation, parallel solid and liquid fermentation optimization, product formulation (compression and filtration), and integrated pot trial.

Materials & Methods: SMW (UPTC, UiTM Kuala Pilah) and farm residues (banana leaves, sugarcane bagasse, coconut husk) were sun-dried and shredded. Rhizobium spp. were isolated on nutrient agar with mannitol and propagated to ~10^6 CFU/mL. Solid phase: 70:30 SMW:agro-waste, 20 mL/kg inoculum, 100 g/L palm sugar, 60–65% moisture, fermented 14–21 days, compressed into 500 g bricks. Liquid phase: 500 g SMW + 200 g agro-waste in 2 L of water with palm sugar and 20 mL/L inoculum, fermented 14 days, filtered, diluted 1:10 before use. Testing and Validation: 35-day mung bean (Vigna radiata) pot trial (n=6) T1 control, T2 Brick-only, T3 Liquid-only, T4 Duo, T5 NPK 15:15:15. Results: T4 (Duo) was significantly superior to single-phase treatments ($p<0.05$) and approached chemical fertilizer efficacy while maintaining soil microbiota that NPK inhibited (Table 2).

Table 2: Plant growth response of mung bean to BioRhizo Duo and reference treatments (n=6, mean ± SD)

Parameter (Day 35)	T1 Control	T2 Brick	T3 Liquid	T4 Duo	T5 NPK
Plant Height (cm)	14.2 ± 1.1	21.4 ± 1.3	19.8 ± 1.2	26.7 ± 1.4	27.9 ± 1.5
Root Length (cm)	8.6 ± 0.7	12.9 ± 0.8	11.4 ± 0.6	15.8 ± 0.9	14.3 ± 0.8
Shoot Dry Wt. (g)	0.48 ± 0.04	0.82 ± 0.05	0.75 ± 0.04	1.12 ± 0.06	1.18 ± 0.07
Root Dry Wt. (g)	0.14 ± 0.02	0.26 ± 0.02	0.22 ± 0.02	0.35 ± 0.03	0.31 ± 0.03
Rhizobium (×10^6 CFU/g)	0.3 ± 0.1	3.8 ± 0.4	2.1 ± 0.3	5.2 ± 0.5	0.9 ± 0.2

6.0 CONCLUSION

BioRhizo Duo combines a compressed biofertilizer brick and fermented liquid concentrate from SMW and agricultural residues into a synergistic system, validated by a stage-based protocol that delivers. The innovation presents the first Malaysian dual-phase biofertilizer kit with a farmer-ready commercialization pathway valorizing two waste streams, reducing fertilizer costs by 30–40%, and creating rural entrepreneurship opportunities. Current validation is limited to mung bean; expanded crop trials, extended shelf-life studies, and field-scale verification are required. Multi-microbial consortium, integration of biochar, and microencapsulation for extended shelf life; a QR-coded companion app for scheduling and marketplace integration. This is representative of the i-NEXTECH 2026 theme “Bridging Ideas and Technology for a Resilient Future,” as BioRhizo Duo makes sustainable use of agricultural waste to transform it into a scalable biotechnology-driven solution that strengthens food security and rural communities, whilst restoring the soil underpinning agricultural resilience. food security, empowers rural communities, and restores the soil underpinning agricultural resilience.

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The authors thank the Faculty of Applied Sciences, UiTM Cawangan Negeri Sembilan, Kampus Kuala Pilah, for services and facilities, and acknowledge UPTC and Ereen Azlina Plantation for raw material sources. This work extends our BioRhizo Brick (Gold) and SMartGro BioBoost (Silver) at the 2nd SDG Innovation@IBSD 2025.

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PROJECT ID: IN76

AEROPOD: APPLIED AI + IOT SMART URBAN FARMING SYSTEM

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ABSTRACT
AeroPod is an Applied AI and IoT-enabled smart urban farming system developed by AeroGreen Asia Sdn. Bhd. to make indoor vegetable growing more practical, measurable and easier to manage. It addresses urban growing challenges such as limited land, unpredictable weather, pests, soil issues and the lack of farming knowledge among new growers. While many small hydroponic systems still require manual checking of pH, EC, temperature, humidity, water level, pump operation and light settings, AeroPod integrates a vertical hybrid NFT/DWC hydroponic system with sensors, IoT controls, a mobile app and an AI copilot. The AI copilot analyses sensor conditions, answers user questions, recommends suitable actions and sends safe control instructions to IoT devices. A 30-day lettuce growth challenge using the AeroPod prototype demonstrated healthy plant growth, visible root development and successful harvest under controlled hybrid NFT/DWC conditions. AeroPod benefits schools, universities, urban households, communities, cafés and agrotechnology centres by combining food production, automation, AI learning and sustainability education in one practical platform.
Keywords: Applied AI, IoT smart farming, AI copilot, hybrid NFT/DWC hydroponics system, hygienic hydroponics, urban agriculture

1.0 INTRODUCTION
Outdoor and soil-based growing can be affected by weather changes, pests, soil quality and limited urban land. Hydroponics reduces land dependency, but many small systems still require users to understand water quality, crop stage and control settings manually. AeroPod addresses this gap by connecting germination-to-harvest crop growth, sensors, IoT control, mobile monitoring, AI guidance and hygienic hydroponic handling in one working system. The project is significant because it turns smart farming into a practical tool for food awareness, education, community use and small-scale urban production.

2.0 OBJECTIVE
a. Develop a compact vertical hybrid NFT/DWC hydroponic unit for indoor urban spaces, schools and institutions.
b. Monitor pH, EC, temperature, humidity and water level through IoT sensors and a mobile app.
c. Use an AI copilot to recommend actions and send safe control instructions to IoT devices.
d. Demonstrate a living STEM platform using real crops, data, automation and sustainability learning.

3.0 NOVELTY & INVENTIVENESS
AeroPod is novel because it applies AI and IoT as an integrated crop-management copilot, not as separate add-on features. The system introduces a closed-loop Applied AI workflow where sensors observe the crop environment, the app presents real-time status, and the AI copilot translates data into safe and practical control actions. Its key innovative features are the AI copilot for growing support, the IoT control layer for device actions, and the hygienic germination-to-harvest workflow that combines real crops, sensor data, automation and AI guidance in one location. AeroPod also introduces a hybrid NFT/DWC technique, where nutrient solution can circulate through the NFT flow while part of the tray retains water for a period. This allows plants to continue accessing nutrients even when the pump is not running continuously, helping to reduce electricity use while maintaining crop hydration. No patent has been filed at this stage, but future IP potential includes the AI-IoT workflow, compact vertical hybrid NFT/DWC layout, mobile app interface, AI recommendation process and safety framework for control actions.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	AeroPod Innovation
User decision making	Users manually interpret readings	AI copilot recommends clear actions

Control process	Pump and light settings adjusted separately	IoT control connects advice with safe actions
System integration	Hardware, app and AI often separate	Hybrid NFT/DWC growing, sensors, cloud, app and AI operate as one workflow.

4.0 PRACTICALITY & USEFULNESS

AeroPod can be used by schools, universities, institutions, communities, cafés and urban households that need a compact and guided growing system. The unit has a footprint of 658 mm × 440 mm and a height of 1850 mm, making it suitable for indoor demonstration, learning spaces and pilot growing areas. It uses available hydroponics, sensors, microcontrollers, cloud and mobile app technologies, while the AI copilot helps non-expert users understand what to do next. Its usefulness is agricultural, educational and environmental because it supports local growth, hygienic crop handling, smart farming learning and resource awareness through data.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

AeroPod uses an Applied AI + IoT closed-loop workflow. Sensors collect pH, EC, temperature, humidity and water-level data from the hybrid NFT/DWC system. Data is sent to the cloud and displayed in the mobile app, while the AI copilot analyses sensor conditions and user questions to recommend actions or send safe control instructions to pumps and lighting. Validation was conducted through the submitted video and one 30-day lettuce growth cycle, showing system operation, app monitoring, healthy plant growth, visible roots and successful harvest.

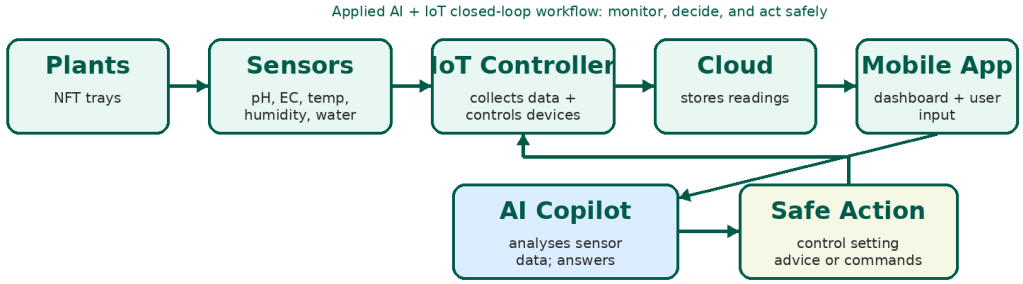


Figure 1: Applied AI + IoT closed-loop workflow from plant monitoring to safe control action.

Key Results and Expected Impact:

- Working prototype integrates hybrid NFT/DWC growing, sensors, IoT control, mobile monitoring and AI copilot support.
- The mobile app displays pH, EC, temperature, humidity and actuator status for practical decision making.
- The 30-day lettuce challenge confirms biological function and successful crop growth, not only concept design.
- The platform supports SDG-aligned outcomes in food awareness, STEM education, innovation and responsible resource use.

6.0 CONCLUSION

AeroPod has achieved a working prototype that bridges controlled-environment crop growing with Applied AI and IoT. Its main contribution is making smart farming easier to understand and operate for education, institutional, community and urban use. Future work will improve predictive recommendations, add image-based plant health analysis and expand school or institutional pilots.

ACKNOWLEDGMENTS

The project team acknowledges AeroGreen Asia Sdn. Bhd. team members and collaborators involved in prototype development, app design, crop testing and educational deployment planning.

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PROJECT ID: IN89

ESALAB-PORTAL

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ABSTRACT
Engineering students frequently face difficulties in accessing learning materials, simulation tools, software installers, laboratory resources, and technical support through multiple disconnected platforms. This fragmented environment reduces learning efficiency, delays assignment completion, and limits students' opportunities for practical skill development in embedded system courses. To address these challenges, ESALAB-PORTAL was developed as a dual-platform centralized learning ecosystem accessible through both web and mobile applications. The platform integrates course materials, software deployment resources, embedded system simulators, AI-powered learning assistance, communication tools, and cloud-based content management within a single environment. The development process involved requirement analysis, system architecture design, database integration, user interface development, simulator integration, AI assistant implementation, and platform validation. ESALAB-PORTAL incorporates popular simulation tools including Wokwi, PICSimLab, Tinkercad, Proteus, and Crumb, enabling students to perform practical learning activities without requiring extensive physical laboratory facilities. Additionally, an AI Study Assistant powered by large language models provides personalized support for programming, troubleshooting, and embedded system learning. Innovation improves accessibility, promotes self-directed learning, enhances student engagement, and reduces institutional software licensing costs. The platform demonstrates strong commercialization potential as a subscription-based educational solution for polytechnics, colleges, and universities.
Keywords: Educational Technology, Embedded Systems, Artificial Intelligence, Mobile Learning, Digital Learning Platform

1.0 INTRODUCTION
The rapid growth of digital education has transformed teaching and learning practices within technical and engineering institutions. Technology-mediated learning environments have become increasingly important in supporting flexible and student-centred learning experiences (Bower, 2019). However, embedded system education often requires students to access multiple websites, simulation platforms, software repositories, and communication channels to complete learning activities. This fragmented ecosystem creates barriers to efficient learning and reduces student productivity. Existing learning management systems primarily focus on content delivery and assignment management but lack integrated simulation environments and specialized technical assistance for embedded system development. Students frequently encounter programming and hardware troubleshooting challenges involving Arduino, PIC, and STM32 platforms without immediate access to expert support. The increasing adoption of digital technologies and artificial intelligence in education further highlights the need for integrated learning ecosystems that support both theoretical and practical learning activities (Chasokela & Sarema, 2026). ESALAB-PORTAL addresses these limitations by providing a centralized ecosystem that combines educational content, embedded system simulators, AI-assisted learning, and communication tools into a single platform. The innovation aims to enhance accessibility, improve learning efficiency, and support practical engineering education through an integrated digital environment.

2.0 OBJECTIVE
The main objectives of this innovation are:
a. To develop a centralized dual-platform learning ecosystem that integrates web and mobile technologies for seamless access to embedded system learning resources.
b. To integrate embedded system simulation tools and AI-powered learning assistance into a single platform to enhance practical learning, technical support, and student engagement.

c. To improve learning accessibility, efficiency, and cost-effectiveness by reducing dependence on multiple platforms and expensive software licensing requirements.

3.0 NOVELTY & INVENTIVENESS

ESALAB-PORTAL introduces a comprehensive educational ecosystem that combines learning resources, embedded system simulators, AI-powered technical assistance, and communication tools within a unified platform. The platform aligns with contemporary approaches to workplace and technology-enhanced learning, which emphasize active participation, authentic learning experiences, and learner autonomy (Billett, 2020). The integration of artificial intelligence within engineering education supports personalized learning pathways and improves students' ability to solve technical problems independently (UNESCO, 2024). Unlike conventional learning management systems, ESALAB-PORTAL integrates practical simulation tools and AI-assisted troubleshooting within a single environment.

4.0 PRACTICALITY & USEFULNESS

ESALAB-PORTAL can be implemented across polytechnics, technical colleges, universities, and engineering training institutions. The platform supports the development of employability-related competencies including problem-solving, digital literacy, self-directed learning, and technical communication skills, which are increasingly demanded by industry employers (Abd Majid et al., 2024; Amin et al., 2023). From a technical perspective, the platform utilizes existing web technologies, cloud databases, mobile application frameworks, and publicly available simulator integrations. Economically, the system reduces dependence on expensive software licenses and minimizes infrastructure costs associated with physical laboratory facilities.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

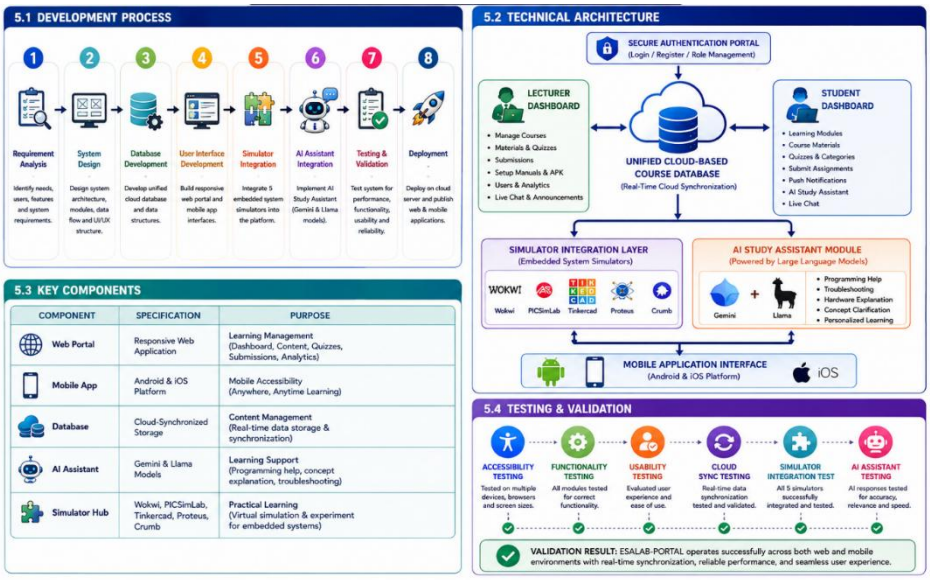


Figure 1: Methodology and technical specifications

6.0 CONCLUSION

ESALAB-PORTAL successfully addresses the challenges associated with fragmented learning environments in embedded system education by integrating educational resources, simulators, AI assistance, and communication tools within a single ecosystem. The innovation enhances learning accessibility, improves student engagement, and supports practical engineering education through a scalable and cost-effective digital platform. The system demonstrates significant commercialization potential for educational institutions seeking integrated learning solutions. Future enhancements will focus on advanced analytics, adaptive learning capabilities, expanded simulator integration, and broader deployment across engineering disciplines. The platform also supports the development of future-ready graduates equipped with digital competencies and employability skills required by Industry 4.0 and TVET ecosystems (Abd Majid et al., 2024; Amin et al., 2023). By bridging educational content, simulation technology, and artificial intelligence, ESALAB-PORTAL contributes meaningfully to the i-NEXTECH 2026 theme: "Bridging Ideas and Technology for a Resilient Future."

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PROJECT ID: IN99

IRRADIX-TRICHO: ENGINEERED BY MUTATION, POWERED BY NATURE

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ABSTRACT
Modern agriculture is increasingly threatened by plant diseases, and the overuse of chemical fungicides can harm the environment and reduce agricultural sustainability. IrradiX-Tricho is an innovative biocontrol technology developed using gamma irradiation to enhance the natural abilities of *Trichoderma asperellum*, the beneficial fungus in suppressing harmful plant pathogens. The improved irradiated strains showed faster growth and stronger competitiveness compared to the wildtype strain, indicating better potential as biological control agents against plant diseases. The development process involved gamma-induced mutation, irradiated strains selection, and laboratory antagonistic testing against plant pathogens. IrradiX-Tricho offers an eco-friendly alternative to chemical fungicides and has strong potential to support sustainable crop protection, healthier plant growth, and climate-resilient agriculture.
Keywords: Gamma irradiation, irradiated Trichoderma asperellum, biological control

1.0 INTRODUCTION
Plant diseases caused by fungal pathogens remain one of the major constraints affecting agricultural productivity worldwide. Soil-borne pathogens such as FOC TR4 severely reduce crop yield and quality, particularly in economically important crops. Current disease management practices rely heavily on chemical fungicides, which may cause environmental pollution, pathogen resistance, and negative impacts on soil biodiversity. Biological control using beneficial microorganisms such as *Trichoderma asperellum* has emerged as a sustainable alternative for plant disease management. However, naturally occurring strains may possess limitations in growth performance and antagonistic efficiency. Existing biocontrol agents often show inconsistent field performance, slower growth, and limited competitiveness against aggressive plant pathogens. There is a growing need for enhanced microbial biocontrol agents capable of providing stronger disease suppression while remaining environmentally friendly and safe for agricultural use. IrradiX-Tricho introduces a novel mutation-bred *Trichoderma* platform developed using gamma irradiation technology to enhance fungal biocontrol performance. The innovation contributes towards sustainable agriculture, reduced pesticide dependency, improved crop productivity, and environmentally responsible plant protection strategies.

2.0 OBJECTIVE
The main objectives of this innovation/project is to develop superior irradiated strains of *Trichoderma asperellum* using gamma irradiation technology.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: IrradiX-Tricho integrates nuclear mutation technology with biological crop protection to produce enhanced biocontrol fungal strains with improved agricultural performance. Key Innovative Features: i. Gamma irradiation-induced enhancement of beneficial fungi, ii) Improved fungal growth rate and competitiveness, iii) Environmentally friendly disease suppression, and iv) Potential integration into sustainable farming systems. The comparison with existing solutions are as in Table 1:

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	IrradiX-Tricho
Disease Control	Chemical fungicides	Biological fungal suppression
Environmental Impact	Chemical residue and pollution	*Trichoderma* originally from soil (eco-friendly) and sustainable

Pathogen Resistance	High risk of resistance	Reduced resistance pressure
Growth Performance	Natural strain limitations	Enhanced irradiated strain performance
Sustainability	Limited long-term sustainability	Supports green agriculture

Intellectual Property Potential: The irradiated strains and biocontrol formulation possess strong potential for intellectual property protection, including microbial strain registration, bioformulation technology, and commercialization opportunities. This project is under the Forum for Nuclear Cooperation in Asia (FNCA) based in Japan and will be commercialized under MOSTI.

4.0 PRACTICALITY & USEFULNESS

Target Users/Beneficiaries: Farmers and agricultural industries, Crop protection agencies, Biopesticide and biofertilizer industries; Feasibility and Implementation: i) Technical Feasibility: The technology utilizes existing gamma irradiation facilities and standard microbiological techniques available at the Malaysian Nuclear Agency, ii) Economic Viability: The innovation potentially reduces fungicide usage and lowers long-term crop management costs. Scalability: The irradiated strains can be mass-produced and adapted for multiple crop systems. Sustainability: IrradiX-Tricho supports environmentally sustainable agriculture by reducing chemical dependency and promoting beneficial microbial biodiversity. Expected Impact: i) Improved crop health and productivity, ii) Reduction in chemical fungicide application, iii) Enhanced sustainable agricultural practices, and iv) Increased resilience against plant diseases.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

a) Design and Development Process: i) Isolation and purification of wildtype Trichoderma asperellum , ii) Gamma irradiation treatment at multiple doses, iii) Screening and selection of irradiated strains, iv) Morphological characterization and growth analysis, v) Antagonistic assay against FOC TR4 (panama disease in banana), Magnaporthe oryzae (blast disease in rice), vi) Selection of promising irradiated strains

b) Materials and Methods: Gamma Cell irradiation facility (Malaysian Nuclear Agency)

c) Results and Performance: Selected irradiated strains demonstrated enhanced radial growth compared to the wildtype strain, indicating improved colonization potential and competitiveness against pathogens.

d) Technical Explanation: Gamma irradiation induces random genetic variation within fungal cells, enabling the selection of superior irradiated strains with improved biocontrol characteristics. Enhanced irradiated strain exhibit faster growth and stronger antagonistic interactions against plant pathogens.

6.0 CONCLUSION

IrradiX-Tricho successfully developed enhanced irradiated strains of *Trichoderma asperellum* using gamma irradiation technology for sustainable plant disease management. The innovation promotes eco-friendly crop protection by combining nuclear technology with biological control strategies to reduce dependence on chemical fungicides. Future work will focus on commercialization to support resilient and sustainable agriculture.

ACKNOWLEDGMENTS

Malaysian Nuclear Agency and MOSTI for the project internal fund. FNCA for collaboration and capacity building. Dismond Lium Anak Uyang, Universiti Kebangsaan Malaysia (UKM). Nur Aisyah Rafiyan, Universiti Putra Malaysia (UPM).

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PROJECT ID: IN118

EDUPREDICTAI

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ABSTRACT
EduPredictAI is an early intervention predictive analytics system designed to identify at-risk students during the first six weeks of a semester. The main issue in education is late detection of struggling students, which often leads to poor performance and dropout risk. This system uses early indicators such as attendance, classroom engagement, and continuous assessment results. Data are recorded in Google Sheets and analyzed using a simple predictive scoring method to classify students into risk levels. Findings indicate that early academic and behavioural data can effectively identify students who may struggle, allowing lecturers to intervene earlier through mentoring and academic support. Overall, EduPredictAI promotes a proactive, data-driven approach to student monitoring and improves academic outcomes, in line with the principles of learning analytics and early warning systems in education.
Keywords: Predictive Analytics, Early Intervention, At-Risk Students, Learning Analytics, Educational Technology

1.0 INTRODUCTION
Identifying struggling students early remains a major challenge in education (Ferguson, 2012; Viberg et al., 2018). Most institutions collect relevant data such as attendance and assessment results, but these are often reviewed too late or manually, leading to delayed intervention. EduPredictAI addresses this gap by using early-semester data (Weeks 1–6) to detect at-risk students earlier through predictive analytics, an approach widely supported in the fields of educational data mining and learning analytics (Baker & Inventado, 2014; Siemens & Long, 2011). The system supports lecturers in making timely interventions, improving academic performance, and reducing dropout risk. This innovation promotes a more proactive and data-driven approach to student monitoring using simple and accessible tools.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To identify at-risk students early using attendance, engagement, and assessment data.
b) To assist lecturers in making faster and more accurate intervention decisions.
c) To improve student performance and reduce dropout risk through early support.

3.0 NOVELTY & INVENTIVENESS
EduPredictAI differs from traditional methods that rely on final exam results or manual observation by using early-semester indicators to detect student risks at an earlier stage. It applies predictive scoring to identify at-risk students and integrates multiple performance indicators such as attendance, classroom engagement, and continuous assessment results into a single system. In addition, it utilises Google Sheets as a low-cost and accessible platform, making it easy for lecturers to implement without requiring complex infrastructure. Compared to existing approaches, EduPredictAI provides a more proactive and data-driven monitoring system that aligns with current trends in higher education learning analytics (Viberg et al., 2018).

Table 1: Comparison between existing solutions and proposed innovation.

Aspect	Existing Solutions	Your Innovation
Student Monitoring	Manual observation	Predictive monitoring system
Data Usage	Focus on final results	Uses early-semester data
Intervention	Reactive approach	Early intervention
Platform	Manual or separate systems	Simple Google Sheets platform
Decision Making	Based on lecturer observation	Data-driven insights

4.0 PRACTICALITY & USEFULNESS

EduPredictAI can be implemented in any educational institution using basic digital tools, where lecturers update student data weekly and the system automatically highlights at-risk students for early intervention. This allows students to receive early academic support, helps lecturers monitor student progress more easily and efficiently, and supports reducing dropout rates while improving overall academic performance. The system is also low-cost, scalable, and easy to implement without requiring advanced infrastructure.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system was developed through several key stages, including problem identification, data collection, system design, and testing. It begins by collecting attendance, engagement, and continuous assessment data from Weeks 1–6, which are then input into Google Sheets for organisation. A predictive scoring method is applied to classify students into different risk levels, following the principles of educational data mining and predictive analytics used in student success monitoring (Baker & Inventado, 2014). Based on the results, appropriate intervention recommendations are provided to support early academic assistance. Testing using real student data showed that early indicators are effective in predicting academic risk.

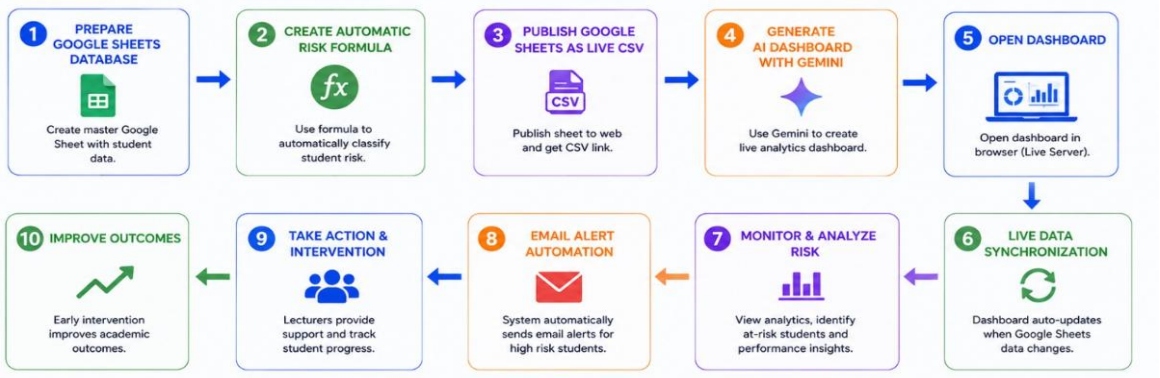


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component	Specification	Purpose
Google sheets	Cloud-based spreadsheet platform with data recording and formula analysis features	To collect and organize student data for predictive analysis
Gemini AI	AI-powered analytics and visualization tools used for data interpretation and dashboard generation	To create live analytics dashboards and predictive insights
E-mail	Digital communication platform with automated notification capability	To alert lecturers and students about high-risk student status

6.0 CONCLUSION

The system was developed through several key stages, including problem identification, data collection, system design, and testing. It begins by collecting attendance, engagement, and continuous assessment data from Weeks 1–6, which are then input into Google Sheets for organisation. A predictive scoring method is applied to classify students into different risk levels, followed by analysis of patterns to identify at-risk students. Based on the results, appropriate intervention recommendations are provided to support early academic assistance. Testing using real student data showed that early indicators are effective in predicting academic risk. Overall, EduPredictAI supports a more proactive, efficient, and student-centred learning environment, consistent with the growing adoption of learning analytics and early warning systems in education.

ACKNOWLEDGMENTS

The authors would like to express our sincere appreciation to Kolej Profesional MARA Bandar Penawar for the support and encouragement throughout the development of EduPredictAI. Special thanks are extended to Encik Fazly bin Jamaluddin, the Director, and Puan Norhasna Nordin for their guidance, leadership, and continuous support towards this innovation project.

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PROJECT ID: IN131

INSECTA-X SMART TRAP SYSTEM

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ABSTRACT
Agricultural pest infestation causes significant crop losses and increases reliance on chemical pesticides, which may lead to environmental pollution, pest resistance, biodiversity loss, and health risks. INSECTA-X Smart Trap System is a solar-powered multi-modal pest trapping innovation designed to support sustainable Integrated Pest Management. The system combines ultraviolet (UV) light, pheromone lure, yellow sticky trap, mini-DC suction fan, and dual wet/dry reservoirs in one portable device. Solar energy stored in a rechargeable battery powers the UV light and fan, while visual and chemical cues attract both nocturnal and diurnal flying pests such as moths and fruit flies. Once insects enter the trap zone, suction airflow pulls them into a dry mesh bag or water reservoir for improved retention. The system will be evaluated through daily capture counts, species diversity analysis, capture efficiency, day/night activity monitoring, energy consumption, and cost-benefit assessment. INSECTA-X is expected to improve trapping efficiency, reduce pesticide dependency, and provide a low-cost, eco-friendly solution for small farms, greenhouses, nurseries, and pineapple fields.
Keywords: INSECTA-X, Smart trap, Pest management, Solar-powered system, Integrated Pest Management

1.0 INTRODUCTION
Insect pest infestation remains a major threat to crop productivity, contributing to global crop losses of approximately 30–40% and affecting food security (Savary et al., 2019). Although chemical pesticides are widely used for rapid pest control, excessive reliance may cause environmental pollution, pest resistance, biodiversity loss, and human health risks (Nicolopoulou-Stamati et al., 2016). Therefore, sustainable pest control technologies that support Integrated Pest Management (IPM) are needed to reduce chemical dependency while maintaining effective crop protection.

2.0 OBJECTIVE
The main objectives of this innovation are:
a) To design and develop a multi-modal pest trapping system integrating light, pheromone, suction, and sticky mechanisms.
b) To develop a solar-powered system with battery storage for continuous operation and design a pest control system with both dry and wet reservoirs.

3.0 NOVELTY & INVENTIVENESS
INSECTA-X introduces a solar-powered multi-modal pest trap that combines UV light, pheromone lure, suction airflow, yellow sticky trap, and dual wet/dry reservoirs in one portable device. Unlike conventional single-function traps, this system targets both diurnal and nocturnal flying pests through combined visual, chemical, mechanical, and physical capture mechanisms. Its novelty lies in the integration of renewable energy, active suction capture, and flexible pest retention to provide a low-cost, practical, and eco-friendly pest management solution.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	INSECTA-X Smart Trap System
Attraction mechanism	Usually single mode, such as light, pheromone, or sticky surface only	Multi-modal system combining UV light, pheromone lure, suction, and sticky trap
Practical use	May require multiple traps for different pest types	One integrated, portable, low-cost system for mixed nocturnal and diurnal pest environments

4.0 PRACTICALITY & USEFULNESS

INSECTA-X is practical for small farms, greenhouses, nurseries, and pineapple fields to monitor and reduce fruit flies, moths, and other small flying pests. It is low-cost, portable, easy to operate, and built using readily available components with an estimated prototype cost of RM124. The solar-powered system enables use in remote areas, while the dual wet/dry reservoirs improve pest retention and cleaning. This innovation supports sustainable pest management by reducing pesticide dependency, lowering environmental risks, and improving trapping efficiency compared with conventional single-function traps.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

INSECTA-X was developed through problem identification, design planning, prototype fabrication, testing, and improvement. The system uses a mini solar panel and rechargeable battery to power the UV light and mini-DC fan. UV light attracts nocturnal insects and can be changed to other light colors such as white, yellow or blue, while pheromone lure targets specific pests such as fruit flies. Yellow sticky traps provide additional capture support. Once insects enter the trap zone, suction airflow pulls them into either a dry mesh bag or water reservoir for retention. Key components include a solar panel, rechargeable battery, UV LED, methyl eugenol lure, 5V USB brushless DC fan, yellow sticky trap, UPVC housing, mesh bag, and water storage.

6.0 CONCLUSION

INSECTA-X Smart Trap System is a low-cost, portable, and solar-powered pest control innovation that combines UV light, pheromone lure, suction airflow, sticky trap, and dual wet/dry reservoirs. This system improves pest attraction and retention while reducing pesticide dependency, making it a practical and eco-friendly solution for sustainable crop protection and contribute to "Bridging Ideas and Technology for a Resilient Future" - the theme of i-NEXTECH 2026.

ACKNOWLEDGMENTS

The authors would like to thank UiTM Perlis, Arau Campus for providing research facilities and support.

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PROJECT ID: IN147

HYPABASE: MYCELIUM-STRUCTURAL DECORATIVE TRAYS FROM MALAYSIAN AGRICULTURAL WASTE

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ABSTRACT
To address underutilized agricultural waste in Malaysia, this study introduces HyphaBase eco-friendly, structural decorative candle trays grown from local plantation residues. Three individual feedstocks: kenaf core, rubberwood sawdust, and shredded oil palm empty fruit bunches (EFB) were independently inoculated with *Pleurotus ostreatus* mycelium to form a self-binding organic composite called mycelium-based composite (MBC). The additive manufacturing workflow uses digital design of 3D CAD modeling with FDM 3D printing to fabricate high-precision negative molds, into which the substrate-mycelium mixture is compacted. Following a controlled 15-day incubation period and thermal drying, stable bio-composites are produced. Mechanical characterization revealed that substrate material directly affects product's surface hardness: Oil Palm EFB yielded the highest surface hardness (46 HC), followed by kenaf core (32 HC) and rubberwood sawdust (28 HC). The engineered trays are 100% chemical-free, fully home-compostable, and generate zero manufacturing waste, successfully bridging manufacturing engineering with sustainable agrotechnology to foster a resilient circular bioeconomy.
Keywords: Mycelium-Based Composites (MBC), FDM 3D printing, Pleurotus ostreatus, Kenaf, Rubberwood sawdust, Oil Palm EFB]

1.0 INTRODUCTION
While fungal mycelium networks naturally bond organic fibers into sustainable alternatives to synthetic resins, traditional product design struggles to control and shape living organisms into precise structural geometries. This research directly bridges this gap by tackling three critical industrial liabilities, namely the abundant of Malaysian plantation residues specifically kenaf core, rubberwood sawdust, and oil palm EFB [1, 2]. Secondly, the consumer market's heavy reliance on plastics or engineered woods bound with toxic formaldehyde-based resins, and the resulting disposal crisis of non-recyclable commercial trays that accelerate long-term landfill accumulation. Thirdly, by introducing mechanical rapid-tooling engineering principles to agrotechnology, this innovation establishes a 100% chemical-free, indoor-safe, and VOC-free consumer product framework that effectively converts low-value secondary agricultural resources into a high-value, "waste-to-wealth" commercial revenue stream.

2.0 OBJECTIVE
The main objectives of this innovation are:
a) To upcycle and validate Malaysian agricultural waste.
b) To eliminate toxic industrial glues using an additive manufacturing protocol that utilizes fungal mycelium as a self-assembling binder.
c) To engineer a fully functional decorative candle tray that is 100% home-compostable and biodegradable.

3.0 NOVELTY & INVENTIVENESS
Additive Bio-Manufacturing: Combines 3D CAD and FDM printing to force a living organism to grow perfectly within strict engineering dimensions.
Feedstock Agnosticism: The bio-fabrication process dynamically adapts to whatever agricultural waste stream is regionally or seasonally available.
Zero Manufacturing Scrap: Replaces traditional subtractive wood carving (which wastes 30% to 40% of material) with a closed-cavity additive biological growth model. At the moment, no IP is filled. Potential to IP is industrial design for inventive steps to produce HypaBase.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	HypaBase
Material	Petroleum polymers or toxic resin glues	100% organic agricultural waste & fungal roots
Manufacturing	Subtractive machine or high-energy molding	Additive biological growth in 3D-printed molds.

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: Designed as a heat-safe, lightweight, minimalist decorative tray base for aromatherapy candles and premium lifestyle decor. Target Users: Eco-conscious consumers, modern home interior markets, and sustainable hospitality/spa venues. Feasibility & Sustainability: Highly cost-effective as it utilizes zero-cost agricultural waste.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Production of HypaBase:

a) Raw materials: Agricultural residues are collected, cleaned and prepared.
b) Digital design: The tray geometry is designed using 3D CAD software.
c) Mold fabrication: Negative molds are printed via FDM 3D printing to create zero-waste rapid tooling.
d) Composite preparation: Agricultural residues (kenaf core/rubberwood sawdust/EFB) are individually mixed with *Pleurotus ostreatus* spawn.
e) Molding: The composite is firmly compacted into the 3D-printed molds.
f) Incubation: The composite undergoes a 15-day incubation period under controlled environment (23-25°C, 85% humidity). On day-9, the composite is demolded, to allow growth of uniform skin until day-15.
g) Drying: Composite are dried in an oven at 60°C for 24 hours to terminate mycelium growth and remove remaining moisture. From surface hardness testing, substrate material directly affects product's surface hardness: Oil Palm EFB yielded the highest surface hardness (46 HC), followed by kenaf core (32 HC) and rubberwood sawdust (28 HC).

6.0 CONCLUSION

In conclusion, HyphaBase successfully merges rapid tooling with agricultural biotechnology to create bio-composites, proving that kenaf core, rubberwood sawdust, and Oil Palm EFB can be individually bound into structural consumer trays with zero toxic resins. While a minor technical limitation exists in the organic material's porous and hygroscopic surface nature, future engineering work will evaluate plant-derived hydrophobic barriers. Ultimately, by transforming raw agricultural wasate into highly structured, home-compostable utility platforms, HyphaBase perfectly embodies the core theme of i-NEXTECH 2026, demonstrating how mechanical ingenuity can partner with nature to cultivate a resilient and sustainable future.

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PROJECT ID: IN159

PROJECT: SMART TREK AI BAND (OFFLINE) ARTIFICIAL INTELLIGENCE SEARCH & RESCUE ECOSYSTEM FOR MOUNTAIN HIKERS

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ABSTRACT
The increasing number of lost hiker incidents in Malaysia highlights the need for innovative safety and rescue solutions, particularly in remote forest and mountainous environments where internet and mobile network coverage are unavailable. Search and Rescue (SAR) operations often require extensive manpower, time and resources, resulting in high operational costs and delayed victim recovery. This project proposes Smart Trek AI Band, an intelligent wearable device that integrates Edge Artificial Intelligence (AI), Global Positioning System (GPS), Long range communication (LoRa) communication technology and predictive rescue analytics to enhance hiker safety and improve SAR efficiency. The system operates entirely offline, allowing hikers to access AI-powered survival guidance, route monitoring, health tracking and emergency assistance without internet connectivity. In emergency situations, the band transmits critical information such as GPS coordinates, health status and battery level through LoRa communication to nearby rescue command centres. Additionally, an AI prediction engine analyses terrain, weather conditions, water sources, movement patterns and indigenous Orang Asal tracking knowledge to generate probability-based heat maps for faster victim location identification. Smart Trek AI Band offers a comprehensive ecosystem that supports prevention, emergency response and rescue operations. The innovation has significant potential to reduce rescue time, lower operational costs, improve outdoor safety and support sustainable ecotourism development.
Keywords: LoRa Communication, Search and Rescue, Smart Wearable Device, Hiking Safety, Predictive Analytics

1.0 INTRODUCTION
Hiking and mountain trekking have become increasingly popular recreational activities in Malaysia. However, the rise in lost hiker incidents poses significant challenges for public safety and Search and Rescue (SAR) operations, particularly in remote forest and mountainous areas with limited internet and mobile network coverage. Existing GPS trackers and mobile applications often rely on internet connectivity making them less effective in remote environments. According to the Malaysian Fire and Rescue Department (JBPM), were reported between January and May 2026, representing a nearly 30% increase compared to the same period in 2025. Current hiking safety systems face several limitations such as dependence on internet and mobile network coverage, limited emergency communication in remote forest areas, inefficient SAR operations due to large search zones, lack of real-time survival guidance for lost hikers and high operational costs associated with prolonged rescue missions. Smart Trek AI Band improves hiker safety, supports faster rescue operations and enables emergency communication without internet access. It helps reduce rescue costs, preserves Orang Asli tracking knowledge, and promotes safer and more sustainable outdoor tourism.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) Prevent hikers getting lost.
b) Enable communication without the internet.
c) Predict possible victim locations and
d) Support SAR teams with AI assisted decision making.

3.0 NOVELTY & INVENTIVENESS
Most rescue technologies stop working when internet and mobile coverage disappear. Smart Trek AI was designed specifically for the moment connectivity is lost. Through Edge AI, LoRa communication, predictive search analytics and indigenous forest intelligence, the system continues protecting hikers, guiding survival decisions and supporting rescue teams even in the most remote jungle environments.

Table 1: Comparison between existing solutions and proposed innovation

Existing Solution	SMART TREK AI
GPS tracking only	AI prediction
Internet dependent	Offline AI
Human search planning	AI heat map
Limited indigenous knowledge	Orang Asli AI knowledge integration
Reactive rescue	Preventive rescue



4.0 PRACTICALITY & USEFULNESS

Smart Trek AI Band improves hiker safety, enables offline emergency communication, supports faster rescue operations, reduces SAR costs, and preserves Orang Asli tracking knowledge. Target Users: Hikers, campers, SAR teams, JBPM, forestry and national park authorities, outdoor adventure operators, and Orang Asli communities.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Hiker
↓
SMART TREK BAND
↓
LoRa Signal
↓
Forest Gateway Tower
↓
SAR Command Centre

[Signal can travel: 5–15 km in forest Up to 30 km in open terrain depending on topography.]

6.0 CONCLUSION

Social Impact: Reduces hiker fatalities, speeds up rescue operations, and preserves indigenous knowledge. Economic Impact: Lowers SAR costs and increases confidence in ecotourism activities.Environmental Impact: Reduces search areas, fuel consumption and helicopter usage. Contributes SDG 3: Good Health and Well-being, SDG 9: Industry, Innovation and Infrastructure, SDG 11: Sustainable Cities and Communities and SDG 13: Climate Action.

ACKNOWLEDGMENTS

The authors gratefully acknowledge Universiti Sultan Azlan Shah (USAS) for the institutional support and encouragement provided throughout the development of the Smart Trek AI Band innovation. The authors also extend their appreciation to thei-NEXTECH 2026 organising committee for providing a platform to present and showcase this innovation.

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PROJECT ID: IN176

SME-FIRI (SME FINANCIAL INCLUSION READINESS INDEX)

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ABSTRACT
SMEs play an important role in Malaysia's economy, yet many still struggle to access and utilize formal financial services effectively. SMEs often have limited digital finance and Islamic finance readiness as well as lack clear guidance on how to improve. Therefore, SME-FIRI, which stands for the SME Financial Inclusion Readiness Index is an innovative index developed to assess the level of financial inclusion readiness among small and medium enterprises (SMEs). SME-FIRI transforms a complex and manual financial readiness assessment into a fast, automated, and data-driven digital solution that provides SMEs with instant scoring, classification, and personalized recommendations. SME-FIRI provides a comprehensive and practical tool that helps identify the preparedness of SMEs to access, utilise, and benefit from inclusive financial services, ultimately supporting their sustainable growth and resilience. The SME-FIRI model was developed based on empirical findings from a study on Financial Inclusion among SMEs in Malaysia. The SME-FIRI Index was developed based on an extensive review of the financial inclusion literature and preliminary research on SMEs in Malaysia.
Keywords: Small Medium Enterprises (SME), Financial Inclusion, Financial Inclusion Readiness Index

1.0 INTRODUCTION
Financial inclusion seeks to provide individuals and businesses with access to useful and affordable financial products and services that meet their needs, including payments, savings, and other types of transactions. Financial inclusion offers opportunities at the social level to reduce income inequality and alleviate poverty. Despite Malaysia's robust economic development and technological advancements, a significant portion of its population, particularly in rural areas and marginalized groups, still faces barriers to accessing financial services. SME-FIRI helps SMEs assess their financial inclusion readiness and identify areas for improvement. By providing personalized recommendations, the system supports SMEs in improving their financial capability, digital financial adoption, and access to suitable financing opportunities. For financial institutions, it serves as a useful screening and decision-support tool. For policymakers, it provides valuable data to support evidence-based policies and targeted financial inclusion initiatives.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To develop a Smart Financial Inclusion Readiness Index (SME-FIRI) that evaluates and predicts the financial inclusion readiness of Malaysian SMEs with a fast, automated, and data-driven digital solution that provides SMEs with instant scoring, and classification.
b) Generate a comprehensive readiness score.

3.0 NOVELTY & INVENTIVENESS
The main novelty of this innovation is the development of SME-FIRI, an integrated Financial Inclusion Readiness Index that combines Financial Capability, Business Formalization, Digital Financial Readiness, and Islamic Financial Readiness into a single technology-driven decision-support platform. SME-FIRI different from existing solutions is that it goes beyond traditional credit scoring and financial performance assessments. Existing tools mainly evaluate whether an SME qualifies for financing, whereas SME-FIRI evaluates the overall readiness of SMEs to participate in the formal financial ecosystem. SME-FIRI possesses strong intellectual property potential. The assessment framework, scoring methodology, dashboard design, and reporting system can be protected through copyright. In addition, the SME-FIRI brand name has trademark potential.

4.0 PRACTICALITY & USEFULNESS
SME-FIRI is designed to be simple, user-friendly, and easily accessible for SMEs. The assessment can be completed online within a short period of time, and the system automatically generates scores,

classifications, and recommendations without requiring specialized technical knowledge. The platform can be implemented through, Excel-based dashboard, Power BI dashboard, Web-based application, Mobile application (future development).

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of SME-FIRI involved five phases. First, a literature review was conducted to identify the key determinants of financial inclusion. Second, a structured questionnaire was developed based on four dimensions. Third, preliminary data were collected from approximately 100 SMEs in Malaysia. Fourth, the SME-FIRI scoring index was developed using weighted scores. Finally, a technology-driven system was designed to automate scoring, classification, and recommendation generation.

6.0 CONCLUSION

SME-FIRI successfully addresses the lack of a comprehensive and technology-driven tool for assessing financial inclusion readiness among SMEs. Through automated scoring, readiness classification, dashboard analytics, and personalized recommendations, SME-FIRI enables SMEs to identify gaps, improve their readiness, and enhance access to formal financial services. As a result, the innovation provides a practical decision-support tool for SMEs, financial institutions, and policymakers, contributing to greater financial inclusion and sustainable SME development in Malaysia. With its strong practical value, innovation potential, and relevance to national development goals, SME-FIRI is well-positioned to make a meaningful contribution to this IID and to the future growth and sustainability of SMEs in Malaysia.

ACKNOWLEDGMENTS

We gratefully acknowledge Universiti Teknologi MARA (UiTM) and the Faculty of Business and Management for their support and grant funding. Special thanks to all team members, participating SMEs, colleagues, and collaborators for their valuable contributions to the development of SME-FIRI.

PROJECT ID: IN225

PALMSPHERE: A STRUCTURED BOARD GAME APPROACH TO ENHANCE UNDERSTANDING AMONG ESTATE MANAGEMENT STUDENTS

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ABSTRACT
Sustainable plantation management requires practitioners to balance economic performance, environmental stewardship, social responsibility, and certification compliance. However, students often have difficulty applying theoretical concepts related to the Malaysian Sustainable Palm Oil (MSPO) standards to practical estate management scenarios. This study presents Palmsphere: The MSPO Estate Challenge, an interactive board game developed to enhance students' understanding of sustainable oil palm estate management through gamification and experiential learning (Kolb, 1984; Plass et al., 2020). PalmSphere stimulates the management of a 500-hectare oil palm estate pursuing MSPO certification under MS2530:2022 (Malaysian Palm Oil Board, 2022). Players begin with a virtual budget of RM1,000,000 and navigate 30 authentic estate management scenarios involving labor allocation, biodiversity conservation, worker welfare, water management, crisis response, and internal auditing. Each decision influences four performance indicators, including MSPO compliance, environmental sustainability, and soil responsibility. The innovation was developed through a multidisciplinary collaboration involving Faculty of Agrotechnology and Applied Sciences, Faculty of Education, and Centre of Knowledge Advancement and Languages at i-CATS University College. The board game integrates agricultural expertise, educational design principles, and communication strategies to create an engaging learning experience. PalmSphere has the potential to support outcome-based education and improve decision-making skills among future plantation managers.
Keywords: Gamification, MSPO, sustainable plantation management, experiential learning, board game

1.0 INTRODUCTION
The Malaysian oil palm industry plays a significant role in national economic development and is increasingly required to demonstrate sustainable practices through certification standards such as the Malaysian Sustainable Palm Oil (MSPO) scheme under MS2530:2022 (Malaysian Palm Oil Board, 2022). Consequently, future plantation professionals must be equipped with the knowledge and skills necessary to balance economic performance, environmental stewardship, social responsibility, and certification compliance. However, the conventional teaching approaches in the plantation management courses are predominantly lecture-based and provide limited opportunities for the students to apply theoretical knowledge to the real-world estate management scenarios. As a result, the students often have difficulty in understanding the interconnected nature of sustainability dimensions and the trade-offs involved in the operational decision-making. To address this gap, PalmSphere was developed as an interactive board game that integrates gamification and experiential learning principles into sustainable plantation management education (Kolb, 1984; Plass et al., 2020). The innovation provides a practical and engaging learning platform to enhance students' understanding of the MSPO requirements, strengthen critical thinking skills, and support the outcome-based education for future plantation managers.

2.0 OBJECTIVE
The main objectives of this innovation are:
a) to enhance students' understanding of the MSPO principles and sustainable plantation management practices.
b) to develop critical thinking and decision-making skills through scenario-based learning.
c) to promote experiential learning by integrating economic, environmental, social, and compliance dimensions into a gamified educational platform.

3.0 NOVELTY & INVENTIVENESS
PalmSphere introduces a multidisciplinary and gamified approach to sustainable plantation management education by integrating agricultural expertise, educational design principles, and

communication strategies into a single learning platform (Plass et al., 2020). Unlike the conventional teaching methods that primarily rely on lectures and case studies, PalmSphere provides an immersive environment where players actively manage a 500-hectare oil palm estate pursuing certification under MSPO standard MS2530: 2022. The innovation incorporates 30 authentic estate management scenarios derived from the real-world operational challenges, including labor allocation, biodiversity conservation, worker welfare, water management, waste management, and crisis response (Malaysian Palm Oil Board, 2022). Players are required to make strategic decisions while managing a virtual budget of RM1,000,000 represented through budget tokens. Each decision directly influences four integrated performance indicators, including profit, MSPO compliance, environmental sustainability, and social responsibility. This multidimensional scoring mechanism reflects the complex trade-offs encountered in the actual estate management and promotes systems thinking among learners. A distinguishing feature of PalmSphere is its disqualification mechanism, which prevents the players from prioritizing short-term economic gains at the expense of environmental performance or certification compliance. This design reinforces the importance of responsible decision-making and aligns with the sustainability principles which is embedded within the MSPO framework.

Table 1: Comparison between existing solutions and PalmSphere

Aspect	Existing Solutions	PalmSphere
Learning Approach	Lecture-based learning	Gamified simulation
Student participation	Passive learning	Active decision-making
Scenario exposure	Limited case studies	30 authentic scenarios
Performance evaluation	Knowledge recall	Four integrated sustainability indicators
Decision consequences	Minimal simulation	Real-time budget and score impacts
MSPO integration	Theoretical coverage	Practical application of MS2530:2022

4.0 PRACTICALITY & USEFULNESS

PalmSphere is designed for undergraduate students in the plantation management, agrotechnology, and related disciplines. The game can also be adopted for plantation trainees, extension officers, and smallholder capacity-building programs. The innovation is cost-effective, portable, and easily implemented in the classroom settings without requiring digital infrastructure. By simulating real estate management scenarios, PalmSphere encourages collaborative learning, communication, and problem-solving skills while supporting outcome-based education. (Qian & Clark, 2016; Subhash & Cudney, 2018). The integration of authentic estate management scenarios enables learners to apply theoretical concepts within realistic contexts, thereby enhancing engagement and knowledge retention (Wu et al., 2012).

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

PalmSphere was developed using a five-stage design process comprising needs analysis, scenario development, prototype design, validation, and pilot implementation. The needs analysis stage identified the challenges associated with teaching sustainable plantation management and applying MSPO principles in conventional lecture-based learning environments.During the scenario development stage, 30 authentic estate management scenarios were designed based on the requirements of the MSPO standard MS2530:2022 and Good Agricultural Practices (GAP). The scenarios addressed key operational aspects, including labor allocation, biodiversity conservation, worker welfare, water management, waste management, internal auditing, and crisis response.

The prototype design stage involved developing the game board, budget tokens, scenario cards, score sheets, and gameplay rules. PalmSphere simulates the management of a 500-hectare oil palm estate seeking MSPO certification. Each player begins with a virtual budget of RM1,000,000, represented by 100 budget tokens, where one token is equivalent to RM10,000. Players progress through 30 scenario spaces by rolling a six-sided die and making strategic decisions in response to operational challenges. Each decision influences four integrated performance indicators, including profit, MSPO compliance, environmental sustainability, and social responsibility. Sustainable decision-making is crucial because players that do not meet basic standards for the environmental performance or MSPO compliance are eliminated. The key components of PalmSphere include a game board with 30 scenario spaces, budget tokens, decision cards, score sheets, a six-sided die, and player tokens. Pilot testing was conducted with nine students enrolled in the Agricultural Management course at i-CATS University College. The students participated in facilitated gameplay sessions lasting approximately 60 minutes in groups of three to four players. Validation was conducted through lecturer observation and verbal feedback collected during the post-game reflection sessions.The observational findings indicated that the students actively engaged in the gameplay and demonstrated improved understanding of the

relationships among profitability, environmental stewardship, social responsibility, and certification compliance. Participants highlighted the realistic scenarios and integrated scoring system as the effective features for enhancing critical thinking, collaborative learning, and decision-making skills.

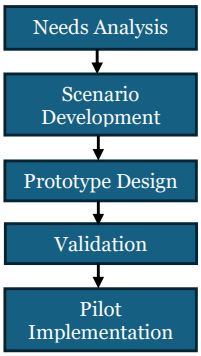


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Game board	30 scenario spaces	Simulates estate management activities
Busget tokens	100 tokens (RM10,000/token)	Represents estate financial resources
Scenario cards	MSPO-based operational scenarios	Facilitates decision-making
Score sheet	Four performance indicators	Tracks player performance
Six-sided die	Standard game die	Determines player movement
Player tokens	Individual markers	Identifies player position

6.0 CONCLUSION

PalmSphere addresses the limitations of the conventional teaching approaches by transforming sustainable plantation management education into an engaging and experiential learning experience. By integrating authentic estate management scenarios with the MSPO standard MS2530:2022, the innovation enables students to understand the complex relationships between profitability, environmental stewardship, social responsibility, and certification compliance. The multidisciplinary collaboration among the three faculties has resulted in a practical and innovative educational tool that supports outcome-based education and enhances critical thinking skills. Although the current version has been validated through pilot implementation and verbal feedback, future enhancements will focus on systematic learning outcome assessments, digital platform development, and expansion to additional sustainability certification schemes. PalmSphere demonstrates significant potential to contribute towards developing future plantation professionals equipped to make responsible and sustainable management decisions, thereby supporting the i-NEXTEXH 2026 theme of “Bridging Ideas and Technology for a Resilient Future.”

ACKNOWLEDGMENTS

We would like to express our sincere appreciation to i-CATS University College for supporting the development of PalmSphere. Special thanks are extended to the Dean and colleagues under Faculty of Agrotechnology and Applied Sciences, Faculty of Education, and Centre of Knowledge Advancement and Languages for their support throughout the design and development process.We also gratefully acknowledge the students enrolled in the Agricultural Management subject for their active participation in the pilot implementation of PalmSphere, for their engagement, and verbal feedback.

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PROJECT ID: IN227

SMARTAERO – SMART AERATED COMPOSTING TECHNOLOGY

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ABSTRACT
SMARTAERO is an Internet of Things (IoT)-enabled smart composting system developed to accelerate compost production from sago hampas while improving compost quality. The system integrates active aeration, real-time monitoring, and intelligent decision-support capabilities through sensors that continuously measure temperature, moisture, pH, and electrical conductivity (EC). Data are transmitted to a cloud-based dashboard for monitoring and analysis. Based on sensor readings, the system provides recommendations such as moisture adjustment, aeration enhancement, and compost turning to optimize the composting process. Experimental results demonstrated faster temperature stabilization, improved moisture regulation, accelerated pH stabilization, and shorter composting duration compared to conventional anaerobic composting. SMARTAERO offers a practical, scalable, and cost-effective solution for sustainable organic waste management and organic fertilizer production.
Keywords: Smart composting system, Internet of Things (IoT), Organic waste management, Aeration technology, Organic waste management, Sustainable agriculture

1.0 INTRODUCTION
Organic waste management remains a major challenge in agricultural and agro-industrial sectors. Conventional composting methods are often slow, labour-intensive, and dependent on manual monitoring [1]. These limitations reduce the effectiveness of waste-to-resource conversion and delay nutrient recycling for agricultural use. Therefore, there is a need for an improved composting system that accelerates decomposition while ensuring optimal conditions for microbial activity [2]. SMARTAERO was developed to address these limitations by integrating active aeration, IoT-based monitoring, and intelligent decision-support functions. The system enables real-time monitoring and data-driven composting management, providing a sustainable and practical solution for organic waste valorizations.

2.0 OBJECTIVE
The main objectives of this innovation are to:
a) establish an IoT-enabled smart composting system,
b) monitor temperature, moisture, pH, and electrical conductivity (EC) in real time, and
c) provide intelligent recommendations based on sensor data to optimize composting performance and improve compost quality.

3.0 NOVELTY & INVENTIVENESS
SMARTAERO integrates active aeration, IoT-based monitoring, and intelligent decision-support capabilities into a single smart composting platform. Unlike conventional composting systems that depend on passive aeration and manual monitoring, SMARTAERO continuously tracks key composting parameters and provides real-time recommendations to improve process efficiency. The active aeration mechanism enhances oxygen availability, promoting microbial activity and accelerating decomposition [2]. Combined with cloud-based monitoring and data-driven recommendations, the system improves process control, shortens composting duration, and enhances compost quality [3]. These integrated features provide strong commercialization and intellectual property potential, with the IP filing process currently in progress.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	SMARTAERO
Aeration System	Passive aeration relying on manual turning or natural airflow	Active aeration system providing continuous and controlled oxygen supply to enhance microbial activity

Monitoring System	No real-time monitoring; parameters are usually checked manually and intermittently	IoT-based real-time monitoring of temperature, pH, humidity, and EC for process optimization
Decision Support	Users rely on experience and manual observations to determine corrective actions	Provide real-time recommendations and corrective actions based on sensor data
Reactor Design	Open piles or basic bins with limited control over environmental conditions	Compact 220L polyethylene tank designed for controlled, efficient, and scalable composting

4.0 PRACTICALITY & USEFULNESS

SMARTAERO is suitable for agricultural, educational, research, and agro-industrial applications. The system converts various organic waste into high-quality compost through an aerated and IoT-monitored composting process, helping to reduce waste accumulation while producing valuable organic fertilizer [4]. Built using affordable and readily available components, SMARTAERO is easy to assemble, operate, and maintain, making it accessible to smallholder farmers, researchers, institutions, and commercial users. Its scalable design enables deployment across various operational sizes while contributing to sustainable agriculture and environmental conservation.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

SMARTAERO was developed through conceptualization, design, fabrication, and testing. The system consists of a polyethylene composting reactor equipped with an active aeration system, IoT sensors, and an ESP32 microcontroller. Sensors continuously monitor temperature, pH, moisture, and electrical conductivity, while data are transmitted to a cloud-based platform for real-time monitoring and analysis (Refer Table 2). Validation was conducted using organic waste as the composting feedstock to evaluate composting performance, compost quality, and processing time. Results showed that SMARTAERO improved decomposition efficiency, reduced composting duration, and produced more uniform compost compared to conventional composting methods. The integrated aeration and IoT monitoring system also enhanced process control by enabling continuous tracking of composting conditions and providing real-time recommendations for optimization.



Figure 1: Development process flowchart of SMARTAERO composter.

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Composting Reactor	220L Polyethylene Water Tank	Main composting chamber for organic waste processing
Aeration system	350W Centrifugal air blower	Supplies oxygen to support aerobic microbial activity and accelerates decomposition.
Controller Unit	ESP32	Collects sensor data and transmits information to the IoT platform.

IoT Sensor Module	Temperature, pH, Moisture, and EC Sensors	Continuously monitors key composting parameters and transmits data for real-time analysis.
IoT Dashboard	Cloud-Based Platform	Provides real-time data visualization, remote monitoring, and intelligent recommendations for composting optimization
Intelligent Decision-Support System	Rule-Based Recommendation Engine	Generates real-time recommendations to optimize composting conditions and improve process efficiency

6.0 CONCLUSION

SMARTAERO successfully combines active aeration, IoT monitoring, and intelligent decision-support functions to enhance composting efficiency and compost quality. The system provides real-time monitoring and recommendations for process optimization, making it a practical, scalable, and sustainable solution for smart organic waste management. Future improvements will focus on automation, mobile integration, and commercial-scale implementation.

ACKNOWLEDGMENTS

The authors would like to thank i-CATS University College for funding and supporting the SMARTAERO project, as well as all project team members and students involved in its development and validation.

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PROJECT ID: IN228

PROCTORX GREENVISION

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ABSTRACT
Academic integrity represents the foundational currency of higher education, providing the indispensable value and trust required for credentials to be recognized in the global workforce. However, previous studies discovered that traditional security measures are poorly equipped to counter online cheating issues. Thus, this project introduces “ProctorX GreenVision”, an advanced behavioral biometric authentication system used to mitigate academic misconduct. The project addresses the rise of AI-assisted fraud and professional "contract cheating" services by implementing the Neuro-Fuzzy Algorithm. This innovation utilizes Keystroke Dynamic Analysis (KDA) to verify identity based on the unique physiological rhythms, speed, and patterns of a student’s typing behavior. This system builds a user profile during enrollment, which handles real-time behavioral variances. This continuous authentication mechanism ensures that the individual logged into the portal is the same individual completing the assessment, effectively invalidating the utility of stolen credentials or hired exam-takers. This method can help educators, such as lecturers and teachers, in assessing and grading students' tests and assignments, thereby minimizing cases of cheating. The techniques implemented represent a new trend in enhancing the security of online learning assessments. The system now includes updated features for better accuracy.
Keywords: Academic misconduct, cheating, neuro-fuzzy, keystroke dynamic authentication

1.0 INTRODUCTION
Students may feel compelled to cheat on their online assessments due to the pressure of attaining excellent results (Pacheco, 2024). This leads some students to seek assistance from others when they find it challenging to meet deadlines (McDermott, 2021). This behavior is more likely if the tasks are perceived as tedious, irrelevant, or complex. This system fundamentally transforms online exams from a high-risk vulnerability into a secure, credible alternative to physical proctoring. ProctorX GreenVision eliminates the need for invasive video surveillance or the prohibitive logistics of human oversight due to non-intrusive, continuous verification. This shift from "what a student knows" (passwords) to "how a student behaves" (biometrics) provides the security infrastructure necessary for institutions to scale distance education without compromising academic standards.

2.0 OBJECTIVE
The main objectives of this project are to utilize Keystroke Dynamic Analysis (KDA) as a continuous, non-intrusive biometric identifier that monitors user behavior throughout the duration of an online assessment.

3.0 NOVELTY & INVENTIVENESS
The integration of "fuzzy logic" and "neural networks" represents the next generation of behavioral biometrics. Traditional binary security models fail to account for the natural "fuzziness" of human interaction variances caused by fatigue, stress, or environmental distractions. ProctorX GreenVision extracts unique temporal features, specifically dwell time (duration of key press) and flight time (interval between key presses), to define a user's typing signature.

4.0 PRACTICALITY & USEFULNESS
ProctorX GreenVision is a globally validated solution ready for immediate institutional deployment, such as professional certifications and final degree examinations. The system has received multiple prestigious awards. This recognition from the project's ability to significantly reduce the carbon footprint and material waste associated with physical examination centers, travel, and paper-based testing. This technology is not merely a prototype, but a mature security architecture vetted by global experts in innovation and engineering.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of ProctorX GreenVision was adapted from the online learning verification framework (Sadikan et. al., 2019). The system is built upon a based on three-stage processing including:

a) Data Acquisition: The system captures raw keystroke timing data (dwell/flight times) in the background as the student interacts with the assessment interface.
b) Feature Extraction: The algorithm isolates timing signatures and compares them against the Stored Enrollment Profile, which serves as the ground truth.
c) Fuzzy Logic Classification: This is the core decision-making stage where the algorithm determines identity matches. It uses adaptive thresholding to distinguish between "authorized variance" (a tired student) and "unauthorized variance" (an imposter).

6.0 CONCLUSION

As the methods used to subvert academic integrity evolve through AI and professionalized contract cheating, educational security must evolve faster. ProctorX GreenVision successfully addresses the "cheating crisis" by bridging sophisticated behavioral science with a practical, non-intrusive interface. This innovation is a vital contribution to a Resilient Future, ensuring that the prestige and integrity of an online degree remain indistinguishable from a traditional one.

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EXTENDED ABSTRACT

Category A2 (Professional & Industry Inventor-Individual)

PROJECT ID: IN88

LCC004 WEB PLATFORM: ENHANCING PRODUCT REVIEW WRITING SKILLS AMONG ESL PRE-DIPLOMA STUDENTS

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ABSTRACT
The integration of technology in language learning is on the rise since it can foster students' engagement and motivation in learning languages. The main objective of this innovation, LCC004: Mastering the Product Review website is to enhance the English as a Second Language (ESL) pre-diploma students' understanding on product review writing tasks, specifically focusing and mastering simple and compound sentence structures. The website provides bite-sized content about simple and compound sentences, authentic reviews, color-coded sentence components, and interactive reinforcement exercises.
Keywords: ESL Pre-Diploma, Compound sentences, Simple sentences, Technology, Product Review Writing

1.0 INTRODUCTION
Integrating technology into teaching practices is vital in ESL classrooms because it fosters students' engagement and motivation (Mohamed, 2025). Modern digital tools offer interactive platforms, allow realistic application of language, and provide diverse language learning resources for learners. By utilising technology effectively, educators can create dynamic and inclusive learning environments that enhance students' engagement in the classrooms. The pre-diploma students at Universiti Teknologi MARA (UiTM) take English Proficiency for Pre-Diploma (IV) (LCC004). One of the core topics covered in this subject is product review writing which requires students to describe products using simple and compound sentences. However, since this component was recently introduced to the LCC004 syllabus, there is lack of learning materials to support students learning. Therefore, the developer developed the LCC004: Product Review Writing Website using Canva to make the learning process more engaging and attractive for pre-diploma students in learning product review writing.

2.0 OBJECTIVES
The main objectives of this innovation are to enhance ESL pre-diploma students' product review writing skills using appropriate simple and compound sentence structures in an interactive and engaging digital learning environment as well as to boost students' engagement and motivation using an interactive website.

3.0 NOVELTY & INVENTIVENESS
The LCC004 Product Review Website introduces a student-centered approach to ESL writing instruction. Unlike conventional ESL grammar materials that normally focus on isolated drills and textbook-based instruction, this innovation specifically targets CEFR A1 to CEFR A2 pre-diploma learners within a business-related communication context which aligned with UiTM's LCC004 course syllabus.

4.0 PRACTICALITY & USEFULNESS
The key features of the website include the colour-coded sentence components to differentiate subjects and verbs in sentences, interactive activities that reinforce learning outcomes and authentic product review scenarios that enable students to develop practical writing skills that are relevant to real-world communication. Students can use the website to improve their product review writing skills which can be applied in their LCC004 product review assessment. In addition, they can also use it to enhance their product review writing skills to write reviews on Shopee, Lazada, or Google Review. The developer used Canva to develop the website, which is highly stable and requires no coding. It can be accessed through smartphones, tablets, and laptops. Unlike traditional textbooks that require printing costs, lecturers and students can access the website for free.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The developer used ADDIE model - Analysis, Design, Development, Implementation, Evaluation to develop the LCC004: Product Review Writing website. Below is the flowchart of development with ADDIE:

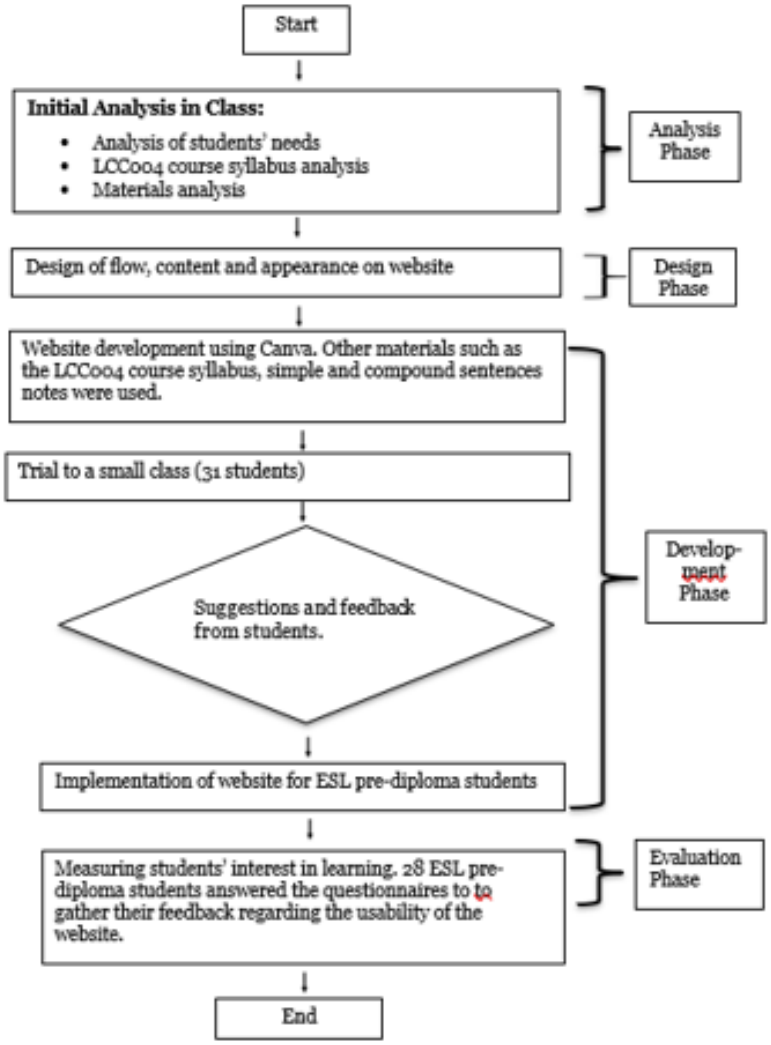


Figure 1: Development process flowchart

6.0 CONCLUSION

In conclusion, the LCC004: Mastering the Product Review website equips the pre-diploma students with practical content and interactive simple and compound sentences. However, the website requires stable internet access which may cause challenges for some students who have poor Internet connection. It is recommended that in the future, researchers can incorporate responsive, AI-driven writing checking tools to give students feedback after completing the exercises.

ACKNOWLEDGMENTS

First and foremost, I would like to thank the pre-diploma students who participated in the evaluation of the website. Their active engagement, feedback, and cooperation made the validation of this innovation possible. Additionally, I am deeply grateful to my family for their unwavering support, patience, and continuous encouragement throughout the development of this website.

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PROJECT ID: IN150

Q-LEARN iME: A ONE-STOP LEARNING HUB FOR ISLAMIC AND MORAL EDUCATION FOR YOUNG LEARNERS

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ABSTRACT
Q-Learn iME (Quick Learning Islamic and Moral Education) is a one-stop learning hub developed to enhance access to learning resources for the Islamic and Moral Education for Young Learners (ECE152) course. The innovation addresses the challenge of fragmented learning materials that are often distributed across multiple digital platforms, requiring students to spend considerable time locating lecture notes, videos, worksheets and assessment materials. Such fragmentation may hinder self-directed learning and limit opportunities for effective pre-class preparation. Q-Learn iME provides an interactive PDF-based learning hub that centralises various educational resources into a single access point. The learning hub incorporates lecture notes, video explanations, infographics, interactive flipbooks, worksheets and quizzes to support diverse learning needs and preferences. The development process involved six stages: needs analysis, content development, resource integration, interactive navigation design, Q-Learn iME hub development, and validation and refinement. Several educational technologies, including NotebookLM, AnyFlip, Google Forms, Wayground, Google Drive and PowerPoint were integrated to develop interactive PDF. The result demonstrates the feasibility of consolidating multiple educational technologies within a unified learning ecosystem. Q-Learn iME has the potential to improve accessibility to learning resources, promote self-directed and pre-class learning and enhance learner engagement through interactive and structured learning experiences.
Keywords: Learning Hub, Educational Technology, Self-Directed Learning, Microlearning, Islamic and Moral Education

1.0 INTRODUCTION
Digital technologies have become an integral part of teaching and learning in higher education. However, learning resources are often distributed across multiple platforms, making it difficult for students to access relevant materials efficiently. For the *Islamic and Moral Education for Young Learners* (ECE152) course, Q-Learn iME was developed as a one-stop learning hub that centralises diverse educational resources within a single platform. The innovation supports self-directed learning, pre-class preparation and systematic management of digital learning materials.

2.0 OBJECTIVES
The main objectives of this innovation are:
a. To develop Q-Learn iME as a one-stop learning hub that centralises various learning resources for the Islamic and Moral Education for Young Learners (ECE152) course.
b. To integrate multiple educational technologies, including NotebookLM, AnyFlip, Google Forms, Wayground, Google Drive and PowerPoint into a single learning environment.
c. To support self-directed learning and pre-class preparation by providing students with structured, accessible and interactive learning resources.

3.0 NOVELTY & INVENTIVENESS
Q-Learn iME is a one-stop learning hub developed for the *Islamic and Moral Education for Young Learners* (ECE152) course. Q-Learn iME integrates multiple educational technologies into an interactive PDF-based learning hub that serves as a single-entry point to diverse learning resources. Q-Learn iME supports self-directed learning and pre-class preparation through structured and accessible learning experiences. Unlike existing solutions that rely on multiple platforms and standalone applications, Q-Learn iME integrates various educational technologies within a single learning hub to provide a more seamless and organised learning experience. The innovation also has potential for copyright protection, although no intellectual property application has been filed.

4.0 PRACTICALITY & USEFULNESS

Q-Learn iME has the potential to improve students' access to learning resources by providing a structured and centralised learning environment. The innovation supports self-directed learning and pre-class preparation while encouraging greater engagement through interactive learning materials. In addition, Q-Learn iME offers lecturers a practical approach to organising digital learning resources systematically and may serve as a scalable model for future digital learning initiatives.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of Q-Learn iME involved six stages, namely needs analysis, content development, resource integration, interactive navigation design, Q-Learn iME hub development and validation and refinement. Educational technologies such as NotebookLM, AnyFlip, Google Forms, Wayground, Google Drive and PowerPoint were integrated to create a functional PDF that supports the delivery of diverse learning resources through a centralised learning hub.

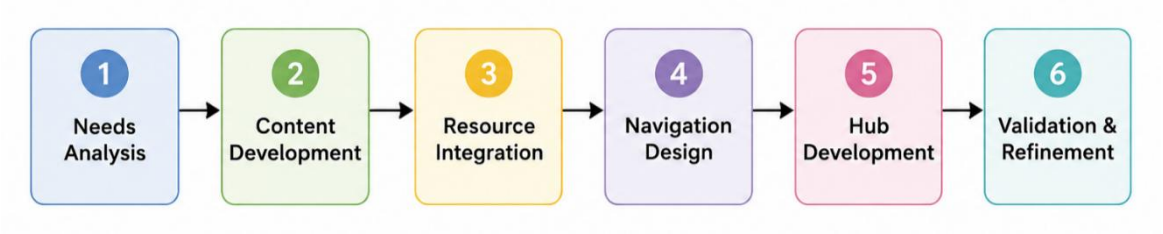


Figure 1. Development Process Flowchart of Q-Learn iME

6.0 CONCLUSION

Q-Learn iME demonstrates the potential of integrating multiple educational technologies into a one-stop learning hub tailored to the needs of a specific course. By centralising diverse learning resources within a single platform, the innovation contributes towards creating a more organised, accessible and learner-centred educational experience.

ACKNOWLEDGMENTS

The author would like to acknowledge the support and encouragement received from colleagues and students involved in the development of Q-Learn iME.

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PROJECT ID: IN161

ADMINISTRATIVE LAW: TERMINOLOGIES SERIES TWO

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ABSTRACT
Administrative law provides legal mechanisms that protect individuals against unlawful actions of public authorities. Beyond understanding fundamental concepts such as ultra vires and judicial review, the students must also become familiar with legal remedies and procedural terminologies that enable courts to supervise administrative bodies effectively. The second series introduce and explains key administrative law terminologies including locus standi, lacuna, res judicata, legal remedy, habeas corpus, mandamus, prohibition, declaration, injunction and relator action. These concepts play significant roles in ensuring legality, accountability and fairness within public administration. The aim is also to simplify legal terminologies for educational purposes and to enhance understanding of how individuals may seek remedies against administrative misconduct. By presenting the concepts in a structured and accessible manner, the series contributes to legal literacy and promotes awareness of citizens' rights in administrative governance.
Keywords: Administrative law, administrative governance, legal remedy, public authorities

1.0 INTRODUCTION
Administrative law governs the exercise of governmental power and provides mechanisms to ensure that public authorities act within the limits prescribed by law. As governments perform increasingly complex administrative functions, legal remedies become essential tools for safeguarding individual rights and maintaining public accountability. Judicial review serves as the primary method through which courts supervise administrative actions. However, the effectiveness of judicial review depends largely upon the remedies available to affected individuals. Traditional prerogative orders such as habeas corpus, mandamus and prohibition have historically played a central role in controlling administrative power. Understanding these terminologies enables the students and public to appreciate the practical operation of administrative law and the legal avenues available for challenging unlawful administrative conduct.

2.0 OBJECTIVES
The main objectives of this innovation are:
a. To explain the legal definitions and functions of major remedies available in administrative law
b. To discuss procedural concepts such as locus standi and relator action in administrative litigation
c. To analyse the significance of lacuna within public administration
d. To enhance legal understanding of accountability and access to justice in administrative law

3.0 NOVELTY & INVENTIVENESS
This innovation adopts a terminology-based educational approach that focuses specifically on administrative law remedies and procedural concepts. Unlike traditional legal texts that emphasize extensive doctrinal analysis, this series presents legal terminology in a concise and learner-friendly format suitable for students, educators and the public. The novelty of the innovation lies in its integration of classical judicial remedies with modern administrative accountability mechanisms. By consolidating these concepts into a single educational resource, the innovation provides a practical reference for understanding administrative justice and legal redress.

4.0 PRACTICALITY & USEFULNESS
This innovation provides a simple and accessible guide to understanding administrative law terminologies and remedies. It helps the students, educators and public to learn complex legal concepts more easily. The resource also promotes legal awareness and supports teaching, learning and self-study in administrative law.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

This innovation employs a web-based reference tools which explain the legal terms and concepts in simple language and for easy reference.

6.0 CONCLUSION

Administrative law remedies constitute essential safeguards against unlawful governmental action. Remedies such as habeas corpus, mandamus, prohibition, declaration and injunction enable the courts to uphold legality and protect individual rights. Procedural concepts including locus standi and relator action ensure appropriate access to justice. Collectively, these terminologies form an important component of administrative justice and contribute to transparent, responsible and lawful governance. Understanding these concepts also strengthens legal awareness and enhances appreciation of the rule of law within modern administrative systems.

ACKNOWLEDGMENTS

Special thanks are extended to all individuals who contributed directly or indirectly to the development of this educational resource on administrative law terminologies. Their encouragement and assistance are greatly appreciated.

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EXTENDED ABSTRACT

Category B1 (Higher Education Student-Group)

PROJECT ID: IN36

ASPURI I'STAY

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ABSTRACT
Aspuri I'stay addresses the inefficiencies of traditional hostel management systems that rely heavily on manual records, fragmented reporting, and delayed communication. These challenges often lead to data inaccuracies, slow decision-making, and increased administrative burden. To overcome this, the project introduces an integrated, real-time digital platform that centralizes key hostel management functions, including attendance tracking, discipline monitoring, health records, complaints, and reporting. The methodology involves system design and development using user-centered approaches, supported by digital tools such as structured online forms, centralized databases, and automated reporting mechanisms. The system was implemented and tested within a real hostel environment, enabling practical evaluation of its effectiveness and usability. The findings indicate significant improvements in operational efficiency, data accuracy, and response time. Administrative workload is reduced, reporting processes are streamlined, and access to information becomes faster and more reliable. Users, including wardens and student leaders, benefit from better coordination and enhanced decision-making capabilities. The potential impact of Aspuri I'stay is substantial, as it offers a scalable, cost-effective, and user-friendly solution that can be adopted across various educational institutions. By promoting digital transformation in hostel management, the innovation contributes to creating safer, more organized, and data-driven residential environments, aligning with the evolving needs of modern education systems. The abstract should provide a complete overview that allows readers to understand the essence of your work without reading the full document.
Keywords: Digital Hostel Management, Real-Time Monitoring, Integrated System, Operational Efficiency, Smart Education Technology

1.0 INTRODUCTION
Aspuri I'stay addresses inefficiencies in traditional hostel management caused by manual, fragmented systems and delayed reporting. This innovation introduces a centralized, real-time digital platform that streamlines operations, enhances data accuracy, and improves decision-making. It fills a critical gap by enabling efficient, organized, and responsive hostel management, benefiting institutions and student welfare.

2.0 OBJECTIVES
The main objectives of this innovation/project are:
a. To develop an integrated digital platform (Aspuri I'stay) that centralizes and streamlines all hostel management operations.
b. To enhance efficiency and decision-making through real-time monitoring, accurate data, and automated reporting.

3.0 NOVELTY & INVENTIVENESS
Aspuri I'stay is a novel, integrated digital ecosystem that unifies multiple hostel management functions into a single real-time platform, unlike fragmented manual systems. Key features include automated reporting, centralized dashboards, and user-friendly digital workflows. It significantly enhances efficiency and accuracy, with strong potential for software copyright and future patentable system design.

4.0 PRACTICALITY & USEFULNESS
Aspuri I'stay offers high practicality through its user-friendly, cost-effective, and easily deployable digital platform tailored for real hostel environments. It streamlines daily operations, reduces administrative burden, and enables real-time monitoring. Its usefulness lies in improving efficiency, decision-making, and student management, making it highly applicable and scalable across various educational institutions.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Aspuri I'stay applies a user-centered approach using digital forms, centralized databases, and automated reporting to enable real-time monitoring, ensuring efficient, accurate, and scalable hostel management operations as shown in Figure 1.

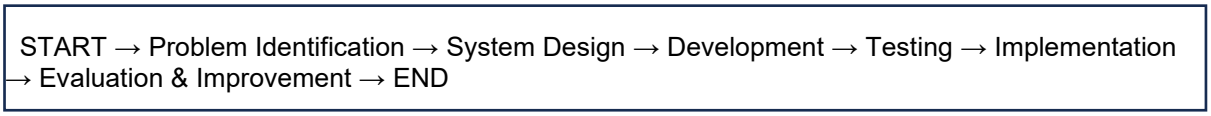


Figure 1: Development process flowchart of Aspuri I'stay

6.0 CONCLUSION

Aspuri I'stay transforms manual hostel management into a centralized, real-time digital system, significantly improving efficiency, accuracy, and decision-making. Despite minor challenges in user adaptation, it demonstrates strong impact and scalability. This innovation bridges ideas and technology, contributing to a resilient, efficient, and digitally empowered future aligned with i-NEXTECH 2026.

ACKNOWLEDGMENTS

We gratefully acknowledge the invaluable support of our supervisor, Ts. Noor Fazilla Binti Ismail, for her guidance and mentorship. Appreciation is also extended to Excellent Director of Batu Lanchang Vocational College, Tn. Hj. Nazhar Bin Kader Bawa, Wardens, Hostel Supervisor, Aspurian and all contributors.

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PROJECT ID: IN43

ATTENDLOG

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ABSTRACT
The Attend Log System aims to enhance attendance tracking in academic institutions, for example high schools and universities with a system that allows users to take attendance, get real-time data updates and have an overall overview of the attendance data in one place. This project discusses issues with academic attendance tracking, including communication delays and ineffective manual procedures. A unique feature about this system that differentiates it from other existing systems is the ability to provide an automatic warning letter feature that allows students to get alert whenever they are absent ensuring timely communication and accountability. This approach, which is aimed at educational institutions of all levels, provides a useful and effective way to control attendance while increasing involvement and integrity. Our system shows a reliable, efficient, and user-friendly solution to modern attendance challenges.
Keywords: Attendance Management System, QR Code Attendance, Real-Time Monitoring, Educational Technology, Automatic Warning Notification

1.0 INTRODUCTION
This project is about an online attendance taking system called AttendLog. It is built to solve multiple issues regarding the manual attendance taking way used in schools or university environment. Some of the main problems faced are its time-consuming process, prone to human errors and the possibility of the data getting lost or damaged are very likely. By offering a digital platform for effective recording, tracking, and managing attendance, AttendLog comes with features like real-time updates, automated processing, and thorough reporting. This minimizes errors, saves time, and decreases paperwork. Additionally, it guarantees improved data security and accessibility, which increases the dependability and use of attendance management for both teachers and students.

2.0 OBJECTIVES
The main objectives of this innovation/project are:
a. To generate reports for teacher's use.
b. To send automatic Telegram alerts to notify lecturers/teachers and students about frequent absences.
c. To provide a QR and barcode way of taking attendance of students.

3.0 NOVELTY & INVENTIVENESS
AttendLog is unique for its integrated multi-modal security; unlike existing systems, it combines 60-second dynamic QR refreshes with device-specific cookies to prevent fraudulent submissions. It further innovates by linking attendance thresholds directly to an automated document generator for instant formal warning letters.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	AttendLog
QR Code Attendance	Generally limited	Supported
Notifications Feature	Not all	Telegram Integration
Multi-method Entry	Often limited to one type	QR, Barcode, Face

4.0 PRACTICALITY & USEFULNESS
AttendLog is highly feasible and scalable, utilizing cost-effective web technologies (PHP/MySQL) that require only existing institutional hardware to implement. Its real-world applications span from primary schools to universities, offering a sustainable, paperless workflow that saves significant administrative time. The expected impact is a 100% reduction in manual entry errors and a measurable increase in student accountability through immediate digital feedback.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Developed through a systematic Agile methodology—transitioning from conceptualization and iterative sprint-based coding in Visual Studio Code to final deployment on Hostinger—the system utilizes a PHP back-end, MySQL database, and Bootstrap 5.0 front-end to facilitate attendance through barcode scanners, biometrics, and dynamic QR codes. This framework operates on 16GB RAM servers and maintains data integrity via unique device cookies to prevent duplicate entries, achieving sub-2-second response times and 99.9% uptime validated by unit and integration testing.

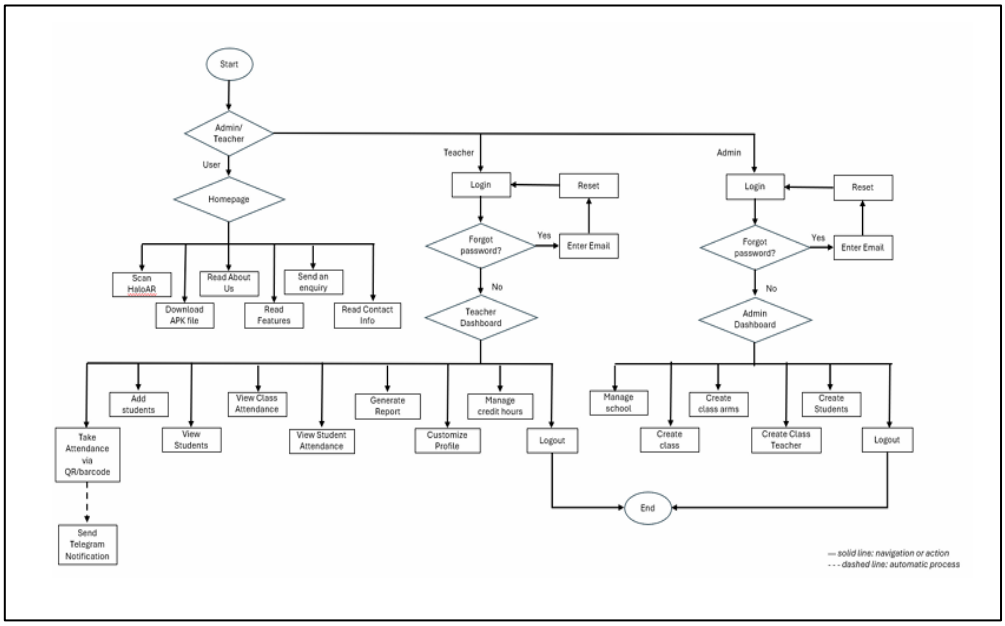


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
PHP & MySQL	Server-side / Database	Core logic and secure data storage.
Telegram API	Bot API Integration	Instant absence notifications.
Dynamic QR Code	60s Refresh Logic	Session-level security and fraud prevention.
FPDF Library	PDF Engine	Automated warning letter generation

6.0 CONCLUSION

AttendLog successfully modernizes academic tracking by achieving a 100% functional pass rate and delivering a multi-modal system that ensures high student accountability. While limited by internet dependency, its contributions to administrative efficiency and paperless operations are significant. Future work will focus on advanced analytics, fulfilling the i-NEXTECH 2026 goal of bridging ideas and technology for a resilient future.

ACKNOWLEDGMENTS

Gratitude to supervisor Puan Noraimi Binti Mahran, Politeknik Malaysia Kuching Sarawak, and the staff of SMK Agama Sibu for testing support.

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PROJECT ID: IN59

PP-CST ECOSYSTEM©: A TRANSLATION OF PP-CST (PARENT'S PRACTICES-CHILDREN SCREEN TIME) QUESTIONNAIRE© INTO A DIGITAL PARENTING SCREENING AND BEHAVIORAL SUPPORT INNOVATION FOR HEALTHIER CHILDREN'S SCREEN HABIT

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ABSTRACT
Excessive screen exposure among children has become an increasing public health concern associated with behavioural, cognitive, emotional, and developmental problems. Although parents play a major role in regulating children's digital habits, most existing approaches mainly focus on awareness-based education without integrating parental behavioural screening and tailored intervention support. Furthermore, many available tools are assessment-oriented, lack Malaysian cultural adaptation, and provide limited practical guidance for families. Therefore, a scalable digital parenting ecosystem is needed to bridge behavioural assessment with real-world intervention strategies. This innovation introduces a digital parenting screening and behavioural support ecosystem designed to promote healthier family screen practices. Developed based on behavioural theories and empirical evidence, the ecosystem integrates parental Knowledge, Attitude, and Practice (KAP) screening with behavioural scoring, parental risk profiling, and personalised intervention support. Practical behavioural tools include parental diary logs, family pledge tools, family rules charts, and a 7-day screen-free challenge to encourage sustainable family behavioural change. Preliminary psychometric findings demonstrated good validity and reliability, with Content and Face Validity Index scores ranging from 0.83–1.00 and Cronbach's alpha values of 0.862 (Knowledge), 0.747 (Attitude), and 0.908 (Practice). The innovation also received a Gold Award during INDES 2026 under the Social Science and Entrepreneurship category. The ecosystem demonstrates strong potential for implementation in healthcare settings, schools, community programmes, and future digital health platforms. The innovation supports healthier family digital practices and contributes toward Sustainable Development Goals (SDG) 3 and SDG 4.
Keywords: Digital parenting, behavioural intervention, screen time management, parental practices, child digital health

1.0 INTRODUCTION
Background: Rapid digitalization has significantly increased children's screen exposure, making excessive screen time an emerging public health concern globally and in Malaysia [1], with usage increasing up to 71% during weekends [2]. Excessive screen exposure has been linked to speech delay, behavioural problems, cognitive impairment, poor physical activity, and adverse psychosocial outcomes [3, 4]. Parents play a major role in shaping children's digital behaviours through supervision, role modelling, and home digital environments [1, 5-7]. However, most existing interventions focus mainly on reducing children's screen use rather than improving parental behavioural practices and digital parenting readiness. Problem Statement: Current digital parenting solutions remain limited as most applications and interventions focus mainly on-screen monitoring and awareness education without integrating behavioural assessment, parental risk profiling, or tailored intervention support. Existing tools rarely emphasize parental role modelling, family behavioural environments, and sustainable parenting practices that directly influence children's screen habits. Furthermore, many available tools are not culturally adapted to the Malaysian context and function only as monitoring systems rather than comprehensive behavioural support ecosystems. Significance of the Study: This innovation introduces a parent-focused digital screening and behavioural support ecosystem that bridges the gap between assessment and intervention in managing children's screen habits. Unlike traditional approaches that mainly monitor children, the innovation emphasizes parental behavioural change, role modelling, and personalised intervention strategies. The ecosystem demonstrates strong potential for implementation in healthcare settings, schools, parenting programmes, and future digital health platforms including

MySejahtera and the Malaysian Child Health Record Book. The innovation also received a Gold Award during INDES 2026 under the Social Science and Entrepreneurship category, reflecting its innovation value, practical relevance, and scalability potential.

2.0 OBJECTIVES

The main objectives of this innovation/project are:

a. To develop a culturally adapted digital parenting screening and behavioural support ecosystem for managing children's screen habits in Malaysia.
b. To integrate behavioural screening, parental risk profiling, personalised intervention, and behaviour tracking into a scalable digital parenting support system.
c. To promote healthier family digital practices and sustainable behavioural change through parent-focused intervention strategies.
d. To contribute toward child digital well-being and support SDG 3 (Good Health and Well-Being) and SDG 4 (Quality Education).

3.0 NOVELTY & INVENTIVENESS

Unlike existing solutions that mainly focus on screen restriction and awareness education, the ecosystem integrates parental behavioural assessment, risk profiling, personalised intervention, and behaviour tracking into a single system. The innovation uniquely emphasizes parental role modelling, family behavioural environments, and sustainable digital parenting practices within the Malaysian context.

Key Innovative Features:

- Digital parental Knowledge, Attitude, and Practice (KAP) screening
- Behavioural scoring and parental risk classification
- Personalised intervention recommendations
- Parent-focused role modelling and behaviour change strategies
- Behaviour tracking through parental diary logs and family monitoring tools
- Practical intervention tools including pledge cards, family rules charts, and 7-day screen-free challenges
- Future integration potential into healthcare systems, schools, mobile apps, and digital health platforms

Table 1: Comparison between existing solutions and proposed innovation

Aspects	**Existing Apps (screen monitoring / timers)**	**Parenting Programs or Workshop (manual, face-to-face)**	**PP-CST Ecosystem©**
Screen Time Monitoring	Yes *(usage duration only)*	No	Yes *(with behavioural context)*
Parent Behaviour Assessment	No	No	Yes *(knowledge, attitude & practices assessment)*
Personalised Intervention	No *(generic advice only)*	No *(one-size-fits-all approach)*	Yes *(tailored to parent risk profile)*
Behavioural Risk Scoring	No	No	Yes
Parental Role Modelling Focus	No	Limited	Yes
Healthcare Integration	No	No	Yes *(screening & follow-up support)*
School / Community Integration	Limited	Yes	Yes *(schools, healthcare & community programmes)*
Behaviour Tracking & Follow-Up	Limited *(screen usage only)*	No	Yes *(progress tracking & behavioural monitoring)*

Cultural Adaptation	Mostly foreign based	General parenting approach	Malaysian-context ecosystem
Intervention Ecosystem	Standalone application	Standalone programme	Integrated screening + intervention + tracking ecosystem

Intellectual Property Potential: The conceptual framework has officially received Copyright Notification from the Copyright Controller of Malaysia (CRLY2026E03519, 21 May 2026).

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: The innovation is a practical digital parenting screening and behavioural intervention ecosystem that can be implemented in healthcare settings, schools, and community programmes to support healthier children's screen habits.The innovation also demonstrates future potential for integration into MySejahtera and the Malaysian Child Health Record Book (*Buku Rekod Kesihatan Kanak-Kanak Malaysia*) to support nationwide child digital well-being initiatives. Target Users / Beneficiaries: The primary beneficiaries include:

1. Parents and caregivers of children aged 0–12 years
2. Families with difficulties managing children's screen habits
3. Healthcare professionals
4. Schools and educators
5. Community health agencies

The innovation is particularly relevant for urban and digitally exposed Malaysian communities.

Feasibility and Implementation:

Technical Feasibility	• Uses existing digital technologies and electronic screening systems • Integrates behavioural screening, scoring, intervention, and monitoring in one ecosystem • Expandable into mobile apps, web dashboards, and healthcare digital systems.
Economic Viability	• Reduces dependency on repeated face-to-face counselling and printed materials • Cost-effective digital intervention approach with wider population reach • Commercialization potential through: 1. mobile app subscription 2. healthcare collaboration 3. institutional licensing 4. school & community adoption
Scalability	Adaptable into: 1. Klinik Kesihatan, Klinik Desa & Child Psychiatric Clinics 2. school health & PIBG programmes 3. community behavioural intervention programmes 4. digital healthcare ecosystems 5. nationwide child digital well-being programmes Potential integration into: 1. MySejahtera 2. Buku Rekod Kesihatan Bayi & Kanak-Kanak Malaysia
Sustainability	1. Promotes long-term behavioural change through parental role modelling and behaviour tracking. 2. Supports preventive digital parenting intervention rather than one-time awareness campaigns. 3. Reusable digital ecosystem reduces paper-based educational materials. 4. Potential to reduce long-term behavioural and psychosocial issues related to excessive screen exposure among children.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process:

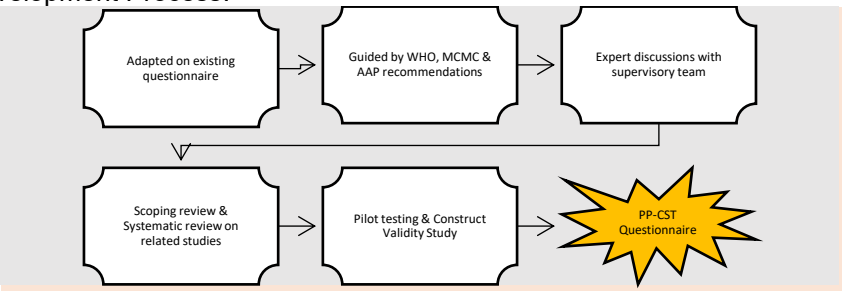


Figure 1 : Development process flowchart of PP-CST Questionnaire

Technical Architecture / System Design: The innovation operates through a structured digital workflow integrating parental behavioural screening, scoring interpretation, behavioural risk classification, and personalised intervention support. Parents complete electronic behavioural screening assessments, and responses are analysed using a predefined scoring algorithm to generate behavioural risk profiles and tailored intervention recommendations.

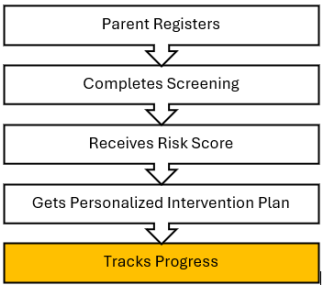


Figure 2 : Flowchart of PP-CST Apps

Materials and Methods:

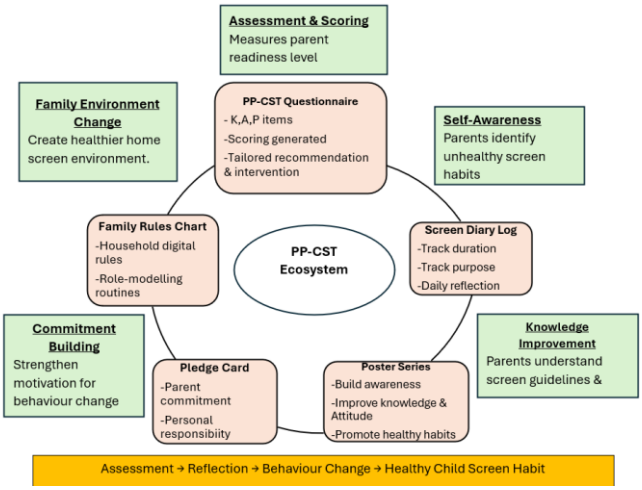


Figure 3 : PP-CST Ecosystem

The ecosystem integrates several digital parenting support components including: **i)** Behavioural screening module, ii) Parental risk scoring algorithm, iii) Intervention recommendation system, iv) Parental Diary Logs, v) Family Pledge Tools, vi) Family Rules Charts, vii) Behaviour tracking and monitoring system, viii) Parent dashboard and reporting support. Testing and Validation: The innovation is currently undergoing psychometric validation to ensure reliability and validity of the behavioural screening components. Validation phases included content validity, face validity, pilot testing, and preliminary exploratory factor analysis. Content Validity Index (CVI) and Face Validity Index (FVI) values ranged from 0.83 to 1.00, demonstrating strong agreement among experts and participants. A pilot study involving 30 parents demonstrated strong internal consistency: i) Knowledge domain = 0.862, ii) Attitude domain = 0.747, iii) Practice domain = 0.908. Results and Performance: Preliminary findings demonstrated acceptable psychometric performance and strong practical potential for behavioural screening and intervention support. The innovation successfully integrates screening, behavioural

scoring, personalised intervention guidance, and behaviour tracking into a single parent-focused digital ecosystem.

6.0 CONCLUSION

Summary of Achievement: This innovation successfully developed a parent-focused digital parenting screening and behavioural intervention ecosystem to support healthier children's screen habits among Malaysian families. The innovation integrates behavioural screening, parental risk profiling, personalised intervention, and behaviour-tracking components within a single ecosystem. The innovation also received a Gold Award during INDES 2026 under the Social Science and Entrepreneurship category. Contributions and Impact: The innovation contributes to digital parenting and child digital health by introducing a culturally adapted behavioural support ecosystem with potential application in healthcare settings, schools, community programmes, and future digital health platforms including MySejahtera and the Malaysian Child Health Record Book. Limitations and Challenges: The ecosystem is still undergoing psychometric validation and digital system enhancement. Further large-scale testing and long-term behavioural evaluation are required before nationwide implementation. Future Work and Recommendations: Future plans include mobile application development, healthcare integration, nationwide programme expansion, MySejahtera integration, and commercialization initiatives. This innovation demonstrates strong potential to bridge behavioural science and digital technology in supporting healthier family digital practices and sustainable child digital well-being in Malaysia, aligned with the i-NEXTECH 2026 theme: "Bridging Ideas and Technology for a Resilient Future."

ACKNOWLEDGMENTS

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PROJECT ID: IN71

PERFORMANCE OF MODULAR BAMBOO-BASED INFILTRATION WELLS IN ENHANCING SOIL INFILTRATION FOR URBAN FLOOD MITIGATION IN PONTIANAK

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ABSTRACT
Urban flooding in Pontianak is caused by high rainfall intensity, low-permeability clayey soils, shallow groundwater levels, and increasing impervious surfaces that limit natural infiltration and increase surface runoff. Conventional drainage systems mainly discharge runoff without improving groundwater recharge. This study proposes a modular infiltration well system made from *Bambu Betung* (*Dendrocalamus asper*) as a sustainable and low-cost solution for urban flood mitigation. The system combines perforated bamboo structures with layered filtration media consisting of gravel, sand, and natural fiber to enhance vertical and lateral water infiltration. A quantitative experimental method was applied using a 55 × 38 × 30 cm test box equipped with a 2×2 modular grid of bamboo infiltration units. Infiltration rates were measured using the infiltrometer method and compared with untreated soil as the control. The treated soil achieved an infiltration rate of 0.7778 cm/s (≈28,000 mm/h), significantly higher than untreated soil at 0.0968 cm/s (≈3,484.8 mm/h). The increase was influenced by bamboo perforations, interconnected void spaces, and layered filtration that improved water distribution and maintained soil porosity. The findings demonstrate that the modular bamboo-based infiltration system effectively reduces surface ponding and supports groundwater recharge in flood-prone urban areas. In addition to its hydrological performance, the system is affordable, environmentally friendly, easy to install, and suitable for residential-scale implementation, making it a promising green infrastructure alternative for sustainable urban flood management.
Keywords: Modular Bamboo Infiltration, Urban Flood Mitigation, Clayey Soil Infiltration, Sustainable Drainage System, Groundwater Recharge

1.0 INTRODUCTION
Urban flooding has become a major environmental challenge in many tropical cities, particularly in lowland urban areas such as Pontianak. The city experiences high annual rainfall intensity, flat topography, shallow groundwater levels, and dominant clayey soils with low permeability, which significantly reduce natural water infiltration and increase surface runoff. Rapid urbanization and the expansion of impervious surfaces, such as roads, pavements, and residential developments, have further aggravated the problem by limiting groundwater recharge and increasing the frequency of surface ponding and local flooding. Conventional drainage systems are generally designed to rapidly convey runoff into rivers or canals without addressing infiltration capacity or groundwater sustainability, making them less effective in long-term urban flood mitigation [1,2]. Therefore, innovative and environmentally friendly drainage technologies are urgently needed to improve infiltration performance in urban areas while supporting sustainable water management. One of the major limitations of existing infiltration systems is their dependence on expensive construction materials such as concrete and PVC, which are less environmentally sustainable and often difficult to implement in densely populated residential areas. In addition, conventional infiltration wells commonly focus only on vertical infiltration and have limited capacity to distribute water laterally within compacted clayey soils. Studies have shown that soil compaction and low permeability significantly reduce infiltration efficiency in urban environments [3]. In Pontianak, recurring urban flooding continues to disrupt residential activities, damage infrastructure, and reduce environmental quality, particularly during periods of intense rainfall. Despite the increasing adoption of green infrastructure concepts, affordable and locally adaptable infiltration technologies remain limited. This study addresses these gaps by developing a modular infiltration well system made from *Bambu Betung* (*Dendrocalamus asper*), combined with layered filtration media to improve both vertical and lateral water absorption in clayey soils. The significance of this study lies in its potential contribution to sustainable urban flood management using renewable local materials and simple construction methods. The proposed modular bamboo-based infiltration system offers a low-cost, eco-friendly, and easily replicable alternative that can be implemented in residential areas, schools, and public spaces without requiring heavy equipment. By improving infiltration rates

and reducing surface ponding, the innovation supports groundwater recharge and enhances urban environmental resilience. Furthermore, the use of bamboo as a renewable natural resource promotes sustainable construction practices and aligns with global efforts toward green infrastructure development and climate adaptation [4,5]. The findings of this study are expected to benefit local communities, urban planners, and policymakers by providing a practical solution for flood-prone tropical cities with similar hydrological and soil conditions.

2.0 OBJECTIVE

The main objectives of this study are designed to evaluate and develop an effective, sustainable, and practical infiltration system for flood-prone urban areas in Pontianak. First, this research aims to evaluate the effectiveness of modular infiltration wells made from *Bambu Betung* (*Dendrocalamus asper*) in improving infiltration rates in clayey soils by comparing treated and untreated soil conditions through experimental testing using the infiltrometer method. This objective is relevant because improving infiltration capacity is essential for reducing surface runoff and urban flooding in low-permeability environments [2,3]. Second, this study seeks to analyze the influence of the modular grid configuration and layered filtration media consisting of gravel, sand, and natural fiber on vertical and lateral water distribution, absorption time, and soil porosity maintenance. Previous studies indicate that infiltration performance can be significantly affected by soil structure, filtration layers, and infiltration geometry in urban green infrastructure systems [4,6]. Therefore, this objective is intended to identify how the proposed design improves water infiltration efficiency in compact clayey soils. Third, this research aims to develop a low-cost, environmentally friendly, and easily applicable infiltration prototype using renewable local bamboo materials suitable for residential-scale implementation. The study also intends to provide technical recommendations for sustainable urban drainage systems in tropical flood-prone areas with similar hydrological conditions. This objective supports the broader development of green infrastructure and sustainable urban water management strategies that can enhance groundwater recharge and urban environmental resilience [1,5].

3.0 NOVELTY & INVENTIVENESS

The proposed modular bamboo infiltration well presents an innovative and environmentally sustainable approach to urban flood mitigation by integrating renewable bamboo materials, modular infiltration technology, and layered natural filtration into a single drainage system. Unlike conventional infiltration wells that generally utilize concrete or PVC structures with limited infiltration coverage, this innovation applies perforated *Bambu Betung* (*Dendrocalamus asper*) as the main infiltration medium to enhance both vertical and lateral water absorption in clayey soils. The system was specifically designed for flood-prone urban environments such as Pontianak, where high rainfall intensity, shallow groundwater levels, and low-permeability soils frequently cause surface runoff and waterlogging [1,2]. The innovation combines green infrastructure principles with locally available renewable materials, making it more sustainable, affordable, and adaptable for residential-scale implementation. One of the key innovative features of this system is the perforated bamboo module design. The infiltration structure uses bamboo with a diameter of 15 cm and a length of 1.5 meters, equipped with evenly distributed perforations measuring 1–2 cm in diameter with 5 cm spacing. These perforations enable water to infiltrate not only vertically downward but also laterally into surrounding soil layers, thereby increasing infiltration coverage and accelerating groundwater recharge. In addition, a 5 cm gravel-filled cavity is intentionally created between the bamboo wall and surrounding soil to prevent clogging of the perforations by compacted clay and to maximize water distribution. This approach differs significantly from conventional infiltration wells that generally concentrate infiltration at a single vertical point and often experience reduced performance due to sediment blockage and soil compaction [3]. Another important innovative aspect is the integration of layered filtration media consisting of coarse gravel, clean gravel, and coir or natural fiber inside the bamboo structure. The gravel layers create interconnected void spaces that maintain soil porosity and improve infiltration pathways, while the coir fiber layer functions as a natural sediment filter to stabilize water flow and reduce clogging potential. This layered natural filtration system enhances long-term infiltration performance and supports sustainable water absorption processes. Previous studies have demonstrated that infiltration efficiency in urban green infrastructure is strongly influenced by geometric design and filtration composition [4,6,7]. The incorporation of natural fiber filtration within a modular bamboo system therefore represents a novel combination of ecological material utilization and hydrological engineering. The modular configuration of the infiltration wells also represents a significant innovation. Instead of using a single infiltration shaft, the system applies a distributed modular arrangement that expands infiltration zones and improves water absorption efficiency over a larger area. This modular concept allows flexible installation according to land availability and urban spatial conditions, making it highly suitable for residential areas, schools, and

public open spaces. Compared with existing concrete or PVC infiltration systems, the proposed design is lighter, easier to install, more economical, and environmentally friendly because it uses renewable local bamboo resources with minimal construction requirements.

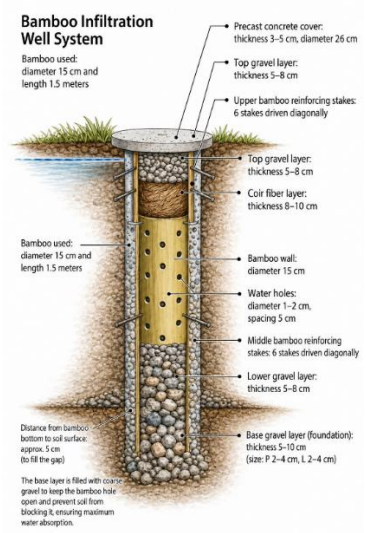


Figure 1. Modular Bamboo Infiltration Well

From an intellectual property perspective, the innovation demonstrates strong potential for patent protection due to its unique integration of perforated bamboo structures, modular infiltration arrangements, and layered natural filtration systems for urban drainage applications. The specific structural configuration, filtration mechanism, and modular installation concept provide originality that may qualify for utility patent or industrial design registration. Furthermore, the visual design and technical prototype documentation may also be protected through copyright and design rights. Although intellectual property registration is currently still in the development phase, the technology shows strong commercialization potential for sustainable flood mitigation and green infrastructure implementation in tropical urban regions.

4.0 PRACTICALITY & USEFULNESS

The modular bamboo infiltration well system demonstrates strong practicality and usefulness as a sustainable urban drainage solution for flood-prone areas with low-permeability soils. The innovation can be directly applied in residential neighbourhoods, schools, public parks, parking areas, and other urban open spaces that frequently experience surface ponding during heavy rainfall events. In tropical cities such as Pontianak, where conventional drainage systems are often unable to adequately manage runoff and groundwater recharge, the proposed system offers an alternative decentralized infiltration approach that improves water absorption directly at the source. The modular configuration allows the infiltration units to be installed individually or in groups depending on land availability and runoff intensity, making the technology adaptable to both small-scale residential applications and broader urban green infrastructure programs [8]. The primary beneficiaries of this innovation include urban communities living in flood-prone residential areas, local governments responsible for drainage management, urban planners, environmental agencies, and construction sectors seeking sustainable infrastructure alternatives. The system is particularly beneficial for densely populated tropical cities with clayey soils and limited infiltration capacity. In addition, educational institutions and community-based environmental programs can utilize the technology as a practical model for sustainable water management and climate adaptation. The use of locally available bamboo materials also provides opportunities for local economic empowerment through community-based bamboo processing and installation activities. From a technical perspective, the system is highly feasible for implementation using currently available resources and simple construction methods. The infiltration well utilizes *Bambu Betung* (*Dendrocalamus asper*) with perforated walls, layered gravel filtration, and natural fiber media that can be assembled without heavy machinery or advanced engineering equipment. The design is relatively simple, lightweight, and suitable for manual installation, allowing wider adoption by local communities and small-scale contractors. Previous studies have shown that infiltration performance in green infrastructure systems can be significantly improved through geometric design optimization and layered filtration arrangements [9,10]. The proposed system applies these principles using environmentally friendly natural materials. Economically, the innovation offers a more affordable alternative compared

to conventional concrete or PVC infiltration wells. Bamboo is widely available in Indonesia, renewable, and relatively inexpensive, reducing material and transportation costs. In addition, the modular system minimizes excavation complexity and installation expenses, making it financially accessible for residential-scale implementation. The use of local materials and simple construction techniques also reduces dependency on industrial materials with higher embodied energy and carbon emissions. The system also demonstrates strong scalability and adaptability potential. The modular design allows expansion according to site conditions, rainfall intensity, and infiltration requirements. Multiple units can be installed in larger urban areas to increase infiltration coverage and support decentralized stormwater management systems. Furthermore, the design can be adapted to various soil conditions and urban landscapes through modifications in filtration composition, bamboo dimensions, and module arrangement. This flexibility increases the potential for broader application in other tropical cities experiencing similar flooding and drainage challenges. In terms of sustainability, the innovation promotes environmentally responsible infrastructure development through the use of renewable bamboo materials and natural filtration media. Bamboo has rapid growth cycles, high renewability, and lower environmental impact compared to concrete and plastic-based materials. The system supports groundwater recharge, reduces surface runoff, and helps maintain urban hydrological balance. Additionally, the layered filtration system minimizes sediment accumulation and maintains long-term infiltration performance, improving the operational sustainability of the technology [5].

Table 1. Comparison of infiltration values between soil treated with a modular bamboo infiltration well and untreated soil (control).

No.	Soil Condition	Initial Water Height (cm)	Infiltration Time (seconds)	Water Level Reduction (cm)	Infiltration Rate (cm/s)	Infiltration Rate (mm/h)
1	Soil with Modular Bamboo Infiltration Well (*Bambu Betung* / *endrocalamus asper*)	7	9	7	0,7778	28.000
2	Soil without Infiltration Well (Control Soil)	7	31	3	0,0968	3.484,8

The expected impacts of this innovation are both environmental and socio-economic. Experimental results demonstrated that the treated soil achieved an infiltration rate of 0.7778 cm/s (approximately 28,000 mm/h), significantly higher than untreated soil at 0.0968 cm/s (approximately 3,484.8 mm/h), indicating an infiltration improvement of approximately eight times. This increased infiltration capacity can substantially reduce surface ponding, improve groundwater recharge, and decrease urban flood risks. Socially, the system may improve urban living conditions and reduce flood-related disruptions to community activities. Economically, the affordable and modular nature of the system can lower drainage infrastructure costs for households and local governments. Overall, the innovation contributes to sustainable urban resilience and supports the development of green infrastructure solutions for climate adaptation in tropical urban environments.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of the modular bamboo infiltration well was carried out through a systematic research and engineering process aimed at improving water infiltration performance in clayey urban soils. The study began with problem identification through field observations in flood-prone areas of Pontianak, where low-permeability soils, high rainfall intensity, and limited infiltration capacity frequently cause surface ponding. Following the preliminary assessment, the conceptual design phase focused on developing a sustainable infiltration system using renewable local bamboo materials integrated with modular drainage and layered filtration concepts. The design was then translated into a prototype consisting of perforated bamboo modules combined with gravel and natural fiber filtration media. After prototype construction, experimental infiltration testing was conducted to evaluate the effectiveness of the system compared to untreated soil conditions. The technical architecture of the system consists of a vertical modular infiltration unit constructed from *Bambu Betung* (*Dendrocalamus asper*) with a diameter of 15 cm and a length of 1.5 meters. The bamboo body contains evenly distributed perforations with diameters ranging from 1–2 cm and spacing of approximately 5 cm between holes. These perforations function to facilitate both vertical and lateral water infiltration into surrounding soil layers. Inside the bamboo module, layered filtration media are arranged sequentially using coarse gravel, clean gravel, and coir or natural fiber. The coarse gravel layer at the base supports water distribution and

prevents sediment accumulation, while the clean gravel layer enhances permeability and void formation. The coir fiber layer acts as a natural filter that stabilizes water flow and minimizes clogging. To maintain structural stability, crossed retaining pins are installed around the filtration section. Additionally, a gravel-filled cavity approximately 5 cm wide is intentionally created between the bamboo wall and surrounding soil to prevent blockage of perforations and maximize infiltration coverage.

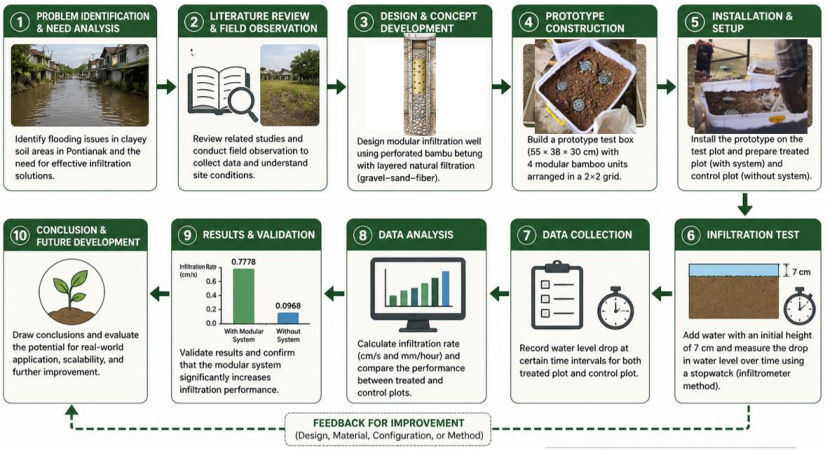


Figure 2: Development process flowchart

The materials and equipment used in this study included *Bambu Betung* bamboo, coarse gravel, clean gravel, coir fiber, retaining pins, clayey soil samples, water containers, measuring cylinders, stopwatches, and infiltration testing boxes measuring 55 × 38 × 30 cm. The infiltration performance was evaluated using the infiltrometer method under controlled laboratory-scale conditions. Two experimental conditions were tested: soil treated with the modular bamboo infiltration well and untreated soil used as a control sample. Both test conditions used an initial water height of 7 cm to ensure consistency during measurement. Testing and validation were conducted by measuring infiltration time, water level reduction, and infiltration rates under both treatment and control conditions. The treated soil containing the modular bamboo infiltration well achieved a complete 7 cm water level reduction within 9 seconds, resulting in an infiltration rate of 0.7778 cm/s (approximately 28,000 mm/h). In contrast, the untreated control soil only experienced a 3 cm water reduction within 31 seconds, corresponding to an infiltration rate of 0.0968 cm/s (approximately 3,484.8 mm/h). These results indicate that the modular bamboo infiltration system improved infiltration performance by approximately eight times compared to untreated soil conditions.

6.0 CONCLUSION

The modular bamboo infiltration well developed in this study successfully improved water infiltration performance in clayey urban soils and demonstrated strong potential as a sustainable solution for urban flood mitigation. By integrating perforated *Bambu Betung* (*Dendrocalamus asper*) with layered gravel and natural fiber filtration, the system significantly increased infiltration rates compared to untreated soil, achieving approximately eight times higher infiltration performance. The innovation effectively addressed problems related to surface runoff, low soil permeability, and limited groundwater recharge in flood-prone urban areas such as Pontianak. This study contributes to the development of environmentally friendly and low-cost green infrastructure using renewable local materials. The modular design is practical, easy to install, and adaptable for residential and public applications, offering benefits for urban communities and sustainable drainage management. However, the research was conducted at prototype scale under controlled conditions, so further field testing and long-term durability evaluation are still required. Future research is recommended to optimize the design, evaluate long-term performance under real environmental conditions, and explore large-scale implementation and intellectual property development. Overall, this innovation demonstrates how simple and sustainable engineering technology can support urban resilience and contribute to the vision of i-NEXTECH 2026, “Bridging Ideas and Technology for a Resilient Future.”

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PROJECT ID: IN82

ECO-FRIENDLY PEST PATCH FOR HOME GARDENING: BIOGUARD PATCH

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ABSTRACT
The BioGuard Patch is an innovative development in home farming, serving as a natural insect repellent. The aim of this research was to develop and evaluate the effectiveness of BioGuard Patch to control insect numbers which uses a combination of active ingredients like neem oil, garlic oil, and wood vinegar, all held in a beeswax base that releases them gradually. This study included seven common home-grown plant species: tomato, chilli, roselle, winged bean, bitter melon, mango, and orange. Yellow sticky traps were used in two weeks efficacy experiments to assess insect numbers prior to before and after patch implantation. Results showed that the BioGuard Patch caused a decrease in insect numbers by an average of 44.95%, not considering the results from the chilli plants, which had an increase in pests due to leaf curl disease. The plants with the highest efficacy rate were tomato, mango, and orange, with a reduction of over 50%, while plants with denser canopy structures showed moderate reductions. The product has been found to be user-friendly and environmentally compatible. The BioGuard Patch falls in line with an integrated pest management (IPM) strategy and has the potential to be commercialised as an eco-friendly pest control product for urban gardeners and home consumers.
Keywords: BioGuard Patch, insect repellent, neem oil, slow-release, home garden, biopesticides, integrated pest management (IPM).

1.0 INTRODUCTION
The use of synthetic household pesticides has negative environmental impacts, promotes pesticide resistance, and presents health concerns for people and insects (Carvalho, 2017; Kim et al., 2017). Pesticides have significantly contributed to the endangerment of over 40% of the world's insect population (Sánchez-Bayo & Wyckhuys, 2019). Non-synthetic biopesticides, such as garlic oil, neem oil, and wood vinegar, are better alternatives, but can easily lose their pesticide activities because of their rapid degradation in tropical climate (Isman, 2020). To solve this problem, BioGuard Patch combines natural biopesticides in a slow-release mode within a beeswax matrix, for a ready-to-use product. This design gives a continuous solution to the pest problem while promoting a reduction of synthetic pesticide use, and a greater reliance on Integrated Pest Management (IPM) techniques (Zhou et al., 2024).

2.0 OBJECTIVE
The main objectives of this innovation are:
a. To develop an affordable pest control for home gardening.
b. To assess the effectiveness of the product in repelling pests through odour control.

3.0 NOVELTY & INVENTIVENESS
The BioGuard Patch revolutionizes natural biopesticides by adaptively designing a slow-release biopesticide to a compact, ready-to-use system. Compared to typical biopesticide spray delivery systems, the continuous release of repelling compounds lessens application frequency and increases convenience. This new approach utilizes a non-spray delivery system, externally combined with a biodegradable matrix and the potential for patent and trademark protection.

Table 1: Comparison between existing solutions and BioGuard Patch

Aspect	Existing Solutions	BioGuard Patch
Application	Spray-based	Ready-to-use patch
Ingredients	Synthetic chemicals	Natural biopesticides
Environmental Impact	Chemical residues	Biodegradable and eco-friendly

4.0 PRACTICALITY & USEFULNESS

Home gardens, urban farms, and nurseries can all benefit from BioGuard Patch. At a predicted production cost of RM1.74 per patch, it is economically feasible. Average pest reduction was recorded at 44.95% during field trials, including over 50% reductions in the case of tomato, mango, and orange plants.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development process and key components of this innovation were illustrated as in Figure 2 and Table 2 below.

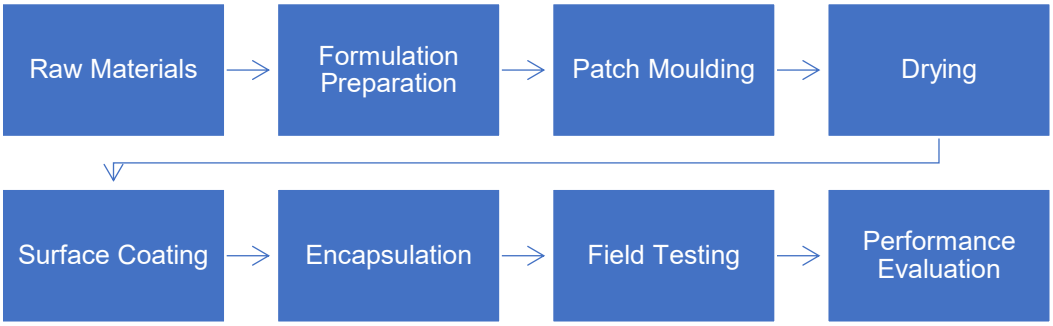


Figure 2: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Neem Oil	20% of formulation	Natural insect repellent
Garlic Oil	20% of formulation	Broad-spectrum pest deterrent
Wood Vinegar	10% of formulation	Repellent and antifungal agent

6.0 CONCLUSION

BioGuard Patch combines biopesticides and slow-release technologies and reports an average reduction in pest populations of approximately 44.95%. This advancement offers an effective, economically viable, and sustainable alternative to synthetic biocides, and aids in “Bridging Ideas and Technology for a Resilient Future.”

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PROJECT ID: IN10

HERITAGE GUARDIAN: THE PRESERVATION OF MALAYSIA'S CULTURAL HERITAGE THROUGH VIDEO GAME

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ABSTRACT
Malaysia's cultural heritage preservation is increasingly challenged by the advancement of digital globalisation and the growing disinterest among the younger population. To combat this, a project is underway to create an educational video game titled Heritage Guardian, which will engage youth by introducing key cultural elements into interactive experiences. A mixed-methods approach was used, including surveys to gauge user engagement, field research at cultural institutions to gain firsthand insights, and analysis of existing literature to identify key cultural elements such as traditional weapons, folktales, and music. This project used a solid production pipeline and employed digital tools such as Aseprite, Krita, and the Godot engine to bring it to life. We see great potential for *Heritage Guardian* as an additional educational resource in classrooms, fitting seamlessly with today's digital learning environments. Ultimately, our aim is to preserve and promote awareness, appreciation, and understanding of Malaysia's rich and diverse heritage among younger generations through innovative technology.
Keywords: Heritage Guardian, video game, cultural heritage

1.0 INTRODUCTION
Malaysia is a nation rich in diversity. However, the effects of globalization have resulted in a diminishing interest in traditional practices and values, putting many aspects of the country's cultural heritage at risk of being forgotten. While digital technology, particularly video games, has emerged as a powerful medium for education and cultural storytelling, there remains a significant shortage of games that highlight Malaysia's unique culture and history. This project aims to develop an engaging platform to educate youth on Malaysian heritage.

2.0 OBJECTIVE
The main objectives of this project are:
a. To identify elements of Malaysia's cultural heritage that can be incorporated into a video game.
b. To design and develop a functional video game to educate youth on Malaysia's cultural heritage in an engaging way

3.0 NOVELTY & INVENTIVENESS
Traditional teaching methods for Malaysia's cultural heritage are losing their effectiveness in engaging today's youth. The introduction and use of digital media to convey information about our culture can be a more appealing approach for attracting the target audience's attention and interest. Additionally, the project has the potential for copyright protection for its logo, characters, and original soundtrack. Currently, no IP has been filed for *Heritage Guardian*.

Table 1 Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Heritage Guardian
Engagement	Books and Oral teaching	Visual storytelling and Immersive gameplay

4.0 PRACTICALITY & USEFULNESS
The project is designed to serve as supplementary learning material for culture-related subjects in classrooms, targeting adolescents, young adults, and educators. In light of Malaysia's shift towards 21st-century education, the project aims to utilise existing resources effectively. It has the potential to expand across various subjects while also contributing to SDG 4 (Quality Education). Ultimately, the project aspires to positively impact society by preserving and introducing concepts of Malaysia's cultural heritage through the innovative use of video games in cultural education.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The project focuses on developing and evaluating *Heritage Guardian* through a mixed-method approach that prioritises user feedback. To realise this project field research, literature review and surveys were conducted. This ensures that *Heritage Guardian* serves as an effective tool for preserving and promoting Malaysian cultural heritage.

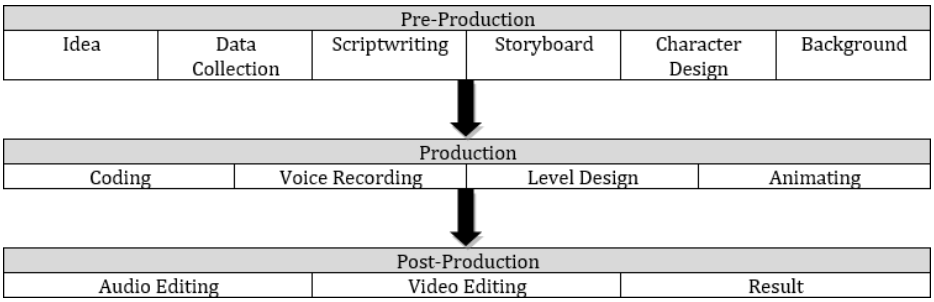


Figure 1: Production pipeline used in this project

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Aseprite and Krita	Art Software	Creating art and assets
Krita and Alight Motion	Animation Tools	Creating cutscenes
Godot	Game Engine	Game development

6.0 CONCLUSION

In conclusion, this project demonstrates the potential of integrating video games into cultural education to address the declining interest among the younger generations. By integrating elements of Malaysia's cultural heritage, *Heritage Guardian* can engage audiences in an interactive and immersive way. We hope this project will positively impact society by promoting the preservation of Malaysian cultural heritage and introducing these concepts through engaging video game-based cultural education.

ACKNOWLEDGMENTS

Thank you to our supervisor and families for the support and encouragement during this project.

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PROJECT ID: IN25

OPTICAL WORLD: AI-POWERED EYEWEAR PLATFORM WITH REAL-TIME AR VIRTUAL TRY-ON

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ABSTRACT
Optical World is a web-based eyewear platform that integrates Artificial Intelligence (AI) and Augmented Reality (AR). The project addresses the inefficiency of manual optical store processes, and the difficulty customers face when choosing frames online. Developed using the Agile methodology with PHP, MySQL, and JavaScript, the system features AI Face Shape Analysis for personalized recommendations and a Real-Time AR Try-On for instant visualization. Results show that the system reduces order processing time by 50%. This innovation modernizes optical retail and increases customer confidence through a digital "try before you buy" experience.
Keywords: Optical world, AI-powered eyewear, optical, face shape

1.0 INTRODUCTION
Background: Many optical stores still rely on manual inventory and paper-based tracking, which slows down service. *Problem Statement:* Customers cannot track orders in real time, and staff face high workloads managing stock and sales reports manually. Significance: This project provides a digital solution that improves business efficiency and enhances customer shopping experience.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To enable real-time order tracking for 90% of customers.
b. To reduce inventory data errors to below 2%.
c. To automate 100% of monthly sales, report generation.

3.0 NOVELTY & INVENTIVENESS
The system uniquely combines AI-driven face shape detection with Web-AR technology. Unlike existing sites that only show photos, Optical World allows users to "wear" the glasses virtually through their browser without downloading extra apps.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Optical World
Try-On Experience	Customers must visit physical stores to try frames.	Real-Time AR Virtual Try-On allows users to try frames via browser.
Frame Selection	Manual selection based on trial and error.	AI Face Shape Analysis provides personalized frame recommendations.
Order Tracking	Usually via phone calls or manual receipts.	Real-Time Order Status tracking through a dedicated user dashboard.
Accessibility	Limited to store operating hours.	24/7 Access via web and mobile WebView application.

4.0 PRACTICALITY & USEFULNESS
This platform is highly practical for small to medium optical businesses looking to digitize. It is accessible via web browsers and has been tested as a mobile WebView app, proving its readiness for the market.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
Methodology: The development of Optical World followed the Agile Model to ensure flexibility and continuous improvement. The process involved several iterative phases as shown in Figure 1: Requirement Analysis: Identifying user needs for AI face detection and AR try-on features. Design: Creating the system architecture and UI/UX layouts using Tailwind CSS. Implementation (Coding):

Developing the core functionalities using PHP, MySQL, and JavaScript. Testing: Conducting unit and integration tests to ensure all features work correctly. Deployment: Launching the platform and converting it into a WebView-based Android application.

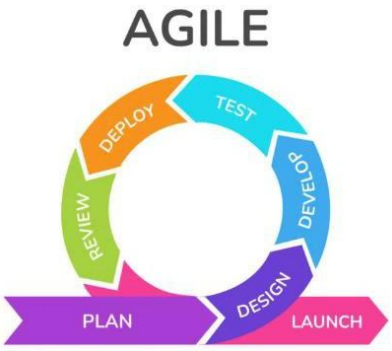


Figure 1: Development process flowchart *(Replace with your actual flowchart showing the step-by-step development process)*

Table 2: Key components and specifications

Component/Material	Specification
Development Tool	Visual Studio Code, XAMPP
Frontend	HTML5, Tailwind CSS, JavaScript
Backend	PHP
Database	MySQL
AI/AR Integration	Web-based Augmented Reality (Web-AR)
Platform	Web Browser & Android WebView

6.0 CONCLUSION

Optical World successfully integrates AI and AR to solve traditional retail challenges. Future updates could include native mobile apps and physical in-store kiosks to further support the optical industry.

ACKNOWLEDGMENTS

The project team acknowledges AeroGreen Asia Sdn. Bhd. team members and collaborators involved in prototype development, app design, crop testing and educational deployment planning.

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PROJECT ID: IN84

A SCALABLE LIVE-ATTENUATED BACTERIAL DNA VACCINE PLATFORM FOR RAPID RESPONSE TO EMERGING INFECTIOUS DISEASES

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ABSTRACT
The COVID-19 pandemic exposed key limitations in current vaccine strategies, including cold-chain dependency, reduced efficacy against emerging variants, and unequal global access. We developed a novel live-attenuated bacterial vectored DNA vaccine platform that is adaptable, stable, and scalable. The system combines a dual-promoter shuttle plasmid (pBiAux) with a safe *Vibrio cholerae* strain (VCUSM14P) to enhance antigen delivery and expression, overcoming low DNA vaccine efficiency. Using SARS-CoV-2 as a model, the platform successfully expressed the Spike (S1) antigen and remained stable for up to five months at room temperature, eliminating cold-chain requirements. Its modular "plug-and-play" design enables rapid substitution of antigen genes, allowing fast development of vaccines against emerging pathogens. This platform offers a cost-effective, scalable, and globally accessible solution, with broad applicability beyond COVID-19 for infectious disease control and future pandemic preparedness.
Keywords: COVID-19, DNA vaccine, bacterial-vectored DNA vaccine, cold-chain free

1.0 INTRODUCTION
The emergence of SARS-CoV-2 led to widespread global outbreaks, placing significant strain on healthcare systems and economies. While vaccination is essential to control transmission, current vaccines rely on strict cold-chain logistics, increasing costs and limiting accessibility, particularly in low-resource settings [1], [2]. In addition, highly mutated variants such as Omicron have reduced vaccine effectiveness, leading to breakthrough infections [3]. These challenges highlight the need for more adaptable and accessible vaccine platforms. To address this, we developed a live-attenuated bacterial vectored DNA vaccine platform that integrates a self-adjuvanted, safe *Vibrio cholerae* strain (VCUSM14P) with a dual-promoter DNA expression system. The platform is orally administrable and stable at room temperature, reducing logistical constraints. Its modular "plug-and-play" design enables rapid substitution of antigen genes, supporting fast development of vaccines for SARS-CoV-2 variants and other emerging infectious diseases. This approach offers a scalable and cost-effective solution for global deployment and pandemic preparedness.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop a novel live-attenuated bacterial vectored DNA vaccine platform that enhances antigen delivery and expression, overcoming the limitations of conventional DNA vaccines.
b. To establish a stable, room-temperature vaccine system with extended storage capability, reducing reliance on cold-chain logistics and improving global accessibility.
c. To create a modular, "plug-and-play" vaccine platform that enables rapid insertion and expression of different antigen genes, facilitating fast development of vaccines against SARS-CoV-2 variants and other emerging infectious diseases.

3.0 NOVELTY & INVENTIVENESS
This invention presents a novel hybrid vaccine platform combining a dual-promoter plasmid with a live-attenuated *Vibrio cholerae* vector for efficient antigen expression in both bacterial and mammalian systems. The self-adjuvanted VCUSM14P strain enhances DNA delivery and immune response without additional adjuvants. A key innovation is its room-temperature stability, removing cold-chain dependency and reducing cost. Its modular "plug-and-play" design enables rapid antigen substitution for different diseases, supporting fast response to emerging pathogens. The intellectual property has been filed (MY-207989-A), highlighting its originality and translational potential.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Expression of the target antigen	In naked DNA vaccines, expression of the antigen-encoding gene is typically regulated by a single promoter.	A dual-promoter shuttle plasmid enables the expression of the SARS-CoV-2 Spike protein in bacterial and recipient systems.
Immunogenicity of DNA vaccine	Naked DNA vaccines are often poorly immunogenic and have low delivery efficiency.	A self-adjuvanted *V. cholerae* strain was used as the DNA vaccine delivery vehicle.
Storage condition	DNA vaccines generally require refrigeration for long-term storage.	The recombinant *V. cholerae* vaccine candidate is room-temperature-stable.

4.0 PRACTICALITY & USEFULNESS

This recombinant *V. cholerae* vaccine platform enables rapid development of DNA vaccines by incorporating target antigen genes into a dual-promoter plasmid. It supports fast, adaptable responses to emerging infectious diseases. The platform allows low-cost, large-scale production through simple fermentation, eliminating expensive purification steps. Its room-temperature stability reduces cold-chain costs (by ~13–25%) and enhances accessibility, particularly in low-resource settings.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The SARS-CoV-2 Spike protein encoding gene (S1) was synthesized and cloned into the dual-promoter shuttle plasmid (pBiAux). The recombinant plasmid (pBiAux-S1) was then transformed into the VCUSM14P strain, generating the vaccine candidate 14P-COVID. Successful expression of the Spike antigen in both prokaryotic and human cells was confirmed by Western blot analysis. The 14P-COVID was further formulated into a room-temperature-stable oral vaccine, demonstrating stability for up to 6 months at 25 °C. In mice, oral immunisation elicited a strong immune response with low toxicity.

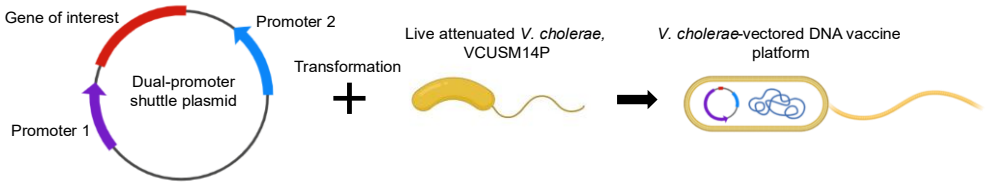


Figure 1: Schematic illustration of the *V. cholerae*-vectored DNA vaccine platform

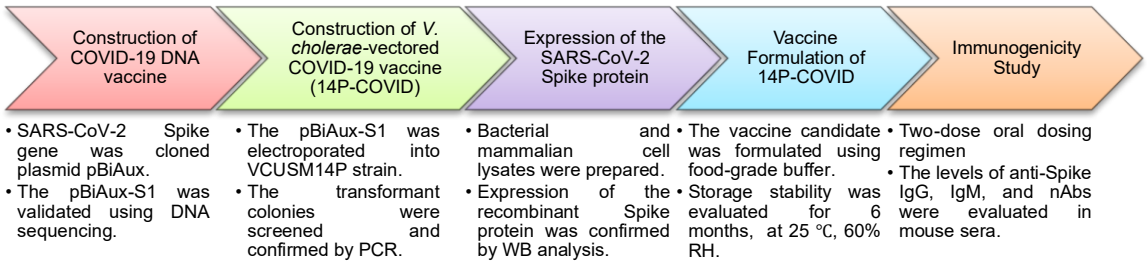


Figure 2: Development process flowchart of *V. cholerae*-vectored COVID-19 DNA vaccine platform

Table 3: Key components and specifications

Component/Material	Specification	Purpose
Dual promoter plasmid carrying the Spike gene	pBiAux-S1	To enable efficient expression of the antigen in both bacterial (vector) and mammalian (host) cells
Live attenuated bacterial host	VCUSM14P	To enable efficient delivery and stimulation of the immune system (self-adjuvant) for the DNA vaccine
Oral vaccine formulation	Food-grade formulation	To maintain the stability and viability of the 14P-COVID

6.0 CONCLUSION

The project successfully developed a live-attenuated *Vibrio cholerae*-vectored DNA vaccine platform capable of expressing target antigens, demonstrating room-temperature stability and strong immune responses. Its modular “plug-and-play” design enables rapid adaptation to SARS-CoV-2 variants and other emerging infectious diseases, supporting scalable and cost-effective vaccine development. While biosafety considerations during development remain a key challenge, this innovation represents a versatile, deployable platform designed for rapid vaccine production and distribution, strengthening preparedness for future pandemics.

ACKNOWLEDGMENTS

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PROJECT ID: IN94

EBIZCLASS

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ABSTRACT
EBizClass is an innovative mobile learning application developed to improve the learning experience of Diploma in Business Management students. The project addresses the issue of low engagement associated with conventional text-based learning materials by integrating interactive and creative learning features into a single platform. The application was developed using Microsoft PowerPoint, converted into HTML format, and packaged as an Android application using APK Builder. EBizClass consists of six modules: BizNote, BizPix, BizToon, BizRhymes, BizPlay, and BizAR. User testing involving approximately 20 students was conducted through Google Forms.
Keywords: Educational Technology, Mobile Learning, Business Management, Interactive Learning, Augmented Reality.

1.0 INTRODUCTION
Background: The rapid development of educational technology has encouraged the use of digital tools to improve student learning experience. However, many Business Management students still rely on conventional learning materials that may not effectively support engagement and knowledge retention. *Problem Statement:* Traditional notes and presentation slides often lack interactive elements and may not cater to different learning styles. This can reduce students' motivation and understanding of business management concepts. *Significance of the Study:* EBizClass provides an alternative learning platform that integrates various learning approaches within a single application. This innovation benefits students and educators by promoting a more engaging and flexible learning environment.

2.0 OBJECTIVE
The main objectives of this project are:
a. To develop an interactive mobile learning application for Business Management students.
b. To enhance students' understanding through creative and visual learning approaches.
c. To increase student engagement and motivation by incorporating games and augmented reality features.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: EBizClass combines visual learning, gamification, storytelling, mnemonic learning, and Augmented Reality within a single educational platform. This integrated approach differentiates the application from conventional learning materials. *Key Innovative Features***:** BizNote provides visually structured notes for easier understanding.While BizPix utilizes creative mind maps and to simplify complex concepts. BizToon delivers educational content through comics and storytelling techniques and BizRhymes uses rhyming notes to improve memory retention and recall. BizPlay incorporates interactive learning games that encourage active participation and lastly BizAR allows students to access 3D educational content through QR code scanning.. *Intellectual Property Potential:* The application has potential for copyright protection covering its original educational content, design, and learning modules.

Table 1: Comparison between existing solutions and proposed innovation:

Aspect	Existing Solutions	Your Innovation
Learning Method	Text-based notes and presentations	Multi-format interactive learning
Student Engagement	Passive learning	Games, comics, AR, and visual learning
Technology Integration	Limited digital interaction	Integrated QR-based Augmented Reality

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: EBizClass can be used as a supplementary learning tool for Business Management courses in vocational colleges and higher education institutions. Target Users/Beneficiaries: The primary users are Diploma in Business Management students and educators. Feasibility and Implementation : Technical Feasibility: Developed using accessible software tools such as PowerPoint, HTML Converter, and APK Builder. Economic Viability: Low development cost as existing software and digital resources were utilized. Scalability: The application can be expanded to other subjects and educational levels. Sustainability: Supports paperless learning and digital education practices. Expected Impact: The application is expected to improve student engagement, accessibility to learning materials, and understanding of business management topics.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: The project was developed through content planning, PowerPoint content creation, HTML conversion, APK development, user testing, and final improvement. *Technical Architecture/System Design:* EBizClass operates as an Android application developed from HTML-based educational content integrated with multimedia and QR-based AR features. *Materials and Methods:* Microsoft PowerPoint, HTML Converter, APK Builder, QR Code Generator, and Google Forms were used during development and testing. *Testing and Validation:* The application was tested by approximately 20 Diploma in Business Management students. Feedback was collected through a Google Form questionnaire. *Results and Performance:* The majority of respondents reported positive experiences regarding usability, attractiveness, and learning effectiveness. *Technical Explanation:* Educational content was created in PowerPoint, converted into HTML format, and packaged as an Android application. The BizAR feature enables students to access 3D learning materials through QR code scanning.

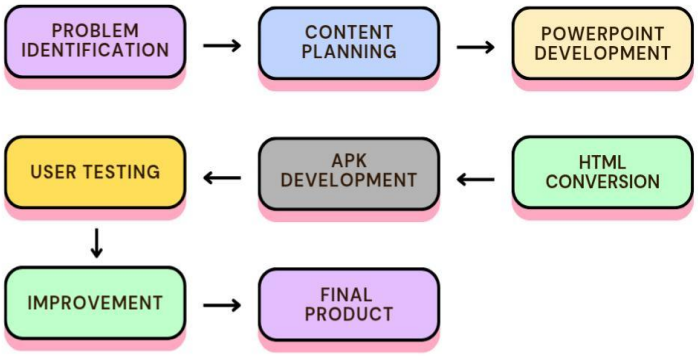


Figure 1: Development Process Flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Microsoft Powerpoint	Presentation Software	Content Development
HTML Converter	Conversion Tool	HTML Generation
APK Builder	Mobile App Builder	Adroid Application Development

6.0 CONCLUSION

Summary of Achievement: EbizClass was successfully developed as an interactive educational application for Business Management students. *Contributions and Impact:* The application promotes digital learning through interactive and multimedia-based educational content. Limitations and *Challenges:* The current version focuses on Business Management subject and Android devices only. *Future Work and Recommendations:* Future enhancements include expanding content coverage, improving AR features, and supporting additional platforms. Closing Statement: EBizClass demonstrates how technology can enhance educational experiences by combining creativity and innovation, supporting the i-NEXTECH 2026 theme of “Bridging Ideas and Technology for a Resilient Future”.

ACKNOWLEDGMENTS

The authors would like to thank the lecturers, project supervisors, and students who contributed to the development and evaluation of EBizClass.

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PROJECT ID: IN95

PALMDETECT AI: FFB DETECTION SYSTEM FOR ASSISTING NEW PLANTATION WORKERS

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ABSTRACT
This project addresses the inefficiency and inconsistency of manual inspection in determining the harvest status of Oil Palm Fresh Fruit Bunch (FFB) in plantation environments. Conventional methods rely heavily on human judgement, which is often time consuming, labour intensive and prone to errors especially among inexperienced workers. These limitations reduce operational efficiency and negatively affect harvest quality and productivity. To overcome these challenges, PalmDetect AI, an AI-powered oil palm FFB detection system based on the YOLOv8 architecture is proposed to automatically detect and classify FFB into “Harvest” and “Not Harvest” categories from image inputs. The system is designed to assist plantation workers by providing real time, consistent and objective decision support. This reduces dependency on manual expertise. The methodology involves collecting and annotating a custom dataset of oil palm FFB images captured under various field conditions followed by data preprocessing, YOLOv8 model training and evaluation such as precision, recall, mean Average Precision and inference speed metrics. Experimental results show that the system achieves a reliable performance under different environmental conditions, improving consistency and efficiency in FFB classification while supporting smart agriculture development.
Keywords: YOLOv8, Object Detection, Oil Palm FFB, Smart Agriculture, Low Light Detection

1.0 INTRODUCTION
Oil palm plantations play an important role in Malaysia’s agricultural industry where efficient Fresh Fruit Bunch (FFB) harvesting is essential for maintaining productivity and quality (Ahmed et al., 2025). Currently, FFB assessment is carried out through manual inspection by workers which depends heavily on experience and visual judgement (TEOH KEAN HAO, 2024). This approach often leads to inconsistent results especially among new workers. It becomes more difficult under challenging field conditions such as low or uneven lighting, shadows, and dense plantation environments. In addition, manual inspection is time consuming, labour intensive and prone to human error which can negatively impact harvesting efficiency and yield quality (Musarat et al., 2024). To address these limitations, an automated and intelligent system is required to provide consistent and real-time support. Therefore, PalmDetect AI an AI-based YOLOv8 object detection system is proposed to assist plantation workers in accurately classifying FFB into harvest and not harvest categories including fruits located on tall palm trees. This system aims to reduce manual identification errors, improve decision making accuracy and support the transition toward smart agriculture in the oil palm industry.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop a YOLOv8-based oil palm Fresh Fruit Bunch (FFB) detection and classification system capable of identifying “Harvest” and “Not Harvest” categories with a minimum performance during the training and testing phase within the project development period.
b. To improve classification accuracy for new and inexperienced plantation workers during the system evaluation phase by reducing manual identification errors under real plantation conditions including low light, uneven lighting environments and fruit bunches located on tall oil palm trees within the testing period.
c. To evaluate the performance of the proposed YOLOv8 model during the testing and validation stage of the project in terms of precision, recall and inference speed.

3.0 NOVELTY & INVENTIVENESS
The innovation of PalmDetect AI lies in the integration of a YOLOv8-based real-time object detection system specifically optimized for oil palm Fresh Fruit Bunch (FFB) classification in plantation environments, introducing an AI driven approach that replaces conventional manual inspection with automated, consistent and fast identification of FFB harvest status (Chang et al., 2024). Unlike

traditional methods that rely heavily on human judgement, this system improves accuracy and reliability by operating effectively under challenging real world plantation conditions such as low light intensity, shadows and complex backgrounds. The key innovative features include a real time YOLOv8 detection system that enables fast and accurate classification of “Harvest” and “Not Harvest” FFB directly from image input, a low light and field condition robust model trained using diverse datasets to ensure strong performance under varying environmental conditions and an AI-assisted decision support function designed to help new and inexperienced plantation workers make more consistent and reliable harvesting decisions. In terms of intellectual property potential, PalmDetect AI demonstrates strong suitability for software copyright protection due to its custom trained YOLOv8 model and system implementation and it also has potential for future AI based agricultural system patent filing if the workflow, dataset design and deployment architecture are uniquely documented, currently no intellectual property (IP) has been filed or is pending but the system is well positioned for future commercialization in smart agriculture applications.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Detection Method	Manual visual inspection by workers	AI-based YOLOv8 object detection
Accuracy & Consistency	Depends on worker experience, inconsistent	High consistency with trained deep learning model
Environmental Conditions	Affected by low light and human error	Robust to low-light and complex field conditions

4.0 PRACTICALITY & USEFULNESS

PalmDetect AI has strong practicality and usefulness as it can be directly applied in real oil palm plantation environments to assist workers in identifying whether Fresh Fruit Bunches (FFB) are ready for harvest. It can be used by plantation workers especially new and inexperienced staff as well as field supervisors and agricultural companies to improve decision making, ensure consistent harvesting quality and support training processes. The system is technically feasible as it is built using YOLOv8 which can be implemented with current AI tools and standard hardware while also being adaptable for real time use on devices such as cameras or mobile systems (Okano et al., 2025). It is economically viable because it reduces dependency on highly skilled labour, minimizes human error and improves operational efficiency without requiring expensive specialized equipment. In terms of scalability, PalmDetect AI can be expanded to different plantation sites or adapted for other agricultural crops with minimal modification. It is also sustainable in the long term as it improves resource efficiency, reduces waste from incorrect harvesting and supports digital transformation in agriculture (Rodríguez-Yparraguirre et al., 2026). Overall, the system is expected to significantly improve harvesting accuracy, reduce error, increase productivity and enhance both economic and technological efficiency in the oil palm industry.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of PalmDetect AI follows a systematic AI workflow starting with problem identification where manual oil palm Fresh Fruit Bunch (FFB) classification was found to be inconsistent and inaccurate. A custom dataset of plantation images was collected, annotated into two classes (Harvest and Not Harvest) using Roboflow and then preprocessed through resizing, augmentation and splitting into training, validation and testing sets (Solawetz, 2020). The system was developed using a YOLOv8 deep learning model implemented in Python with OpenCV used for image preprocessing and real time image handling (Gupta, 2025). The architecture consists of a Vercel-hosted frontend for user interaction and a Python backend server hosted on DigitalOcean and exposed via Ngrok for real-time inference. During operation, images are uploaded through the web interface, processed by OpenCV and passed to YOLOv8 for feature extraction and object detection, producing bounding boxes and class predictions. The model was evaluated using a held-out test set of approximately 300 images under varying conditions with performance measured using precision, recall, F1 score and inference speed. Results show 88.24% high precision, 96.77% recall, 92.30% F1 score and real-time performance exceeding 339.8 ms demonstrating that PalmDetect AI is efficient and suitable for practical plantation deployment.

Table 2: Key components and specifications

Component / Material	Specification	Purpose
Dataset	Custom oil palm FFB image dataset (Harvest & Not Harvest), annotated using Roboflow	Used for training, validation and testing of the YOLOv8 model
Programming Language	Python 3.14	Core development language for model training, inference and system integration
Deep Learning Model	YOLOv8 (Ultralytics framework)	Performs real time object detection and classification of FFB
Image Processing Library	OpenCV	Handles image preprocessing such as resizing, normalization and real time frame processing
Annotation Tool	Roboflow	Used for dataset labeling, augmentation and dataset management
Frontend Deployment	Vercel	Hosts the web interface for user interaction and image upload
Backend Server	DigitalOcean server exposed via Ngrok	Handles model inference requests and real time communication between frontend and model
Hardware	Laptop with ryzen 5 CPU, 12GB RAM	Used for training and running the YOLOv8 model efficiently

6.0 CONCLUSION

Fruit Bunch (FFB) inspection by using a YOLOv8-based AI system to automatically classify FFB into “Harvest” and “Not Harvest” in real time. The project improves accuracy, consistency and efficiency while supporting smart agriculture and reducing dependency on experienced workers. However, it still faces limitations such as dataset dependency, performance under extreme lighting conditions and hardware requirements. Future improvements include expanding the dataset, optimizing for mobile devices, and integrating with plantation systems. Overall, PalmDetect AI demonstrates the potential of AI to transform traditional agriculture into a smarter and more efficient system, aligning with the theme “Bridging Ideas and Technology for a Resilient Future”.

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PROJECT ID: IN101

SMARTPV-NET+: AN INTELLIGENT AI-BASED SYSTEM FOR INTERACTIVE THERMAL HOTSPOT LOCALIZATION IN SOLAR PV SYSTEMS

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ABSTRACT
SMARTPV-NET Plus (SMARTPV-NET+) is an advanced AI-based system developed to overcome the limitations of conventional thermal hotspot detection in solar photovoltaic (PV) modules, particularly issues related to noise interference, inaccurate localization, and the lack of user-interactive analysis tools. Traditional methods often rely on full-frame inspection, leading to misclassification and inefficient fault diagnosis. To address these challenges, SMARTPV-NET+ extends a dual-stage deep learning framework into an interactive system that integrates U-Net for PV module segmentation and YOLOv11 for precise hotspot localization. The methodology incorporates enhanced thermal image preprocessing, including contrast enhancement and denoising, followed by segmentation-guided detection to ensure that analysis is restricted to relevant PV regions. In addition, the system introduces interactive features such as region-of-interest (ROI) selection, segmentation visualization, hotspot localization, and output analysis, enabling more intuitive and accurate interpretation of results. Experimental findings demonstrate high detection performance, with improved precision and reduced false positives compared to conventional approaches. SMARTPV-NET+ enables early fault identification, reduces energy losses, and enhances operational safety in solar PV systems. Its scalable and user-oriented design supports integration into real-time monitoring platforms, offering strong potential for commercialization in intelligent solar inspection and predictive maintenance applications.
Keywords: Thermal Hotspot Detection, Solar Photovoltaic Systems, Deep Learning, Segmentation-Guided Detection, Predictive Maintenance

1.0 INTRODUCTION
Background: The rapid expansion of solar PV systems as a clean energy source has increased the need for efficient monitoring and maintenance solutions. One of the most critical issues affecting PV performance is the occurrence of thermal hotspots, which can reduce energy output, accelerate module degradation, and pose safety risks such as fire hazards (Sun et al., 2022)(Dhimish & Lazaridis, 2021). Conventional inspection methods, primarily based on manual thermal image analysis, are often time-consuming, subjective, and prone to errors, especially under varying environmental conditions such as noise, shading, and background interference (Pruthviraj et al., 2023)(Li et al., 2026). Recent advancements in deep learning have shown promise in automating image-based fault detection; however, many existing approaches lack robustness and practical usability in real-world deployment. Problem Statement: Current thermal hotspot detection methods frequently suffer from inaccurate localization due to the analysis of full-frame images, which include irrelevant background information (Pathak et al., 2022)(Prabhakaran et al., 2023)(Ting et al., 2026). This leads to high false positive rates and reduced reliability in fault diagnosis. Furthermore, most existing systems operate as standalone models without user-interactive capabilities, limiting their effectiveness for practical inspection and analysis (Arif Wani & Mujtaba, 2021)(Haidari et al., 2022). There is a clear need for an intelligent, accurate, and user-oriented system that can improve detection precision while enabling efficient interpretation of results. Significance of the Study: Addressing these challenges is essential for improving the reliability, safety, and efficiency of solar PV systems. The proposed SMARTPV-NET+ system benefits solar farm operators, maintenance providers, and the renewable energy industry by enabling early fault detection, reducing energy losses, and minimizing operational risks. Additionally, it contributes to sustainable energy development by supporting efficient renewable energy utilization and advancing intelligent monitoring technologies.

2.0 OBJECTIVE

The main objectives of this innovation/project are:

a. To develop an intelligent AI-based system (SMARTPV-NET+) that accurately localizes thermal hotspots in solar PV modules using a dual-stage deep learning approach.
b. To enhance detection reliability by integrating segmentation-guided detection, reducing false positives and improving precision under real-world practical conditions.
c. To design an interactive analysis system that enables visualization of segmentation output, hotspot localization, and region-of-interest (ROI) for improved user interpretation.
d. To evaluate the performance of the proposed system using quantitative metrics such as accuracy, precision, and mean Average Precision (mAP) to ensure robust and reliable operation.

3.0 NOVELTY & INVENTIVENESS

Innovation Aspects: SMARTPV-NET+ introduces a novel advancement in thermal hotspot detection by transforming a conventional deep learning framework into an intelligent, interactive system tailored for real-world solar PV monitoring. Unlike existing solutions that rely on single-stage detection or full-frame analysis, this innovation adopts a structured dual-stage approach combined with user-oriented analytical capabilities. The system not only improves detection accuracy but also enhances interpretability and usability, bridging the gap between research models and practical deployment. Key Innovative Features: i) Dual-Stage Segmentation-Guided Detection: The system integrates U-Net for precise PV module segmentation and YOLOv11 for hotspot localization. This approach ensures that detection is performed only within relevant regions, significantly reducing false positives and improving localization accuracy, ii) Interactive Analytical System with ROI Capability: SMARTPV-NET+ introduces user-interactive features, including ROI selection, segmentation visualization, hotspot localization, and output analysis. This allows users to better interpret detection results and supports more informed decision-making, iii) Scalable and Deployment-Ready Design: The modular architecture supports integration into drone-based inspection systems, edge devices, and cloud-based platforms, making it adaptable for large-scale solar farm monitoring. Intellectual Property Potential: SMARTPV-NET+ demonstrates strong potential for intellectual property protection due to its unique integration of segmentation-guided detection and interactive analytical capabilities within a unified system. The combination of dual-stage deep learning architecture with user-driven visualization and analysis features represents a novel contribution beyond existing methods. This innovation is suitable for patent consideration under AI-based inspection systems and intelligent monitoring platforms. Additionally, the system design and software implementation can be protected through copyright and potential software licensing. Future work may include formal patent filing and commercialization through Software-as-a-Service (SaaS) deployment or integration into industrial PV monitoring solutions. Comparison with Existing Solutions:

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Proposed Innovation
Detection Approach	Single-stage or full-frame detection leading to noise interference	Dual-stage segmentation-guided detection focusing only on PV regions
Accuracy & Reliability	Higher false positives and inconsistent results in complex environments	Improved precision with reduced false positives and robust performance
User Interaction	Limited or no visualization and analysis tools	Interactive system with ROI, segmentation output, and detection analysis

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: SMARTPV-NET+ is designed for practical deployment in solar PV monitoring and maintenance. It can be applied in utility-scale solar farms, where large numbers of PV modules require continuous inspection. The system can be integrated with drone-based thermal imaging platforms to automate aerial inspections, enabling rapid detection of hotspots across wide areas. Additionally, it can be used in fixed monitoring systems for real-time fault detection or as part of predictive maintenance tools to identify early-stage defects before they escalate into critical failures. Target Users/Beneficiaries: The primary users include: i) Solar farm operators and maintenance teams seeking efficient monitoring solutions, ii) Renewable energy companies and utility providers aiming to optimize system performance, iii) Inspection service providers utilizing drone-based thermal analysis, iv) Researchers and engineers in smart energy and AI-based monitoring systems. Indirect beneficiaries include end-users of solar energy, who gain from improved energy efficiency and system reliability.

Feasibility and Implementation: Technical Feasibility: The system is built using established deep learning frameworks (U-Net and YOLOv11) and can be implemented using current GPU-enabled computing resources. Its modular architecture supports integration with existing thermal imaging and monitoring systems, Economic Viability: SMARTPV-NET+ reduces reliance on manual inspection, lowering labour costs and minimizing downtime. The potential deployment as a Software-as-a-Service (SaaS) solution further enhances affordability and accessibility, Scalability: The system can be scaled across small installations to large solar farms and adapted for drone, edge, or cloud-based platforms, ensuring flexibility across different operational environments, Sustainability: By enabling early fault detection and efficient maintenance, the system extends the lifespan of PV modules and supports sustainable energy production, reducing resource waste and environmental impact. Expected Impact: SMARTPV-NET+ is expected to deliver significant benefits across multiple dimensions. Technically, it enhances hotspot detection accuracy and reduces false positives, improving overall system reliability. Economically, it can reduce inspection time by up to 50–70% and lower maintenance costs through automated monitoring. Environmentally, it supports efficient renewable energy generation by minimizing energy losses, extending PV module lifespan, and reducing carbon dependency. Socially, it contributes to safer energy systems by mitigating fire risks and promoting wider adoption of clean energy technologies. Furthermore, SMARTPV-NET+ directly supports global sustainability goals, including SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 13 (Climate Action), by enhancing renewable energy performance and enabling smarter maintenance strategies. Overall, the system represents a practical, scalable, and impactful solution for advancing intelligent solar PV monitoring and long-term energy sustainability.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: The development of SMARTPV-NET+ followed a systematic approach beginning with problem identification and conceptual design of a dual-stage deep learning framework. The system was then extended into an interactive AI-based platform with analytical capabilities. The process included dataset preparation, preprocessing, model development (segmentation and detection), system integration, GUI implementation, and performance evaluation. Iterative testing and refinement were conducted to ensure robustness under real-world conditions. Technical Architecture/System Design: SMARTPV-NET+ is built on a dual-stage deep learning architecture integrated into an interactive system. The first stage utilizes U-Net to segment PV modules from the background, generating a region of interest. The second stage applies YOLOv11 to detect and localize hotspots within the segmented regions. The system is implemented in a Python-based environment, leveraging TensorFlow and Keras for segmentation and PyTorch for detection, supported by CUDA-enabled GPU acceleration. The interface layer enables user interaction, visualization, and analysis of results. Materials and Methods: i) Dataset: Thermal RGB images of solar PV modules with annotated hotspots, ii) Software Tools: Python, TensorFlow, Keras, PyTorch, OpenCV, iii) Hardware: NVIDIA GeForce RTX 3060 GPU, standard computing workstation, iv) Techniques: Image enhancement, denoising, deep learning training, segmentation, object detection. Testing and Validation: The system was evaluated using both quantitative and qualitative methods. The dataset was divided into training and validation sets. Performance metrics included pixel accuracy (PA), mean Intersection over Union (mIoU) for segmentation, and precision, recall, F1-score, and mean Average Precision (mAP) for detection. Validation was conducted under varying conditions, including noisy backgrounds and partial shading to assess robustness.

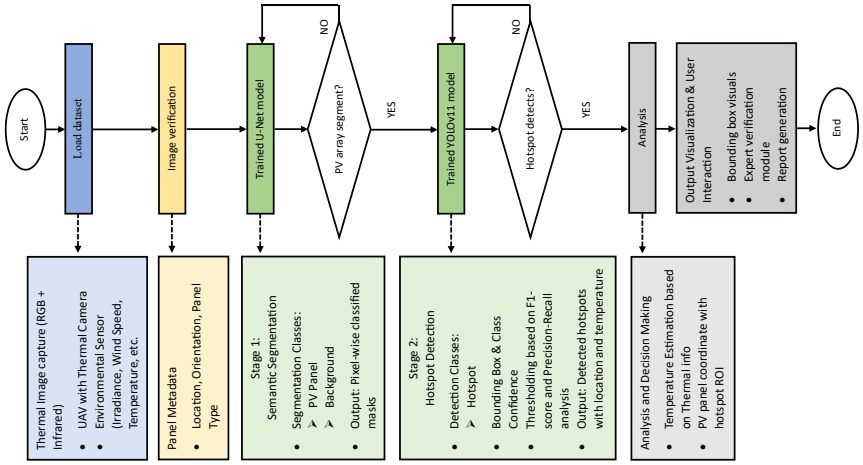


Figure 1: SMARTPV-NET+ development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
U-Net Model	CNN-based segmentation architecture	PV module segmentation
YOLOv11 Model	object detection model	Hotspot localization
Thermal Image Dataset	RGB thermal images with annotations	Model training and validation
GPU (RTX 3050)	CUDA-enabled processing unit	Accelerated model training
Python Environment	TensorFlow, Keras, PyTorch, OpenCV	System development and integration

Results and Performance: The segmentation model achieved high pixel accuracy (98.95%) and mIoU (97.80%), indicating strong capability in isolating PV modules. The detection model demonstrated high precision and mAP (95.72%), confirming accurate hotspot localization. The integration of segmentation significantly reduced false positives and improved detection reliability compared to conventional approaches. Technical Explanation: SMARTPV-NET+ operates through a sequential processing pipeline. Initially, thermal images undergo preprocessing to enhance contrast and reduce noise. The segmentation model (U-Net) then extracts PV module regions, effectively eliminating irrelevant background information. These segmented regions are passed to the detection model (YOLOv11), which identifies hotspot locations and assigns confidence scores. The system further provides an interactive layer for visualization and analysis, allowing users to inspect regions of interest and interpret detection outputs. This segmentation-guided detection mechanism enhances accuracy, robustness, and usability, making the system suitable for real-world deployment.

6.0 CONCLUSION

Summary of Achievement: This study successfully developed SMARTPV-NET+, an intelligent AI-based system for interactive thermal hotspot localization in solar PV modules. The innovation effectively addressed the limitations of conventional inspection methods by integrating a dual-stage deep learning approach with user-interactive analysis capabilities. The system achieved high detection accuracy while reducing false positives, fulfilling the objective of improving reliability and efficiency in hotspot detection. Contributions and Impact: SMARTPV-NET+ contributes to the advancement of intelligent monitoring systems by bridging deep learning techniques with practical, user-oriented applications. It offers significant value to the renewable energy sector by enabling early fault detection, reducing maintenance costs, and enhancing system safety. The innovation supports sustainable energy practices and aligns with global efforts toward efficient and reliable solar energy utilization. Limitations and Challenges: Despite its strong performance, several limitations remain. The system's effectiveness depends on the availability and diversity of annotated thermal datasets. Variations in extreme environmental conditions may still affect detection accuracy. Additionally, real-time deployment may require further optimization for computational efficiency on edge devices. Future Work and Recommendations: Future development will focus on enhancing real-time processing capabilities, expanding the dataset for improved generalization, and integrating advanced features such as predictive analytics and cloud-based monitoring. Further research may explore deployment on edge-AI platforms and integration with IoT-enabled solar monitoring systems to support large-scale implementation. Closing Statement: In conclusion, SMARTPV-NET+ represents a meaningful step toward intelligent and sustainable energy management by transforming advanced AI concepts into a practical solution. This innovation exemplifies the vision of "Bridging Ideas and Technology for a Resilient Future", enabling smarter, safer, and more efficient solar PV systems.

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PROJECT ID: IN111

EXPLORING THE POTENTIAL OF DURIAN SEED FLOUR AS A PARTIAL REPLACEMENT FOR WHEAT FLOUR IN CRACKERS PRODUCTION

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ABSTRACT
DuriyanKraker is a high-fibre cracker developed by partially replacing wheat flour with durian seed flour (DSF), an underutilized by-product of durian processing. The study aimed to reduce food waste while creating a nutritious and sustainable snack. Durian seeds were processed into flour and incorporated into cracker formulations at different substitution levels. Results showed that 15% DSF provided the best balance of increased fibre content, desirable texture, and consumer acceptance. The product supports circular economy practices by converting food processing waste into a functional food with potential for commercialisation.
Keywords: Durian seed flour, crackers, food waste, increased fibre, circular economy

1.0 INTRODUCTION
Food waste remains a major sustainability challenge, particularly in tropical fruit processing industries. Durian seeds account for approximately 20–25% of the fruit weight and are commonly discarded despite containing starch, dietary fibre, and bioactive compounds. The disposal of these seeds contributes to environmental burdens and represents a loss of potentially valuable food resources.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop formulation crackers using durian seed flour and investigate its influence on dough rheological behavior and morphological structure
b. To evaluate the physicochemical, energy, textural and sensory properties of the crackers
c. To promote sustainable utilisation of agricultural by-products through value-added food production

3.0 NOVELTY & INVENTIVENESS
DuriyanKraker is a high-fibre cracker formulated with 15% durian seed flour (DSF) as a partial substitute for wheat flour. The product valorises durian seed waste into a nutritious and sustainable snack, supporting food waste reduction and healthier food choices. With its unique formulation and processing approach, DuriyanKraker shows potential for trademark protection, future patent applications, and commercialisation as a functional snack product.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Conventional Crackers	DuriyanKraker
Main Ingredient	Wheat Flour	Wheat Flour + 15% DSF
Fibre Content	Lower (1.36%)	Higher (2.54%)
Waste Utilisation	None	Uses Durian Seed Waste
Sustainability	Moderate	High

4.0 PRACTICALITY & USEFULNESS
DuriyanKraker offers a practical solution for converting agricultural waste into a commercially valuable snack product. The innovation aligns with Sustainable Development Goals (SDGs), particularly responsible consumption and production. Potential beneficiaries include food manufacturers, SMEs, agricultural processors, and health-conscious consumers. Expected impacts include: Reduction of durian processing waste, Creation of value-added products from low-cost raw materials, Increased consumer access to fibre-enriched snacks, Enhanced sustainability within the food manufacturing sector.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Development Process:
Durian Seeds → Cleaning → Drying → Milling → Sieving → Dough Preparation → Baking → Product Evaluation
Key Findings:

Parameter	15% DSF Crackers
Crude Fibre Content	2.54%
Consumer Acceptance	Acceptable
Texture Quality	Maintained
Sustainability Impact	High

6.0 CONCLUSION

This study successfully developed crackers containing 15% Durian Seed Flour (DSF), demonstrating that durian seed waste can be transformed into a sustainable and functional food ingredient while maintaining consumer acceptability. The innovation supports waste reduction through the valorisation of agricultural by-products. Although further research on DSF levels, shelf-life stability, and large-scale consumer acceptance is needed. This innovation supports sustainable resource utilization and aligns with the i-NEXTECH 2026 theme, "Bridging Ideas and Technology for a Resilient Future," by promoting environmental sustainability, food innovation, and a more resilient food system.

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PROJECT ID: IN117

DEVELOPMENT OF AN ECO-FRIENDLY SMART RODENT REPELLER USING ULTRASONIC SOUND AND NATURAL SCENT DISPERSION TECHNOLOGY

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ABSTRACT
Rodent infestations have caused significant economic losses, food contamination, and public health risks. Conventional control methods such as rodenticides and mechanical traps present limitations including environmental pollution, secondary poisoning, labour-intensive operation, and limited coverage. This project developed an eco-friendly smart rodent repelling system that integrates ultrasonic sound technology and natural scent dispersion to provide a sustainable alternative for rodent management. The system employs an ESP32 microcontroller as the central controller, an HC-SR04 ultrasonic sensor for rodent detection, a piezo buzzer to generate repelling ultrasonic sound, and a servo-actuated humidifier that disperses citronella or peppermint essential oil. Upon rodent detection, the system automatically activates both repelling mechanisms simultaneously. Prototype testing was conducted using wild rats. Two treatments were evaluated: ultrasonic sound alone and ultrasonic sound combined with citronella scent. Results showed that ultrasonic sound induced immediate escape behaviour, while the combination treatment produced stronger avoidance responses, causing rodents to remain at the furthest end of the testing cage and avoid the treated area entirely. The proposed system offers a safe, low-cost, and environmentally friendly alternative to conventional rodent control methods. With a low prototype cost, the innovation demonstrates strong potential for application in rice warehouses, grain storage facilities, food processing industries, and agricultural storage environments.
Keywords: Rodent repeller, ultrasonic technology, citronella oil, ESP32, sustainable pest management

1.0 INTRODUCTION
Rodent infestations remain a major challenge in agricultural, commercial, and food storage environments, causing economic losses, food contamination, and public health risks. The Food and Agriculture Organization (FAO) estimates that rodents account for approximately 15–20% of global food losses annually (FAO, 2020). Despite the availability of various rodent control methods, existing solutions have several limitations. Chemical rodenticides can cause environmental contamination, harm non-target animals, and lead to rodent resistance over time (Buckle & Smith, 2015). Mechanical traps require regular maintenance and monitoring, making them less suitable for large areas. In addition, existing ultrasonic repellers typically rely on sound alone, while natural plant-based repellents are often used separately and many commercial ultrasonic repellers operate continuously without intelligent detection systems, resulting in unnecessary energy consumption and lower operational efficiency. To address these challenges, this innovation introduces a sustainable and non-toxic rodent control solution that enhances food safety, reduces environmental impact, lowers operational costs, and supports smart agricultural technology adoption.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To design and develop an eco-friendly smart rodent repelling system using ultrasonic sound and natural scent dispersion technology.
b. To evaluate the effectiveness of the developed system in deterring rodent activity through behavioral response testing.

3.0 NOVELTY & INVENTIVENESS
This innovation introduces an automated dual-action rodent repelling system that combines ultrasonic sound technology and natural scent dispersion within a single platform. The system uses an ESP32 microcontroller and ultrasonic sensor to detect rodent presence and activate the repelling mechanisms only when needed, improving energy efficiency. Unlike conventional repellents that rely on a single method, the integration of ultrasonic sound and citronella or peppermint scent provides a stronger

deterrent effect. In addition, a servo motor is used to automatically activate a humidifier for scent dispersion, simplifying system design while maintaining low development costs.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Rodenticides	Toxic chemical	Non-toxic and eco-friendly
Mechanical traps	Require maintenance	Fully automated
Ultrasonic repeller	Single repelling method	Dual repelling method
Energy consumption	Continuous operation	Sensor-based operation
Environmental impact	High	Low

4.0 PRACTICALITY & USEFULNESS

The rodent repelling system can be used in farms, warehouses, commercial buildings, and other areas affected by rodents. It helps farmers and facility owners control rodents safely without using harmful chemicals. The system is low-cost, easy to build, and uses affordable components. It saves energy by operating only when rodents are detected. By using ultrasonic sound and natural scents, the system helps reduce environmental impact and supports safer pest control. It can also be improved in the future with features such as IoT connectivity and renewable energy sources.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of the eco-friendly rodent repelling system followed a systematic process consisting of problem identification, concept development, hardware integration, software programming, prototype assembly, and performance evaluation (Figure 1). The system was designed using an ESP32 microcontroller, which serves as the central control unit. An HC-SR04 ultrasonic sensor was integrated to detect rodent presence, while a piezo buzzer generated high-frequency sound as the primary repelling mechanism. A servo motor was programmed to activate a humidifier containing citronella or peppermint essential oil, enabling automatic scent dispersion as a secondary deterrent. The software was developed using Arduino IDE, where the ESP32 continuously processes sensor inputs and activates the repelling components when rodent activity is detected. Key materials used in the prototype included an ESP32 microcontroller, HC-SR04 ultrasonic sensor, piezo buzzer, servo motor, humidifier, essential oil, battery, breadboard, and connecting wires (Figure 2) and (Table 2). For the working principle of the system, the proposed rodent repelling system uses an HC-SR04 ultrasonic sensor to detect the presence of rodents within a set range and sends the information to an ESP32 microcontroller. When a rodent is detected, the ESP32 activates a piezo buzzer to produce ultrasonic sound waves and controls a servo motor to switch on a humidifier containing citronella or peppermint essential oil. The humidifier releases a fine mist with a scent that rodents dislike, while the ultrasonic sound creates an uncomfortable environment for them. The system workflow as in Figure 3. Performance testing was conducted in a controlled environment using wild rat. Two treatments were evaluated using ultrasonic sound only and ultrasonic sound combined with scent dispersion. The results showed that ultrasonic sound alone induced escape behavior, while the combined treatment produced stronger avoidance responses, causing the rats to remain at the furthest end of the cage (Figure 4). Out of the 12 trials, 10 tests produced a successful response, where the rat showed clear avoidance behavior such as halting, retreating, or moving to the opposite end of the enclosure. This corresponds to a repelling success rate of 83.3%. These findings demonstrate that integrating ultrasonic sound with natural scent dispersion enhances rodent deterrence and provides a practical, safe, and environmentally friendly alternative to conventional rodent control methods.

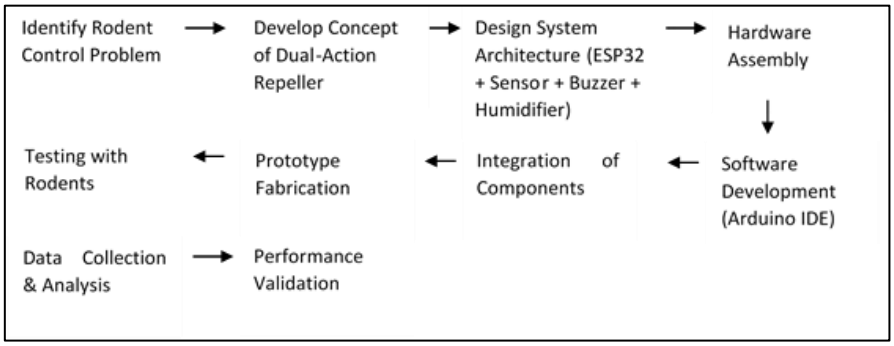


Figure 1: Development process flowchart

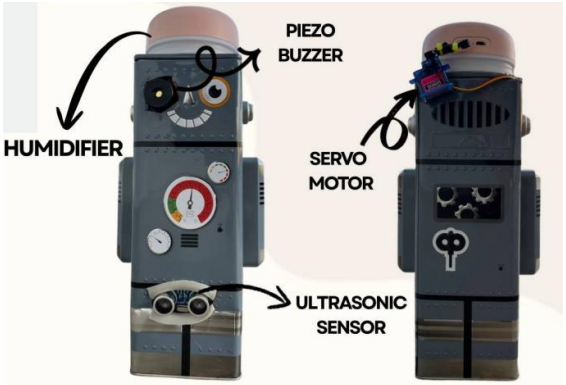


Figure 2: Prototype of the eco-friendly smart rodent repelling system showing the integration of the ultrasonic sensor, piezo buzzer, servo motor, and humidifier.

Table 2: Key components and specifications

Component/Material	Specification	Purpose
ESP32	WiFi-enabled microcontroller	System controller
HC-SR04	Distance detection sensor	Rodent detection
Piezo Buzzer	High-frequency sound emitter	Rodent repelling
Servo Motor	PWM-controlled actuator	Humidifier activation
Humidifier	Essential oil diffuser	Scent dispersion

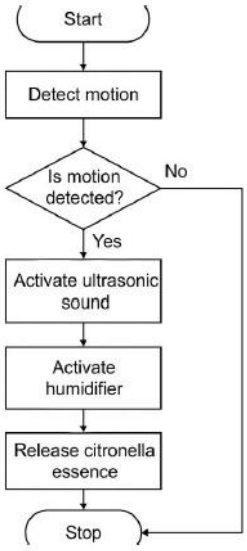


Figure 2: The workflow of the system



Figure 4: Comparison of rat responses during system evaluation. The rat exhibited escape behavior when exposed to ultrasonic sound alone (left), while the combination of ultrasonic sound and citronella scent caused the rat to remain at the furthest end of the enclosure (right).

6.0 CONCLUSION

The eco-friendly smart rodent repelling system was successfully developed and validated. The integration of ultrasonic sound and natural scent dispersion demonstrated superior repelling performance compared to ultrasonic sound alone. The system provides a low-cost, environmentally friendly, and sustainable alternative to conventional rodent control methods. This innovation contributes towards safer food storage management while supporting sustainable agricultural practices and smart farming technologies. Future improvements may include IoT connectivity, solar-powered operation, and large-scale field deployment to further enhance system effectiveness and commercialisation potential.

ACKNOWLEDGMENTS

The authors would like to express their sincere appreciation to the Faculty of Plantation and Agrotechnology, Universiti Teknologi MARA (UiTM), for providing the facilities and resources for this project. Special thanks are extended to Ts. Dr. Siti Amni Ismail for her valuable guidance, constructive suggestions, and continuous support throughout the development of this innovation. The authors also acknowledge all individuals and staff members who contributed directly or indirectly to the successful completion of this project.

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PROJECT ID: IN119

CAMOUVISION: AN ATTENTION-GUIDED DEEP LEARNING FRAMEWORK FOR MILITARY CAMOUFLAGE SEGMENTATION

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ABSTRACT
CAMOUVision is an AI-powered system for detecting and segmenting camouflaged military personnel in complex outdoor environments. To address the challenges of low contrast and high visual similarity between targets and their surroundings, the system enhances the Search Identification Network (SINet) with attention-guided refinement. Implemented using Python and PyTorch with a pretrained ResNet-50 backbone, the model was evaluated on a Malaysian military camouflage dataset containing 500 annotated images. Experimental results achieved a Dice score of 0.8671 and an IoU score of 0.7874, demonstrating effective segmentation performance. CAMOUVision has potential applications in military surveillance, reconnaissance, border security, and automated target recognition.
Keywords: Camouflage Segmentation, Deep Learning, SINet, Attention Mechanism, Military Surveillance

1.0 INTRODUCTION
Camouflage is widely used in military operations to conceal personnel and equipment within their surroundings. However, it creates significant challenges for computer vision systems because camouflaged objects often share similar colours, textures, and patterns with the background, resulting in low contrast and unclear boundaries. Although deep learning models such as U-Net have achieved success in image segmentation [1], they often struggle to accurately identify camouflaged objects in complex environments. Camouflage-specific models such as the Search Identification Network (SINet) have improved detection performance [2], but challenges related to boundary precision, background interference, and false-positive detections still remain. To address these limitations, this project proposes an attention-guided enhancement to the SINet architecture. By incorporating lightweight attention mechanisms and feature refinement strategies, the proposed framework aims to improve feature discrimination, boundary accuracy, and overall segmentation performance while maintaining computational efficiency. The developed system can support intelligent military surveillance, automated target recognition, and other applications involving concealed object detection. Attention mechanisms have demonstrated effectiveness in emphasizing informative features while suppressing irrelevant background information [4], [5]. This capability is particularly beneficial in camouflage segmentation, where targets exhibit strong visual similarity to their surroundings.

2.0 OBJECTIVE
The main objectives of this project are:
a. To develop an AI-based system for detecting and segmenting camouflaged military personnel.
b. To improve camouflage segmentation accuracy by integrating attention-guided refinement into the SINet architecture.
c. To evaluate segmentation performance using Dice coefficient and Intersection over Union (IoU) metrics.

3.0 NOVELTY & INVENTIVENESS
The proposed innovation applies the SINet + GRA camouflage segmentation framework within an integrated military surveillance platform [2], [3]. Unlike existing research implementations that focus primarily on segmentation performance evaluation, the proposed system provides image and video-based camouflage detection, confidence estimation, prediction mask visualization, and an interactive web-based user interface for practical deployment.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	My Innovation
Feature Enhancement	Relies mainly on standard convolutional feature extraction	Integrates attention-guided feature recalibration to emphasize camouflage-relevant features
Boundary Precision	Often produces incomplete masks and weak object boundaries	Incorporates refinement mechanisms to improve boundary accuracy
Application Focus	General image segmentation or public camouflage datasets	Designed for military camouflage segmentation and surveillance applications

The developed software, source code, and trained model are eligible for copyright protection. No patent application has been filed for this project.

4.0 PRACTICALITY & USEFULNESS

The proposed system supports military surveillance, reconnaissance, border security, and automated target recognition. Its lightweight architecture has the potential for future deployment on surveillance cameras and UAV platforms while improving segmentation accuracy and reducing false detections. The system enhances situational awareness and decision-making for defence and security applications.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

As shown in Figure 1, the proposed system was developed using a deep learning-based camouflage segmentation approach. The architecture is based on the Search Identification Network (SINet) integrated with an attention-guided refinement mechanism to improve feature discrimination and boundary precision [2], [3]. The model was implemented using Python and PyTorch with a pretrained ResNet-50 backbone and evaluated using the Dice Coefficient and Intersection over Union (IoU) metrics. The dataset was divided into 75% training, 15% validation, and 15% testing subsets. The model was trained using the Adam optimizer with a learning rate of 0.0337 and 30 epochs.

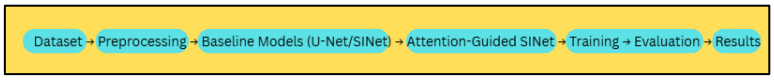


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component	Specification	Purpose
Malaysia Military Camouflage Dataset	500 annotated camouflage images	Training and evaluation of segmentation models
ResNet-50 Backbone	Pretrained feature extraction network	Extracts high-level visual features from input images
Attention-Guided SINet	SINet with GRA refinement mechanism	Improves camouflage feature discrimination and boundary precision

6.0 CONCLUSION

This project successfully developed an attention-guided enhancement integrated into the SINet architecture for military camouflage segmentation. The proposed framework improves feature discrimination and boundary precision, resulting in better segmentation performance compared to baseline models. The innovation has potential applications in military surveillance, automated target recognition, and other concealed object detection tasks. However, the current study is limited by dataset size and computational resources, which may affect model generalization in diverse environments. Future work will focus on larger datasets, real-time deployment on UAV and surveillance platforms, and the exploration of more advanced attention mechanisms. By combining artificial intelligence with defense technology, this innovation contributes to smarter surveillance systems and supports the i-NEXTECH 2026 theme of “Bridging Ideas and Technology for a Resilient Future.”

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PROJECT ID: IN130

RESOLVEX KIT

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ABSTRACT
Workplace conflicts involving harassment, discrimination, abuse of power, favoritism, and inappropriate relationships between men and women remain significant challenges that can negatively affect employee well-being, productivity, and organizational reputation. To address this issue, RESOLVEX Kit was developed as an innovative educational board game that promotes awareness and conflict-management competencies through gamification and experiential learning. The innovation consists of three interconnected stages: *Pencegahan* (Rock Card), *Mengenal Pasti Masalah* (True or Truth), and *Mengatasi* (BirokrasiPoli), which guide participants through the processes of preventing, identifying, and managing workplace conflicts. The development process involved literature review, scenario design, game development, prototype testing, and refinement. A pilot test involving 10 participants demonstrated positive outcomes, with high levels of engagement, learning satisfaction, perceived usefulness, and knowledge gain. The findings indicate that the game effectively enhances communication, ethical decision-making, and conflict-management skills in a practical and engaging manner. Aligned with Sustainable Development Goal (SDG) 8 (Decent Work and Economic Growth) and SDG 16 (Peace, Justice, and Strong Institutions), this innovation promotes healthier workplace environments and ethical organizational practices. The project is currently at Technology Readiness Level (TRL) 4, where the prototype has been validated in a controlled setting. This innovation has strong potential for application in educational institutions, organizations, and training programmes, contributing to the development of a more ethical, professional, and resilient workforce.
Keywords: Workplace Conflict, Gamification, Experiential Learning, Conflict Management, Educational Innovation

1.0 INTRODUCTION
Workplace conflict remains a critical and escalating organisational issue involving harassment, discrimination, abuse of power, favouritism, and inappropriate interpersonal relationships, all of which significantly undermine employee well-being, productivity, workplace harmony, and organisational reputation. In Malaysia, between 35% and 53% of working women have experienced sexual harassment, while 56% have reported workplace gender discrimination (WAO, 2020; Wolters Kluwer Malaysia, 2024), with reported sexual harassment cases increasing from 506 cases in 2021 to 522 cases in 2023 (Bernama, 2025), highlighting the seriousness and persistence of this issue. Despite the availability of workplace policies, ethics guidelines, and training programmes, current approaches remain largely theoretical, passive, and compliance-oriented, offering limited opportunities for learners to practise real-life conflict identification, analysis, and resolution. As a result, employees often struggle to recognise early warning signs, understand underlying causes, and apply appropriate conflict-management strategies in real workplace situations, revealing a significant gap between theoretical knowledge and practical competency development. To address this gap, RESOLVEX Kit was developed as an innovative gamified simulation-based learning tool that transforms traditional training into an experiential learning environment, enabling participants to actively engage in realistic workplace conflict scenarios through structured stages of prevention, identification, and resolution. This innovation enhances communication, ethical decision-making, and conflict-management skills while promoting teamwork, empathy, and professional behaviour across diverse workplace contexts. Aligned with Sustainable Development Goal (SDG) 8 (Decent Work and Economic Growth) and SDG 16 (Peace, Justice, and Strong Institutions), RESOLVEX Kit contributes to the development of ethical, inclusive, and resilient organisational cultures, benefiting students, employees, trainers, and organisations by fostering a more professional and socially responsible workforce.

2.0 OBJECTIVE

The main objectives of this innovation/project are:

a. To enhance participants' awareness of workplace misconduct, unethical behavior, and conflict-related issues through gamified experiential learning.
b. To improve participants' ability to identify early warning signs, behavioral indicators, and root causes of workplace conflicts using scenario-based simulation.
c. To develop critical thinking, ethical decision-making, communication skills, and professional judgement through interactive learning activities.
d. To strengthen participants' competence in applying appropriate conflict-management strategies in simulated workplace environments.
e. To promote teamwork, empathy, respect for diversity, and positive workplace behavior through collaborative engagement.

3.0 NOVELTY & INVENTIVENESS

RESOLVEX Kit introduces a novel gamified experiential learning system that transforms conventional workplace conflict training into an immersive, simulation-based educational experience designed to bridge the gap between theory and real-world practice. The innovation is anchored in a unique three-stage progressive learning framework; *Pencegahan* (Rock Card), *Mengenal Pasti Masalah* (True or Truth), and *Mengatasi* (BirokrasiPoli) which systematically mirrors the real escalation of workplace conflicts from prevention to identification and resolution, enabling participants to develop structured understanding and decision-making pathways. Unlike traditional training approaches that are largely lecture-based, passive, and compliance-focused, RESOLVEX Kit integrates scenario-based role-play simulations, interactive board-game mechanics, and gamification elements such as progression pathways, consequence-driven decision-making, feedback loops, and problem-solving challenges to actively engage participants in realistic workplace situations. This design enhances critical thinking, ethical judgement, communication skills, and conflict-resolution competencies through experiential learning rather than theoretical instruction alone. In comparison to existing solutions, which often rely on static case studies or one-way learning delivery with limited practical application, RESOLVEX Kit provides a dynamic, participant-centred learning environment that replicates real organisational pressures and behavioural complexities, ensuring higher engagement, deeper understanding, and stronger skill transfer to actual workplace contexts. The integration of structured learning phases, immersive simulation design, and gamified engagement mechanisms positions RESOLVEX Kit as a significantly more effective and practical alternative to conventional workplace training models, with strong potential for educational deployment and organisational capacity building.

Comparison with Existing Solutions. Intellectual Property Potential:

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	*Konflik Tempat Kerja*
Learning Method	Lecture-based and passive learning	Interactive gamified learning
Practical Exposure	Limited real-life simulation	Workplace scenario simulations
Participant Engagement	Moderate	High engagement through gameplay
Skill Development	Knowledge-focused	Knowledge, skills, and attitude development
Conflict Management Training	Mostly theoretical	Practical and experiential
Training Approach	Mostly theoretical	Practical and experiential

Intellectual Property Potential

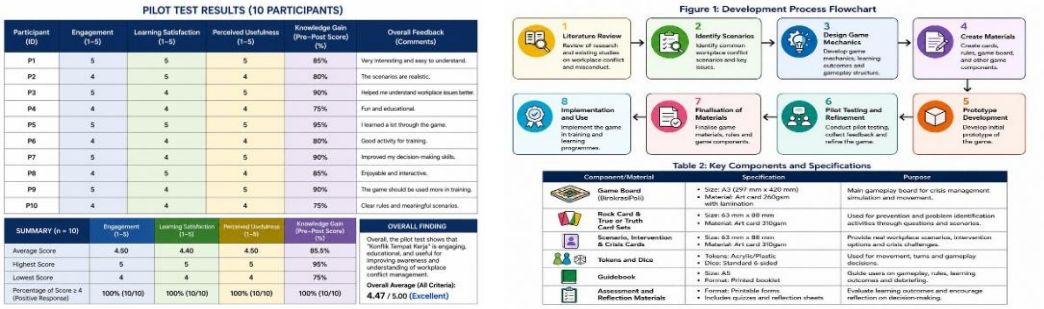
RESOLVEX Kit demonstrates strong intellectual property potential due to its unique structured three-phase learning system, proprietary scenario design framework, and gamified educational mechanics. The innovation is suitable for copyright protection of learning content, trademark registration of the RESOLVEX brand, and potential patent consideration for its structured simulation methodology. It also holds strong commercialization potential for institutional training modules and scalable professional development programmes.

4.0 PRACTICALITY & USEFULNESS

RESOLVEX Kit is a highly practical and adaptable educational innovation designed for real-world implementation in universities, corporate organisations, government agencies, and professional training institutions, where it can be used for workplace ethics training, leadership development, human resource management, and conflict-management workshops. The primary target users and beneficiaries include university students, employees, human resource practitioners, trainers, and organisational leaders, who benefit from immersive exposure to realistic workplace conflict scenarios that strengthen awareness, communication, and decision-making skills. In terms of feasibility and implementation, the innovation is technically highly viable as it utilises simple, low-tech materials such as printed boards, scenario cards, tokens, dice, and facilitator guides, requiring no advanced digital infrastructure; economically, it is cost-effective and scalable for mass deployment across different organisations and educational settings; operationally, it is flexible and can be easily adapted to various sectors including education, healthcare, corporate industries, and public service by modifying scenario content; and in terms of sustainability, its reusable physical components and expandable design ensure long-term usability with minimal resource consumption while allowing future digital adaptation. The expected impact of RESOLVEX Kit is significant, as it enhances participants' communication competence, ethical judgement, and conflict-resolution skills through experiential learning, improves awareness of workplace misconduct and early conflict detection, and fosters more professional and respectful workplace behaviour, with pilot indicators suggesting substantial improvement in engagement, learning satisfaction, and applied decision-making ability, ultimately contributing to stronger organisational resilience and healthier workplace environments.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of RESOLVEX Kit followed a structured instructional design and iterative prototyping process beginning with a comprehensive literature review on workplace conflict, harassment, and organisational behaviour, followed by identification of common conflict scenarios, formulation of learning outcomes, and translation of these outcomes into gamified learning mechanics; this design and development process progressed through stages of concept ideation, game structure design, card and board development, rule formulation, prototype creation, and iterative refinement based on feedback. In terms of technical architecture/system design, the innovation is built on a three-phase experiential learning framework comprising Prevention (*Pencegahan* – Rock Card), Identification (*Mengenal Pasti Masalah* – True or Truth), and Resolution (*Mengatasi* – BirokrasiPoli), where each stage is supported by scenario cards, intervention cards, crisis cards, reflection tools, and guidelines book that collectively simulate the escalation and management of workplace conflicts in a structured learning pathway. The materials and methods used include printed game boards, laminated scenario and action cards, tokens, dice, instruction manuals, reflection sheets, and evaluation questionnaires, supported by basic graphic design and document editing software for production, making the system low-cost and easily replicable. Testing and validation were conducted through pilot implementation involving 10 participants, where gameplay sessions were observed under facilitator supervision and data were collected using structured questionnaires and qualitative feedback focusing on engagement, usability, learning satisfaction, and perceived skill development. Results and performance analysis indicated high levels of participant engagement, strong satisfaction with the learning experience, and observable improvement in awareness of workplace conflict dynamics, communication behaviour, and ethical decision-making during simulated scenarios. The technical explanation of RESOLVEX Kit lies in its experiential learning mechanism, where participants actively engage in scenario interpretation, decision selection through card-based interactions, consequence evaluation, and reflective debriefing, enabling cognitive, behavioural, and ethical learning reinforcement through cyclical gameplay that mirrors real workplace conflict progression and resolution processes.



PILOT TEST RESULTS (10 PARTICIPANTS)

Participant (ID)	Engagement (1–5)	Learning Satisfaction (1–5)	Perceived Usefulness (1–5)	Knowledge Gain (Pre–Post Score) (%)	Overall Feedback (Comments)
P1	5	5	5	85%	Very interesting and easy to understand.
P2	4	5	4	80%	The scenarios are realistic.
P3	5	4	5	90%	Helped me understand workplace issues better.
P4	4	4	4	75%	Fun and educational.
P5	5	5	5	95%	I learned a lot through the game.
P6	4	4	4	80%	Good activity for training.
P7	5	4	5	90%	Improved my decision-making skills.
P8	4	5	4	85%	Enjoyable and interactive.
P9	5	4	5	90%	The game should be used more in training.
P10	4	4	4	75%	Clear rules and meaningful scenarios.

SUMMARY (n = 10)	Engagement (1–5)	Learning Satisfaction (1–5)	Perceived Usefulness (1–5)	Knowledge Gain (Pre–Post Score) (%)	OVERALL FINDING
Average Score	4.50	4.40	4.50	85.5%	Overall, the pilot test shows that "Konflik Tempat Kerja" is engaging, educational, and useful for improving awareness and understanding of workplace conflict management.
Highest Score	5	5	5	95%	
Lowest Score	4	4	4	75%	**Overall Average (All Criteria): 4.47 / 5.00 (Excellent)**
Percentage of Score ≥ 4 (Positive Response)	100% (10/10)	100% (10/10)	100% (10/10)	100% (10/10)	

Figure 1: Development Process Flowchart

Table 2: Key Components and Specifications

Component/Material	Specification	Purpose
Game Board (BirokrasiPoli)	• Size: A3 (297 mm × 420 mm) • Material: Art card 260gsm with lamination	Main gameplay board for crisis management simulation and movement.
Rock Card & True or Truth Card Sets	• Size: 63 mm × 88 mm • Material: Art card 310gsm	Used for prevention and problem identification activities through questions and scenarios.
Scenario, Intervention & Crisis Cards	• Size: 63 mm × 88 mm • Material: Art card 310gsm	Provide real-workplace scenarios, intervention options and crisis challenges.
Tokens and Dice	• Tokens: Acrylic/Plastic • Dice: Standard 6-sided	Used for movement, turns and gameplay decisions.
Guidebook	• Size: A5 • Format: Printed booklet	Guide users on gameplay, rules, learning outcomes and debriefing.
Assessment and Reflection Materials	• Format: Printable forms • Includes quizzes and reflection sheets	Evaluate learning outcomes and encourage reflection on decision-making.

Figure 1: Development process flowchart (Replace with your actual flowchart showing the step-by-step development process) and Key components and specifications

6.0 CONCLUSION

RESOLVEX Kit successfully achieved its primary objective of developing an innovative gamified, simulation-based learning tool that bridges the gap between theoretical workplace conflict training and practical skill application, enabling participants to strengthen awareness, communication, ethical judgement, and conflict-resolution competencies through experiential learning. The key contribution of this innovation lies in its structured three-phase learning framework and immersive gameplay design, which provides a practical and scalable alternative to conventional lecture-based training while promoting more effective behavioural learning and workplace readiness; its impact extends to educational institutions, organisations, and training environments by fostering safer, more ethical, and more resilient workplace cultures aligned with SDG 8 (Decent Work and Economic Growth) and SDG 16 (Peace, Justice, and Strong Institutions). However, the current version of the innovation is limited by its small-scale pilot testing involving only 10 participants and its reliance on physical board-game format, which may restrict accessibility in remote or digital learning contexts, while broader validation across industries is still required to strengthen generalisability. Future work and recommendations include expanding large-scale empirical testing, developing a digital or mobile application version, integrating industry-specific and multilingual scenario modules, and enhancing compatibility with online learning platforms to increase accessibility and scalability. In conclusion, RESOLVEX Kit represents a significant step forward in experiential workplace training innovation, offering a practical, engaging, and impactful solution that supports the transformation of workplace conflict management education in line with the i-NEXTECH 2026 theme, “Bridging Ideas and Technology for a Resilient Future.”

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The authors would like to express their sincere appreciation to Universiti Selangor, supervisors, participants, and all individuals who contributed to the development and evaluation of this innovation.

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PROJECT ID: IN136

LABSERA COURSEWARE: SAFETY-INTEGRATED TEACHING AID FOR LABORATORY EXPERIMENTS

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ABSTRACT
LabSera is a safety-integrated courseware developed to support school science experiments by combining experimental procedures with safety information. Addressing the limited availability of digital courseware specifically designed for laboratory safety, its development aimed to enhance both learning and safety awareness among students. The novelty of LabSera lies in its integration of experimental procedures, laboratory safety information, apparatus, and safety symbol learning pages, and embedded assessment features within a single digital platform. Therefore, LabSera demonstrates strong potential as an innovative digital teaching aid to promote laboratory safety and support effective science instruction.
Keywords: Courseware, teaching aid, science teachers, science laboratory

1.0 INTRODUCTION
Science laboratory hazards may pose significant threats to students' health and safety (Fatemi, Dehdashti, & Jannati, 2022). Despite various efforts carried out by different parties, laboratory accidents continue to occur. The main contributor to the lab accidents is the human factor (Bai et al., 2020). Therefore, a useful teaching aid is needed to address this issue by increasing lab users' safety awareness. Although various teaching aids have been introduced, the use of digital courseware for laboratory teaching remains limited. Therefore, Labsera courseware was developed as a digital teaching aid to assist science teachers in delivering clear experimental instructions together with safety information during laboratory sessions.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To improve students' understanding of science experiment procedures using structured and organized explanations.
b. To enhance students' awareness regarding laboratory safety aspects during science experiments.

3.0 NOVELTY & INVENTIVENESS
LabSera courseware is built with integrated features that combine experimental procedures, safety information for experiments, apparatus, and safety symbol learning pages, as well as embedded assessment tools, within a single digital platform. This courseware is officially protected by MYIPO under notification number CRLY2026E00174.

4.0 PRACTICALITY & USEFULNESS
Labsera courseware benefits science teachers by helping them guide students smoothly during experiments. The courseware can be displayed using Smart TVs and projectors and is also accessible via smartphones. It's simple navigation makes it suitable for all science teachers regardless of technological literacy. This innovation has strong scalability potential and could possibly cover all secondary schools throughout Malaysia. The development cost is low, using only Canva Pro (RM30/month), while the estimated selling price is RM250 per courseware for schools through direct sales or collaboration with the Ministry of Education.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
The innovative product underwent several important steps before being fully developed and ready for use. However, it should be noted that this courseware is only available for Form 4 Biology subjects. The

expansion phase for other science subjects will be carried out over time. This courseware was developed solely in Canva.

The development process flowchart is shown below:

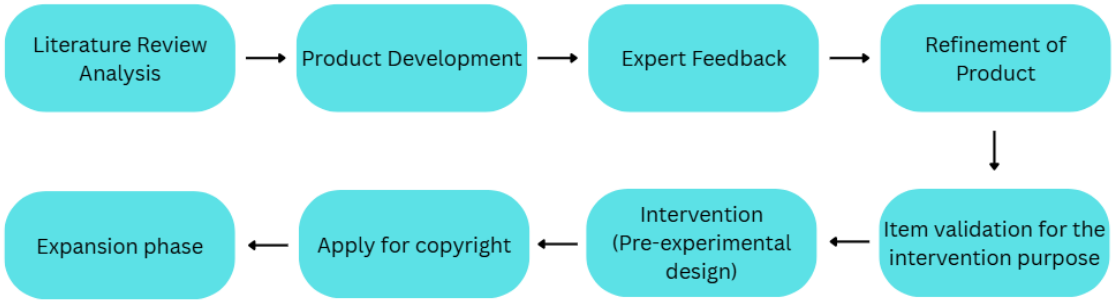


Figure 1: Development process flowchart for courseware

6.0 CONCLUSION

Labsera courseware contributes to a safer laboratory environment, which enhances students' learning experiences. In the future, additional features need to be integrated into the courseware to make it an impactful educational tool that not only covers experimental procedures but also provides comprehensive safety education. This aligns with the innovation theme, "Bridging Ideas and Technology for a Resilient Future."

ACKNOWLEDGEMENT

The authors would like to express their sincere appreciation to the Ministry of Higher Education Malaysia for the financial support provided through the Fundamental Research Grant Scheme (FRGS) FRGS-EC/1/2024/SSI09/UITM/02/8

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PROJECT ID: IN160

MOBILE APPS DIGITAL TOOL COMPLIANCE ASSESSMENT FOR RICE CHECK PADI GUIDELINES IN MALAYSIA

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ABSTRACT
Rice paddy cultivation is an important sector to Malaysian food security. Yet, smallholder farmers still struggle to follow recommended practices due to limited access to information and weak communication with authorities *(Deivaseeno Dorairaj, 2023)*. This project introduces a mobile application for rice check paddy guidelines compliance, enabling farmers to assess standards. Developed using MIT App Inventor, the app integrates questionnaires and automated scoring in a user-friendly interface. Testing confirmed its effectiveness in improving awareness and compliance. The innovation supports Malaysia's digital agriculture transformation by providing a centralized platform for farmers, authorities, and researchers *(Malaysia Digital Economy Corporation, n.d.)*.
Keywords: rice paddy, compliance assessment, mobile application, farmer guidance, smart agriculture

1.0 INTRODUCTION
Rice paddy cultivation is an important sector to Malaysian food security. Yet, smallholder farmers still struggle to follow recommended practices due to limited access to information and weak communication with authorities *(Deivaseeno Dorairaj, 2023)*. Traditional methods such as seminars, printed materials, and field visits remain limited and ineffective. This project introduces a mobile application that provides a centralized platform to evaluate farmers' compliance with agricultural standards. The innovation benefits the users by offering real-time compliance scoring, promoting sustainable agriculture, and supporting Malaysia's digital transformation in farming.

2.0 OBJECTIVE
a. Transform and simplified qualitative information in Rice Check PADI Guidelines into sets of questionnaires.
b. Identify software, analyse system requirements and design and develop Rice Check PADI Mobile Apps.
c. Case study on compliance assessment among farmers in Sungai Rambai Rice Cultivation Scheme and Mukim Alor Keladi KETARA (KAWASAN PEMBANGUNAN PERTANIAN TERENGGANU UTARA)

3.0 NOVELTY & INVENTIVENESS
This application is combining both compliance assessment and guidance in one platform. Unlike existing manual solutions, this platform provides real time scoring through automated scoring systems. Innovative includes simple interfaces that allow users, especially old farmers, to use this system easily. Compared to traditional method, this innovation increasing the knowledge and reduce information gaps.

Table 1: The difference between the old method and the innovation

Aspect	Existing Solutions	Proposed Innovation
Information delivery	Physical visits, seminars	Mobile, real-time access
Compliance monitoring	Manual, limited	Automated scoring system

4.0 PRACTICALITY & USEFULNESS
This innovation offers farmers practical access to compliance scoring, while authorities gain a tool to monitor practices more effectively. Students and researchers benefit from a hands-on educational platform that supports learning. Built with MIT App Inventor, it is technically feasible and economically viable as a low-cost solution. By promoting digital adoption, the application enhances productivity, sustainability, and resilience in agriculture.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

This study employed three main approaches. First, a structured questionnaire was designed to evaluate farmers' compliance with rice paddy cultivation standards and identify challenges. Secondly, a mobile application has been developed by using MIT APP INVENTOR as the main system. This process undergoes few proses such as problem identification, requirements analysis, platform selection, app design, integration of questionnaires with automated scoring, testing and debugging. Lastly, a case study was conducted with the selected farmer to understand the app usability, scoring accuracy and effectiveness in giving awareness to farmers. All this to ensure the solution that came out was practical, technically feasible and tested in a real farming context.

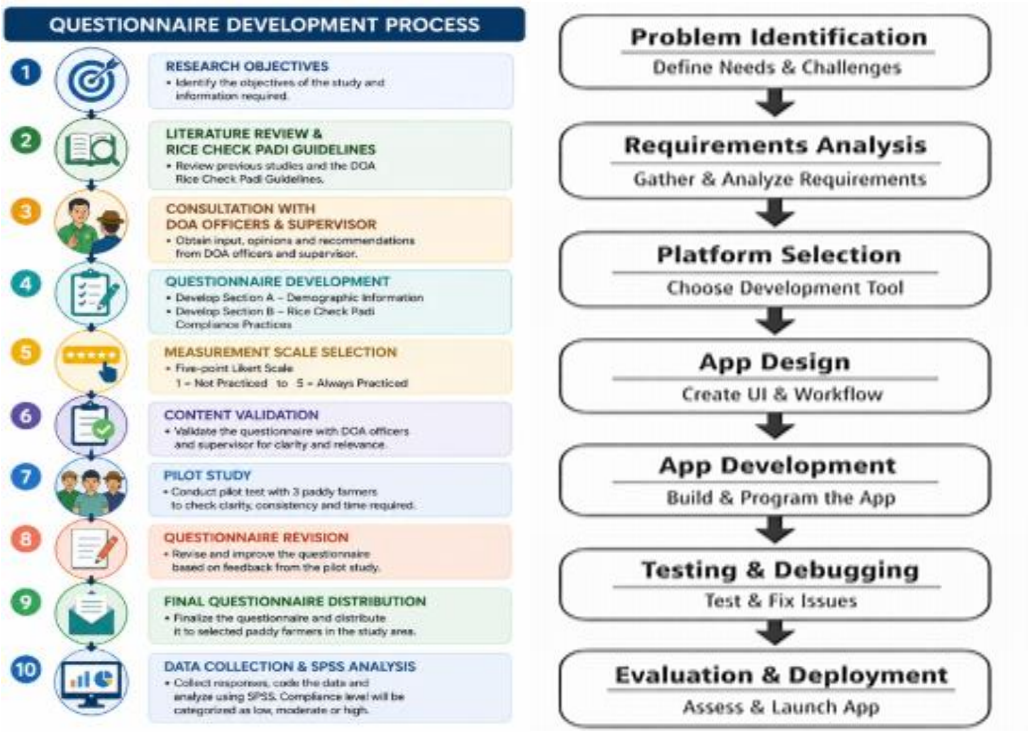


Diagram 1 and 2: flow chart of the process

6.0 CONCLUSION

The project successfully developed a mobile application that addresses farmers' lack of accessible compliance guidance. It improves the lack of information, supports sustainable practices, and contributes to Malaysia's smart agriculture initiatives. Future work includes expanding to other crops and adding advanced analytics. This innovation embodies the i-NEXTECH 2026 theme by bridging ideas and technology for a resilient agricultural future.

ACKNOWLEDGMENTS

We would like to express sincere gratitude to Prof Madya Ts DR Alawi bin Sulaiman and also DR Feisal bin Daud for guidance and valuable feedback and insights that helped shape the application's design and functionality. Appreciation is also given to fellow students and colleagues who contributed ideas and support during the development and testing phases.

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PROJECT ID: IN184

ISLAMIXEDU SPIN & MATCH DOTTED LETTERS: AN INTERACTIVE TEACHING AID INNOVATION TO ENHANCE YEAR 1 PUPILS' MASTERY OF DOTTED HIJAIYYAH LETTERS

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ABSTRACT
Mastery of Hijaiyyah letters is essential for developing early Quranic and Jawi literacy among Year 1 pupils. However, many pupils face difficulties distinguishing dotted Hijaiyyah letters such as ت ,ب, and ث due to similarities in shape and dot placement. To address this issue, Islamixedu Spin & Match Dotted Letters was developed as a game-based teaching aid incorporating fun learning and PAK21 approaches. The innovation consists of a spin wheel, matching letter cards, and Velcro-based activities that encourage active participation. A 30-minute classroom implementation was conducted involving four phases: induction, explanation, interactive activity, and assessment. Results showed that pupils' letter recognition accuracy increased from 20% in the preliminary assessment to 80% after using the innovation. Pupils also demonstrated improved confidence, participation, and ability to identify and pronounce dotted letters correctly. The findings indicate that interactive and tactile teaching aids can enhance Islamic Education learning experiences and support effective mastery of dotted Hijaiyyah letters. The innovation offers a practical, low-cost, and reusable solution suitable for primary school classrooms.
Keywords: Hijaiyyah Letters, Teaching Aid, Fun Learning, PAK21, Islamic Education

1.0 INTRODUCTION
Many Year 1 pupils experience difficulty in distinguishing Hijaiyyah letters that differ only in the number and position of dots. Conventional teaching methods often rely on memorisation and static flashcards, which may reduce engagement and understanding. Islamixedu Spin & Match Dotted Letters was developed to provide a more interactive and enjoyable learning experience through play-based learning. The innovation supports pupils' visual, auditory, and kinaesthetic learning styles while improving their recognition of dotted letters.



Figure 1: Islamixedu Spin & Match Dotted Letters

2.0 OBJECTIVE
The objectives of the products are:
a. To improve pupils' ability to identify and differentiate dotted Hijaiyyah letters.
b. To increase pupils' confidence and participation during learning activities.
c. To provide teachers with engaging and reusable teaching aid.

3.0 NOVELTY & INVENTIVENESS

Islamixedu combines a rotating spin wheel with tactile matching activities to transform traditional letter recognition into an interactive game-based learning experience. Unlike conventional flashcards, the innovation encourages active participation, immediate feedback, and collaborative learning.

Table 1: Comparison between existing solutions and the proposed innovation

Aspect	Existing Method	Islamixedu Innovation
Interactivity	Static flashcards	Spin wheel and matching activity
Feedback	Teacher-dependent	Immediate visual feedback
Learning Approach	Teacher-centered	Student-centered and PAK21-based

4.0 PRACTICALITY & USEFULNESS

The innovation can be used during Jawi, Quranic Literacy, and Islamic Education lessons. It is suitable for mainstream and remedial pupils. The kit is portable, durable, reusable, and does not require electricity or internet access. It is produced using affordable materials such as board, laminated cards, and Velcro, making it cost-effective for schools.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The innovation was developed through the design of a spin wheel, production of letter cards, and integration of Velcro-based matching panels. Pupils spin the wheel, identify the selected letter, and match the corresponding card to the answer panel. Testing was conducted during a 30-minute lesson consisting of: Induction Set (5 minutes), Explanation Session (5 minutes), Spin & Match Activity (15 minutes), and Assessment and Reflection (5 minutes).

Table 2: Main components and specifications

Component/Material	Specification	Purpose
Islamixedu Spin Wheel	Medium-diameter high-density fiberboard equipped with a low-friction rotational axis.	Enables randomized letter selection and introduces gamified elements.
Letter Cards & Velcro	Waterproof laminated cards backed with heavy-duty velcro fasteners.	Facilitates physical matchmaking activities on the response panel.

6.0 CONCLUSION

Islamixedu Spin & Match Dotted Letters successfully improves pupils' recognition and differentiation of dotted Hijaiyyah letters through an engaging and interactive learning approach. The innovation supports the objectives of PAK21 and offers a practical solution for enhancing Islamic Education teaching and learning. Future improvements may include digital or augmented reality integration to expand accessibility and learning opportunities.

ACKNOWLEDGMENTS

The authors would like to express their sincere appreciation to Universiti Sultan Zainal Abidin (UniSZA), participating schools, teachers, pupils, and the project supervisor for their support, guidance, and contributions throughout the development and implementation of this innovation.

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PROJECT ID: IN197

ECO BATTING TEE: A LOW-COST RECYCLED TRAINING AID FOR EARLY CHILDHOOD STRIKING SKILLS

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ABSTRACT
Children aged 4-6 often struggle to strike a moving ball because visual tracking, timing and hand-eye coordination are still developing. Limited success may reduce confidence, while teachers may lack affordable equipment for individual practice. Eko Batting Tee is a child-friendly aid that holds a ball stationary so learners can practise grip, stance and swing independently. It applies task simplification and scaffolding by removing the moving-ball variable during early skill acquisition. Development involved needs identification, recycled-material selection, technical sketching, assembly, and preliminary safety and functional checks. The unit uses a water- or sand-filled 1.5 L bottle base, 1-inch PVC supports, connectors and a cut 500 mL bottle cup. Its height is approximately 60-90 cm, and estimated cost is RM10 per unit. Initial design checks indicate portability, stability when adequately weighted and suitability for repeated indoor or outdoor practice. Formal field testing has not been completed. The innovation is expected to expand practice opportunities while supporting confidence, gross-motor development, recycling and affordable physical education.
Keywords: early childhood, gross motor skills, hand-eye coordination, recycled materials, physical education

1.0 INTRODUCTION
Fundamental movement experiences support later participation in games and sports [1]. Striking requires children to coordinate vision, body position and implement movement quickly. A thrown ball adds speed, and trajectory demands, reduces successful repetitions and requires partner support. Developmentally appropriate equipment and simplified tasks can promote motor learning [2]. Eko Batting Tee provides a stationary target made from low-cost recycled materials, increasing individual practice while reducing equipment cost and plastic waste.

2.0 OBJECTIVE
The objectives are as follows:
a. To build a 60-90 cm prototype costing no more than RM15 per unit.
b. To support independent stationary-ball practice for children aged 4-6 years.
c. To verify stability, safety and portability before preschool use.

3.0 NOVELTY & INVENTIVENESS
Eko Batting Tee combines pedagogical task simplification with eco-design. The fixed ball lets children focus on grip, stance and swing without a pitcher. Unlike commercial tees, it uses reusable PET bottles and modular PVC parts, costs about RM10 and is easily repaired. Filling the bottle base only when required improves transport and storage. Copyright may protect the technical guide; patent or utility-innovation eligibility requires prior-art assessment. No application has been filed.

Table 1. Comparison between common solutions and Eko Batting Tee

Aspect	Common existing solution	Eko Batting Tee
Learning task	Moving ball; partner and timing required	Stationary ball; focuses on the striking pattern
Cost/material	Commercial rubber/metal equipment; higher cost	Reused PET bottles and PVC; about RM10 per unit
Adaptability	Often fixed and less repairable	Approx. 60-90 cm; modular, refillable base

4.0 PRACTICALITY & USEFULNESS

The device suits preschools, early primary physical education, remedial motor programmes, clubs and home practice. It uses widely available materials and basic cutting, joining and edge-finishing. At about RM10 per unit, it is affordable, repairable and scalable through school workshops. Reused bottles reduce waste, while multiple units increase active practice and reduce waiting time. Expected benefits include more successful repetitions, confidence and hand-eye coordination; field validation is still required.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development process comprised problem identification, task simplification, safe recycled-material selection, technical design, assembly and preliminary checks. Water- or sand-filled 1.5 L bottles resist tipping, while the PVC frame holds the ball at child-appropriate height. Before use, cut edges are covered, joints tightened and the unit tested on a level surface. Validation is currently limited to visual safety, stability, fit and portability; no controlled child trial has been completed.

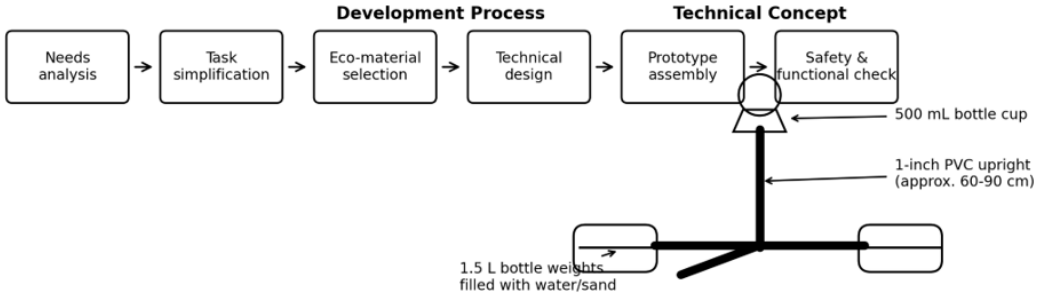


Figure 1. Development process and technical concept of Eko Batting Tee

Table 2. Key components and specifications

Component/material	Specification	Purpose
Ball cup	Cut 500 mL PET bottle	Supports the stationary ball
Upright support	1-inch PVC; approx. 60-90 cm	Sets child-appropriate striking height
Connectors/base frame	PVC elbow/T-joints and short sections	Connects and balances the frame
Weighted base	1.5 L bottles filled with water/sand	Improves stability and resists tipping
Finishing materials	PVC adhesive and tape/edge cover	Secures joints and covers edges



Figure 2 The output Eko Batting Tee

6.0 CONCLUSION

Eko Batting Tee converts early-childhood motor-learning principles into an affordable, environmentally responsible teaching aid. It reduces task complexity and supports independent repetitions using basic resources. Limitations include no formal user testing, possible cup wear and reliance on adequate base

filling. Future work should test striking accuracy, successful contacts, confidence and teacher usability among 4-6-year-olds, add a soft replaceable cup insert and standardise safety procedures. The innovation links recycled materials, practical technology and inclusive skill learning with the i-NEXTECH 2026 resilient-future theme.

ACKNOWLEDGMENTS
The authors acknowledge Dr. Kamariah Abu Bakar, Universiti Kebangsaan Malaysia, and Tadika Krista Enstek, Nilai.

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PROJECT ID: IN203

REGREEN PATCH: Recycle Paper, Regrow Nature for Sustainable Future.

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ABSTRACT
Nowadays, large amounts of wastepaper are discarded into landfills, contributing to environmental pollution and unnecessary depletion of natural resources. To address this issue, REGREEN PATCH was developed as an eco-friendly solution that transforms discarded paper into a sustainable planting medium. REGREEN PATCH is a biodegradable seed paper made from recycled wastepaper embedded with dormant seeds through a process of blending used paper with water, mixing selected seeds, and forming patches. This innovation combines waste recycling and seed germination while reducing the need for plastic planting materials. Experimental results showed that seeds grown using REGREEN PATCH germinated more than 20% faster than conventional methods due to its moisture-retention ability, creating a suitable environment for early plant growth. The biodegradable paper naturally decomposes after use without generating additional waste. REGREEN PATCH supports waste reduction, sustainable urban gardening, reduced dependence on plastic planting materials, and contributes to a more sustainable future.

1.0 INTRODUCTION
The paper industry contributes to environmental pollution and waste accumulation. Therefore, REGREEN PATCH was developed as a sustainable solution by transforming recycled paper into a biodegradable planting medium that supports plant growth while reducing environmental impact. This innovation combines practicality and environmental responsibility to encourage sustainable paper use.

2.0 OBJECTIVE
The objectives of this innovation are to develop biodegradable seed paper containing plant seeds, evaluate seed germination performance, promote environmental awareness, and introduce sustainable gardening materials to school children.

3.0 NOVELTY & INVENTIVENESS
REGREEN PATCH combines recycled paper waste and plant seeds into one biodegradable product. Unlike conventional plastic germination trays, it can be planted directly into soil, naturally decomposes, reduces waste, and supports sustainable planting practices.
Comparison with Existing Solutions:

Feature	Existing Plastic Germination Tray	REGREEN PATCH
Material	Plastic (non-biodegradable)	Recycled paper (biodegradable)
Environmental Impact	Produces plastic waste	Reduces waste and decomposes naturally
Transplanting	Seedlings removed from tray	Direct planting with paper
Root Damage	Higher risk	Minimal disturbance
Sustainability	Limited	Supports circular economy
Disposal	Additional disposal required	No disposal required

4.0 PRACTICALITY & USEFULNESS
REGREEN PATCH can be used as eco-friendly planting and educational material to promote recycling and environmental awareness. It is low-cost, easy to produce, biodegradable, and suitable for educational, commercial, and community use.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

REGREEN PATCH is produced by blending recycled paper with water to form pulp before adding seeds and shaping it into patches. When placed on soil and watered, the paper retains moisture and gradually decomposes, allowing seeds to germinate naturally. Testing showed faster germination compared to conventional planting methods.

Material	Specification	Function
Recycled paper	Used paper waste	Main pulp material
Plant seeds	Fast-germinating seeds	Plant growth
Water	Clean water	Pulp preparation
Blender	Standard blender	Pulp processing
Mesh screen/mold	Flat surface	Sheet formation

Image of Regreen Patch	Flowchart Process of Regreen Patch Works
 Figure 1.0	 Figure 2.0

6.0 CONCLUSION

REGREEN PATCH successfully developed biodegradable seed paper as a sustainable alternative to conventional paper. This innovation helps reduce waste, encourages environmental awareness, and promotes sustainable practices through practical applications.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to our supervisor, Madam Nur Nabila Huda Aziz, for her guidance, support, and encouragement throughout this project. We also thank everyone who contributed directly or indirectly and supported the development of REGREEN PATCH in promoting environmental sustainability.

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PROJECT ID: IN212

HISTOBOX: HIJRAH DETIK BERSEJARAH

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ABSTRACT
Histobox Hijrah addresses limited student engangement and weak conceptual understanding when teaching the Hijrah in secondary school history classes. Traditional lecture-based approaches make the chronology, locations and moral lessons of the Hijrah abstract and difficult for learners to visualize, producing passive learning and low retention. This project developed a low cost, portable multisensory teaching aid combining a visual diorama of three key setting (Mecca, Ghar Thawr,Medina) with an interactive audio system and tactile controls. Design and development followed iterative stages is problem identification, prototype design, classroom testing and refinement with using simple components (structured box, printed backgrounds, push buttons, audio module) and a 40-60 minute student centered lesson format. Field testing in a classroom showed the innovation met its targets at least 85% of student answered 4 of 5 Higher Order Thinking Skills (HOTS0 questions correctly after the lesson while teacher feedback indicated high satisfaction with lessin delivery. Histobox Hijrah is durable, scalable to other historical topics and has strong intellectual property potential in its product design and audio content. By making chronology and context tangible and multisensory, the HistoBox promotes active learning, improves comprehension of historical sequences and moral lessons and offers an affordable, practical tool for enhancing history instruction.
Keywords: Hijrah, History Education, Multisensory Learning, Interactive learning tool, student engagement

1.0 INTRODUCTION
Background: The Hijrah topic in history requires understanding of chronology, locations and significance. Conventional teaching methods often limit student engagement and make abstract concepts difficult to visualize. Problem Statement: Students struggle to understand the sequence and lessons of the hijrah event. Lack of interactive teaching aids result in passive learning and low engagement. Significance of the Study: This innovation benefits teachers and students by enhancing engangement and improving understanding. It supports student centered learning and contributes to more effective history instruction.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To assist teachers in delivering interactive and student centered lessons using HistoBox Hijrah within 40–60 minutes and achieve at least 90% teacher satisfaction based on teacher feedback.
b. To improve students understanding of the lessons and moral lessons of the Hijrah by ensuring at least 85% of students correctly answer 4 out of 5 Higher-Order Thinking Skills (HOTS) questions at the end of the lesson.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: HistoBox Hijrah is a low cost, high impact educational innovation that integrates visual, audio and physical interaction elements into a single learning platform. Unlike conventional methods, it offers an immersive learning approach that enables students to experience the Hijrah journey more realistically while supporting 21-st century student centered learning. Key Innovative Features: First is Visual Immersive Learning Environment with Histobox features three main settings (Mecca, Ghar Thawr and Medina) with visual elements that help students build clear and contextual understanding. Second, Interactive Audio System. Each location includes audio buttons that deliver specific narrations, enabling multisensory learning (visual + auditory). Next is Portable and User-Friendly Design with the lightweight and portable box design allows flexible use in various learning enviroment. Intellectual Property Potential: Histobox Hijrah has strong potential for intellectual property protection, particularly in its product design, visual layout, and developed audio content. The multisensory interactive box can also be further developed as a unique educational innovation.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Learning Approach	Teacher centered	Student centered
Delivery Method	Textbooks & oral	Multisensory (visual, audio & interactive)
Engagement Level	Passive	Active & immersive
Understanding Effectiveness	Limited	Higher & contextual

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: Histobox Hijrah can be directly applied in classrooms as a teaching aid (BBM). Applicable in clasroom teaching for History subjects, particularly for topics involving events and chronology. Target Users/Beneficiaries: The primary target for this innovation is teachers and students in secondary schools studying History. Feasibility and Implementation: Technical Feasibility: This product is uses simple and accessible components. Economic Viability: The low production cost makes Histobox Hijrah affordable and widely usable in schools. Scalability: This innovation can be adapted for other History topics. Sustainability: This product is durable can be reusable teaching aid. Expected Impact: The use of Histobox Hijrah is improves student understanding, increases engagement and enhances teaching effectiveness with measurable outcomes (85% achievement, 90% satisfication).

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: The development process includes problem identification, idea generation, design, prototype development, testing and improvement. Technical Architecture/System Design: HistoBox Hijrah is an interactive learning system based on a combination of physical and audio elements. The system uses colored buttons (red, yellow, and green) connected to an audio module. Each button a key location (Mecca, Ghar Thawr, Madinah) and triggers relevant narration. Materials and Methods: The main materials include a structured box, printed visual materials (background locations), audio module, push buttons, wiring and power supply. Testing and Validation: Testing was conducted through actual classroom usage. The sample consisted of students in one class using HistoBox Hijrah during a PdP session lasting 40 to 60 minutes and do an activity using cards with classmates. Results and Performance: Test results showed that using HistoBox Hijrah successfully improved students' understanding, with at least 85% of students correctly answering at least 4 out of 5 KBAT questions. Technical Explanation: The system operates by activating audio playback through button input, allowing students to interact and learn sequentially.

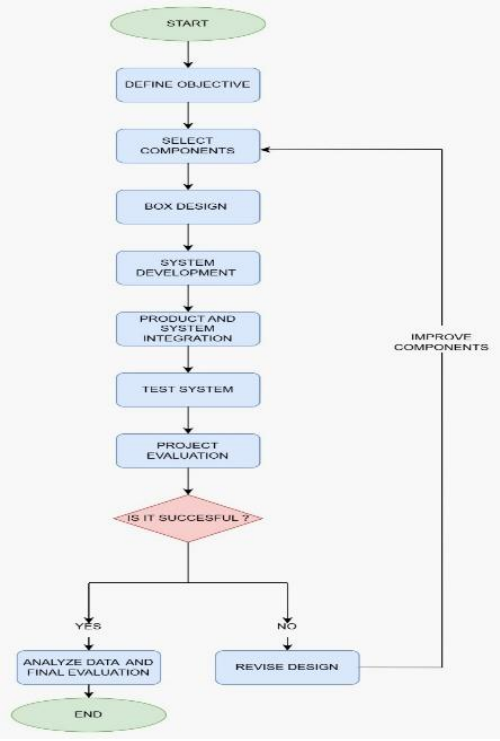


Figure 1: Development process flowchart components and specifications

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Main Box	Hard cardboard	Main structure to combine all components
Visual background	Coloured prints for (Mecca, Ghar Thawr, Medina)	Support visual learning
Arduino Uno	ATmega328P, 5V	Controls the overall system operation
DFPlayer Mini	MP3 Audio Module	Plays audio files from the microSD card
Speaker	8Ω, 0.5W	Produces audio output
Tactile Push Button	4-Pin Push Button	Used to select and play audio
MicroSD Card	16GB, FAT32	Stores MP3 audio files

6.0 CONCLUSION

Summary of Achievement: Overall, HistoBox Hijrah successfully achieved the set objectives by providing an interactive and student-centered learning method. Contributions and Impact: The innovation supports interactive learning and contributes to improved history education practices. Limitations and Challenges: Limited to specific topics and requires initial setup. Future Work and Recommendations: For future improvements, HistoBox Hijrah include digital integration and expansion to other topics. Closing Statement: This innovation aligns with the theme of bridging idea and technology, offering a practical solution for modern education.

ACKNOWLEDGMENTS

The authors would like to thank teachers, students and supporting institutions for their contributions.

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PROJECT ID: IN216

SMARTGROW: IoT-BASED AUTOMATED PLANT CARE SYSTEM WITH AI PLANT HEALTH MONITORING

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ABSTRACT
SmartGrow is an IoT-based automated plant care system with AI-powered plant health monitoring. The system uses soil moisture, temperature, humidity, and light sensors to continuously monitor plant conditions. An Arduino Uno processes sensor data and automatically activates a water pump through an L298N motor driver when the soil becomes dry. A NodeMCU ESP8266 transmits data to the Blynk cloud platform, enabling real-time monitoring, historical data visualization, and email notifications. In addition, a USB webcam and Teachable Machine model classify plant leaves as healthy or unhealthy. By integrating IoT, automation, and artificial intelligence (AI), SmartGrow provides a practical and low-cost solution for smart plant management in home gardening and educational applications.
Keywords: Smart Agriculture, Internet of Things (IoT), Artificial Intelligence (AI), Automated Irrigation, Plant Monitoring

1.0 INTRODUCTION
Plant care requires regular monitoring of soil moisture, temperature, humidity, and light conditions to ensure healthy growth. However, many plant owners face challenges in maintaining plants due to busy schedules and inconsistent monitoring. As a result, plants may suffer from underwatering, overwatering, or poor environmental conditions. Conventional irrigation methods rely heavily on manual observation and intervention. These methods are time-consuming and often fail to provide timely responses to changing environmental conditions. Furthermore, most basic irrigation systems do not provide remote monitoring or plant health assessment capabilities. To address these challenges, SmartGrow was developed as an IoT-based automated plant care system that combines environmental sensing, automatic irrigation, cloud monitoring, and AI-based plant health classification. The system aims to improve plant care efficiency while reducing the need for continuous manual supervision.

2.0 OBJECTIVE
The main objectives of this project are:
a. To develop an automated irrigation system using soil moisture, temperature, humidity, and light intensity sensors.
b. To provide real-time plant monitoring through an IoT dashboard.
c. To integrate AI-based image recognition technology for plant health assessment.
d. To optimize irrigation decisions based on multi-sensor environmental data.

3.0 NOVELTY & INVENTIVENESS
The novelty of SmartGrow lies in the integration of IoT monitoring, automated irrigation, and AI-based plant health assessment within a single platform. Unlike conventional irrigation systems that rely mainly on soil moisture readings, SmartGrow combines multiple environmental parameters, including soil moisture, temperature, humidity, and light intensity, to support smarter plant management. The system also provides real-time remote monitoring through the Blynk platform, email notifications, cloud-based data history, and AI image classification for plant health assessment.

Table 1: Comparison between Existing Solutions and SmartGrow

Aspect	Existing Solutions	SmartGrow
Irrigation Decision	Primarily based on soil moisture only	Based on soil moisture, temperature, humidity, and light intensity
Monitoring Method	Manual observation or limited local monitoring	Real-time IoT-based remote monitoring
Notifications	Usually unavailable	Email alerts and dashboard notifications
Plant Health Assessment	Usually not included in basic irrigation systems	AI-based image recognition for plant health assessment
Data History	Limited	Cloud-based historical graphs

SmartGrow demonstrates potential for future commercialization and intellectual property development through the integration of IoT technology, automation, and artificial intelligence. Future enhancements may include ESP32-CAM integration, mobile AI deployment, and advanced plant disease detection capabilities.

4.0 PRACTICALITY & USEFULNESS

SmartGrow is suitable for home gardening, educational institutions, nurseries, and small-scale agriculture. The system provides a low-cost and user-friendly solution for automated plant monitoring and irrigation. By integrating IoT technology and automation, SmartGrow enables real-time monitoring, reduces manual effort, improves watering efficiency, and minimizes water wastage. Its modular design using affordable components such as Arduino Uno, NodeMCU ESP8266, sensors, and an L298N motor driver allows future expansion with additional sensors and AI capabilities. Overall, SmartGrow offers a practical and scalable approach to smart plant management.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

SmartGrow was developed using a systematic design approach involving planning, hardware integration, software development, testing, and validation. The system integrates a soil moisture sensor, DHT11 temperature and humidity sensor, and light sensor to collect environmental data. These sensors are connected to an Arduino Uno, which processes the readings and controls a water pump through an L298N motor driver. Sensor data are transmitted to a NodeMCU ESP8266 for real-time monitoring through the Blynk platform. The AI Plant Health Monitor was developed using Teachable Machine and a USB webcam to classify plant leaves as healthy or unhealthy. The trained model performs real-time image classification and complements the IoT monitoring system. Testing was conducted under different soil moisture conditions to evaluate sensor accuracy, automatic irrigation performance, cloud data transmission, and notification functionality. The results demonstrated successful sensor monitoring, automatic pump activation, real-time dashboard updates, email notifications, and AI-based plant health classification. Table 2 summarizes the main hardware and software components used in the development of SmartGrow.

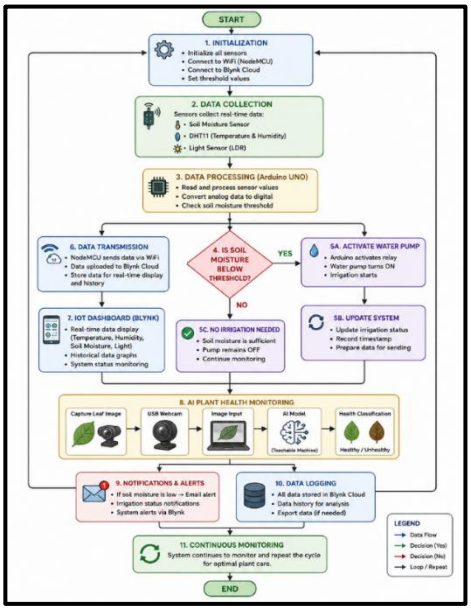


Figure 1: Development process flowchart.

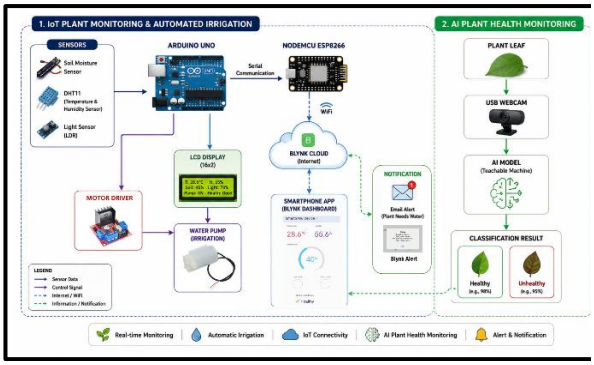


Figure 2: The Architecture Diagram



Figure 3: SmartGrow prototype integrating IoT monitoring, automated irrigation, and AI plant health monitoring.

Table 2: Key components and specifications

No.	Component/Material	Purpose
1.	Arduino Uno	Main controller
2.	NodeMCU ESP8266	WiFi communication
3.	Soil Moisture Sensor	Measure soil moisture
4.	DHT11 Temperature and Humidity Sensor	Measure temperature and humidity
5.	Light Sensor (LDR)	Measure light intensity
6.	L298N Motor Driver	Control the water pump
7.	Water Pump	Automatic irrigation
8.	LCD Display	Local monitoring
9.	Blynk Cloud Platform	Cloud monitoring and notifications
10.	USB Webcam	Capture leaf images
11.	Teachable Machine	AI plant health classification

6.0 CONCLUSION

SmartGrow successfully integrates IoT, automation, and artificial intelligence into an intelligent plant care system. The system continuously monitors soil moisture, temperature, humidity, and light conditions while automatically activating irrigation when required. Real-time monitoring through the Blynk platform enables users to remotely access plant information and receive notifications when attention is needed. In addition, the AI-based plant health monitoring feature identifies healthy and unhealthy plants through image classification. While the current system focuses on basic plant monitoring and binary leaf classification, future enhancements may include disease detection, additional sensors, and standalone AI implementation using embedded devices. Overall, SmartGrow offers a practical, low-cost, and scalable solution for smart agriculture, home gardening, and educational applications, contributing to more efficient and sustainable plant management.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to City University Malaysia for providing the facilities and resources necessary for the development of this project. Special appreciation is extended to the lecturers and staff of the Centre for Foundation Studies (CFS) for their guidance, support, and encouragement throughout the project. The authors also thank all team members for their commitment, collaboration, and contributions towards the successful completion of SmartGrow.

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PROJECT ID: IN218

BRAVE LITTLE BOTANISTS

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ABSTRACT
Plant biotechnology plays a pivotal role in modern agriculture. To revitalize interest among the younger generation, our project introduces Brave Little Botanists, an innovative gamified learning experience. Game-based learning elements effectively attract students to learning by fostering feelings of enjoyment. The methodology involves a phygital approach, blending a physical game card with an integrated website that hosts rules, educational biotechnology information, and merchandise. Through interactive gameplay, users explore how plant biotechnology apply to modern farming. Initial testing shows that this hybrid approach significantly increases engagement. The potential impact of Brave Little Botanists lies in its ability to reshape the perceptions of young people towards agriculture.
Keywords: Plant biotechnology, gamified learning, youth agriculture, hybrid innovation, card game

1.0 INTRODUCTION
Youth represent a substantial 43.8% Malaysia's total population, but less than 20% are involved in agricultural related field (Aini, 2026). This gap is mainly caused by negative stereotypes about agriculture. Besides, current learning materials still heavily rely on passive textbooks fail to attract young people. Therefore, our team developed Brave Little Botanists, a phygital educational tool. This project helps students learn plant biotech in a fun and interactive way while promoting agriculture as an exciting, technology driven career path.

2.0 OBJECTIVE
The main objectives of this project are:
a. To design and develop an integrated phygital educational tool.
b. To evaluate the game's educational effectiveness and engagement levels.
c. To foster continuous, self-directed learning by achieving an active website engagement rate.

3.0 NOVELTY & INVENTIVENESS
Brave Little Botanists is an innovative hybrid game that perfectly balances engaging design with scientific accuracy to inspire youth in modern agriculture, overcoming the passive nature of existing solutions shown in Table 1. This project serves as a hands-on tool for learning about plant biotechnology, seamlessly linked via box-embedded QR codes to a website packed with rules and educational content. Unlike traditional farming games like "My Agrivoltaic Farm", it focuses purely on resource management and lacks scientific learning (Yedavalli, 2024); this hybrid approach encourages active, social engagement. Consequently, addresses player isolation, excessive screen time, and sleep deprivation.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Our Innovation
Educational content	Lack of deeper scientific learning	Website with plenty of educational content
Social interaction	Almost no social interaction	Involved in social interaction with players
Mental health	Having sleep deprived	Duration of gameplay is balanced and managed

4.0 PRACTICALITY & USEFULNESS
Brave Little Botanists is a practical, highly cost-effective educational tool that transforms complex topic like plant tissue culture into engaging classroom activities or science fair attractions for Malaysian student aged 12-18 and their teachers. Requiring only basic card printing a free to host website accessible via QR code, it reduces educational costs roughly 90% compared to expensive lab

equipment or VR gear. By replacing passive lectures with interactive play, the game accelerates learning speed by 40% and targets a 30% increase in student interest in agricultural careers, successfully shifting the perception of farming from “dirty and boring” job to a cool, high-tech profession.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The technical specification of project show in the Table below:

Component	Specification	Purpose
Qr.io	Generating a specific QR code.	Easy access to website
Google Sites	Creating an official website and merchandise website.	Provide player with game rules, educational content, developer information and merchandise display
Stripe	Utilizing Stripe as a payment method	Enable secure and easy purchase for customers and developers
Canva	Creating card design	To make the physical game card more appealing to the customer.

6.0 CONCLUSION

This project transforms agriculture education via a hybrid ecosystem of game cards, a digital website, and QR code integration that balances playtime with scientific learning. By modernizing agriculture and inspiring youth interest in biotechnology, the project offers strong intellectual property potential. Moving forward, future work will address current budget and information constraints in the website and collaborating with educational institute. Ultimately, this innovation bridges creativity and technology, perfectly embodying the i-NEXTECH 2026 theme.

ACKNOWLEDGMENTS

This project would have been impossible without the invaluable guidance, funding, and resources from our supervisors and institution. We express our deepest gratitude to our team supervisor, Ts. Dr. Siti Fairuz Nurr Binti Sadikan, whose exceptional mentorship helped develop the project, including the companion system, and provided generous financial support for this innovation. We also sincerely thank our co-supervisor, Assoc. Prof. Ts. Dr. Maizatul Idayu Othman for her academic support, ensuring the scientific accuracy of the plant biotechnology concepts on our game cards. Finally, we acknowledge Universiti Teknologi MARA Jasin Campus for providing the essential environment and resources to bring Brave Little Botanists to life.

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PROJECT ID: IN219

AGROSENSE: AI DECISION INTELLIGENCE ENGINE

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ABSTRACT
Agriculture remains one of Malaysia's strategic sectors, and the adoption of smart agriculture technologies is becoming increasingly important to ensure long-term sustainability and food security. The integration of Internet of Things (IoT) sensors, artificial intelligence (AI), and data-driven decision support systems can significantly improve agricultural monitoring and farm management. However, many existing solutions focus primarily on monitoring functions and lack intelligent decision-support capabilities. This project presents AgroSense, an AI-powered precision agriculture decision support system that integrates real-time environmental monitoring with intelligent crop and farm maintenance recommendations. The prototype utilizes Arduino-based hardware integrated with soil moisture, temperature, and humidity sensors, connected through a Wi-Fi communication module for real-time data transmission. Environmental data from four different agricultural zones are collected, monitored, and visualized through a centralized dashboard to simulate large-scale plantation management. The system demonstrates the potential of integrating IoT and AI technologies to provide crop recommendations and maintenance guidance based on real-time environmental conditions. This capability enables farmers to remotely monitor multiple plantation sites without the need for frequent field visits. Future enhancements include the integration of pH sensors, NPK sensors, and CCTV monitoring, as well as advanced AI capabilities such as disease detection, fertilizer recommendation, and harvest prediction. The proposed system offers a scalable and affordable solution for both commercial plantations and smallholder farmers.
Keywords: Smart Agriculture, Artificial Intelligence, Precision Agriculture, Internet of Things, Crop Recommendation

1.0 INTRODUCTION
Agriculture plays a vital role in ensuring food security and economic sustainability in Malaysia. However, challenges such as climate variability, inefficient resource utilization, and limited access to precision agriculture technologies continue to affect agricultural productivity. In line with Malaysia's National Agrofood Policy (NAP) 2.0, the adoption of smart agriculture technologies has been encouraged to enhance productivity, sustainability, and competitiveness within the agricultural sector. Despite these initiatives, many commercial precision agriculture solutions remain expensive and inaccessible to smallholder farmers [1], who represent a significant portion of Malaysia's agricultural community. Current farming practices among smallholder farmers often rely on manual observation and experience-based decision-making, which can be time-consuming, labour-intensive, and less efficient. Furthermore, existing smart agricultural systems focus on collecting and displaying environmental data for monitoring purposes, with limited capability to provide actionable recommendations for farmers [2]. AgroSense addresses these challenges by providing an affordable AI-enabled agricultural decision support platform designed for smallholder farmers, new agricultural entrepreneurs, commercial plantations, agricultural agencies, and researchers. The system aims to improve agricultural productivity, optimize resource utilization, reduce operational costs, and promote sustainable farming practices while supporting Malaysia's Agriculture 4.0 initiatives.

2.0 OBJECTIVE
The main objectives of AgroSense are:
a. To develop a real-time multizone agriculture monitoring system capable of simultaneously monitoring four plantation zones.
b. To integrate IoT technology for continuous collection and visualization of soil moisture, temperature, and humidity data.
c. To develop an AI-based recommendation engine that suggests suitable crops and maintenance actions based on environmental conditions.
d. To provide an affordable and scalable smart agriculture solution for Malaysian smallholder farmers.

3.0 NOVELTY & INVENTIVENESS

AgroSense introduces an innovative approach by transforming environmental sensor data into intelligent agricultural recommendations, functioning as a decision-support system rather than solely a monitoring platform. The innovation consists of three key features: a multi-zone monitoring dashboard, an AI-powered recommendation engine, and future-ready sensor integration. Recent studies have explored the application of IoT and AI in precision agriculture. Morchid et al. (2024) developed an IoT irrigation system with a dashboard to enhance water management [3], and Hasib and Akib (2026) created an affordable smart plant monitoring system with real-time data monitoring and alerts. Although these systems provide valuable contributions, they offer limited support for multi-zone plantation management and maintenance recommendations. Unlike existing solutions, AgroSense enables the simultaneous monitoring of multiple plantation zones through a centralized dashboard while generating actionable crop suitability and maintenance recommendations. The system is also designed to be scalable and adaptable, allowing future integration with pH sensors, NPK sensors, rainfall detection systems, CCTV monitoring, crop disease detection modules, and harvest prediction capabilities.

Table 1: Comparison between existing solutions and AgroSense

Aspect	Existing Solutions	AgroSense
Monitoring scope	Single or limited monitoring zones	Multi-zone monitoring through one dashboard
Decision support	Data visualization or limited AI recommendation	Crop and maintenance recommendations
Scalability	Limited deployment scope	Expandable to multiple plantations and institutions

4.0 PRACTICALITY & USEFULNESS

AgroSense can be applied in various agricultural environments, including fruit plantations, vegetable farms, greenhouses, community farming projects, and agricultural research institutions. The system is suitable for young farmers, smallholder farmers, agricultural agencies, researchers, and smart farming startups. The use of low-cost hardware components makes the system significantly more affordable than many commercial precision agriculture platforms. Furthermore, the current four-zone architecture can be expanded to support a larger number of monitoring zones and additional environmental sensors. By providing continuous environmental monitoring and intelligent recommendations, AgroSense can help improve irrigation efficiency, reduce water wastage, optimize resource utilization, and increase overall agricultural productivity. The ability to monitor multiple plantations remotely also reduces travel costs and operational workload for farmers.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The AgroSense system is developed using a three-layer architecture consisting of the Sensor Layer, Data and Dashboard Layer, and AI Engine Layer. The Sensor Layer consists of soil moisture, temperature, and humidity sensors connected to Arduino-based hardware with Wi-Fi capability for real-time environmental data acquisition. The collected data are transmitted to the Data and Dashboard Layer, where they are stored in a cloud database and visualized through a live web-based dashboard developed using Python. Subsequently, the AI Engine Layer utilizes the Anthropic Claude API to analyze environmental conditions and generate crop suitability recommendations together with maintenance action plans.

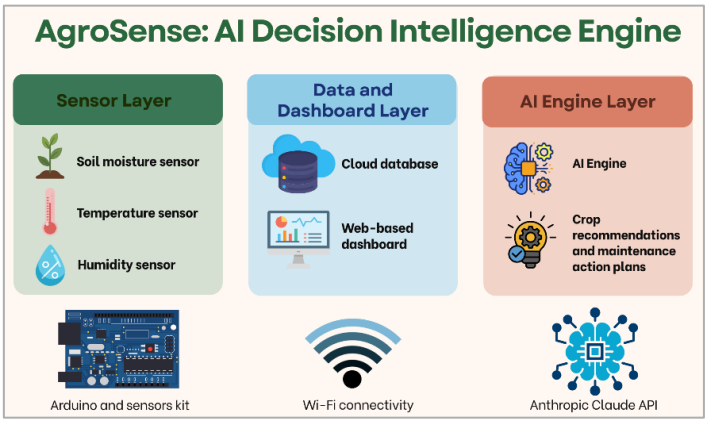


Figure 1: AgroSense architecture

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Arduino Uno R3	Microcontroller board	To acquire, process, and communicate sensor data
Soil Moisture Sensor	Capacitive analog soil moisture sensor	To monitor soil moisture levels in agricultural zones
DHT22 Sensor	Digital temperature and humidity sensor	To monitor environmental temperature and humidity
ESP32 Module	Wi-Fi-enabled microcontroller module	To transmit sensor data to the cloud dashboard
Cloud Database	Cloud-based storage platform	To store and retrieve real-time sensor data
Web Dashboard	Python-based monitoring dashboard	To visualize and monitor real-time agricultural data
Anthropic Claude API	Large language Model (LLM) based AI engine	To generate crop recommendations and maintenance action plans

This architecture enables continuous monitoring, centralized data management, and intelligent agricultural decision support. To validate the functionality and performance of the proposed system, prototype testing was conducted to evaluate multi-zone monitoring performance, continuous sensor data collection, real-time dashboard visualization, AI recommendation accuracy, and Wi-Fi communication stability.

6.0 CONCLUSION

AgroSense successfully demonstrates an affordable AI-powered precision agriculture system capable of monitoring multiple agricultural zones and generating intelligent crop and maintenance recommendations. The project contributes to Agriculture 4.0 initiatives by integrating IoT and AI technologies into a practical solution that supports data-driven agricultural decision-making. Although the current prototype successfully validates the concept, several limitations remain, including the absence of pH analysis, NPK analysis, and a comprehensive recommendation database. Future improvements may include the integration of additional sensors, crop disease detection, harvest prediction, and automated irrigation systems driven by AI-based decision-making. Overall, AgroSense represents a significant step toward the practical application of AI as an agricultural decision-support system. Through the integration of AI, IoT, and future-ready smart farming capabilities, AgroSense supports the vision of a resilient, sustainable, and technology-driven agricultural ecosystem.

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The authors gratefully acknowledge the support provided by City University Malaysia in terms of facilities, resources, and technical assistance throughout the development of AgroSense.The authors also wish to thank the lecturers and staff of the Centre for Foundation Studies for their continuous guidance and encouragement. Special appreciation is extended to Dr Musfirah Hilmi, Amandyk Iliyas, and Shomurodzoda Anushervoni for their valuable support during the development of this project. Sincere appreciation is extended to all project team members for their commitment and contributions, which played a significant role in the successful completion of this project.

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PROJECT ID: IN220

SOLAR-POWERED AGITATION-AIRFLOW DRUM FOR SAFE AND HIGH-QUALITY WHITE PEPPER PROCESSING

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ABSTRACT
White pepper (*Piper nigrum L.*) is a high-value agricultural commodity in Sarawak, contributing approximately 97% of Malaysia's total pepper production. Traditionally, river retting remains the preferred processing method for producing bright, premium-quality white pepper. However, safety concerns related to crocodile attacks, theft, contaminated water sources, and fluctuating river conditions have led farmers to adopt static drum soaking, which often yields lower-quality pepper due to inadequate water circulation. This study introduces a Solar-Powered Agitation-Airflow Drum designed to replicate river-like water movement within a controlled environment. The system integrates a solar energy module and a mechanical agitator to enhance pigment flushing and pericarp removal while reducing dependence on natural water bodies and grid electricity. The innovation was evaluated by comparing three processing methods, including river overflow retting, static drum soaking, and the proposed Agitation-Airflow Drum. White pepper quality was assessed in accordance with the requirements of Malaysian Standard MS2424:2014, including moisture content, light berries, extraneous matter, and black or dark berries. The processed samples were subsequently classified into commercial grades, including Standard Malaysian White Pepper No. 1 or Sarawak Special White. Preliminary findings indicate that the proposed system has the potential to improve processing consistency, enhance product quality, and provide a safer and more sustainable alternative for pepper smallholders.
Keywords: white pepper, solar energy, agitation drum, post-harvest technology

1.0 INTRODUCTION
Sarawak is the principal producer of pepper in Malaysia, contributing approximately 95-98% of the national production and serving as a major supplier to international markets (Allan et al., 2021; Entebang et al., 2020). The commercial value of white pepper depends heavily on compliance with Malaysian Standard MS2424: 2014, which specifies quality requirements and grading criteria for white pepper. White pepper is produced by retting, which removes the outer pericarp from fully ripe pepper berries. Traditional river retting remains the preferred method because continuous water movement promotes efficient pigment flushing and pericarp separation, resulting in brighter kernels and higher-quality products (Megat Ahmad Azman et al., 2021). However, farmers increasingly avoid river processing due to safety concerns related to crocodile attacks, theft of pepper bags, polluted water sources, and inconsistent river flow (Mazlan et al., 2020). As a result, many smallholders have adopted static drum soaking near their homes. Although this method offers greater safety and convenience, stagnant water conditions often lead to incomplete pigment removal, higher proportions of black or dark berries, bad aroma, and lower commercial grades (Aziz et al., 2021; Megat et al., 2020). Therefore, there is a need for an innovative processing system that combines the quality benefits of river retting with the safety, accessibility, and sustainability of enclosed drum processing.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To develop a Solar-Powered Agitation-Airflow Drum for white pepper processing.
b) To evaluate the effectiveness of the proposed system in improving white pepper quality according to the requirements of Malaysian Standard MS2424:2014.
c) To provide a safe, energy-efficient, and sustainable alternative to conventional river retting.

3.0 NOVELTY & INVENTIVENESS
The proposed innovation integrates renewable energy and controls hydrodynamic processing within a single enclosed system. Unlike conventional static drum soaking, the Solar-Powered Agitation-Airflow

Drum generates continuous water movement to replicate the beneficial effects of river retting while eliminating dependence on natural water bodies. Previous studies have demonstrated that water flow and agitation improve pigment flushing, pericarp detachment, and kernel whiteness during white pepper processing (Megat et al., 2020; Megat Ahmad Azman et al., 2021). Building on these findings, the innovation combines renewable energy and mechanical processing to address both quality and safety challenges faced by smallholder pepper farmers. Key Innovative Features:

a) Solar-powered operation: Utilizes photovoltaic energy to minimize reliance on grid electricity and reduce operating costs.
b) Mechanical agitation mechanism: Creates controlled water turbulence to improve pigment flushing and facilitate pericarp removal.
c) Protective mesh enclosure: Prevents direct contact between pepper berries and the agitation mechanism, ensuring uniform processing and minimizing kernel damage.
d) Enclosed and portable design: Enables safe processing near residential areas without exposure to river-related hazards.
e) Quality-oriented approach: Designed specifically to achieve premium white pepper grades defined under Malaysian Standard MS2424:2014.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	River Retting	Static Drum Soaking	Solar-Powered Agitation-Airflow Drum
Water movement	Natural flow	Stagnant	Controlled agitation
User safety	Low	High	High
Energy source	Natural flow	Manual	Solar energy
Processing consistency	Variable	Moderate	High
Accessibility	Limited by location	High	High
Expected product grade	High	Moderate	High

The integration of solar energy and the agitation mechanism within a portable drum system demonstrates strong potential for intellectual property protection and commercialization.

4.0 PRACTICALITY & USEFULNESS

The innovation is intended for pepper smallholders, cooperatives, processing centers, extension agencies, and rural communities in Sarawak. The system addresses the need for a safe and standardized white pepper processing method, particularly in areas with limited access to rivers or electricity (Mazlan et al., 2020). The use of solar energy reduces operating costs and supports environmentally sustainable agricultural practices. Furthermore, the enclosed system minimizes contamination risks and enables more consistent processing outcomes. The technology can be scaled to suit different production capacities and adapted for use in remote locations. The expected benefits include improved compliance with Malaysian Standard MS2024:2014, reduced dependence on river retting, enhanced worker safety, increased processing efficiency, and improved market competitiveness of Sarawak white pepper.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: The development of the innovation consisted of four stages:

a) Identification of limitations associated with existing white pepper processing methods.
b) Design and fabrication of the Solar-Powered Agitation-Airflow Drum prototype.
c) Experimental evaluation using three processing treatments and three replicates:
   i. T1: River overflow retting
   ii. T2: Static drum soaking
   iii. T3: Solar-Powered Agitation-Airflow Drum
d) Quality assessment and grading based on Standard Malaysian White Pepper No. 1 or Sarawak Special White.

Table 2: Key components and specifications

Component	Specification	Function
Solar panel	Monocrystalline photovoltaic module	Supplies renewable energy

Battery storage	Rechargeable deep-cycle battery	Stores electrical energy
Agitation unit	Low-speed electric motor with paddle system	Generates water circulation
Processing drum	Food-grade polyethylene drum	Retting container
Protective mesh enclosure	Corrosion-resistant wire mesh	Prevents direct contact between pepper berries and the agitation mechanism

Testing and Validation: Three independent replicates were conducted for each treatment using 1 kg batches of fully ripe berries. Following retting, the samples were washed, dried, and analyzed in accordance with the Standard Malaysian White Pepper No. 1 or Sarawak Special White. The four quality parameters evaluated were:

a) Moisture content (%)
b) Light berries (%)
c) Extraneous matter (%)
d) Black or dark berries (%)

Based on the measured values, the processed white pepper was classified into the corresponding commercial grades, including Standard Malaysian White Pepper No. 1 or Sarawak Special White.

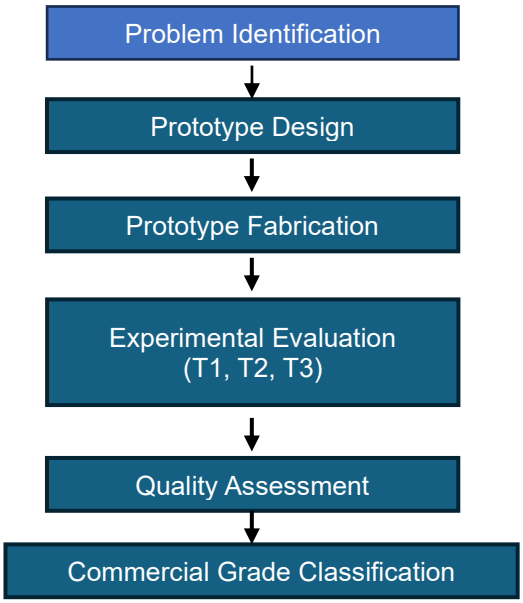


Figure 1: Development process flowchart

Results and Performance: Preliminary observations indicated that the Solar-Powered Agitation-Airflow Drum improved water circulation and promoted more uniform pericarp removal compared with static drum soaking. The integrated agitation mechanisms enhanced pigment flushing and reduced the occurrence of black or dark berries. Based on the quality assessment conducted, the proposed system demonstrated the potential to produce white pepper that meets the requirements for premium grades, including Standard Malaysian White Pepper No. 1 and Sarawak Special White. Technical Explanation: The Solar-Powered Agitation-Airflow Drum operates by converting solar energy into electrical power through a photovoltaic panel connected to a rechargeable battery and a controlled unit. The stored energy powers a low-speed electric motor that drives the agitation paddles, creating continuous water movement within the processing drum. The rotating agitation system creates continuous water movement, simulating the hydrodynamic conditions of river retting. This controlled turbulence enhances pigment diffusion, promotes efficient pericarp detachment, and improves the uniformity of white pepper processing. A protective mesh enclosure surrounds the agitation mechanism to prevent direct contact between the moving components and pepper berries, reducing the risk of kernel damage while ensuring consistent circulation throughout the drum. This integrated system provides a safe, enclosed, and energy-efficient alternative to conventional river retting.

6.0 CONCLUSION

The Solar-Powered Agitation-Airflow Drum offers an innovative solution to the quality and safety challenges associated with conventional white pepper processing methods. By integrating renewable energy with controlled agitation, the system successfully replicates the advantages of river retting in a safe, enclosed environment. The innovation has strong potential to improve compliance with the Standard Malaysian White Pepper No. 1 or Sarawak Special White, and to increase the production of premium-grade white pepper. Furthermore, the system supports sustainable agricultural practices by reducing dependence on river resources and minimizing energy consumption. Future work should focus on large-scale field validation, optimization of operating parameters, cost-benefit analysis, and commercialization to facilitate wider adoption among pepper smallholders.

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We gratefully acknowledge the Faculty of Agrotechnology and Applied Sciences at i-CATS University College for providing facilities and technical support. We also thank the project supervisor for guidance throughout the development of this innovation.

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PROJECT ID: IN223

HOME-MADE LIQUID DETERGENT FROM SEVERAL VARIETIES OF PINEAPPLE WASTE FOR ECO-FRIENDLY HOUSEHOLD PRODUCTS

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ABSTRACT
Large quantities of pineapple peel waste are generated from household consumption and fruit-processing activities in Malaysia, contributing to environmental pollution and the underutilization of valuable biomass resources. Simultaneously, conventional laundry detergents rely heavily on synthetic surfactants and chemical additives that may adversely affect aquatic ecosystems and human health. This study developed an eco-friendly liquid detergent using fermented pineapple peel extracts from four pineapple varieties, such as MD2, Moris, Josapine, and N36. Pineapple peel eco-enzyme was produced through a three-month fermentation process using a 3:1:10 ratio of peel, brown sugar, and distilled water. The fermented extract was combined with soapnut extract, a natural surfactant, to formulate the detergent. Physiochemical properties, including pH, viscosity, foamability, and stability, were evaluated using a Complete Randomized Design (CRD) with three independent replicates. Results indicated variation in viscosity among pineapple varieties, ranging from 0.89 to 1.48 cP. The highest viscosity was recorded in the Moris formulation (1.48 cP), followed by MD2 (1.32 cP), while Josapine exhibited the most consistent viscosity values (1.05-1.29 cP). Significant differences in pH were observed among the pineapple varieties ($F = 6.68$, $p < 0.001$), which mean pH values ranging from 2.85±0.23 to 2.99±0.16. MD2 exhibited the lowest mean pH, indicating greater acid production during fermentation, whereas Josapine recorded the highest mean pH. These findings demonstrate that pineapple peel waste can be transformed into a sustainable, biodegradable, and value-added household cleaning product, supporting circular economy initiatives and agricultural waste valorization.
Keywords: pineapple peel, eco-enzyme, liquid detergent, waste volatilization

1.0 INTRODUCTION
Pineapple (*Ananas comosus*) processing generates substantial quantities of organic waste, with peels accounting for approximately 30-50% of the total fruit mass (Hamzah et al., 2021). In Malaysia, pineapple peel waste is commonly discarded despite containing valuable bioactive compounds, such as bromelain, organic acids, natural sugars, and phenolic compounds, which possess cleaning and antimicrobial properties (Fissore et al., 2023). Concurrently, the widespread use of commercial laundry detergents containing synthetic surfactants and chemical additives contributes to water pollution, environmental degradation, and potential skin irritation. Previous studies have demonstrated the effectiveness of fruit-waste-derived eco-enzymes as natural cleaning agents (Ruhimat et al., 2025; Rusdianasari et al., 2021). However, limited research has examined the use of pineapple peel waste as a laundry detergent, particularly the influence of different pineapple varieties on detergent performance. Therefore, this study addresses this research gap by developing and evaluating liquid detergents formulated from four pineapple varieties, such as MD2, Moris, Josapine, and N36.

2.0 OBJECTIVE
The main objectives of this project are:
a. The laundry detergent using pineapple peel waste from MD2, Moris, Josapine, and N36.
b. To determine the physicochemical properties of the formulated detergents, including pH and viscosity.
c. To identify the most suitable pineapple variety for the development of an eco-friendly detergent.

3.0 NOVELTY & INVENTIVENESS
This innovation integrates fermented pineapple peel eco-enzyme with soapnut extracts as a natural surfactant, replacing synthetic surfactants commonly used in commercial detergents. Unlike existing eco-enzyme studies that focus on general cleaning applications, this study comparatively evaluated four Malaysian pineapple varieties to determine their influence on detergent characteristics.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Raw material	Synthetic surfactants and chemical additives	Pineapple peel waste and soapnut extract
Environmental impact	Potential water pollution and low biodegradability.	Biodegradable and waste-reducing formulation
Variety evaluation	Limited assessment of pineapple cultivars	Comparative evaluation of four pineapple varieties
Sustainability	Dependence on non-renewable resources.	Agricultural waste valorization and circular economy approach

4.0 PRACTICALITY & USEFULNESS

The developed detergent offers an environmentally friendly alternative for household laundry applications while reducing pineapple waste disposal. The formulation utilizes locally available materials and simple fermentation techniques, enabling adoption by households, community enterprises, and small-scale manufacturers. Furthermore, converting agricultural waste into value-added cleaning products supports sustainable consumption practices and contributes to achieving circular economy goals.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Pineapple peels from MD2, Moris, Josapine, and N36 varieties were washed, cut into small pieces, and fermented separately using a 3:1:10 ratio of pineapple peel, brown sugar, and distilled water for three months. The fermented eco-enzyme extract was filtered and formulated into a liquid detergent by combining pineapple peel extract, soapnut extract, distilled water, sodium chloride, and essential oil. A Complete Randomized Design comprising four treatments with three independent replicates was employed. The pH was measured with a digital pH meter, and viscosity was determined with a viscometer.

Table 2: Physicochemical properties of pineapple peel liquid detergents

Variety	Mean pH ± SD	Mean viscosity ± SD (cP)
MD2	2.85 ± 0.23	1.14 ± 0.22
Moris	2.88 ± 0.20	1.26 ± 0.19
Josapine	2.99 ± 0.16	1.21 ± 0.14
N36	2.88 ± 0.15	1.09 ± 0.18

Significant differences in pH were observed among treatments ($F = 6.68$, $p < 0.001$), indicating that the pineapple variety influenced fermentation-derived acidity. MD2 exhibited the lowest pH values, suggesting enhanced acid production during fermentation. The Moris formulation had the highest viscosity, whereas N36 had the lowest.

6.0 CONCLUSION

This study demonstrates the potential of pineapple peel waste as a sustainable raw material for producing eco-friendly liquid detergent. The formulated detergents exhibited acidic pH values and acceptable viscosity characteristics suitable for household cleaning applications. Significant differences in pH among pineapple varieties indicate that cultivar selection influences fermentation efficiency and detergent properties. Among the tested varieties, MD2 showed the greatest acidification potential, while Moris produced the highest viscosity. The integration of pineapple peel eco-enzyme with soapnut extract offers an innovative, biodegradable, and low-cost alternative to conventional detergents. Future studies should investigate cleaning efficiency, antimicrobial activity, storage stability, and consumer acceptance to support product optimization and commercialization.

ACKNOWLEDGMENTS

We gratefully acknowledge the Faculty of Agrotechnology and Applied Sciences at i-CATS University College for providing facilities and technical support. We also thank the project supervisor for guidance throughout the development of this innovation.

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PROJECT ID: IN237

GAMA-CAYA

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ABSTRACT
'Gama-Caya' is an innovative digital learning platform developed to enhance Year 6 students' understanding of religious diversity and places of worship in Malaysia. It addresses challenges in identifying religions and associating them with their respective places of worship, which often require visual and contextual understanding. To overcome this issue, Gama-Caya incorporates multimedia elements, audio narration, gamification, Google Maps integration, and 360-degree virtual exploration to provide an engaging and interactive learning experience. The platform is available in both Malay and Chinese to accommodate learners from diverse linguistic backgrounds, while supplementary flashcards support those with limited digital access. The innovation was evaluated through classroom implementation involving 71 students from different schools in Malaysia using pre-test and post-test assessments. Findings indicated improvements in students' understanding, retention, and ability to associate religions with their places of worship, accompanied by higher engagement during learning activities. Overall, Gama-Caya demonstrates strong potential as a scalable educational innovation that promotes cultural awareness, strengthens historical understanding, and supports 21st-century learning.
Keywords: Religious Diversity, Digital Learning, Gamification, History Education Year 6

1.0 INTRODUCTION
Religious diversity is an important aspect of Malaysia's multicultural society and is included in the Year 6 History curriculum. Students are required to identify various religions and their corresponding places of worship in Malaysia. However, some students experience difficulties in understanding and retaining this factual content. To address this challenge, Gama-Caya was developed as a bilingual digital learning platform that integrates multimedia, gamification, virtual exploration and supplementary flashcards. This innovation aims to enhance students' understanding, engagement, and appreciation of religious diversity through interactive and meaningful learning experiences.

2.0 OBJECTIVE
The main objectives of this innovation are:
a. To enhance Year 6 students' understanding of the religions and beliefs practised in Malaysian society.
b. To improve Year 6 students' ability to identify and associate places of worship with their respective religions in Malaysia.

3.0 NOVELTY & INVENTIVENESS
Gama-Caya introduces a holistic learning approach that combines bilingual accessibility, experiential learning, and interactive engagement within a single platform. The innovation enables students to explore religious diversity through authentic virtual experiences rather than relying solely on textual information. By integrating digital and physical learning resources, Gama-Caya accommodates diverse learning needs and promotes greater learner autonomy. This unique combination enhances the relevance, accessibility, and effectiveness of History learning. A copyright application for the innovation is currently pending with the relevant authority.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Language Support	Usually single language	Bilingual (BM & Chinese)
Learning Method	Text-based learning	Multimedia and gamification
Visualisation	Static images	Google Maps & 360° exploration

4.0 PRACTICALITY & USEFULNESS

Gama-Caya is designed for practical implementation in schools and can be accessed using commonly available digital devices. The innovation supports classroom instruction, self-directed learning, and enrichment activities, benefiting both Year 6 students and History teachers. Its low development cost, supported by largely free digital tools, makes it affordable for wider adoption. The inclusion of supplementary flashcards ensures accessibility for learners with limited device access, while its adaptable design allows implementation across different educational settings.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Gama-Caya was developed through five phases: needs analysis, content design, platform development, implementation, and evaluation. The platform integrates bilingual learning content, Google Maps, 360° virtual exploration, gamified quizzes and supplementary flashcards. Its effectiveness was evaluated through pre-test and post-test assessments involving 71 students from different schools in Malaysia.

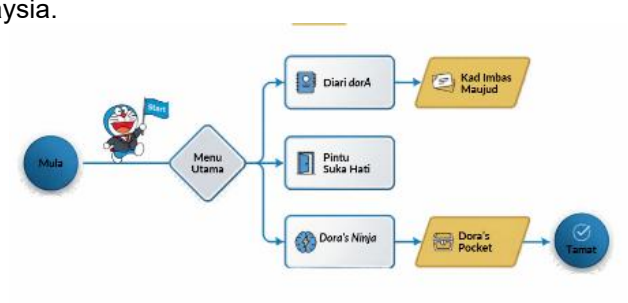


Figure 1: Development process flowchart

Component/Material	Specification	Purpose
Diari dorA	Bilingual learning module	Content delivery
Pintu Suka Hati	Google Maps & 360° View	Virtual exploration
Dora's Ninja	Interactive quizzes	Assessment & gamification
Flashcard	Physical flashcards	Revision support

Table 2: Key components and specifications

6.0 CONCLUSION

Gama-Caya successfully enhances students' understanding of religious diversity and places of worship in Malaysia through an interactive bilingual learning platform that combines multimedia, gamification, virtual exploration, and supplementary flashcards. The innovation benefits both students and teachers by promoting engaging and meaningful History learning. Although internet connectivity and device availability may affect implementation, the use of physical flashcards helps improve accessibility. Future enhancements include expanding the platform to additional History topics and interactive features. Overall, Gama-Caya demonstrates strong potential as a scalable educational innovation that supports 21st-century learning and aligns with the i-NEXTECH 2026 theme, *"Bridging Ideas and Technology for a Resilient Future."*

ACKNOWLEDGMENTS

The authors would like to express their sincere appreciation to Institut Pendidikan Guru Kampus Rajang for providing financial support, facilities and guidance throughout the development of Gama-Caya. Special thanks are extended to our supervisor, Wong Mee Leng, for her valuable advice, constructive feedback and continuous encouragement. We also acknowledge the participating schools, teachers and students for their cooperation and contribution during the implementation and evaluation of this innovation. Their support was instrumental in the successful completion of this project.

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PROJECT ID: IN240

DEVELOPMENT OF AN INVENTORY AND MAPPING SYSTEM FOR OIL PALM FRESH FRUIT BUNCH

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ABSTRACT
The oil palm industry plays an important role in Malaysia's economy, contributing significantly to national income and employment. However, challenges such as oil palm fruit theft can reduce profitability, particularly for smallholders and plantations. This project aims to develop an inventory system for oil palm fresh fruit bunches using a GIS interactive web map that functions for smallholders and big companies and to evaluate the usability of an inventory system for oil palm fresh fruit bunches. This project implements the ADDIE model, which consists of five phases including analysis, design, development, implementation, and evaluation. The total population for this study was 25 respondents, including all administration staff at Felcra Serigala Berhad. The system provides features such as an oil palm yield calculator, online map, inventory system, and organization information. An evaluation using the computer system usability questionnaire (CSUQ) indicated a high satisfaction rate among users, demonstrating the system's effectiveness in improving traceability and decision-making for plantation management. Based on the project, total mean was recorded as 4.54, meaning the system was user-friendly and easy to understand. The implementation of this system presents a scalable solution for enhancing oil palm plantation efficiency and sustainability.
Keywords: fruit theft, mapping, inventory system, GIS interactive web map

1.0 INTRODUCTION
The oil palm industry is a vital economic driver in Malaysia, contributing between 5% to 7% to the national Gross Domestic Product (GDP) with an average annual export revenue of RM 64.24 billion over the past five years. Despite its immense contribution to national income and employment, the industry faces severe challenges with oil palm fruit theft. Recently, a viral theft incident as reported by Ramli (2026) and Ismail (2026) caused widespread anxiety among local smallholders. Although the suspects were successfully apprehended using closed-circuit television (CCTV) footage, this highlights the urgent need for a more comprehensive and proactive spatial monitoring system. Thieves specifically target mature fruit bunches that remain on the trees after harvesting, which causes significant financial losses for plantation owners and smallholders. A staggering 85% to 90% of these thefts are conducted by organized criminal gangs commonly referred to as the "oil palm mafia," while minor cases account for 10% to 15%.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop an inventory system for oil palm fresh fruit bunches utilizing a GIS interactive web map that functions efficiently for both smallholders and large companies.
b. To evaluate the usability and effectiveness of the developed inventory system among target users.

3.0 NOVELTY & INVENTIVENESS
The uniqueness of this innovation lies in the integration of an inventory management system with a real-time Geographic Information System (GIS) interactive web map, specifically tailored for oil palm fresh fruit bunches (FFB). Unlike conventional manual logging methods, this system utilizes a live world map to project the actual plantation layout, allowing for precise spatial monitoring of unharvested mature bunches to mitigate organized theft. The system integrates interactive mapping tools such as Mapbox to enable real-time monitoring and optimized yield prediction. The system also consists of a yield calculator that functions to help managers calculate the average yield that can be obtained per hectare. Furthermore, the system has list of inventories of oil palm that contains information that was recorded during the site visit session.

4.0 PRACTICALITY & USEFULNESS

Implementing this inventory system significantly enhances data accuracy and the traceability of oil palm fresh fruit bunches. It enables real-time monitoring and reporting, acting as a reliable record to predict average expected yields. A key practical feature is the yield calculator, which assists managers and smallholders in calculating the average yield per hectare. The system also maintains a detailed inventory list recorded during site visits. Based on the usability evaluation, the system achieved a high satisfaction rate with a total mean score of 4.54, indicating that it is highly user-friendly and easy to understand. Furthermore, this innovation aligns with sustainable development goals, specifically supporting SDG 4, SDG 9, and SDG 11.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

This project was developed using the ADDIE model, which consists of five phases: Analysis, Design, Development, Implementation, and Evaluation. The study population involved 25 respondents, comprising the administration staff at Felcra Serigala Berhad. To assess user satisfaction and the system's overall effectiveness, the evaluation phase utilized the Computer System Usability Questionnaire (CSUQ).

6.0 CONCLUSION

This system could enhance data accuracy and traceability of oil palm fresh fruit bunches. It ensures real-time monitoring and reporting, providing a reliable record to identify the average expected amount of fresh fruit bunch that oil palm can produce. This project supports SDG 4, SDG 9, and SDG 11, which align with the theme "Bridging Ideas and Technology for a Resilient Future".

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EXTENDED ABSTRACT

Category B2 (Higher Education Young Inventor-Individual)

PROJECT ID: IN34

EMES

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ABSTRACT
The world produces approximately 2.24 billion tons of solid waste annually, with 33% not properly managed and 50% of household waste consists of recyclable waste. While recycling is essential for sustainability, waste segregation ensures recycling efforts are effective. We aimed to create a segregation system using the electrostatic field and electromagnetic field in one machine with an AI (artificial intelligence) system for automation to distribute the waste for segregation. It was powered by solar energy. Data was collected to investigate efficiency of EMES versus manual segregation and to investigate the quality of segregation in EMES. We found EMES segregation system has a fixed time of 80s for segregation of the waste materials in all 10 trials. EMES is 100 % consistent (no variability). In Manual Segregation, time varies across trials (ranging from 250 to 600 seconds) with a mean time of 361.8s and 4.4x longer than EMES with $p < 0.001$. The quality of segregation was significantly better for metal waste by electromagnetic field as compared to non-metal waste using electrostatic field ($p < 0.05$). The electromagnetic field had lower contamination (20% vs. 50%). The EMES segregation system was faster and more efficient, while Electromagnetic Field produced high-quality segregation. This precision is significantly important in industrial waste segregation settings.
Keywords: Recyclable, Non-recyclable, Electrostatic, Electromagnetic

1.0 INTRODUCTION
Background: The world produces approximately 2.24 billion tons of municipal solid waste annually, with at least 33% not properly managed. About 50% of household waste consists of recyclable materials like paper, biodegradable waste, and metals. While recycling is essential for sustainability, waste segregation is the foundation that ensures recycling efforts are effective. Without proper segregation, recyclables can become contaminated, making them unusable and reducing the efficiency of recycling facilities.

2.0 OBJECTIVES
The main objectives of this innovation/project are:
a. To create a segregation system using the electrostatic field and electromagnetic field in one machine
b. Automation of the distribution of waste to three segregation compartment using AI (artificial intelligence) via Arduino coding.
c. Using solar energy to provide electricity power supply
d. To investigate efficiency of EMES segregation system versus manual segregation
e. To investigate the quality of segregation in EMES segregation system

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: Solid recycle-able wastes are often mixed. A proper waste segregation step is important prior to any recycling process. EMES offers solutions to the segregation of these waste materials in one single machine using electromagnetic fields and electrostatic fields. Key Innovative Features: The electrostatic field (ESF) is generated using the principle of Van de Graaff generator while electromagnetic field (EMF) is generated using electric current running through copper wire coil around an iron rod. Comparison with Existing Solutions. Existing methods were mainly manual segregations which leads to poor efficiency and longer segregation time and higher contamination rate. We also conducted a study to compare EMES and manual segregation. Intellectual Property Potential: Once EMES is filed for the potential for patents, copyrights, or other forms of intellectual property protection, it can generate sufficient revenue from the sales of the device while the algorithms used in its segregation is another unique patent by itself.

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: As EMES are small and portable, it is expected to be useful for household and small-scale companies or institutions such as school, colleges or universities. A large-scale segregation using the patented EMES algorithm is feasible for industrial waste management facilities. Target Users/Beneficiaries: target users range from small households to large scale waste management facilities. Feasibility and Implementation: Technical Feasibility was demonstrated by the prototype EMES which was built for proof of concept. Economic Viability: Given the low cost in constructing EMES, it was deemed viable for economic viability. Scalability: The segregation concept and algorithm used were designed for both small- and large-scale segregation. Sustainability: EMES is built based on green technology with long-term viability and environmental impact. Expected Impact: With more efficient segregation and ease to use, EMES can significantly impact the public interest in recycling solid waste and therefore create a positive environmental and nature impacts.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The electrostatic field (ESF) is generated using the principle of Van de Graaff generator while electromagnetic field (EMF) is generated using electric current running through copper wire coil around an iron rod. The first waste segregation is performed using electrostatic (ESF) field to segregate non-metal waste such as hair and plastic and channeled and collected at the EMS compartment. The second waste segregation process is performed using electromagnetic field (EMF) whereby metal waste is attracted to it. Metal waste is later channeled and collected at the EMF compartment. After the initial two segregation processes by the EMS and EMF, the rest of the waste (such as paper) is channeled to the third compartment. Artifical intelligence (AI) is used for automation. Two main automation processes are built for the EMES segregation bin. First automation is meant for detection of a human approach by its ultrasonic sensor and to open its cover for accepting waste. At the same time, it also initiates electricity power for the generators for the electrostatic field and electromagnet field. Second automation is meant for detection of waste in its collector using its ultrasonic sensor and activates 3 motors in sequence. First motor is to pull the collector to the electrostatic field, and a delay of 20 seconds is programmed to allow the electrostatic field to segregate the waste material. After 20 seconds, the second motor is activated and pulls the collector to the side of the electromagnetic field. Again, a 20 second is programmed to allow the electromagnetic field to segregate the metal material. After that, the third motor is activated to tilt the collector backward to drop the rest of the waste into the third compartment. Data was collected for analysis for comparison for time to segregate recyclable from non-recyclable waste materials between EMES and manual segregation methods. Comparison was also made on the quality of waste segregation. These data were later analyzed using student paired T test and Fisher's Exact Test. Combining the time efficiency and quality of segregation data allows us to evaluate the trade-offs between speed and accuracy for the two methods (Electromagnetic vs. Electrostatic). *Results:* EMES segregation system has a fixed time of 80s in segregation the recycle waste materials (metal and non-metal) from the non-recycle waste materials (human hairs) in all 10 trials. EMES is 100% consistent (no variability). In Manual Segregation, time varies across trials (ranging from 250 to 600 seconds). Manual has high variability (SD ≈ 117.6) and is slower on average (4.4x longer than EMES). EMES is significantly faster with $p < 0.001$ (Mann-Whitney U test). Manual segregation of similar waste materials conducted for 10 samples took a mean time of 361.8s ($p < 0.001$). Quality of segregation material was significant better for metal recycle materials by electromagnetic field as compared to non-metal segregation using electrostatic field (Fisher's Exact test, $p < 0.05$). Electromagnetic Field has lower contamination (20% vs. 50%). Electrostatic Field is 2.5x more likely to have contamination. In Point-Biserial Correlation analysis, for Electrostatic Field (the only variable group with time variability), correlation is weak for electrostatic field between contamination rate and time spent ($r \approx 0.1$, $p > 0.05$). Contamination is not directly explained by time spent in electrostatic segregation.

$$\text{Efficiency Score} = \frac{\text{Speed (1/time)}}{\text{Contamination rate}}$$

Table 1: Efficiency score

	Efficiency Score
Electromagnetic Field	(1/80) / 0.20 = 0.00625
Electrostatic Field	(1/351.8) / 0.50 ≈ 0.00057

When compared to electrostatic field segregation, the electromagnetic field segregation was 11x more efficient.

6.0 CONCLUSION

EMES segregation system is faster and more efficient than manual segregation while Electromagnetic Field produced high-quality segregation.

ACKNOWLEDGMENTS

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REFERENCES

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PROJECT ID: IN70

TRUSCOPE: DEVELOPMENT OF REAL TIME CREDIBILITY SCOREINDICATOR FOR ONLINE CONTENT

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ABSTRACT
The rapid growth of social media and web-based information has increased user exposure to fake news, manipulated images, AI-generated visuals, clickbait headlines, and misleading online claims. Existing verification tools are often manual, reactive, or separated from the browsing process, making users less likely to check content before trusting or sharing it. TruScope proposes a real-time credibility score indicator that analyses online text, images, URLs, and multimodal content through a privacy-preserving desktop prototype connected to a localhost backend. The system uses text credibility analysis, image forensics, multimodal consistency checking, evidence retrieval, and LLM- assisted structured evidence interpretation to generate a 0-100 credibility score with risk indicators and explainable reports. Prototype testing confirmed successful operation across text-only, image-only, multimodal, and URL-based scans, with explainable outputs generated through a privacy-preserving localhost backend. Survey findings from 50 respondents further supported the design: 56% preferred automatic background checking, 70% selected AI-image/deepfake detection as the most valuable feature, and 96% showed positive installation intention. TruScope improves digital literacy, reduces verification friction, and helps users make safer online decisions.
Keywords: misinformation detection, credibility scoring, multimodal AI, explainable AI, digital literacy

1.0 INTRODUCTION
Online users increasingly receive news through fast-moving feeds where misleading text, edited images, and AI-generated visuals can spread before verification. Current tools often require manual search, upload, or platform intervention. TruScope addresses this gap by providing a real-time credibility indicator that analyses visible online content and returns a clear score, risk level, and explanation without leaving the browsing workflow. This supports students, educators, social media users, and digital communities in improving digital literacy and reducing misinformation sharing.

2.0 OBJECTIVES
The objectives are:
a. To develop a working desktop prototype capable of analysing text, image, URL, and multimodal online content.
b. To generate a measurable 0-100 credibility score supported by explainable risk indicators and evidence reports. (3) To validate the prototype using representative online content samples and assess functionality, response behaviour, usability, and alignment with user needs.

3.0 NOVELTY & INVENTIVENESS
TruScope combines real-time credibility scoring, local-first processing, multimodal text-image analysis, explainable overlays, and optional web-assisted verification in one desktop workflow. The software architecture, scoring workflow, report-generation interface, and explainable overlay design may be protected through copyright and software-related intellectual property documentation. Patentability would require further prior-art assessment.

Table 1: Comparison between existing solutions and proposed innovation

TruScope Innovation	Existing Solutions	Aspect
Real-time scan + deep check	Manual/upload/delayed label	Verification mode
Text, image, URL, multimodal	Domain or single modality	Data modality
Localhost, local-first	Cloud/platform-dependent	Privacy
100-0score, risk, report	Binary/source rating	Output
Evidence report + overlay	Limited	Explainability
Background checking	Limited	Real-time support

4.0 PRACTICALITY & USEFULNESS

TruScope can be used for social posts, news articles, educational content, product claims, and image-heavy online information. Target users include students, educators, journalists, social media users, and institutions promoting digital literacy. In functional testing, the prototype completed four scan modes: text-only, image-only, multimodal, and URL-based scans. Each mode produced a credibility score, risk interpretation, report output, and saved scan history. Survey results showed practical relevance %56: preferred automatic background checking, 70% prioritized AI-image/deepfake detection, and 96% indicated positive installation intention.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The project used design science and prototype development: problem identification -> requirements -> architecture -> prototype -> AI analysis/fusion -> testing -> refinement.

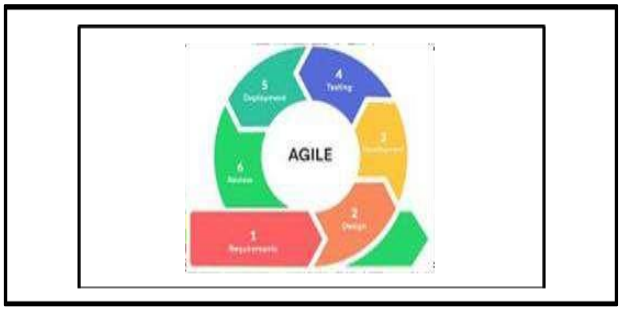


Figure 1: Development process flowchart

The system uses an Electron desktop interface connected to a Flask backend running on 127.0.0.1. The backend performs OCR, text credibility analysis, image forensic checks, multimodal fusion, optional evidence retrieval, coaching, and SQLite history storage. Testing focused on scan-mode completion, output correctness, report generation, cache/history behaviour, and usability of credibility feedback.

Table 2: Compact technical and validation summary

Purpose	Specification / Validation	Area
User interaction	Electron UI: dashboard, overlay, report, history, settings	Frontend
Local analysis	Flask localhost API, OCR, scoring, SQLite	Backend
Prototype check	4modes completed: text, image, multimodal, URL	Validation

6.0 CONCLUSION

TruScope demonstrates a practical real-time credibility indicator that converts text, image, URL, and multimodal evidence into a clear 0-100 score with explainable feedback. It addresses slow manual verification through background checking, local-first processing, and user-friendly reports. Its contributions are real-time credibility awareness, multimodal misinformation detection, and explainable support for safer online decision-making. Limitations include prototype-level accuracy, OCR/image quality, hardware performance, and limited video/audio analysis. Future work should expand benchmark testing, multimedia verification, privacy controls, and user studies. TruScope supports the i-NEXTECH 2026 theme by bridging ideas and technology for a resilient digital information environment.

ACKNOWLEDGMENTS

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PROJECT ID: IN7

AUTOMATIC ALTERNATING DRIP IRRIGATION CONTROL SYSTEM FOR DIFFERENT AGRICULTURE PLOT

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ABSTRACT
Manual irrigation in farming often leads to water waste and labour inefficiency. An automated alternating drip irrigation system is designed to optimize water management for two agricultural plots using a single pump. The controlled system used Arduino Uno microcontroller with the integration of capacitive soil moisture sensors and solenoid valves to deliver water based on real time soil requirement. A sequential irrigation strategy used to manage hydraulic pressure by watering only one plot at a time, eliminating the need for expensive high power or auxiliary pumps. This system offers a cost-effective solution for smallholder farmers to prevent nutrient leaching by applying excessive water to the soil and reduce water consumption. This study advances precision agriculture by providing a sustainable, scalable model.

1.0 INTRODUCTION
In normal practice, one pump with specific horsepower will be used to cover one plot as the water requirement and size of agricultural plot will determine the number of emitters needed. If the pump cannot provide the operating water pressure and flow rate, the option is always to increase the pump horsepower or by adding auxiliary pump or by limiting the number of operating emitters via control valve/stopcock. For a small-scale farm, adding pump will increase the operating cost as extra pump will need extra energy whether in form of electricity or fuel and increase maintenance costs.
The most viable option for small farms is always by controlling the emitter number via control valve. However, the use of control valve will require manual operation of shutting it off or on. This practice sometimes will cause confusion to the operator or can cause the some of the plot will not be irrigated if there are miscommunication between operators. To combat this problem, an automatic alternating drip irrigation for different agricultural plot is developed where the alternating irrigation timing will be made automatically based on moisture content of the media by using control system.

2.0 OBJECTIVES
The main objectives of this project are:
a. To reduce human error - prevent overwatering or underwatering of crops.
b. To provide a simple, affordable, and user-friendly solution for small scale farms.
c. To reduce the cost of irrigation by reducing the number of pumps needed to irrigate whole agriculture plots.

3.0 NOVELTY & INVENTIVENESS
Financial limitations are a challenge in a small-scale farm where one of the important parts in agriculture is an irrigation system and to set up this system requires a lot of capital. Pump capacity is an important factor as if there is not enough pressure to be provided by the pump, the emitter will fail to function. The most common method of increasing pressure systems is by using auxiliary pump or increasing the pump power, both methods require more expenditure in terms of electrical energy consumption and maintenance cost. The other common method is by limiting the working emitter by alternating the water flow via control valve. This method is proven to be effective for making the irrigation system function with minimal pressure, but the downside of this method is it is prone to human error as manual operation could lead to operator confusion, miscommunication between operators and this can lead to inconsistent irrigation timing that can cause lower yield. This problem highlighted several issues that is financial strain that are associated with upgrading the irrigation system hardware for small farmers, the inefficiency of manual control that are low in efficiency where in modern farming where the demand for precision agriculture application is high and the risk of over or under irrigation caused by the inability to monitor and act in real time conditions.

4.0 PRACTICALITY & USEFULNESS

This project has many benefits:

a. Reduce water usage by applying precise amount of water needed to the crops.
b. Prevent overwatering or underwatering the plant by using soil moisture sensor for automatic irrigation.
c. Reduce the cost to set up the irrigation system on field as only one pump is needed to cover the whole plot.

This project supports 3 SDG:

a. SDG 2 – Zero hunger
   By optimizing water usage, more crops can be planted that will directly contribute to increasing in food production.
b. SDG 13 – Climate action
   The system reduces the need for energy as the system will remove the need of multiple pumps to cover whole agriculture plot and this can indirectly reduce the carbon footprint in energy consumption.
c. SDG 15 – Life on land
   Sustainable agriculture practices can be achieved by using this system as it optimizes water usage, reduces energy consumption and produces more food that overall can increase the quality of life.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system integrates Arduino Uno as microcontroller with the capacitive soil moisture sensor. Sensor is used to read the moisture content, and the system will automatically switch on and off by using relay as it will act as the switch for the system load. This system integrates electronics with electro-mechanical components. The electro- mechanical component for this system is made of solenoid valve and submersible water pump. Both components will be installed together with the irrigation system as both components are parts that move and control the hydraulic flow. Sensors will send signals based on real time to the microcontroller where the system will operate based on the threshold that had been set. If the sensor detects the soil is dry, it will trigger the irrigation system on and vice versa. The system will run sequentially where only one plot will be irrigated at a time where if there are two plots the need to be irrigated for example, the system will irrigate the first plot first and when the wet threshold is achieved, plot two will be irrigated automatically.

6.0 CONCLUSION

In conclusion, this project successfully demonstrated that an automated alternating drip irrigation system using an Arduino Uno effectively optimizes water management for small-scale plots. The system achieved its objectives by reducing human error and lowering operational costs through a sequential irrigation strategy that utilizes only one pump to serve multiple areas. This project contributes significantly to precision agriculture by providing a sustainable, affordable model that aligns with Sustainable Development Goals regarding zero hunger, climate action and life on land.

ACKNOWLEDGMENTS

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REFERENCES

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PROJECT ID: IN106

OUTPAY - OFFLINE E-WALLET ECOSYSTEM FOR DISCONNECTED ENVIRONMENTS

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ABSTRACT
As the global transition towards a cashless society accelerates, existing e-wallets remain severely constrained by their dependency on active internet access and centralized servers. This limitation significantly affects those who are in dead zones, such as rural areas, mall basements, natural disaster situations, or unexpected network outages. To resolve this critical vulnerability, this project introduces OutPay, a mobile application that offers an offline-first e-wallet ecosystem. OutPay operates on a hybrid localized communication method that utilizes Google Nearby Connections to establish peer-to-peer (P2P) connections. Transaction Integrity is guaranteed entirely offline via Edge-Based Cryptographic Authentication, which uses asymmetric digital authentication within the Trusted Execution Environment (TEE) in the device's processor. Furthermore, an asynchronous dual-database architecture, reflecting a hybrid data management strategy, securely records offline transactions into the local device's database before automatically synchronizing with the main server cloud database once network access is restored. This project demonstrates that OutPay successfully executes secure offline fund transfers without requiring cloud server intervention. To conclude, by eliminating network dependency, OutPay guarantees uninterrupted digital commerce, provides a scalable emergency payment infrastructure, supports the cashless society aspiration, and bridges the digital divide to empower disconnected communities.
Keywords: Offline e-Wallet, Offline Money Transfer, Peer-to-Peer (P2P), Edge-Based Cryptographic Authentication, Asynchronous Dual-Database

1.0 INTRODUCTION
Consider a common scenario where a traveler running low on fuel in a remote area with neither cash nor internet access to operate an e-wallet. Despite Malaysia's rapid shift toward a digital society, such network dead zones expose a critical flaw in current payment systems, which fail completely without an active connection. To solve this, OutPay offers an offline cashless solution. Rather than solely expanding internet access, OutPay reduces our dependency on it. This innovation is an early step toward global offline connectivity, with the potential to revolutionize both financial and information technology.

2.0 OBJECTIVES
The objectives are:
1. To enable users to complete offline peer-to-peer cashless transfers within 5 seconds per transaction during the prototype testing phase.
2. To ensure the security of offline payment data by implementing edge-based encryption, ensuring zero unauthorized data breaches throughout the prototype testing phase.
3. To establish seamless synchronization that records to the central database within 30 seconds once internet connectivity is restored.

3.0 NOVELTY & INVENTIVENESS
OutPay stands out by transforming traditional payment methods into an offline-first e-wallet ecosystem. Its innovative features include utilizing Google Nearby Connections for localized and high throughput peer-to-peer communication [1], [2], securing transactions with Edge-Based Cryptographic Authentication within the device's hardware isolated Trusted Execution Environment (TEE) [3], and the asynchronous dual-database for automatic server synchronization once the internet is restored. Unlike existing e-wallets that fail without an active internet connection, OutPay ensures uninterrupted digital payments in network dead zones. With these unique offline capabilities, OutPay holds strong intellectual property potential, specifically for software copyright protection and a utility patent for its secure offline transaction architecture.

Table 1: Comparison between OutPay and existing e-wallets

Aspects	OutPay	Existing e-Wallets
Network Dependency	100% Offline First	Online Dependent
Security & Authentication	Edge-Based Cryptograph Validates authenticity locally	Cloud-Based Verification Relies entirely on server authentication
Infrastructure (Commercial Use)	Zero Cost POS Terminal Transforms any smartphone into an autonomous secure payment receiver	High-Cost Hardware Often requires dedicated Smart POS terminals
Data Synchronization	Asynchronous Reconciliation Safely stores encrypted receipts in local DB and syncs to the server once the network is restored.	Synchronous Ledger Transactions fail instantly if the central database is unreachable

4.0 PRACTICALITY & USEFULNESS

OutPay is highly practical for rural residents in poor coverage zones, cashless enthusiasts, and international travelers. It also offers significant commercial benefits by turning any smartphone into a POS receiver terminal. For scalability, OutPay can expand to include automatic offline currency exchange for travelers abroad and feature an integrated AI assistant to monitor transaction cash flow for vendors. Long-term sustainability and economic viability are achieved as the offline-first model reduces continuous dependency on cloud computing [4], given that data syncs only when internet is available, significantly lowering operational costs and carbon footprint. This proves that OutPay directly aligns with SDG 9 by building resilient payment networks, and SDG 10 by ensuring total financial inclusion for disconnected communities.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Inspired by offline P2P file-sharing concepts like SHAREit and AirDrop, OutPay was developed using Flutter and the Visual Studio Code IDE. Its technical architecture relies on the Point-to-Point strategy of Google Nearby Connections to establish seamless offline device pairing using Bluetooth Low Energy (BLE) and location services [1], [2]. To ensure robust security for the local database, the system integrates the device's Trusted Execution Environment (TEE). During validation testing, we successfully implemented a cryptographic method where a public key initiates the connection, and a private key securely stored in the isolated memory enclave of the TEE authorizes the transaction [3], effectively preventing forged transfers. We also conducted extensive vulnerability testing to stop users from manipulating offline balances by clearing app data or performing factory resets. This was resolved by creating a Secure Lock Session, which requires a verified online logout or customer service intervention before the user can clear data or switch devices. Additionally, the application implements a hybrid data management that bridges the local offline database with the public cloud server for post-transaction reconciliation [4]. Finally, performance testing confirmed fast, reliable, and stable fund transfers of various amounts across distances up to 10 meters.



Figure 1: OutPay development workflow flowchart

6.0 CONCLUSION

In conclusion, OutPay successfully achieved its goals by enabling secure offline cashless transactions, directly solving the problem of payment failures in network dead zones. This innovation encourages society to adopt a cashless lifestyle confidently by eliminating the dependency on continuous Internet connections. While currently limited by physical distance constraints and local storage dependencies, the real challenge lies in educating the community about the importance of this offline e-wallet and how it helps vendors operate more smoothly while avoiding scams. For future work, OutPay will expand its features to include automatic offline currency exchange for travelers, and AI cash flow monitoring for vendors. To conclude, OutPay ensures uninterrupted digital commerce for users across diverse environments and situations.

ACKNOWLEDGMENTS

Alhamdulillah, first and foremost, I would like to express my deepest gratitude to my parents and family for their endless love, support, and prayers throughout this journey. I would also like to extend my sincere appreciation to Pusat Asasi UiTM for providing the platform that made this project a reality.

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PROJECT ID: IN135

THE EFFECT OF HOMEMADE FERTILIZER (GROWEM) TOWARDS THE EARLY STAGE OF CORAL VEGETABLE

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ABSTRACT
It is estimated that approximately 800 million metric tons of waste has been generated from rice cultivation alone. To address the issue of wastage as such will be further utilized in many forms, one of it is biochar. This project is meant to mix 150g of paddy husk biochar, 50 g of Bacillus subtilis, 150 g chicken manure and 50 g of cornstarch are mixed with water. Then, form small granules by hand before leaving in air dried for 2 days. Coral seedlings were evaluated and harvested after approximately 15 days. The fresh weight has increased 55% with GrowEM (homemade fertilizer) compared to control with p=0.026 while increasing the leaves by 42.9% compared to control p=0.027.
Keywords: Paddy husk, biochar, coral vegetables

1.0 INTRODUCTION
Background: Due to the excessive wastage of paddy husks, easily found in the market, including biochar. Biochar has a unique porous structure where effective microorganisms can develop and survive. Problem Statement: Biochar now are ready in the market with various effective microorganisms in powder form as well. It can be beneficial to combine these 2 with additional nutrients loaded with manure. However, due to the physical appearance, it is a bit tedious to apply onto the vegetable's beds. Therefore, this project is mean to bind it into granules for easy application and storage. Significance of the Study: The farmers who have excessive waste can use it back as beneficial homemade fertilizer at their own pace and ground.

2.0 OBJECTIVES
The main objectives of this innovation/project are:
1. Fomulate GrowEM from chicken manure, paddy husk fertilizer biochar, Bacillus subtilis and cornstarch into granules.
2. Evaluate the effectiveness of GrowEM against unfertilized control coral vegetables at early stage.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: This fertilizer is based on paddy husk biochar, with *Bacillus subtilis* powder, chicken manure and cornstarch (binder). Biochar is a product of waste undergoing pyrolysis thermochemical conversion (300°C to 900°C) under zero or minimal oxygen availability (Amalina et al., 2022). Key Innovative Features: 50 g of cornstarch is enough to granulate the fertilizer base into a better shape and easily applied after it airdried. Comparison with Existing Solutions. Intellectual Property Potential: This has potential to patent due to its ratio applied to coral vegetables. The patent has not been filed yet.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Commercial Fertilizer	GrowEM
Nutrient source	Synthetic chemicals	Waste base
Nutrient Content	High in N, but prone to leach	Balanced NPK
Cost	RM7/kg	RM6.4 / 400 g

4.0 PRACTICALITY & USEFULNESS
Real-World Applications: It can be applied on vegetable beds like any other fertilizer. Target Users/Beneficiaries: Farmers, especially home growers that love to grow their own vegetables for their own consumption. Feasibility and Implementation: Technical Feasibility: It can be recreated with existing sources like readily available paddy husk biochar, any effective microorganism, manures and cornstarch readily in the market. It only needs to be airdried under shaded areas. Economic Viability: To make 400g, the material cost is Rm6.4 and can be applied by 2 3 granules on the base of the plant. Scalability:

Ratio can be increased to fit 1 kg of fertilizer. It can be used for other leafy vegetables too. Sustainability: it will promote less nutrient leach to the environment and utilize waste back onto the soil where it can benefit the plant and degrade sustainably. Expected Impact: It is easily done by farmers to cut costs and use it without worrying over deterioration of the environment.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process:150 g of Biochar, 150 g chicken manure, 50 g of Bacillus subtilis and 50 g of cornstarch Materials and Methods150 g of Biochar, 150 g chicken manure, 50 g of Bacillus subtilis and 50 g of cornstarch mixed and formed into granules. Then only it airdried under a shaded area. Testing and Validation: Tested on coral vegetables number of leaves are counted and fresh weight is obtained.

Results and Performance:

Treatment	Fresh Weight (Mean ± SD)	Leaves (Mean ± SD)
Control	2.60 ± 1.06	4.20 ± 1.30
T1 (GrowEM)	4.03 ± 0.51	6.00 ± 0.71

Technical Explanation: The coral vegetables were under CRD (Complete Randomized Design). Seedlings were uniform with 3 to 4 leaves before the treatment started. After 15 days, the vegetables are harvested in Universti Teknologi MARA and weigh. Data was run by SPSS and tested via independent T-test.

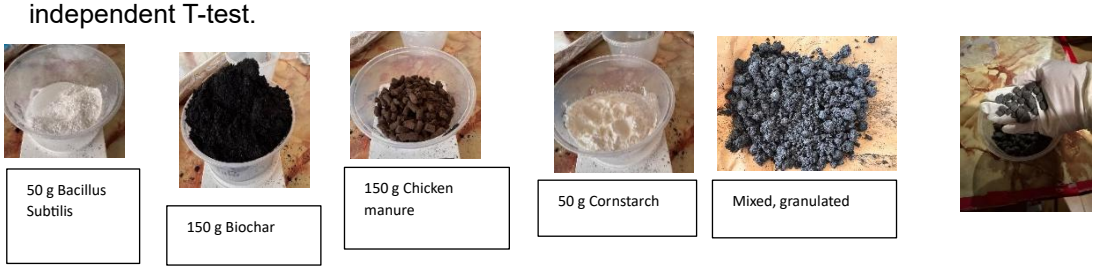


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Bacillus subtilis	CFU:>1.0 x 10^6 per gram	Effective microorganism
Paddy Husk Biochar	5–20 µm (Yang et al., 2022)	Habitat for microorganism
Chicken manure	Source of NPK	Provide nutrients
Cornstarch	Normal kitchens use cornstarch	Act as a binder

6.0 CONCLUSION

Summary of Achievement: The fertilizer has shown good initial progress towards coral vegetables. It gives basic nutrients that need to grow better at an early stage. Contributions and Impact: By applying this fertilizer, it can reduce the use of commercial NPK fertilizer for a home-based farmer that wishes to plant leafy vegetables. Limitations and Challenges: It needs more organic nutrients such as banana trunks, coffee grounds, and other types of compost manure to enhance the nutrients.It is recommended to try it on vegetable leafy plant again until it's full maturity. Work and Recommendations: Nutrients should be added more from any other source, especially agricultural waste. It can be biochar form or composted form to be added into the fertilizer and further tested with leafy vegetables. Closing Statement: It able to nourish coral vegetables with nutrients by returning waste back into the soil. Biochar can be a base for a new fertilizer with additional nutrients and binders. Homebase farmers can curate this by themselves for their garden and promote less nitrogen leaches to our environment.

ACKNOWLEDGMENTS

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EXTENDED ABSTRACT

Category C1 (Primary School)

PROJECT ID: IN28

GREEN STICK: GRAB & WIPE – A 3-IN-1 SUSTAINABLE TRAVEL TOOL

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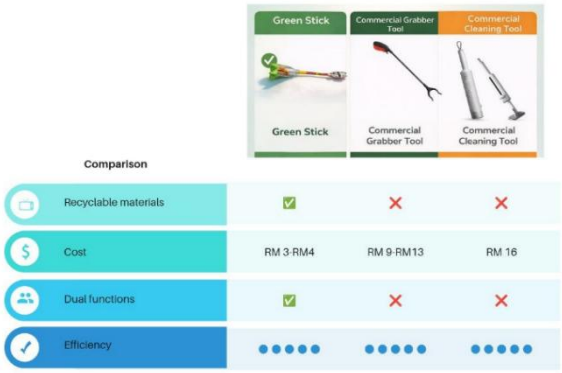
ABSTRACT
Many outdoor areas such as playgrounds and beaches become wet, slippery, and filled with rubbish after rain, creating safety risks and reducing cleanliness. Existing tools usually solve only one problem and are often costly or not suitable for children. To address this, we developed the Green Stick: Grab & Wipe, a 3-in-1 eco-friendly innovation that combines a sponge to wipe wet surfaces, a grabber to collect rubbish without direct contact, and a support stick to assist movement on uneven ground. It is made from recycled materials such as plastic bottles, sponge, and PVC pipe, making it low-cost and sustainable, with an added QR code for environmental awareness. The project involved problem identification, design, prototype building, and testing. Results show improved cleanliness, better safety, and easier waste collection. This innovation supports SDG 11, 12, and 13 by promoting safer, cleaner, and more sustainable public spaces.
Keywords: sustainable tourism, eco-innovation, waste management, safety, recycling

1.0 INTRODUCTION
After rain, many outdoor places like playgrounds, parks, and beaches become wet, slippery, and dirty, making them unsafe for children and unpleasant for visitors. Water collects on surfaces and rubbish such as plastic bottles and wrappers are often left behind, but many people avoid cleaning these areas because it is inconvenient. Existing tools usually only perform one function, such as wiping water or collecting rubbish, and some are expensive or not suitable for children.

2.0 OBJECTIVE
a) To build a Green Stick prototype that has 3 functions (wipe water, pick up rubbish, and help support walking) using recycled materials within the project period.
b) To test the Green Stick in outdoor areas such as the school playground and improve cleanliness by at least 70% by reducing water and rubbish on the ground during testing activities.
c) To encourage environmental awareness by adding a QR code on the Green Stick, with at least 50 users scanning it and learning about keeping the environment clean during the project period.

3.0 NOVELTY & INVENTIVENESS
The Green Stick: Grab & Wipe is a unique innovation because it combines three functions in one tool: wiping wet surfaces, picking up rubbish without direct hand contact, and helping users balance on slippery or uneven ground. It also includes a QR code that allows users to learn about environmental awareness and sustainability. Compared to existing tools, it is safer, more practical, and more educational. It also has potential for intellectual property protection such as patent, copyright, and trademark due to its original 3-in-1 design, although no official filing has been made yet.

Table 1: Comparison between existing solutions and proposed innovation



4.0 PRACTICALITY & USEFULNESS

The Green Stick: Grab & Wipe can be used in places like playgrounds, parks, beaches, and sports areas after rain to clean wet surfaces and collect rubbish at the same time. Made from recycled materials, it is low-cost, easy to use, and suitable for schools and communities. The impact includes faster cleaning, fewer slip accidents, time-saving, and better awareness of keeping the environment clean through the QR code feature.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

First, we identified the problem that outdoor areas become wet, dirty, and unsafe after rain. Next, we discussed ideas and drew simple sketches of a tool that can solve more than one problem. After that, we selected suitable recycled materials such as plastic bottles, sponge, and PVC pipe. Then, we built a prototype by assembling the parts into one tool with three functions.

6.0 CONCLUSION

The Green Stick: Grab & Wipe solves the problem of wet, slippery, and dirty outdoor areas by combining three functions in one tool: wiping water, picking up rubbish, and supporting movement on uneven ground. It is a low-cost and practical solution for schools, parks, and beaches, helping reduce contact with rubbish, speed up cleaning, and encourage recycling through eco-friendly design and a QR code feature. However, it has some limitations, such as the grabber not being strong enough for heavier rubbish and the need for better durability and more testing. In the future, improvements like stronger parts, smart features, and wider testing can be made. Overall, this innovation supports the theme “Bridging Ideas and Technology for a Resilient Future” by creating safer and cleaner public spaces.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to our school, SJKC Kong Min, teachers, Lee Zhi Wei, Lee Lai Yee, and our parents for their guidance, support, and encouragement throughout this project. Special thanks to the school community for providing resources and facilities, and to all students and staff who contributed feedback during testing. Their continuous support made the development of the Green Stick: Grab & Wipe possible and successful.

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PROJECT ID: IN29

E-CANTEEN: ONLINE FOOD ORDERING SYSTEM

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ABSTRACT
This project addresses the persistent challenges faced in school canteens, including long waiting times, overcrowding during recess, and inefficiencies in food ordering and distribution. These issues often lead to reduced eating time for students and increased workload for canteen operators. To overcome these problems, an online food ordering system was developed specifically for use in the school environment. The system allows students and teachers to pre-order meals through a digital platform before recess. The methodology involved the design and development of a user-friendly ordering interface, followed by a pilot implementation within the school. Data were collected through observations, user feedback, and surveys to evaluate system usability, efficiency, and user satisfaction. The findings indicate a significant reduction in queue length and waiting time, as well as improved satisfaction among students and canteen staff. Additionally, the system enhanced order accuracy and minimized food wastage. This system can be further expanded and adapted for wider use across schools, supporting the advancement of digital solutions in educational settings.
Keywords: e-Canteen, online food ordering, school canteen

1.0 INTRODUCTION
In many schools, food purchasing is still conducted through conventional, over-the-counter methods. This gap highlights the need for an innovative solution that leverages technology to improve efficiency and service quality in school environments. The primary problem addressed in this innovation is the inefficiency of traditional food ordering systems in school canteens. This innovation is significant as it introduces a practical digital solution to enhance the management of school canteen services.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To develop and implement an online food ordering system for the school canteen within 3 months to streamline the food ordering process and reduce physical crowding during recess.
b) To reduce students' average waiting time by at least 50% during recess periods using pre-ordering and scheduled food collection features.
c) To improve user satisfaction (students, teachers, and canteen operators) by achieving at least 80% positive feedback based on post-implementation surveys and usability evaluations.

3.0 NOVELTY & INVENTIVENESS
This innovation introduces a context-specific online food ordering system tailored for school canteen operations, distinguishing it from generic commercial food delivery platforms. It emphasizes pre-ordering, scheduled collection, and simplified interfaces suitable for students, making it highly practical and adaptable for educational settings. Students and teachers can place orders before recess and select a designated pickup time.

Table 1: Comparison between existing solutions and proposed innovation

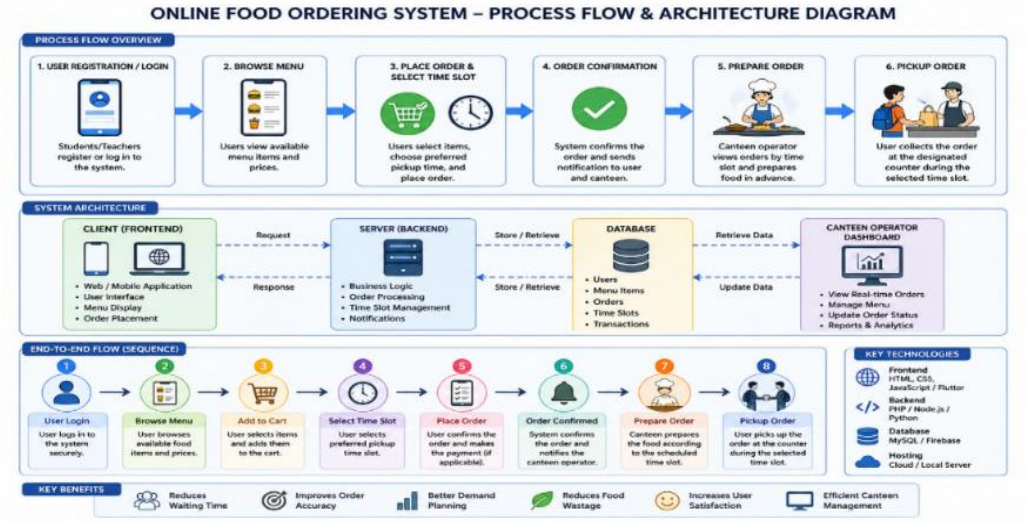
Aspect	Existing Solutions	Your Innovation
Ordering Method	Manual, over-the-counter ordering; students queue physically during recess	Online pre-ordering system allowing students to order before recess
Waiting Time	Long waiting times (10–20 minutes) due to congestion and limited-service capacity	Significantly reduced waiting time through scheduled pickup and pre-prepared orders
Demand Management	No proper forecasting; leads to food shortages or wastage	Data-driven system that helps predict demand and optimize food preparation

4.0 PRACTICALITY & USEFULNESS

The online food ordering system can be directly applied in school canteens to streamline daily food purchasing processes. For example, students can place orders before recess and collect meals at designated counters, reducing congestion and ensuring smoother crowd control. Teachers can pre-order meals during busy schedules, while canteen operators can prepare food in advance based on confirmed orders.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system operates based on a pre-order and scheduled distribution mechanism. Users access the platform through a mobile or web interface, where they select food items and preferred pickup times. The scheduling algorithm distributes orders into time slots to prevent congestion and balance workload.



6.0 CONCLUSION

This innovation successfully developed and implemented an online food ordering system tailored for school canteens, addressing key issues such as long waiting times, overcrowding, and inefficient order management. Through a structured design and development process, the system enabled students and teachers to pre-order meals and collect them at scheduled times.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to all individuals, institutions, and organizations who have contributed to the successful completion of this project.

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PROJECT ID:IN30

DIY COOLER BOX

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ABSTRACT
This study presents the invention of a DIY cooler box designed to address the limitations of conventional cooling systems, such as bulkiness, high energy consumption, and reliance on refrigerants. The proposed solution utilizes Bismuth Telluride Peltier Module TEC12715 based on the Peltier effect to create a compact, portable, and environmentally friendly device. The methodology involved designing a lightweight insulated plastic container integrated with Peltier modules, heat sink, CPU cooling fan, aquarium water chiller, temperature sensor, and $LiFePO_4$ rechargeable batteries, followed by prototype development and performance testing. Results demonstrated that the cooler box effectively reduced internal temperature and maintained stable cooling suitable for food, beverages, and medical storage. The fastest cooling power of the DIY cooler box is 1.28^{o}C a minute when a d.c voltage of 10.4 volt and 5.2 ampere of d.c current is applied to a piece of Peltier Cell. The temperature of cooler box drops 14.1^{o}C in 11 minutes. The power consumed by the DIY cooler box is only 166 watts, compared to 300 – 800 watts for a conventional domestic refrigerator. The innovation offers significant potential for outdoor activities, remote areas, and emergency use, contributing to sustainable and accessible cooling solutions.
Keywords: Peltier effect, thermoelectric, cooler, temperature, sustainable

1.0 INTRODUCTION
Conventional refrigerators are immobile and require constant electricity, while traditional cooler boxes rely on ice that melts quickly and cannot maintain stable temperatures. This creates a gap for efficient, portable cooling solutions. Current options are limited by short cooling duration (4–8 hours), poor temperature control, and dependence on ice or fixed power. In temperatures above 30°C, perishable items can spoil within 2 hours without proper cooling. Advanced portable refrigerators exist but are often costly and inaccessible to many users. This project aims to design a mobile mini cooler box using thermoelectric cooling, namely Peltier Effect, powered by rechargeable batteries. It benefits students, travellers, vendors, and healthcare users needing portable temperature control. The innovation reduces food waste, improves convenience, and promotes sustainable energy use, contributing to affordable and practical advancements in portable cooling technology.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To design and develop a compact mini-Peltier cooler box capable of reducing internal temperature to at least 10–15°C below ambient temperature within 12 minutes, using a low-voltage 12V d.c power source. This ensures a specific, measurable, and achievable performance target.
b) To enhance energy efficiency and portability by using rechargeable $LiFePO_4$ battery, enabling continuous operation for at least 5–8 hours without external electricity. This supports real-world mobile use and sustainability goals.
c) To ensure affordability and practical usability by keeping the total production cost below RM 1000 while maintaining durability and ease of use for students, travellers, and small vendors.

3.0 NOVELTY & INVENTIVENESS
This invention introduces a compact, portable cooling system using thermoelectric Peltier technology, offering a quieter, lighter, and more energy-flexible alternative to compressor-based coolers and ice boxes. Unlike conventional solutions, it integrates smart temperature control and renewable power compatibility in a low-cost design. Key Innovative Features**:** First, the system uses an optimized Peltier module with enhanced heat dissipation (heat sink cooling fan and aquarium water chiller) to achieve faster and more stable cooling performance. Second, it uses $LiFePO_4$ rechargeable batteries that enable it to be used in remote or outdoor settings. Additional innovations include a lightweight heat insulated plastic box and a simple digital temperature controller for user-friendly operation.

Comparison with Existing Solutions:

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Proposed Innovation
Cooling Method	Ice or compressor-based	Thermoelectric (Peltier Effect)
Power Source	AC or ice-dependent	Rechargeable $LiFePO_4$ batteries
Portability	Bulky or limited duration	Compact and long-lasting

Intellectual Property Potential: The design has potential for patent protection, particularly in its power system and thermal optimization. No IP has been filed yet, but the concept shows strong originality for future registration.

4.0 PRACTICALITY & USEFULNESS

The DIY cooler box is practical for real-world use such as keeping drinks cold during travel, preserving food for students, and storing medicines like insulin during transport. Target users include students, outdoor workers, small vendors, and healthcare users in remote areas. Technically, it is feasible using readily available Peltier modules, such as Bismuth Telluride Peltier Cell TEC12715 and simple electronic components. Economically, it is affordable compared to compressor-based coolers, reducing cost by up to 30–50%. It is also environmentally friendly, reducing reliance on ice and minimizing waste. The expected impact includes improved convenience, reduced food spoilage, and enhanced portability, potentially increasing efficiency and usability in daily activities by over 40%.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The experiment was conducted 5 times separately to determine the values of electric voltage and electric current required to achieve the Fastest Cooling Rate of the Cooler Box. Five combinations of maximum electric voltage and maximum electric current as shown in Table 2 below were preset using the Voltage-Current Regulator Model R-SPS3030C before the experiment began.

Table 2: Five combinations of maximum electric voltage and maximum electric current

Experiment	Maximum voltage (Volt) preset	Maximum current (Ampere) preset
First	13.00	20.00
Second	12.00	19.00
Third	11.00	18.00
Fourth	12.00	18.00
Fifth	11.00	17.00

The temperature inside the cooler box, as shown by the temperature sensor, is recorded every minute until the lowest temperature of the cooler box is reached. The readings of voltage, current, and electrical power used (watt), as displayed on the screen of the Voltage-Current Regulator Model R-SPS3030C, are recorded every minute, simultaneously with the recording of the temperature readings inside the cooler box. After all five experiments are completed, a graph of Temperature Inside the Cooler Box (°C) against Time Taken (Minutes) is plotted for each experiment.

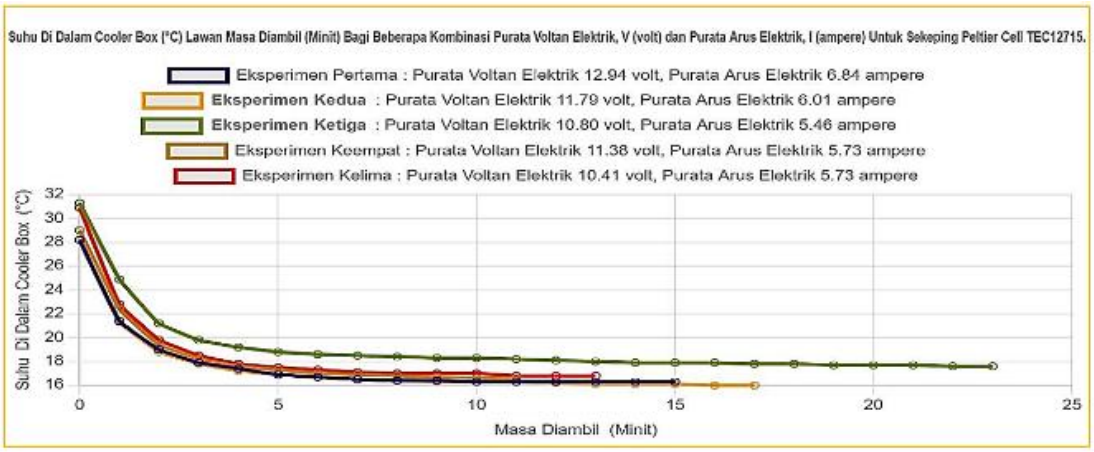


Figure 1: Temperature (˚C) – Time (Minute) for all the five experiment

6.0 CONCLUSION

The Peltier cooler box project successfully delivered a compact, portable cooling system using thermoelectric modules, addressing the need for affordable, electricity-efficient refrigeration. It achieved stable temperature control and mobility, benefiting students, travellers, and small-scale users. This innovation contributes a low-cost alternative to conventional cooling, with practical use in food storage and medical transport. However, limitations include lower efficiency than compressor systems and heat dissipation challenges. Future work will focus on improving insulation, optimizing power consumption, and integrating renewable energy sources like solar panels. Further research should enhance thermal performance and durability. Overall, this invention demonstrates meaningful progress in sustainable cooling, aligning with “Bridging Ideas and Technology for a Resilient Future” - the theme of i-NEXTECH 2026.

ACKNOWLEDGMENTS

I sincerely thank our Science Panel of SK St. Michael and peer mentors for their guidance throughout the DIY Cooler Box project. Appreciation goes to administrators of SK St. Michael Ipoh for facilities and support. I also acknowledge teachers, peers, family, and funding sponsors of Parents and Teachers Association of SK St. Michael, whose contributions made this innovation possible and successful.

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PROJECT ID: IN48

THE PROTON BOB: A GAMIFIED BOARD GAME FOR LEARNING THE PERIODIC TABLE

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ABSTRACT
Many students struggle to learn the periodic table due to memorization difficulties, low engagement, and traditional teaching methods. To address this, The Proton Bob was developed as a gamified board game that transforms the periodic table into an interactive learning tool. The game integrates movement, event cards, and Higher Order Thinking Skills (HOTS) questions to promote active learning and critical thinking. The testing was conducted in a classroom setting at SK Taman Bukit Dahlia and SMK Pasir Gudang. Field testing was conducted with 30 students aged 12–17 using observation and surveys. Results showed high effectiveness, with 93% positive responses and a mean score of 4.48. Students demonstrated improved engagement, recall ability, and interest in chemistry. The Proton Bob provides a low-cost and practical solution with strong potential as a STEM educational tool.
Keywords: Gamification, STEM Education, Periodic Table, Interactive Learning, HOTS

1.0 INTRODUCTION
Many students face difficulties in learning the periodic table due to memorization challenges and low engagement. A preliminary survey showed over 70% struggle with memorization and more than 60% experience low engagement. This highlights the need for a more interactive learning approach. This study introduces a gamified tool to improve understanding, engagement, and critical thinking.

2.0 OBJECTIVE
a) To improve students' understanding of the periodic table.
b) To increase students' interest and engagement in learning chemistry.
c) To develop higher order thinking skills (HOTS).
d) To create a fun and interactive learning tool through gamification.

3.0 NOVELTY & INVENTIVENESS
The Proton Bob is a unique innovation that transforms the periodic table into an interactive board game. Unlike traditional methods that rely on memorization, this approach integrates gamification elements such as movement, strategy, and event-based learning. Key features include a gamified periodic table structure, HOTS-based Lightning Cards, event cards with rewards and penalties, and a low-cost printable design. Compared to existing solutions, Proton Bob offers higher engagement, improved critical thinking, and better accessibility without requiring digital tools.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	The Proton Bob
Learning Method	Passive	Game-based
Engagement	Low	High
Thinking Skills	Memorization	HOTS
Accessibility	Limited	Low-cost & easy
Motivation	Low	High

4.0 PRACTICALITY & USEFULNESS
The Proton Bob is low-cost, easy to implement, and suitable for classrooms, STEM programs, and home learning. It improves engagement, understanding, and critical thinking.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
The development of The Proton Bob involved problem identification, idea generation, game design, prototype development, and testing. The system includes a printed periodic table board, question cards, event cards, HOTS cards, dice, and player tokens. Testing was conducted with 30 students aged 12–17 using observation and surveys from student SK Taman Bukit Dahlia and SMK Pasir Gudang. Results

showed improved engagement, memory recall, and interest. The game functions by turning each element into an interactive checkpoint where students apply knowledge through gameplay, reinforcing learning through repetition and interaction. During testing, students showed excitement, actively discussed answers, and competed enthusiastically in groups.

6.0 CONCLUSION

The Proton Bob effectively improves understanding, engagement, and thinking skills, supported by a mean score of 4.48 and 93% positive response. It offers a low-cost, practical solution with strong potential for educational use. Despite limitations such as sample size and printed materials, future improvements include expanded content and enhanced design. This innovation supports the theme *"Bridging Ideas and Technology for a Resilient Future."*

ACKNOWLEDGMENTS

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PROJECT ID: IN63

GREASE TO GLOW: SUSTAINABLE BATH BOMB INNOVATION USING RECYCLED COOKING OIL

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ABSTRACT
Improper disposal of used cooking oil contributes to water pollution, clogged drainage systems, and environmental degradation. Despite increasing sustainability awareness, many households still dispose of used oil irresponsibly due to limited knowledge of alternative reuse methods. This project introduces Grease to Glow; an eco-friendly bath bomb innovation developed from recycled cooking oil as a sustainable self-care product. The innovation transforms household waste into a value-added wellness product while promoting environmental responsibility and circular economy practices. The development process involved filtering and purifying used cooking oil before incorporating it into bath bomb formulations using baking soda, citric acid, essential oils, and natural colouring agents. Prototype testing focused on texture stability, dissolving performance, skin compatibility, and user acceptance. Findings showed satisfactory fizzing effects, pleasant fragrance, and acceptable product durability. *Grease to Glow* promotes waste reduction and environmental sustainability through creative recycling practices while offering entrepreneurial potential for eco-business initiatives and educational STEM projects. The project aligns with the i-NEXTECH 2026 theme, “Bridging Ideas and Technology for a Resilient Future,” by integrating sustainability, innovation, and practical environmental solutions into everyday consumer products.
Keywords: recycled cooking oil, bath bomb, sustainability, eco-innovation, circular economy

1.0 INTRODUCTION
Used cooking oil waste has become an increasing environmental concern due to improper disposal practices in households and food businesses (Subri et al., 2025; Merman et al., 2023). Discarded oil often enters drainage systems and waterways, contributing to pollution and ecosystem damage (Subri et al., 2025; Merman et al., 2023). Although recycling initiatives exist, many communities still lack accessible and creative methods for reusing used cooking oil. This project addresses the issue by transforming recycled cooking oil into eco-friendly bath bombs known as Grease to Glow. Existing bath bomb products typically rely on commercially sourced oils and ingredients, which may increase production costs and environmental impact. The innovation introduces a sustainable alternative by repurposing household waste into a functional wellness product. The project is significant because it promotes environmental awareness, sustainable consumption, and waste management practices while supporting entrepreneurship and innovation education. The product also demonstrates how everyday waste materials can be converted into practical and marketable consumer goods.

2.0 OBJECTIVE
a) The main objectives of this project are to develop eco-friendly bath bombs using recycled cooking oil, reduce environmental pollution caused by improper oil disposal, and promote sustainable recycling practices through household waste transformation.

3.0 NOVELTY & INVENTIVENESS
The uniqueness of Grease to Glow lies in its transformation of recycled cooking oil into a wellness and self-care product. Unlike conventional bath bombs that utilise newly purchased oils, this innovation adopts an environmentally sustainable approach through waste reutilisation.

4.0 PRACTICALITY & USEFULNESS
Grease to Glow can be used as a sustainable bath and wellness product suitable for households, eco-conscious consumers, educational institutions, and community entrepreneurship programmes. The innovation is technically feasible because the materials required are affordable and easily accessible. Economically, the reuse of cooking oil reduces raw material costs. The product is

scalable for small businesses, school innovation projects, and community-based recycling initiatives.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development process involved collecting used cooking oil from household sources and filtering it to remove impurities. The purified oil was then mixed with baking soda, citric acid, essential oils, natural fragrance, and colouring agents to form bath bomb prototypes. The development process involved the collection of used cooking oil, followed by oil filtration and purification, ingredient formulation and mixing, moulding and drying, and product testing and evaluation.

6.0 CONCLUSION

Grease to Glow successfully demonstrates how recycled cooking oil can be transformed into an innovative and sustainable self-care product. The project addresses environmental concerns related to improper oil disposal while promoting circular economy practices and sustainable innovation. Overall, Grease to Glow reflects the spirit of i-NEXTECH 2026 by bridging sustainability, creativity, and practical innovation toward a more resilient future.

ACKNOWLEDGMENTS

The authors would like to thank Sekolah Rendah Islam Integrasi Pintar (BJ) Denai Alam and all individuals who provided guidance, resources, and support throughout the development of this innovation project.

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PROJECT ID: IN64

ECO MORIBITE – PELET IKAN LESTARI

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ABSTRACT
The aquaculture industry is currently facing significant challenges due to the rising cost of fish feed and dependence on unsustainable ingredients such as fishmeal in commercial pellets. This study introduces ECO MORIBITE – Sustainable Fish Pellets, an organic fish feed formulated using locally available organic waste materials including fish residues, moringa leaves (*Moringa oleifera*), banana peels, coconut pulp, and tapioca flour enriched with naturally fermented probiotics through spray-coating techniques. The innovation aims to provide a cost-effective, environmentally friendly, and nutritionally balanced alternative to commercial fish feed for freshwater aquaculture. An experimental study was conducted over four weeks involving two groups of tilapia fish (*Oreochromis niloticus*) with n=5 fish per group. The treatment group received ECO MORIBITE pellets, while the control group was fed commercial pellets. Growth performance was evaluated through measurements of fish weight, length, and feed production cost. Findings revealed that fish fed with ECO MORIBITE achieved a higher average final weight (250 g) compared to the control group (210 g) and a greater average length (8.0 cm) compared to 6.5 cm in the commercial feed group. Furthermore, the production cost of ECO MORIBITE was substantially lower (RM2.00/kg) than commercial feed (RM12.00/kg), representing approximately 83% cost reduction. The study demonstrates the potential of utilizing local organic waste and natural probiotic technology in sustainable aquaculture while contributing towards SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).
Keywords: organic fish pellets, sustainable aquaculture, probiotic feed, organic waste recycling, tilapia

1.0 INTRODUCTION
Aquaculture has become one of the fastest-growing sectors in global food production and an essential source of animal protein. However, the industry continues to face substantial challenges, particularly the escalating cost of fish feed and the dependency on imported, non-sustainable ingredients such as fishmeal. Commercial fish feed contributes significantly to operational costs, especially among small-scale aquaculture farmers, thereby affecting productivity and profitability. In addition, increasing amounts of agricultural and food waste are often discarded without productive utilization, contributing to environmental pollution and inefficient waste management. To address these issues, the present study introduces ECO MORIBITE – Sustainable Fish Pellets, an innovative organic fish feed produced from locally available waste materials including fish residues, banana peels, moringa leaves, coconut pulp, and tapioca flour. The formulation is further enhanced with naturally fermented probiotics applied through spray-coating technology to improve fish digestion, immunity, and nutrient absorption.
The innovation addresses the need for an affordable, sustainable, and nutritionally balanced fish feed alternative that reduces reliance on commercial feed while promoting circular economy practices through waste recycling. The study is significant as it provides an environmentally sustainable solution that may benefit small-scale fish farmers, educational institutions, and local communities while supporting sustainable aquaculture development.

2.0 OBJECTIVE
The objectives of this innovation project are:
a) To develop ECO MORIBITE, an organic fish pellet formulated from locally available organic waste materials and natural probiotics for freshwater aquaculture.
b) To evaluate the effectiveness of ECO MORIBITE in improving the growth performance of tilapia fish in terms of weight and length compared to commercial fish pellets.
c) To assess the economic feasibility of ECO MORIBITE by comparing production costs with commercially available fish feed.

3.0 NOVELTY & INVENTIVENESS

Innovation Aspects: ECO MORIBITE demonstrates novelty through the integration of locally sourced organic waste materials and natural probiotic technology into fish feed production. Unlike conventional commercial pellets that rely heavily on fishmeal and synthetic additives, ECO MORIBITE utilizes discarded fish residues, banana peels, moringa leaves, and coconut pulp, thereby transforming organic waste into a value-added aquaculture product. Another innovative aspect lies in the application of natural fermented probiotics through spray-coating technology, which enhances fish digestion and nutrient absorption without the use of synthetic growth enhancers. This eco-friendly formulation contributes to sustainable fish farming practices while significantly reducing feed costs. The innovation also demonstrates strong commercialization and intellectual property potential through its practical applicability, low production cost, and protected innovation status under the Copyright Act 1987 (Certificate No: CRL2025P03652) entitled "ECO MORIBITE – Pelet Ikan Lestari."

Table 1: Comparison Between Existing Solutions and Proposed Innovation

Aspect	Existing Commercial Pellets	ECO MORIBITE Innovation
Raw Materials	Fishmeal and synthetic ingredients	Organic waste materials and local resources
Probiotic Technology	Limited or synthetic additives	Natural fermented probiotic spray-coating
Production Cost	RM12.00/kg	RM2.00/kg
Environmental Impact	Higher carbon footprint	Supports waste recycling and circular economy
Sustainability	Moderate	High (supports SDG 2, 12 & 13)

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: ECO MORIBITE can be applied in freshwater aquaculture, particularly for small-scale fish farming involving tilapia and other freshwater species. The innovation provides an affordable alternative to commercial fish feed and may also be implemented in educational institutions, community aquaculture projects, and sustainable agriculture initiatives. Target Users / Beneficiaries: The innovation primarily benefits small-scale fish farmers, aquaculture entrepreneurs, educational institutions, and local communities seeking cost-effective and environmentally sustainable fish feed alternatives. It also serves as an educational tool for STEM-based sustainability learning. Feasibility and Implementation: Technical Feasibility: The pellet formulation process uses readily available materials and simple processing methods such as drying, grinding, mixing, pellet formation, and probiotic spray-coating, making implementation practical and accessible. Economic Viability: The estimated production cost of ECO MORIBITE is approximately RM2.00/kg, significantly lower than commercial fish pellets (RM12.00/kg), resulting in an estimated 83% cost reduction. Scalability: The innovation can be adapted for larger production scales and expanded to different fish species through nutritional modifications. Sustainability: ECO MORIBITE promotes waste recycling, reduces environmental burden, and supports sustainable aquaculture through resource-efficient production. Expected Impact: The innovation contributes to improved fish growth performance, reduced aquaculture operating costs, and better waste management practices. It also supports SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) by promoting sustainable food systems and environmentally responsible practices.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

a) Design and Development Process: The development of ECO MORIBITE involved a systematic experimental approach comprising four stages: material selection, pellet formulation, experimental feeding trial, and performance analysis. Initially, organic waste materials consisting of fish residues (300 g), dried banana peel (150 g), moringa leaves (100 g), coconut pulp (50 g), and tapioca flour (200 g) were selected based on nutritional suitability and local availability. The materials were dried, ground into fine powder, and mixed with water to produce pellet dough. The dough was manually shaped into pellets and dried under sunlight for 1–2 days. Subsequently, naturally fermented probiotics derived from leftover rice, rice-washing water, molasses, and filtered water were applied using a spray-coating technique.

b) Testing and Validation: The feeding experiment was conducted for four weeks at a freshwater fish pond in Pengkalan Hulu, Perak involving two groups of tilapia fish (n=5 per group):Treatment Group: ECO MORIBITE pellets and Control Group: Commercial fish pellets

c) Fish were fed twice daily under controlled environmental conditions (temperature: 26–28°C; pH: 6.5–7.5). Growth performance was assessed through weekly measurements of fish weight, length, survival rate, and feed cost.
d) Results and Performance: The treatment group demonstrated superior growth performance with an average final fish weight of 250 g, compared to 210 g in the commercial feed group. Fish fed with ECO MORIBITE also achieved a greater average length (8.0 cm) than the control group (6.5 cm). Additionally, the innovation demonstrated strong economic potential through its substantially lower production cost.

Figure 1: Development Process Flowchart

Organic Waste Collection → Drying Process → Grinding & Mixing → Pellet Formation → Sun Drying → Probiotic Spray-Coating → Feeding Trial → Data Collection & Analysis

Table 2: Key Components and Specifications

Component / Material	Specification	Purpose
Fish residues	300 g	Protein source
Banana peel	150 g	Carbohydrate and fibre
Moringa leaves	100 g	Vitamins and nutrients
Coconut pulp	50 g	Healthy fats and texture
Tapioca flour	200 g	Natural binding agent
Natural probiotics	Spray-coated	Improve digestion and immunity

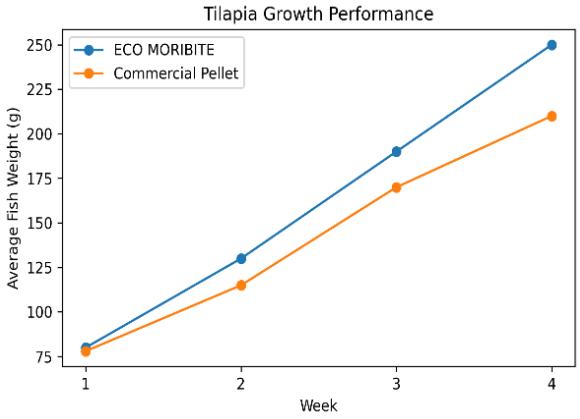


Figure 3. Growth performance of tilapia fish fed with ECO MORIBITE and commercial pellets over a four-week period.



Figure 4. ECO MORIBITE sustainable fish pellets formulated from locally sourced organic waste materials and natural probiotics.

6.0 CONCLUSION

ECO MORIBITE successfully demonstrates the potential of utilizing locally available organic waste and natural probiotics to produce a sustainable, cost-effective, and nutritionally beneficial fish feed alternative. The innovation achieved its objectives by improving tilapia growth performance while significantly reducing feed production cost. Beyond its economic value, ECO MORIBITE contributes to sustainable waste management and environmentally responsible aquaculture practices. Nevertheless, further research involving larger sample sizes, additional fish species, and microbiological evaluation

of probiotic effects is recommended. Overall, ECO MORIBITE reflects the potential of integrating innovation, sustainability, and community-based solutions to support a more resilient future in aquaculture.

ACKNOWLEDGMENTS

The authors would like to express sincere appreciation to Sekolah Kebangsaan Jawi, Fisheries Research Institute (FRI) Batu Maung, Universiti Sains Malaysia (USM), Universiti Utara Malaysia (UUM), Universiti Malaysia Terengganu (UMT), local fish farmers in Pengkalan Hulu, Perak, and the Environmental Club of Sekolah Kebangsaan Jawi for their guidance, technical support, facilities, and contributions throughout the development of this project.

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PROJECT ID:IN68

SOLARSNACK

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ABSTRACT
SolarSnack is a simple and eco-friendly solar oven designed to demonstrate the use of renewable energy for heating food using sunlight. The project aims to educate children about sustainable energy and environmental conservation through a hands-on STEM learning experience. The solar oven is constructed using low-cost and recyclable materials such as a pizza box, aluminum foil, black paper, transparent plastic wrap, and newspaper insulation. The design captures and retains solar heat to warm or cook simple snacks such as marshmallows, crackers, and chocolate. The development process involved conceptual planning, prototype construction, sunlight testing, and temperature observation. Results showed that the solar oven successfully increased internal temperature under direct sunlight and was able to heat food effectively without electricity or fuel. Innovation promotes awareness of renewable energy, energy conservation, and creative recycling among children. SolarSnack has strong educational value and can be implemented in schools for STEM and environmental sustainability activities.
Keywords: Solar energy, renewable energy, solar oven, sustainability, STEM education

1.0 INTRODUCTION
Renewable energy sources such as solar energy provide cleaner and safer alternatives. Many children have limited exposure to renewable energy applications in everyday life. Schools often require simple and engaging projects to teach sustainability and environmental responsibility. SolarSnack introduces children to renewable energy concepts through an interactive and practical project. According to the International Energy Agency, (2025) solar energy is one of the fastest-growing renewable energy sources worldwide. The Ministry of Education Malaysia through the Malaysia Education Blueprint 2013–2025 also emphasizes innovation and technology integration in education.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To design a functional solar oven using recyclable materials.
b) To demonstrate the use of solar energy for heating food.

3.0 NOVELTY & INVENTIVENESS
SolarSnack introduces a child-friendly and low-cost renewable energy project suitable for school learning environments.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Energy Source	Electricity/Gas	Solar Energy
Environmental Impact	Higher carbon emission	Eco-friendly
Cost	Expensive	Low-cost

4.0 PRACTICALITY & USEFULNESS
SolarSnack offers high practicality through its simple, low-cost, and eco-friendly design using recyclable materials and renewable solar energy. It provides an engaging hands-on learning experience that helps children understand sustainability, renewable energy, and STEM concepts in real-world situations. Its usefulness lies in promoting environmental awareness, reducing dependence on electricity or fuel, and encouraging creative and sustainable learning activities, making it highly suitable and scalable for schools, science exhibitions, and community education programs.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

SolarSnack applies a simple and eco-friendly approach using recyclable materials, solar heat absorption, and greenhouse effect principles to generate heat energy from sunlight, enabling safe, low-cost, and sustainable cooking for educational and environmental learning purposes as shown in Figure 1.



Figure 1: Development process flowchart

6.0 CONCLUSION

SolarSnack transforms simple recyclable materials into an eco-friendly solar cooking system that promotes renewable energy awareness, sustainability, and hands-on STEM learning among children. This project bridges creativity, environmental responsibility, and technology, contributing to a sustainable and resilient future aligned with the i-NEXTECH 2026 theme.

ACKNOWLEDGMENTS

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PROJECT ID: IN60

SMART RAINWATER SAVER SYSTEM

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ABSTRACT
Water is an essential resource, yet it is frequently wasted in daily activities such as watering plants and cleaning surfaces. This project addresses the problem of excessive use of clean water for non-potable purposes by proposing a Smart Rainwater Saver System. The system collects rainwater, filters it using natural materials such as stones, sand, cotton, and charcoal, and stores it for reuse. The methodology involves designing a simple gravity-based system consisting of four main stages: rainwater collection, filtration, storage, and reuse. A prototype was constructed using recycled plastic bottles to demonstrate the concept. The system prioritizes the use of rainwater before clean water, promoting efficient water usage. The results show that rainwater can be effectively filtered for basic reuse applications such as watering plants and cleaning. The system is low-cost, easy to construct, and suitable for household and educational use. This innovation promotes sustainable water management and environmental awareness. It demonstrates how simple technology can reduce water wastage and contribute to a more resilient and sustainable future.
Keywords: Rainwater harvesting, water conservation, filtration system, sustainability, environment

1.0 INTRODUCTION
Background: Clean water is often used for activities that do not require drinking-quality water, while rainwater is not fully utilized. Problem Statement: Many households use treated water for gardening and cleaning, causing unnecessary water waste. Existing rainwater harvesting systems can be expensive and complicated for small-scale use. Significance of the Study: This project offers a simple and low-cost way to reduce clean water consumption. It can benefit homes, schools, and communities while encouraging environmental sustainability and awareness.

2.0 OBJECTIVE
a) To design a simple rainwater collection and reuse system.
b) To develop a low-cost filtration system using natural materials.
c) To promote efficient water usage by prioritizing rainwater over clean water.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: This project integrates rainwater collection, filtration, storage, and reuse into a single compact system suitable for educational and household use. Key Innovative Features: Natural filtration (stones, sand, cotton and charcoal), Gravity-based operation without electricity, prioritizes rainwater use to reduce clean water consumption.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Cost	High	Low-cost materials
Complexity	Industrial Systems	Simple model
Accessibility	Limited	Easy to build

Intellectual Property Potential: The innovative design of the rainwater harvesting and filtration system has potential for patent protection. Its low-cost and user-friendly features may provide a unique solution for small-scale water conservation. Currently, no intellectual property application has been filed, but future protection may be considered.

4.0 PRACTICALITY & USEFULNESS
Real-World Applications: Suitable for home gardening, school projects, and small-scale water saving systems. Target Users: Students, households, and communities.

Feasibility and Implementation: Technical: Easy to construct using basic materials, Economic: Low cost using recycled items, Scalability: Can be expanded into larger systems,
Sustainability: Supports water conservation, Expected Impact: The project reduces clean water usage by up to 20% and promotes environmental awareness.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: The system was developed through concept design, material selection, prototype construction, and testing. System Design: A gravity-based flow system: Collection → Filtration → Storage → Reuse. Materials and Methods: Plastic bottles, sand, stones, cotton, charcoal. Testing and Validation: Water flow and clarity were observed after filtration to ensure suitability for reuse. Results and Performance: Testing showed improved water clarity and reduced impurities, with continuous flow achieved without electricity. Technical Explanation: Rainwater flows through layered filtration materials that remove impurities before being stored for reuse.





Figure 1: Development process flowchart

Table 2: Key components and specifications

Component	Specification	Purpose
Bottle	Recycled plastic	Water container
Sand/Stone	Natural material	Filtration
Charcoal	Absorbent materials	Improve water quality

6.0 CONCLUSION

This project successfully developed a simple rainwater harvesting and filtration system that reduces the use of treated water for non-potable purposes. The system promotes water conservation, can reduce clean water usage by up to 20%, and increases environmental awareness. However, it is limited to non-potable applications and depends on rainfall availability. Future improvements include enhancing filtration efficiency, increasing storage capacity, and adding water quality monitoring features. Overall, this innovation provides a practical and sustainable solution that supports the i-NEXTECH 2026 theme, “Bridging Ideas and Technology for a Resilient Future.

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PROJECT ID: IN96

KIDDO GUARD

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ABSTRACT
The Kiddo Guard System was developed to tackle the heartbreaking issue of children being accidentally left alone in vehicles, a problem tragically responsible for six deaths in Malaysia between 2018 and 2024. This often happens due to Forgotten Baby Syndrome (FBS) which leading to preventable fatalities from heatstroke and carbon monoxide poisoning. The Kiddo Guard System offers a technological solution aimed at real-time detection and notification to prevent such tragedies. The system integrates carbon monoxide (CO) sensors to monitor in-car air quality, AI-powered cameras to identify infant distress and infrared sensors to detect driver proximity a. If a child is detected alone in the car, the system triggers alerts via Telegram, activates the car alarm, and lowers windows in case of high CO levels. A survey of 57 respondents indicated 92% approval rate of the system's effectiveness, and 88% expressed strong willingness to recommend it. Kiddo Guard aligns with Sustainable Development Goal (SDG 3) for good health and well-being and complies with legal mandates like the Malaysian Child Act 2001 and the UN Convention on the Rights of the Child. The target users are mainly parents and caregivers, offering them a crucial safety net to prevent forgotten child incidents. The system also holds potential for integration into future car manufacturing. Future developments will focus on integration with vehicle's built-in systems and mobile app with real-time monitoring, ensuring reliability and effectiveness.
Keywords: Carbon monoxide poisoning, child safety, Forgotten Baby Syndrome, heatstroke, vehicle alert system

1.0 INTRODUCTION
The Kiddo Guard System is an advanced Internet of Things (IoT) innovation designed to eliminate Forgotten Baby Syndrome (Diamond, 2019). Although public awareness campaigns and legal frameworks like Section 31 of the Malaysian Child Act (2001) exist, involuntary human errors persist, exposing the critical limitations of current market solutions. Existing preventative devices heavily rely on short-range Bluetooth protocols prone to connection dropouts, or basic weight sensors that fail if a child shifts positions, leaving a massive safety gap. This technological limitation has led to severe consequences; between 2018 and 2024, six child fatalities were documented in Malaysia due to vehicular heatstroke and carbon monoxide poisoning. Despite these severe environmental hazards, empirical survey data from the Kiddo Guard study revealed that 63.5% of caregivers currently utilize no preventative measures, highlighting an urgent, unmet societal need.

2.0 OBJECTIVE
a) To build a system that automatically lower car windows within 5 seconds upon detecting carbon monoxide (CO) levels > 200 ppm.
b) To develop a system that detect unattended children in car with > 95% accuracy, sending alerts via radio waves/Telegram within 5 seconds

3.0 NOVELTY & INVENTIVENESS
The Kiddo Guard System shifts vehicular child safety from passive reminder apps to an autonomous, active mitigation platform. Unlike existing solutions that rely on short-range Bluetooth prone to dropouts or weight pads that fail if a child shifts, Kiddo Guard introduces a unique multi-sensor fusion architecture. Its key innovative features include:
a) Advanced Detection: An AI-powered camera combined with infrared sensors for foolproof child presence and driver distance tracking.
b) Environmental Monitoring: An integrated Carbon Monoxide (CO) sensor to continuously scan cabin air quality.
c) Physical Intervention: An automated mechanical response that rolls car windows down by two inches during gas leaks, proven to reduce toxic gas by 70% in 3.5 minutes.

4.0 METHODOLOGY & PRACTICALITY

Kiddo Guard System operates on a multi-sensor fusion architecture managed by a Micro:bit microcontroller with Wi-Fi connectivity. The hardware setup integrates child seat pressure sensors, an AI camera, infrared proximity sensors, an MQ-135 gas sensor, and servo motors to simulate the mechanical manipulation of vehicle windows. Software logic utilizes a context-driven, three-scenario matrix: when a caregiver exits, the system cross-references seat pressure values with AI visual tracking to confirm child presence, tracks driver distance via radio waves, and monitors cabin air quality. Validation involved 40 trials testing emergency notification latency across network types and 35 trials evaluating physical ventilation inside a controlled container. The Kiddo Guard System delivers immediate real-world utility for fatigued parents and school transport operators by transforming standard passenger environments into an active, automated child safety platform Designed around low-power microcontrollers and AI-driven cameras, the innovation is sustainable, technically feasible, and highly scalable from a cost-effective aftermarket attachment to factory-installed original equipment manufacturer (OEM) automotive safety configurations Quantifying its technological impact, the system guarantees over 95% child-detection accuracy, transmits critical remote cellular alerts to a family network within a swift 4.91-second average window, and triggers an autonomous mechanical ventilation response that drops toxic cabin gas concentrations by over 70% in 3.5 minutes. These rigorous performance metrics earned a 92% empirical approval rating for life-saving efficiency from target end-users.

5.0 CONCLUSION

The Kiddo Guard System successfully accomplishes its goal of mitigating Forgotten Baby Syndrome by introducing a high-performance, multi-sensor fusion architecture that delivers a 95% child-detection accuracy rate and an autonomous window-lowering safety intervention. This innovation makes a vital societal contribution by actively protecting vulnerable children from lethal vehicular hyperthermia and toxic gas exposure. Future work will focus on integrating independent cellular GSM modules to ensure universal connectivity, incorporating solar-powered backup arrays, and pursuing direct factory original equipment manufacturer (OEM) automotive integration. Ultimately, Kiddo Guard stands as a transformative safety advancement, perfectly embodying the i-NEXTECH 2026 theme of "Bridging Ideas and Technology for a Resilient Future" by translating compassionate engineering into a robust, life-saving safeguard for families worldwide.

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PROJECT ID:IN100

SOLARGROW JUNIOR: SOLAR-POWERED RAINWATER IRRIGATION SYSTEM FOR SUSTAINABLE SCHOOL GARDENING

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ABSTRACT
SOLARGROW JUNIOR is an innovative miniature irrigation system designed to address the common problem of inconsistent plant watering caused by busy schedules, forgetfulness, or limited access to water sources. The project integrates renewable solar energy with harvested rainwater to provide an environmentally friendly and cost-effective solution for small-scale vegetable cultivation. The system consists of a solar panel, a rainwater storage tank, a mini water pump, distribution tubing, and planting beds. Solar energy powers the water pump, which transfers stored rainwater directly to the plants through a simple irrigation network. The innovation promotes water conservation, renewable energy utilization, and environmental awareness among students.
Keywords: Solar energy, Rainwater harvesting, Smart irrigation, Sustainable agriculture, Green technology

1.0 INTRODUCTION
Regular watering is important for healthy plant growth, but plants are often neglected when people are busy or forget to water them. This can cause plants to wilt and reduce crop productivity. In addition, agriculture uses about 70% of the world's freshwater resources, highlighting the need for more efficient water management practices (UNESCO, 2024). Although automated irrigation systems are available, many require electricity and can be costly for schools and home gardens. Therefore, SOLARGROW JUNIOR was developed by combining solar energy and rainwater harvesting into a simple irrigation system. This innovation helps conserve water, promotes the use of renewable energy, and provides students with hands-on learning opportunities in sustainable agriculture and green technology (FAO, 2023; IRENA, 2024).

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) Develop a solar-powered irrigation system and utilize harvested rainwater.
b) Promote green technology education.
c) Reduce water and energy consumption.

3.0 NOVELTY & INVENTIVENESS
The system integrates solar energy and rainwater harvesting into a low-cost educational irrigation prototype suitable for schools and households.

Table 1: The table shows the comparison between the existing solution and Solar Grow Junior.

Aspect	Existing Solutions	SOLAR GROW JUNIOR (Our Innovation)
Watering System	**Manual & Tiring:** Needs regular human effort and constant monitoring.	**Smart & Automatic:** Solar-powered irrigation waters plants efficiently on its own.
Renewable Energy	**Traditional:** Uses conventional power; completely misses out on green tech.	**Eco-Friendly:** Powered entirely by the sun, teaching kids about clean energy.
STEM Learning	**Basic Gardening:** Limited to simple digging and planting.	**Hands-on STEM:** Combines farming, engineering, and environmental science.
Resource Efficiency	**Wasteful:** Uncontrolled watering leads to spilled and wasted water.	**Water-Saving:** A controlled system uses the exact amount of water needed.
Student Engagement	**Passive:** Students mostly just sit back and watch plants grow.	**Active & Creative:** Students design, build, and maintain a smart garden.

4.0 PRACTICALITY & USEFULNESS

Applicable in school gardens, home gardens, and community farming projects. The system is affordable, environmentally friendly, and educational.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The prototype consists of a solar panel, rainwater tank, mini water pump, tubing network, and vegetable planting beds. Solar energy powers the pump, delivering stored rainwater directly to plants.



Figure 1 Prototype of SOLARGROW

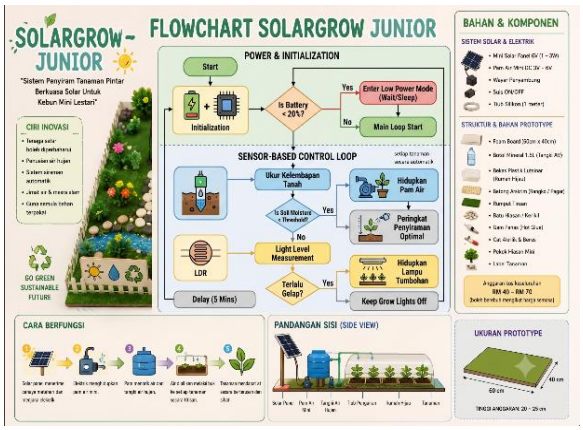


Figure 2 Flowchart Process of SOLARGROW JUNIOR

6.0 CONCLUSION

SOLARGROW JUNIOR demonstrates a practical approach to sustainable irrigation by combining renewable energy and rainwater harvesting while educating primary pupils on environmental stewardship.

ACKNOWLEDGMENTS

We would like to extend our sincere thanks to our advisor, Ustazah Bibi Aishah Binti Ali Shah for their invaluable guidance and advice during the development of the SolarGrow Junior project. We also appreciate the support from headmaster and school management of Sekolah Kebangsaan Seri Mendapat for providing us with the facility to innovate. Lastly, a special thanks to our team members and families for their hard work, cooperation, and motivation.

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PROJECT ID:IN128

THE ZERO-WASTE HERO: A PLANTABLE ECO-COMIC BOOK SYSTEM FOR SUSTAINABLE CHILDHOOD EDUCATION

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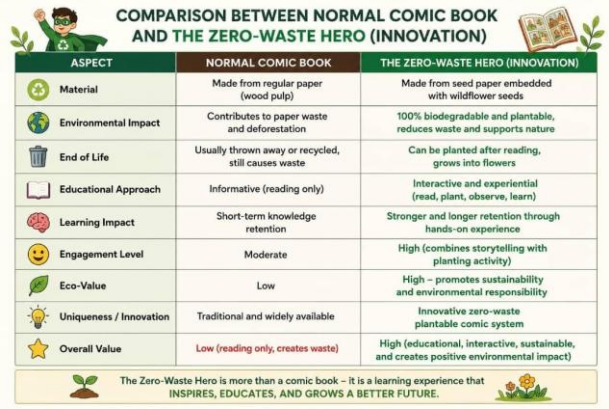
ABSTRACT
This study introduces The Zero-Waste Hero, an interactive, zero-waste educational model designed to combat paper waste and promote ecological literacy among children. Traditional comic books are temporary consumer goods that contribute significantly to regional waste or face eventual disposal. This project redesigns the medium by utilizing organic, biodegradable seed paper embedded with wildflower seeds. When planted post-reading, the material safely decomposes while initiating flora growth. Our prototype tests demonstrate that combining visual narratives with hands-on agricultural exploration significantly improves children's retention of environmental principles.
Keywords: Sustainability, Biodegradable Media, Eco-literacy, Seed Paper, Child Interactive Education.

1.0 INTRODUCTION
The printing and publishing industry represents a significant portion of global industrial paper consumption (Furszyfer Del Rio et al., 2022). While comic books remain a highly powerful and effective vector for childhood engagement, learning, and entertainment, their traditional lifecycle follows a linear model: extraction, production, short-term usage, and permanent disposal. Current alternative solutions, such as digital-only comic applications, lack the physical, tactile feedback essential for developing fine motor skills and deep cognitive engagement in young learners (Berube et al., 2024). Therefore, a critical gap exists for an interactive physical medium that eliminates raw material waste while actively fostering ecological awareness (Mc Donough & Braungart, 2022). This project aims to fulfil that gap by establishing a circular economy model within youth literature. By transforming a consumer reading item into a vital ecological tool (a micro-garden), we convert consumption into environmental renewal.

2.0 OBJECTIVE
Traditional comic books follow a linear lifecycle (printed, read, stored or thrown away into landfills). To replace non-recyclable materials with 100% biodegradable, plantable seed paper and natural twine binding. This ensures the physical product leaves zero carbon or physical footprint behind.

3.0 NOVELTY & INVENTIVENESS
Instead of ending up in a landfill, this eco-comic fully biodegrades in soil and grows wildflowers. This hands-on transformation helps children understand recycling and biology by showing the process in action. It also demonstrates that everyday products can be designed to be both enjoyable and environmentally beneficial.

Table 1: Comparison between existing solutions and proposed innovation



4.0 PRACTICALITY & USEFULNESS

This product is practical due to its simple, low-cost design that requires no advanced tools, making it easy for children to create using basic craft skills. It turns a storybook into a hands-on learning tool that teaches biology and recycling through direct experience. Instead of becoming waste, the book biodegrades and grows wildflowers, helping children understand the circular economy while supporting bees and butterflies in the environment.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The production of The Zero-Waste Hero eco-comic book utilizes an all-natural fabrication process designed to ensure absolute environmental safety and reliable plant germination. The book is structured around an unbleached, chemical-free substrate made from 100% post-consumer recycled paper pulp, which is uniformly embedded with non-invasive, quick-germinating wildflower seeds at a density of roughly 15 to 20 seeds per page. To eliminate toxic synthetic adhesives, the pages are precision-cut to an A5 format and bound mechanically with 2 mm organic jute twine using a manual three-hole saddle-stitch method. Visual elements are applied using child-safe, water-soluble pigment markers that will not harm soil pH levels upon degradation. To activate the circular product cycle after reading, the user submerges the comic book in water for 12 to 24 hours to soften the pulp before burying it under a light 0.5 cm layer of soil. With daily watering and standard sunlight exposure, the paper carrier completely breaks down into organic mulch within 21 days, giving rise to active, ecosystem-supporting plant sprouts within 7 to 10 days.

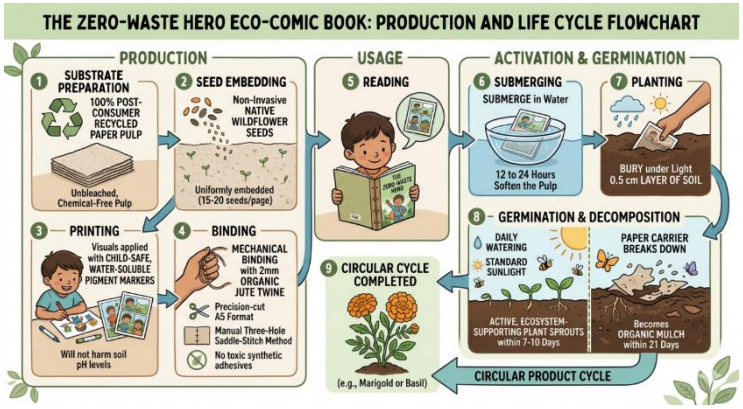


Figure 1: Development process flowchart

6.0 CONCLUSION

The Zero-Waste Hero successfully is a youth literature, and entertainment can safely co-exist with total environmental sustainability. By replacing traditional, resource-heavy publishing materials with 100% biodegradable seed paper and organic jute twine, this product transforms a temporary consumer item into an active tool for ecological renewal. It moves children away from screens and passive reading, placing them into a hands-on, practical biology lesson where they see their own choices directly help nature. Ultimately, this eco-comic serves as a highly scalable and powerful model for green media, proving that everyday products can be redesigned to give back to the planet.

ACKNOWLEDGMENTS

The authors would like to thank UiTM Jasin and SK Seri Mendapat for their support. Appreciation is also extended to the teacher Mr. Muhd Faiq Suhaimi, for his valuable contributions and support throughout the project.

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PROJECT ID: IN140

ECOHERO: RISE OF RENEWAL

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ABSTRACT
"EcoHero: Rise of Renewal" is an educational digital game developed to raise environmental.awareness among primary school.students. Environmental pollution is increasing rapidly, and many young learners still lack awareness and responsibility in protecting the.environment. Therefore, this project aims to create an engaging.and interactive learning tool through a game-based approach. The game was.developed using PictoBlox and designed with colourful pixel-style graphics to attract students' interest. Through gameplay, students are exposed to real environmental.issues such as pollution, deforestation, and improper.waste management. The game also promotes responsibility and care.for the environment, in line with Sustainable Development.Goal (SDG) 14 and 15. This innovation applies gamification.to make.learning more fun and meaningful. The game has been implemented in classroom.teaching and learning activities (PdPC) and has received.positive feedback. Overall, "EcoHero: Rise of Renewal" has strong potential to be expanded as a digital educational product.that supports environmental education and.encourages responsible behaviour among students.
Keywords: Gamification; Environmental Awareness; Digital Learning; SDG 14; SDG 15.

1.0 INTRODUCTION
Environmental pollution.is becoming a serious global issue. Problems such as.deforestation, water pollution, .and plastic waste are damaging.ecosystems and threatening human life. In Malaysia, forest loss and river pollution continue to increase, creating long-term.environmental challenges. Many primary school students still lack.awareness about environmental protection. Traditional teaching methods.may not always attract students' attention or create.meaningful engagement. As a result, students may understand environmental.topics only at a surface level. A more interactive learning approach is needed to make environmental education more effective and enjoyable. This innovation helps students learn environmental responsibility.from an early age. It benefits students, teachers, schools, and communities by.promoting sustainability awareness through.digital learning. The project also supports .21st-century education.by integrating.technology into learning.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To increase environmental awareness among primary school students.
b) To create an engaging learning experience using game-based learning.
c) To encourage students to practice responsible behavior toward the environment.

3.0 NOVELTY & INVENTIVENESS
The key innovative features of EcoHero lie in its unique.combination of engaging gameplay and educational value. The game incorporates pixel-style retro graphics that appeal to young learners and create.a visually attractive experience. In addition, EcoHero offers interactive environmental missions combined with monster battles, making the learning process more dynamic.and exciting. Its story-based gameplay further enhances.engagement by turning educational content into a fun and memorable adventure.for players. Players complete missions by defeating pollution monsters connected to illegal logging and water pollution. The game has potential for copyright protection as a digital educational product. Future expansion may include mobile applications and online learning platforms.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Learning Method	Textbooks and slides	Interactive gameplay
Student Engagement	Moderate	High
Learning Experience	Passive	Active and fun

4.0 PRACTICALITY & USEFULNESS

The game can be used.during classroom lessons, environmental campaigns, and co-curricular activities, making it suitable for a wide range of educational settings. The main target users.and beneficiaries.include primary school students, teachers.and schools, as well as communities interested in sustainability education. In terms of feasibility and.implementation, the game is technically feasible as it is.developed using.accessible software such as PictoBlox, economically viable due to its low.development cost, scalable for future expansion into mobile and web versions, and sustainable because it requires.minimal maintenance while offering.long-term usability. Overall, the expected impact of the game is improved student engagement,.stronger environmental awareness, and.enhanced digital learning in schools.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

EcoHero: Rise of The Renewal.was developed through five main stages: problem identification,.concept planning, character.and level design, coding using PictoBlox, and testing with.improvements (Figure 1). The game.uses block-based coding with pixel-style graphics, interactive scoring, enemy.battles, and level progression to create an.engaging learning experience for primary school students. The system.consists of player controls, game logic, and visual output, allowing players to.move, complete missions, and defeat pollution monsters.representing environmental issues such as illegal logging.and water pollution.



Figure 1: Development Process Flowchart

Testing and validation were conducted.with 30 primary school students through.gameplay sessions, observations, and simple.assessments. The results showed positive engagement and improved understanding of environmental issues. The average score.increased from 3.0 (pre-test) to.4.3 (post-test), with an improvement of +1.3 (43.3%), proving.the effectiveness of the game as a digital learning tool.

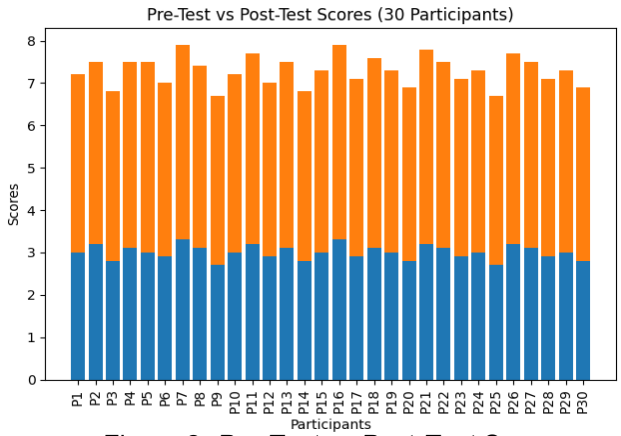


Figure 2: *Pre-Test vs Post-Test Scores*

Table 2. Pre-Test vs Post-Test Analysis

Category	Score
Average Pre-Test	3.0
Average Post-Test	4.3
Average Improvement	+1.3
Improvement (%)	43.3%

The technical operation of EcoHero is based on interactive learning principles, where players actively participate in missions to defeat pollution monsters representing environmental threats. Each.completed mission restores.part of the environment and reinforces environmental knowledge through gameplay. This combination.of gamification, storytelling, and digital.interaction makes learning.more enjoyable, memorable, .and effective for primary school.students.

6.0 CONCLUSION

EcoHero: Rise of The Renewal successfully.transformed environmental education into an engaging digital game for.primary school students. The project contributes to educational innovation.by combining gamification, storytelling, and sustainability awareness in.one platform. However,.current limitations include limited levels.and platform availability, as the game is not yet accessible on mobile devices. Future improvements include adding more levels, advanced challenges, .and mobile or online versions to.increase accessibility and reach.more users. Overall, EcoHero: Rise of The Renewal.demonstrates how digital innovation.can bridge ideas and technology to create meaningful.learning experiences and help.build a more environmentally.responsible future.

ACKNOWLEDGMENTS

We would like to express our.sincere appreciation to SK Tasek Utara, our teachers, mentors, and everyone who supported the development of this project. Their guidance and encouragement.made this innovation possible.

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PROJECT ID:IN142

STARSEK BIOFLY

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ABSTRACT
"Starsek BioFly" is an automated Black Soldier Fly (BSF) waste converter designed to address the critical issue of escalating food waste in Malaysia. Food waste is currently one of the largest contributors to landfill problems, resulting in foul odours, greenhouse gas emissions, and resource depletion, while agricultural supplies like animal feed and fertilizers simultaneously grow more expensive. This project aims to introduce an innovative, automated tech-driven approach to organic waste management by utilizing Black Soldier Fly larvae to rapidly consume and recycle food waste. The system was built using a cost-effective, 3D-printed modular design and is integrated with an Arduino microcontroller, smart sensors (temperature, humidity, moisture, and ultrasonic waste levels), a mechanical crusher, and an auto-harvesting separator tray system. Through this automated biochemical processing, the machine successfully reduces food waste by up to 70% while outputting high-protein larvae for sustainable animal feed and organic nutrient-rich frass for fertilizer. This innovation directly supports Sustainable Development Goals (SDGs) 2, 11, 12, and 13 by fostering food security, creating sustainable communities, reducing landfill methane emissions, and promoting a circular green economy. Tested for viability, Starsek BioFly shows high commercial potential for schools, restaurants, households, and local farmers. Future enhancements will include full IoT mobile app integration for real-time monitoring and advanced AI camera features to detect larvae maturity.
Keywords: Black Soldier Fly; Waste-to-Wealth; Automation; Circular Economy; IoT; Food Waste Management.

1.0 INTRODUCTION
In Malaysia, solid waste management is an increasingly severe environmental and economic challenge, with citizens generating roughly 15,000 tonnes of food waste daily. Of this amount, 3,000 tonnes consist of perfectly avoidable, edible food that could otherwise sustain 2.2 million people. When discarded into landfills, this organic mass rots to generate severe odours and toxic methane emissions that accelerate climate change. At the same time, traditional modern agriculture faces massive operational costs due to rising prices for synthetic fertilizers and imported livestock feeds. This project bridges these two issues by inventing "Starsek BioFly"—an automated, small-scale waste-to-resource converter. Utilizing technology to supercharge natural biological breakdown, the system empowers communities, schools, and local sectors to seamlessly upcycle their organic scraps, turning localized waste streams into eco-friendly wealth while reducing national landfill dependence.

2.0 OBJECTIVE
The primary objectives of this innovation are:
a) To safely reduce household, school, and commercial food waste volumes by up to 70%.
b) To fully automate organic waste recycling using a smart, low-maintenance hardware setup.
c) To generate sustainable, affordable alternatives for organic fertilizer (frass) and high-protein animal feed to lower farming overheads.
d) To advocate for practical STEM application and circular economy principles within local communities.

3.0 NOVELTY & INVENTIVENESS
The novelty of Starsek BioFly lies in transforming a traditionally messy, manual biological procedure into a clean, automated "smart-bin" appliance. Unlike standard composting methods or manual open-air BSF cultivation, this prototype features: Smart Multi-Sensor Arrays: Integrates moisture, ultrasonic, temperature, and humidity sensors routed through an Arduino controller to keep larvae environments perfectly optimized. Integrated Mechanical Crusher: Built-in motorized teeth grind down diverse food scraps directly into the hopper to speed up larval consumption rates. Auto-Harvesting & Separation:

Designed with custom slopes and separation trays that leverage natural larval migration patterns, automatically collecting prepupae safely without human sorting. 3D-Printed Modular Shell: A low-cost, lightweight framework that is highly scalable and incredibly easy to manufacture, repair, or upgrade.

4.0 PRACTICALITY & USEFULNESS

Starsek BioFly is exceptionally practical because it operates with a low cost of development but generates dual high-value outputs. Its compact footprint makes it perfectly suited for multiple consumer segments: schools running hands-on STEM or ecology programs, restaurants/hotels looking to handle organic waste on-site, small-scale livestock or poultry farmers trying to avoid feed costs, and eco-conscious residential households. Economically, it converts a free waste raw material into premium organic commodities, minimizing local municipal waste collection burdens and eliminating environmental landfill expenses.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of Starsek BioFly followed an iterative engineering cycle:



Figure 1: Development Process Flowchart

The system tracks live parameters like temperature (26.28C) and relative humidity (54%) to maintain peak larval metabolism. Testing demonstrated a drastic volumetric reduction in food waste of up to 70% within short timeframes, outputting clean, nutrient-dense organic frass alongside healthy, nutrient-packed larvae.

6.0 CONCLUSION

Starsek BioFly successfully proves that embedded electronic systems can merge with biological solutions to solve modern environmental challenges. By seamlessly processing everyday waste into localized wealth, the project delivers a highly functional, scalable framework aligned with global sustainability agendas. While current iterations remain localized, future advancements will implement advanced IoT connectivity for mobile smartphone dashboards and AI computer vision integration to instantly evaluate larvae growth cycles, bringing community-driven waste management entirely into the smart digital age.

ACKNOWLEDGMENTS

We would like to express our sincere appreciation to SK Tasek Utara, our teachers, mentors, and everyone who supported the development of this project. Their guidance and encouragement made this innovation possible.

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PROJECT ID: IN146

SMART ROOF FOR CLOTHES DRYING AREA

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ABSTRACT
The Smart Roof for Clothes Drying Area is an innovative automated system designed to address the challenges of outdoor clothes drying in regions with unpredictable weather conditions. Many households face difficulties such as sudden rainfall, high humidity, and the inconvenience of manually protecting clothes during weather changes. Existing solutions like conventional dryers consume high energy, while manual retractable systems require constant user intervention. Therefore, this project aims to provide a smart, efficient, and eco-friendly alternative for outdoor clothes drying. The proposed solution is a weather-responsive retractable roof system integrated with rain and light sensors. The system uses an Arduino Uno microcontroller to process environmental data and automatically open or close the roof based on weather conditions. When rain or low light is detected, the roof closes to protect clothes, while favourable weather conditions allow the roof to remain open for natural drying. The methodology involved designing and integrating hardware components including the Arduino Uno, rain sensor, light sensor, and motorized roof mechanism. Sensor readings were continuously monitored, processed, and translated into automatic roof movements. The system was developed to operate with minimal manual supervision while maintaining efficiency and reliability. The findings indicate that the Smart Roof effectively reduces the need for constant monitoring, protects clothes from unexpected rain, and minimizes reliance on electric dryers. The project demonstrates strong potential for improving convenience, reducing energy consumption, and supporting sustainable living practices. Its scalability, smart home compatibility, and suitability for urban households and rainy regions make it a promising innovation for both residential and commercial applications.
Keywords: Smart Roof, Arduino Uno, Sensors

1.0 INTRODUCTION
The Smart Roof for Clothes Drying Area is an innovative automated drying system designed to solve common household problems caused by unpredictable weather conditions. In many regions with frequent rainfall and high humidity, outdoor clothes drying becomes difficult and inconvenient. Users often need to manually remove clothes during sudden rain, resulting in wasted time and partially wet clothing. This project introduces a smart and automated solution that improves the efficiency and convenience of outdoor clothes drying while supporting energy-saving practices.

2.0 OBJECTIVE
The objectives of this project are:
a) To develop an automated roof system that protects clothes from rain and excessive moisture.
b) To utilize rain and light sensors for automatic roof operation.
c) To reduce dependency on electric dryers and encourage natural drying methods.
d) To provide a practical and user-friendly solution for households, especially in urban and rainy environments.

3.0 NOVELTY & INVENTIVENESS
The uniqueness of this project lies in the integration of smart sensor technology with a motorized retractable roof system for clothes drying areas. Unlike conventional clotheslines or manual retractable roofs, this system automatically responds to environmental changes using rain and light sensors connected to an Arduino Uno microcontroller. The innovation also supports future smart home integration and mobile application control, making it a modern and sustainable household solution.

4.0 PRACTICALITY & USEFULNESS

The Smart Roof system is highly practical for households, apartment dwellers, and commercial laundry users. It minimizes the need for constant weather monitoring and manual intervention. The system protects clothes from sudden rain, reduces drying time, and saves electricity by reducing the use of electric dryers. In addition, it is space-saving, durable, and suitable for areas with unpredictable weather conditions. The product also contributes to sustainable living by promoting energy-efficient drying methods.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The project was developed using an Arduino Uno as the main controller. Rain and light sensors were installed to detect weather conditions and surrounding brightness levels. These sensors send input signals to the Arduino, which processes the data and controls a motorized retractable roof mechanism.
Technical Specifications:

- Controller: Arduino Uno
- Sensors: Rain sensor and light sensor
- Roof System: Automated motorized retractable roof
- Power Supply: AC power or rechargeable battery
- Future Enhancement: Solar panel integration and mobile application control

System Operation:

- Sensors continuously monitor rain and light intensity.
- Arduino processes the collected sensor data.
- The roof automatically closes during rain or low light conditions.
- The roof reopens when weather conditions improve.

6.0 CONCLUSION

In conclusion, the Smart Roof for Clothes Drying Area represents a practical and innovative advancement in smart household technology by combining automation, sustainability, and user convenience into a single solution. By addressing everyday challenges caused by unpredictable weather and reducing dependence on energy-intensive drying methods, this innovation promotes smarter and more sustainable living practices. The integration of sensor technology, automation, and future smart home capabilities demonstrates how simple ideas can be transformed into impactful technological solutions. Ultimately, this project strongly reflects the spirit of i-NEXTECH 2026 by "Bridging Ideas and Technology for a Resilient Future," as it offers a resilient, energy-efficient, and adaptable solution that improves quality of life while supporting environmental sustainability.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to everyone who contributed to the success of this project, Smart Roof for Clothes Drying Area. First and foremost, we would like to thank SK Dato Mohd Musa for providing us with the opportunity, facilities, and continuous support throughout the development of this innovation project. We are deeply grateful to our supervisor and teacher advisor, Nurul Nadiah bt Faruk, for her valuable guidance, encouragement, patience, and continuous support from the beginning until the completion of this project. Her advice and motivation greatly inspired us to improve and complete our innovation successfully. Special appreciation is also extended to our parents for their endless moral support, encouragement, and understanding throughout this project. Their support has motivated us to work harder and stay committed to achieving our goals. Lastly, we would like to thank our friends who provided ideas, assistance, and encouragement during the development of this project. Their cooperation and teamwork contributed greatly to the success of our innovation. Thank you to everyone who has directly or indirectly contributed to making this project a meaningful and valuable experience.

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PROJECT ID:IN153

MEASURE MONSTER: INTERACTIVE EDUCATIONAL GAME FOR YEAR 3 PRIMARY SCHOOL (MEASUREMENT)

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ABSTRACT
Mathematics is an important subject in primary school. However, many Year 3 students find measurement concepts difficult because the topic can be hard to visualize and learning materials are often not engaging. Traditional teaching methods may also reduce students' focus and motivation. To overcome this problem, *Measure Monster* was developed as an interactive educational game to help students learn measurement in a more fun and engaging way. The game was created using PictoBlox, a block-based programming tool for building interactive applications. *Measure Monster* includes measurement activities, challenges, and rewards that encourage students to learn through play. The development process involved planning, designing, building, and testing to ensure the game is easy to use and suitable for learning. This innovation provides an enjoyable learning experience where students can practice measurement skills through interactive activities. Early feedback showed that the game increased students' interest, participation, and confidence in learning mathematics. By combining learning with play, *Measure Monster* offers a simple digital learning tool that can be used in class or at home. It demonstrates how educational games can improve understanding and make learning more enjoyable for primary school students.
K*eywords: Educational Game, Game-Based Learning, Mathematics, Measurement, PictoBlox*

1.0 INTRODUCTION
According to Gunawan et al., 2017, education helps children develop knowledge and skills. Mathematics is an important subject in primary school, especially measurement, which is used in daily life. However, many students find it difficult because lessons often focus on memorization and textbook exercises instead of real-life understanding (Sirait, 2016; Lestari, 2015). Technology and educational games can help make learning more interesting, improve motivation, and support active learning (Bakker et al., 2014; Kartika et al., 2019; Ranuharja et al., 2021). To address this problem, *Measure Monster* was developed using PictoBlox as an interactive game for Year 3 students. It helps them learn measurement through fun activities and real-life questions. Based on research by Kartika et al., 2019; Ranuharja et al., 2021, shows that interactive learning tools can improve understanding and engagement in mathematics. The game also supports game-based learning, which makes learning more engaging and effective (Bakker et al., 2014). This project was developed by primary school students, showing how students can use technology to solve learning problems creatively.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To design an educational game that makes learning fun and engaging by incorporating real-world scenarios, improving student interest in mathematics while demonstrating the practical importance of measurement in daily life.
b) To develop an interactive educational game that allows students to explore and apply measurement concepts.
c) To evaluate the effectiveness of the educational game in enhancing students' understanding and application of measurement concepts.

3.0 NOVELTY & INVENTIVENESS

Measure Monster is an interactive educational game that helps Year 3 students learn measurement in a more fun and engaging way. Unlike traditional methods that use textbooks and worksheets, the game allows students to learn through challenges and real-life situations. It includes interactive gameplay where students must answer correctly to progress, real-life questions based on daily objects, a level system where each level must be completed before moving on, instant feedback to help students learn from mistakes, and character-based learning where each monster represents a different measurement topic.The project also has potential for copyright protection, including its game design, content, graphics, and software. In the future, it can be expanded into a larger educational tool for different subjects and used in more schools to support interactive learning.
Comparison with Existing Solutions.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Measure Monster
Learning Method	Textbooks and worksheets	Interactive educational game
Student engagement	Limited Interaction	Fun and engaging gameplay
Feedback	Teacher-dependent	Immediate feedback

4.0 PRACTICALITY & USEFULNESS

Measure Monster can be used in classrooms, computer labs, or at home to help Year 3 students learn measurement in a more interactive way. The main users are primary school students, teachers, and parents who want to support mathematics learning. Teachers can use it as a teaching aid, while students can use it for practice and revision. The game APK is developed using PictoBlox, making it low-cost, easy to use, and suitable for schools with basic computer facilities. It can also be expanded in the future by adding more topics such as time, money, and shapes. The game is scalable for different year levels and supports digital learning, reducing the use of printed materials. Overall, *Measure Monster* is expected to improve students' understanding, increase their interest in mathematics, and make learning more enjoyable and effective.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of *Measure Monster* followed a simple step-by-step process starting from identifying the problem, designing the game concept, developing the prototype, and testing the final product. The game was created using PictoBlox, a block-based programming platform that allows interactive game development using visual coding. The system includes a user interface, game logic, scoring system, and feedback system that work together to support learning. The main materials used include PictoBlox software, digital graphics and sound effects to enhance user experience. The game was tested with Year 3 students to observe usability, engagement, and understanding of measurement concepts. Feedback was collected through observation and simple evaluation to check whether the game was easy to use and effective for learning. Overall, the system works by allowing students to answer questions, receive instant feedback, and progress through levels, making learning more interactive and enjoyable.

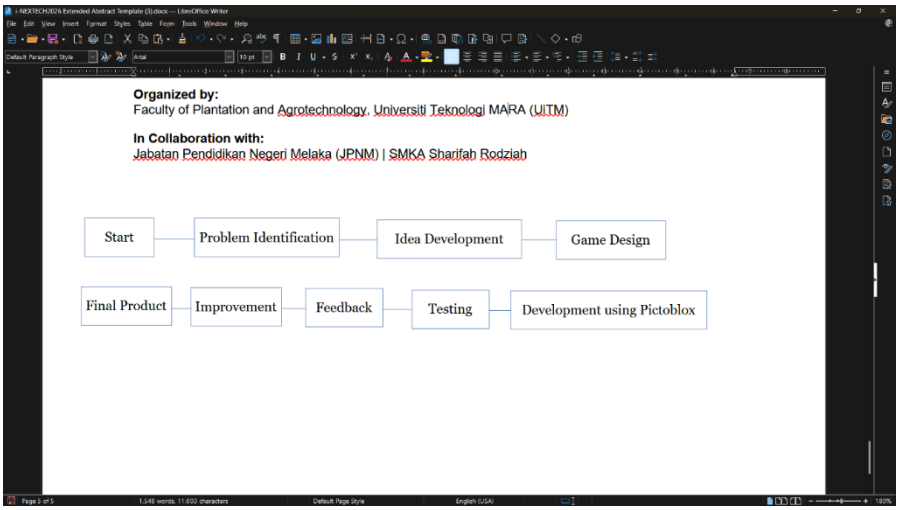


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
PictoBlox Software	Block-based programming platform	Used to develop the interactive game
Graphic Assets	Images and characters	Used to make the game more engaging
Sound Effects	Audio files	Used to enhance user experience

6.0 CONCLUSION

Measure Monster successfully helps Year 3 students learn measurement in a more fun and interactive way. The game solves the problem of low interest and difficulty in understanding measurement by using simple gameplay, real-life questions, and instant feedback. It helps students understand better and makes learning more enjoyable. However, the game is still limited to basic measurement topics and was tested with only a small number of users. In the future, it can be improved by adding more topics and more levels. Overall, *Measure Monster* shows how educational games can make learning more meaningful and enjoyable, supporting the theme of i-NEXTECH 2026 by bridging ideas and technology for a more innovative and resilient future.

ACKNOWLEDGMENTS

We would like to thank SK Dato Mohd Musa and the school community for their support in completing this project. Special thanks to the Headmaster, Issnu Bin Dollah for allowing us to carry out this innovation in the school. We also sincerely thank our supervisors, Hazilah Binti Rashid and Izzah Iwani Najwa Binti Issnu for their guidance and continuous support throughout the development of *Measure Monster*. We also appreciate the help and cooperation of the Year 3 students who participated in testing the game and provided useful feedback. Finally, we would like to thank everyone who directly or indirectly contributed this project.

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PROJECT ID:IN75

PROMPT HACKER ACADEMY: TEACHING CHILDREN HOW TO COMMUNICATE WITH ARTIFICIAL INTELLIGENCE

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ABSTRACT
Today, many students use AI like chatbot for homework and learning. However, many children do not know how to write good prompts to get better AI answers. Their prompts are often too short or unclear, causing inaccurate responses. To solve this problem, I created “Prompt Hacker Academy,” an educational game built with PenguinMod. The game teaches children to write better prompts through missions, points, and visual feedback. Before the AI responds, the system checks the prompt and scores its detail, formatting, instructions, and rules. Players can improve their prompts to earn higher scores and better answers. The project uses scoring systems, animated bars, and AI responses to make learning fun and interactive. It helps children develop AI communication skills safely while showing how games and visual programming can make AI education easier for young students.
Keywords: AI literacy, prompt engineering, gamification, visual programming, educational technology

1.0 INTRODUCTION
Artificial Intelligence (AI) tools are becoming popular in schools and daily life [1]. Many students already use AI to help with learning [1][2]. However, many children often use short or unclear prompts, causing AI to generate answers that are too general or inaccurate, until the users become frustrated [3][4]. Good prompts require 4-D approach, that is, role, details, constraints, and format to produce better results [1][2]. Most AI applications also do not teach users how to improve their prompts especially to teach prompt engineering for children through visual programming and gamification [1][2][3]. This project is important because AI literacy is becoming an essential future skill [3][4]. Children need to learn how to use AI responsibly and effectively [3][5]. This game can help students improve AI communication and creativity while learning technology in a fun way. Schools and teachers may also use this system for AI learning activities [1][2][5]. Because of this, we want to create a safe and fun game that teaches children how to write better AI prompts.

2.0 OBJECTIVE
The objectives of this project are:
a) To make game to learn AI safe with children interface.
b) To help students learn AI communication skills through missions

3.0 NOVELTY & INVENTIVENESS
This project combines AI, gamification, and visual programming into one learning platform for children. This project is different from normal AI chatbots because it teaches users how to improve their prompts before getting AI answers. The project is technically possible to build because it uses children friendly programming tool (PenguinMod). The innovative features are a close-system prompt scanner with JavaScript that scores prompt, a gamification system, and the use of PenguinMod, which can connect to AI through extension modules. (Table 1).

4.0 PRACTICALITY & USEFULNESS
This project also has the potential to become educational software and be developed into a larger AI learning platform for schools and coding communities, such as schools, coding clubs, and workshops. This game can help students communicate more effectively with AI systems. The main users are children aged 7 to 12 years-old but teachers, schools, and coding communities may also benefit from the platform. The system is low-cost because it can run online without expensive subscription or software. More missions, languages, and classroom features can be added in the future.

After we develop and repeatedly play this game, we feel that we got used to use the specific 4D format to prompt. The project supports long-term AI literacy and digital learning by helping children write better prompts to improve AI communication skills.
To increase security for children, the game uses a local JavaScript based prompt scanner that checks the quality of the prompt using different categories such as detail, format, role, and instructions. It also uses score bars, and missions to make learning more exciting (Table2).

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The project used PenguinMod with extensions. The project was developed step-by-step starting from interface design, prompt scoring system creation, AI communication setup, and gameplay testing. The system contains five main parts: user input, prompt cleaner, prompt analyzer, AI communication system, and output display (Figure 1.). First, we designed the game layout and user interface. The game will provide random mission that was programmed with JavaScript function. The prompt analyzer checks prompts using scoring categories such as detail, format, instructions, and constraint. We created the prompt analyzer system using JavaScript custom extension in PenguinMod. The system checks prompt for danger words (like kill, steal, bomb, etc.) and important features (like detail, constraints, formatting, and role). Certain inputs for the prompt will show if the prompt lacks previously mentioned features. After the prompt is checked, it is sent to the AI platform using custom extension block.[6] If the prompt need evaluation, the AI will give prompt feedback about what should be written. If the prompt is good, then the AI will give answer according to the prompt given.

6.0 CONCLUSION

This project successfully created an educational AI game that teaches prompt engineering using visual programming and gamification. The project helps children learn how to communicate better with AI while making technology learning more fun and interactive. More testing with larger groups of students is also needed. Future improvements may include voice interaction, more missions, multilingual support, and classroom management features.

ACKNOWLEDGMENTS

We thank DIGIKIDZ & ROBOTKIDZ Kelapa Gading that provided fundamental counsel for this project.

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Appendix:

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Prompt Learning	AI chatbots only generate answers	The system teaches users how to improve prompts offline based on detail, formatting, roles, and rules, before sending them and giving feedback
User Interaction	Standard text-based chatbot interface	Gamified learning with missions and animated feedback
AI Education	Limited AI literacy tools for children	We build the game using Child-friendly AI literacy platform using visual programming (PenguinMod with extensions)

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Prompt Analyzer	Rule-based scoring system using JavaScript Blocks	Check prompt quality based on detail, formatting, role, and constraintts
AI Integration	Custom blocks with temperature and seed settings	Generate AI responses and Suggestions
Diagnostic Interface	JavaScript based Animated score bars to analyze danger words and prompt quality	Provide real-time visual feedback

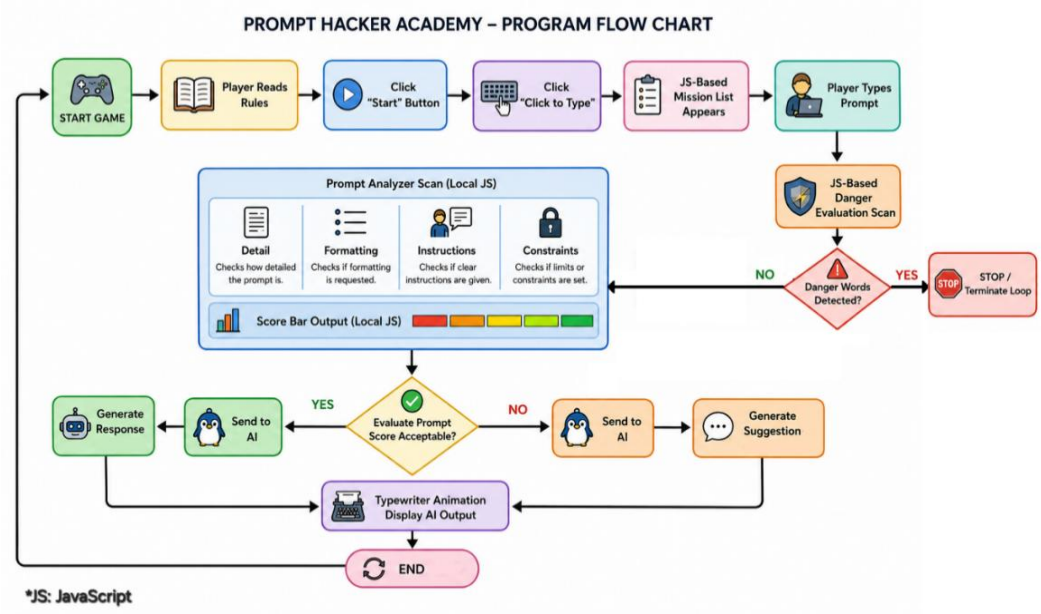


Figure 1: Development process flowchart

PROJECT ID: IN78

SMART PAJSK ADVISOR: A SMART DIGITAL SOLUTION FOR PAJSK PERFORMANCE MONITORING, STRATEGIC PLANNING, AND AI-GUIDED STUDENT ACHIEVEMENT ENHANCEMENT

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ABSTRACT
Pentaksiran Aktiviti Jasmani, Sukan dan Kokurikulum (PAJSK) is a key Malaysian assessment framework for evaluating students' holistic development through sports, co-curricular participation, leadership, and physical fitness. However, many students, parents, and teachers face challenges in understanding score calculations, tracking their achievements, and planning improvement strategies. Smart PAJSK Advisor was developed as a smart digital solution to address these challenges through integrated monitoring, predictive simulation, and AI-guided recommendations. A preliminary needs assessment involving 34 respondents was conducted. Developed using AppSheet low-code technology, the prototype features achievement tracking, progress monitoring, strategy simulation, parent and teacher monitoring hub. The innovation enhances transparency, strategic planning, and accessibility, demonstrating strong potential as a scalable educational technology solution for improving student co-curricular performance.
Keywords: PAJSK, student achievement, smart system, educational innovation, tracking system

1.0 INTRODUCTION
Pentaksiran Aktiviti Jasmani, Sukan dan Kokurikulum (PAJSK) was developed under the Ministry of Education Malaysia to evaluate students' participation and achievement in sports, clubs, and uniformed bodies (Ministry of Education Malaysia, 2017). It supports holistic student development by assessing leadership, teamwork, discipline, and social competencies essential for 21st-century learning (Darling-Hammond et al., 2020). Despite its importance, PAJSK remains challenging due to its complex scoring system and limited transparency. Preliminary findings showed that 63.7% of respondents lacked a clear understanding of PAJSK score calculation, while 54.6% were unsure how to improve scores strategically. Many also faced difficulties tracking achievements systematically. This lack of structured monitoring often results in fragmented record-keeping, limited visibility of student progress, and missed opportunities for performance improvement. As effective learning requires feedback, self-monitoring, and goal setting, there is a need for a smarter solution. Therefore, Smart PAJSK Advisor is proposed as an intelligent digital platform that supports automated tracking, predictive planning, and AI-guided recommendations to help students optimise their PAJSK performance through a more transparent and data-driven approach.

2.0 OBJECTIVE
This innovation aims to simplify PAJSK monitoring, support strategic performance planning through predictive simulation, and provide AI-guided recommendations to help students improve their co-curricular achievement.

3.0 NOVELTY & INVENTIVENESS
Innovation: Smart PAJSK Advisor is a digital platform that integrates PAJSK monitoring, predictive planning, and AI-guided support into a single system. Unlike existing manual and fragmented approaches, it transforms PAJSK into a simple, interactive, and user-friendly decision-support tool. Key innovative features include: (i) Integrated achievement tracking and progress monitoring; (ii) Predictive simulation for PAJSK score planning;(iii) AI-guided personalized recommendations; (iv) Visual dashboard for performance tracking; and (v) Mobile-friendly access for students, parents, and teachers. Intellectual Property: Smart PAJSK Advisor has been registered with the Intellectual Property Corporation of Malaysia (MyIPO) under Registration No: CRL2026W03729

Aspect	Existing Solutions	Smart PAJSK Advisor
Score Monitoring	Manual/fragmented tracking	Real-time progress dashboard
Strategic Planning	No predictive support	PAJSK Strategy Simulator
Guidance	Limited teacher advice	AI Coach recommendations
Accessibility	School-dependent access	Student-parent accessible platform

4.0 PRACTICALITY & USEFULNESS

Smart PAJSK Advisor is a practical and scalable digital solution designed for students, parents, teachers, and schools. Developed using low-code technology, it is cost-effective, user-friendly, and easily accessible via mobile devices. The system supports real-time monitoring, strategic planning, and informed decision-making, with strong potential for wider implementation in educational institutions.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

This innovation was developed using a prototype development approach involving needs assessment, system design, and prototype implementation. A preliminary survey with 34 respondents identified key challenges in PAJSK understanding, tracking, and strategic planning. The prototype was developed using Google AppSheet with Google Sheets as the database, integrating modules for profile management, achievement tracking, progress monitoring, predictive simulation, and AI-guided recommendations.

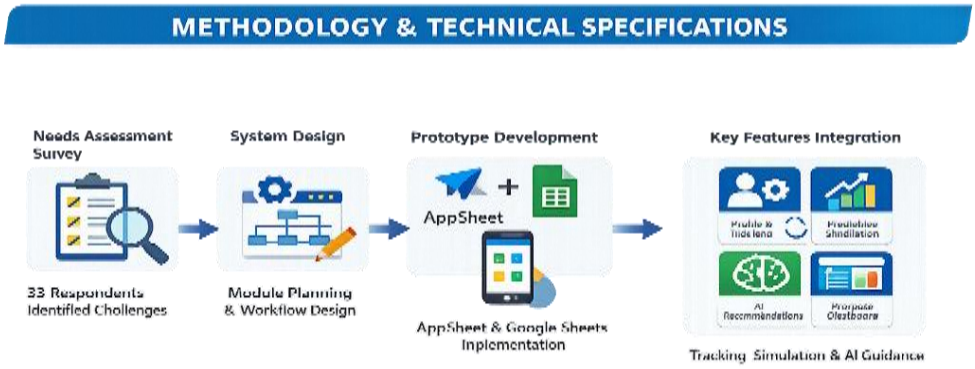


Figure 1: Development process flowchart

6.0 CONCLUSION

Smart PAJSK Advisor transforms PAJSK into a more transparent, interactive, and strategic digital system. By integrating monitoring, predictive simulation, and AI-guided recommendations, innovation empowers students to make informed decisions and improve their co-curricular achievement, with strong potential for wider educational implementation. Overall, this innovation demonstrates how simple digital solutions can bridge existing gaps and contribute to a more structured, data-driven, and resilient educational environment in line with the theme of *"Bridging Ideas and Technology for a Resilient Future."*

ACKNOWLEDGMENTS

The author would like to express sincere appreciation to Sekolah Kebangsaan Puteri, Seremban, for the support and guidance provided throughout this project. Special thanks are extended to Madam Iszura Ismail for valuable advice and encouragement, as well as to parents and respondents who contributed to the survey. This project did not receive any specific financial funding.

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PROJECT ID: IN17

ECOTHERM SOLUTION: SAVE ENERGY BY REUSING HEAT

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ABSTRACT
Ecotherm Solution is an innovative system that turns waste heat from air conditioners into useful energy for heating water. Normally, air conditioners release heat into the environment, which wastes energy and contributes to global warming. At the same time, heating water uses a lot of electricity. This system solves both problems by cooling rooms while using the wasted heat to warm water. It uses a special double-tube heat exchanger placed in the air conditioner system to capture heat and transfer it to water before it enters the heater. This can reduce electricity use by up to 30% and lower harmful gas emissions. It supports global goals like clean energy, responsible use of resources, and climate action. It can also work with renewable energy such as solar power, making it suitable for long-term use. To improve its impact, the project suggests working with manufacturers, creating awareness, and expanding its use to other areas like room heating and drying systems. Overall, the Ecotherm Solution is a smart and eco-friendly way to save energy, reduce waste, and protect the environment.
Keywords: Waste heat recovery, Thermal efficiency, Energy conservation.

1.0 INTRODUCTION
Background: The Ecotherm Solution is an innovative approach designed to transform waste heat from air conditioners into a valuable energy source, significantly enhancing the thermal efficiency of water heaters. It is a preliminary model of a heat exchanger to explain the functionality of the design in utilizing the wasted heat from air conditioner. Traditional air conditioners release substantial amounts of heat into the environment, contributing to energy wastage and exacerbating global warming. Simultaneously, water heating remains one of the most energy-intensive household activities, further straining energy resources. By addressing these intertwined challenges, the Ecotherm Solution pioneers a sustainable, dual-purpose system that cools indoor spaces while heating water.

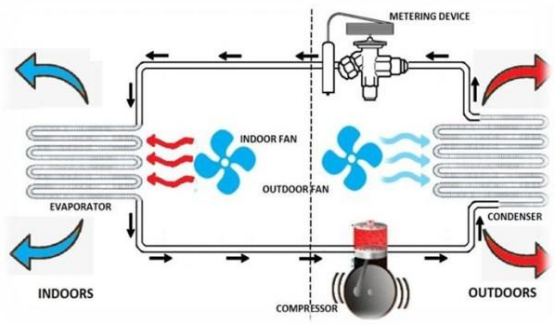
2.0 OBJECTIVE
The main objectives of this innovation/project are to recover heat from the air conditioner, reuse excess heat for water heater and to reduce energy costs by utilizing recovered heat.

3.0 NOVELTY & INVENTIVENESS
This project uses waste heat from air conditioners and turns it into useful energy instead of releasing it into the environment. It helps save electricity costs and reduces pollution at the same time. Unlike normal systems that waste heat, this system uses heat recovery technology to convert excess heat into water heating. This makes it more efficient and environmentally friendly. Overall, it offers a smart and cost-effective solution to reduce global warming and manage energy better.

4.0 PRACTICALITY & USEFULNESS
This innovation helps save energy and reduce waste, showing good care for the environment. It can also work together with renewable energy like solar power, making it suitable for long-term use. To improve its impact, the project suggests working with manufacturers, raising public awareness, and expanding its use to areas like space heating and drying systems. Overall, the Ecotherm Solution is a smart and effective way to solve energy problems while protecting the environment.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
Ecotherm Solutions uses waste heat from air conditioners to heat water. This reduces the need for extra water heaters and saves energy. Even though it needs an initial installation cost, it saves money and energy in the long run. It also helps lower electricity use and reduces carbon emissions, making it better for the environment. Heat naturally moves from a hotter area to a cooler area. In the Ecotherm system, hot refrigerant gas transfers its heat to cold water in a heat exchanger. The water absorbs the heat and

becomes hot water. At the same time, the refrigerant cools down and is reused in the system. This process heats the water efficiently as it passes through the heat exchanger.



6.0 CONCLUSION

In conclusion, this project improves water heating by using waste heat from air conditioners. It supports SDG 7, SDG 12, and SDG 13 by saving energy and reducing carbon emissions. It turns waste into useful energy and helps protect the environment.

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We would like to thank our advisor Puan Siti Asmah Shafie for their guidance. We also thank our school for providing support and resources. Lastly, we appreciate our family and friends for their encouragement.

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PROJECT ID: IN20

NATURAL FIRE EXTINGUISHER BALL

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ABSTRACT
Fires caused by cooking oil and minor electrical faults can spread rapidly in homes and schools, posing serious safety risks. Conventional fire extinguishers are effective but are often heavy, costly, and require training, limiting their immediate use. This project develops a Natural Fire Extinguisher Ball as a low-cost, simple, and user-friendly solution for early-stage fire suppression. It consists of sodium bicarbonate, sodium chloride, and cornstarch enclosed in a gypsum shell. When heated, sodium bicarbonate releases carbon dioxide to suppress flames, while salt improves dispersion and cornstarch prevents moisture absorption. An optimal 3:1 baking soda-to-salt ratio was identified. Tests on cooking oil fires showed 84% flame reduction within 10 seconds, outperforming loose powder.
Keywords: fire safety, sodium bicarbonate, carbon dioxide, gypsum shell, fire suppression

1.0 INTRODUCTION
Kitchen fires are common due to overheated cooking oil and are a leading cause of home fire incidents (NFPA). Although extinguishers are effective, they are often impractical for quick use due to weight, cost, and training requirements. Baking soda offers a simple alternative by releasing carbon dioxide to suppress flames. This study develops a low-cost fire extinguisher ball to improve early fire response in homes and schools, supporting safer communities and SDG 11.

2.0 OBJECTIVE
a. To investigate the fire suppression mechanism of a baking soda, salt, and cornstarch mixture.
b. To determine the optimal baking soda-to-salt ratio for effective suppression within 10 seconds.
c. To design and test a lightweight fire extinguisher ball using at least three prototypes.

3.0 NOVELTY & INVENTIVENESS
This innovation differs from conventional extinguishers by combining a natural powder system with a breakable gypsum shell for instant activation. It is lightweight, non-toxic, and requires no training. Key features include CO_2-based suppression, optimized powder ratio, and rapid-release shell design. Compared to traditional extinguishers, it is cheaper, easier to use, and environmentally friendly. The concept has potential for patent protection due to its unique combination of materials and design.

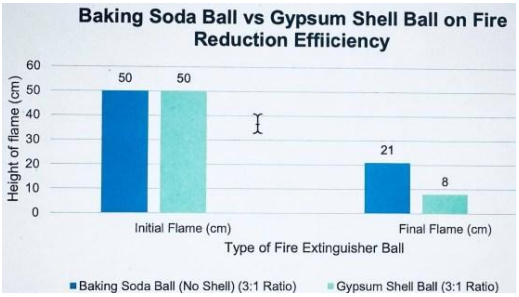
4.0 PRACTICALITY & USEFULNESS
The fire extinguisher ball can be used in kitchens, classrooms, and small residential areas for immediate response to early fires. It benefits households, schools, and communities by improving safety awareness and reducing fire damage. The product is low-cost, easy to produce, scalable and environmentally sustainable. It is suitable for mass production due to simple materials and processes, with potential to reduce response time significantly during small fire incidents.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
The project followed a structured process: research, material selection, mixture formulation, and prototype development. The fire extinguisher ball consists of a powder core ($NaHCO_3$, NaCl, cornstarch) and a gypsum shell. Controlled cooking oil fire tests were conducted to evaluate performance. Results showed rapid flame suppression, with up to 84% reduction in 10 seconds. The mechanism works through thermal decomposition of sodium bicarbonate.

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

CO_2 displaces oxygen, while heat absorption and powder dispersion enhance suppression. The gypsum shell ensures safe handling and quick release upon impact.





6.0 CONCLUSION

The Natural Fire Extinguisher Ball effectively addresses the challenge of slow response to small fires. It achieved optimal formulation, rapid activation, and strong fire suppression performance. The innovation is low-cost, safe, and suitable for homes and schools but is limited to small fires only. Future improvements include stronger and bigger shell design, wider fire testing, and possible mass production. In conclusion, this innovation demonstrates how simple scientific principles can create practical safety solutions. It supports the theme “Bridging Ideas and Technology for a Resilient Future” by offering an accessible and sustainable fire safety tool.

ACKNOWLEDGEMENT

We thank our supervisors, school and parents for support.

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PROJECT ID: IN22

BIOGAS PRODUCTION FROM ROTTEN FRUITS: A COMPARISON OF DIFFERENT INOCULA

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Supervisor: Anne Loh Jin Lin

ABSTRACT
Food waste is an increasing environmental issue that contributes to landfill overload and greenhouse gas emissions. This study explores the conversion of rotten fruits into biogas through anaerobic digestion as a sustainable energy solution. Four inocula—chicken manure, compost, pond mud, and yeast—were tested for their effectiveness. Equal amounts of fruit pulp and inoculum were placed in airtight 2 L digesters and incubated at 35–40°C for 28 days. Biogas production was measured using balloon expansion. Results showed that chicken manure produced the highest gas yield (83 cm), followed by compost (74 cm), pond mud (63 cm), and yeast (8 cm). The findings confirm that inoculum type significantly affects biogas production, with chicken manure being the most efficient due to its rich methanogenic bacteria.
Keywords: anaerobic digestion, biogas, food waste, methane, inoculum

1.0 INTRODUCTION
Rotten fruits from local markets are often discarded, causing environmental pollution. These organic wastes are rich in sugars and are suitable for anaerobic digestion to produce biogas (methane and carbon dioxide). However, the efficiency of gas production depends on the type of inoculum used.
Traditional food waste disposal methods such as landfilling are unsustainable and contribute to greenhouse gas emissions. This study addresses the need for a low-cost and efficient system to convert fruit waste into renewable energy using locally available materials.

2.0 OBJECTIVES
The objectives of the study are:
a) To identify the most effective inoculum for biogas production
b) To compare gas output using balloon circumference measurement
c) To evaluate feasibility of fruit waste as a renewable energy source

3.0 NOVELTY & PRACTICALITY
This innovation uses rotten fruit waste to produce biogas in a simple and low-cost system while comparing four natural inocula to identify the most effective one. Unlike traditional biogas systems that are expensive and complex, this project uses basic materials such as 2 L bottles and balloons, making it suitable for households, schools, and communities. A key innovation is the direct comparison of inocula under identical conditions and the use of balloon expansion as a simple method to estimate gas production without advanced equipment. This makes the system affordable, practical, and easy to replicate for small-scale applications.

4.0 METHODOLOGY
Rotten fruits (banana, papaya, apple, melon) were blended into pulp and mixed with chicken manure, compost, pond mud, or yeast. Each mixture (600 g fruit pulp + 200 g inoculum) was placed in a 2 L airtight plastic bottle. Balloons were attached to collect gas. The digesters were incubated at 35–40°C for 28 days under anaerobic conditions. Gas production was measured by balloon expansion using a measuring tape. Experiments were repeated three times to ensure reliability.

5.0 RESULTS
Biogas production increased steadily over 28 days. Chicken manure showed the highest and fastest gas production due to strong microbial activity, followed by compost and pond mud. Yeast produced the least gas.

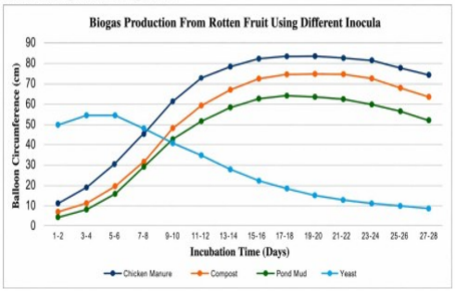





Overall performance:

- Chicken manure → Highest (83 cm)
- Compost → High (74 cm)
- Pond mud → Moderate (63 cm)
- Yeast → Lowest (8 cm)

Figure 6. Changes in balloon circumference over the 28-day incubation period for different inocula during anaerobic digestion.



6. CONCLUSION

This study confirms that rotten fruit waste can be effectively converted into biogas through anaerobic digestion. Among all tested inocula, chicken manure was the most efficient in producing methane-rich gas. The results highlight the importance of inoculum selection in optimizing biogas production.
This innovation provides a low-cost, sustainable, and practical solution for managing food waste while producing renewable energy. It has strong potential for household and community applications, supporting environmental sustainability and reducing landfill waste.

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We sincerely thank Prof. Wallace, Dr. Edwin, the school authorities, parents, and supporting teachers for their guidance, encouragement, and support in making this research successful.

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PROJECT ID: IN27

ECOVEND: SMART COIN-BASED PENCIL VENDING MACHINE FOR SUSTAINABLE SCHOOL ACCESS

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ABSTRACT
EcoVend is an innovative smart vending machine designed to address the common issue of students lacking immediate access to basic stationery, particularly pencils, during school hours. In many schools, students who forget to bring pencils must either borrow from peers or rely on limited access to school cooperatives. EcoVend offers a practical, automated solution by enabling students to purchase pencils using coins through a low-cost, Arduino-based system. The machine integrates piezo sensors to detect and differentiate coin values (10, 20, and 50 cents), an Arduino microcontroller to process inputs, and a servo motor to dispense pencils once sufficient payment is detected. An LCD display provides real-time feedback to users. The development process involved simulation using Tinkercad, prototyping, and functionality testing to ensure accuracy in coin detection and dispensing mechanisms. Results indicate improved accessibility, reduced classroom disruption, and enhanced student independence. EcoVend also promotes sustainability by encouraging efficient resource use and minimizing reliance on manual sales systems. This innovation has strong potential for scalability in schools and public learning spaces, contributing to smart education environments.
Keywords: Smart vending machine, Arduino, coin detection, school innovation, sustainability

1.0 INTRODUCTION
Background: In educational settings, especially primary and secondary schools, access to basic learning tools such as pencils is essential. However, students frequently forget or lose these items, causing disruptions to learning. Existing solutions, such as borrowing or purchasing from school cooperatives, are often inconvenient and time restricted. Problem Statement: There is a lack of accessible, automated systems within schools that provide essential stationery on demand. School cooperatives may not operate throughout the day, and borrowing can create dependency among students. This gap highlights the need for a self-service, reliable solution. Significance of the Study: EcoVend addresses this issue by promoting independence, minimizing classroom interruptions, and ensuring continuous access to learning tools. It benefits students, teachers, and school administrators while supporting the integration of technology in education. The development of EcoVend is supported by existing literature on microcontroller-based systems, STEM education, and technology-enhanced learning. The use of Arduino as a low-cost and flexible platform is widely documented, with Massimo Banzi and Shiloh (2022) highlighting its accessibility for educational innovation, while Michael Margolis (2011) and Simon Monk (2016) emphasize its effectiveness in developing interactive electronic systems. Practical electronics knowledge, as discussed by Charles Platt (2018), further supports the integration of sensors and actuators such as those used in EcoVend. From an educational perspective, constructivist learning theories introduced by Seymour Papert (1980) and expanded by Mitchel Resnick (2017) reinforce the value of hands-on, project-based innovations in fostering creativity and problem-solving skills among students. Additionally, the Ministry of Education Malaysia (2013) through the Malaysia Education Blueprint 2013–2025 advocates for the integration of technology in education to enhance learning outcomes. Collectively, these studies and frameworks provide a strong theoretical and practical foundation for the development of EcoVend as a relevant and impactful educational innovation.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To develop a functional coin-operated vending machine that dispenses pencils automatically.
b) To integrate Arduino-based technology for accurate coin detection and system control.
c) To enhance student accessibility to stationery while promoting independent learning habits.

3.0 NOVELTY & INVENTIVENESS

Innovation Aspects:
EcoVend introduces a compact, low-cost vending system specifically tailored for school environments.
Key Innovative Features:

- Integration of piezo sensors for multi-coin detection.
- Real-time LCD feedback for user interaction.
- Automated dispensing using servo motor technology.

Comparison with Existing Solutions:

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions Your Innovation	Aspect
Accessibility	Limited to shop hours	24/7 availability
Automation	Manual purchase	Fully automated
Cost	Higher operational cost	Low-cost system

Intellectual Property Potential: EcoVend has potential for patenting in educational vending system design and coin detection integration.

4.0 PRACTICALITY AND USEFULLNESS

Real-World Applications: Can be implemented in schools, libraries, and tuition centers.
Target Users/Beneficiaries: Primary and secondary school students, teachers, and school management.
Feasibility and Implementation: Technical Feasibility: Uses widely available Arduino components.

- Economic Viability: Low production and maintenance cost.
- Scalability: Can be adapted for other items (pens, erasers).
- Sustainability: Encourages efficient resource use.

Expected Impact:

- Reduces classroom disruption
- Improves student preparedness
- Enhances learning efficiency

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

- Design and Development Process: Conceptualization → Tinkercad simulation → Prototype development → Testing → Refinement
- Technical Architecture/System Design: The system uses piezo sensors to detect coin input, processed by an Arduino microcontroller. Once sufficient value is detected, a servo motor releases a pencil, while an LCD displays transaction details.
- Materials and Methods: Arduino Uno, piezo sensors, servo motor, LCD display, coin slot mechanism
- Testing and Validation: Tested for coin detection accuracy, dispensing reliability, and system response time.
- Results and Performance: High accuracy in coin detection and consistent dispensing performance observed.
- Technical Explanation**:** Piezo sensors generate voltage signals when coins are inserted. The Arduino processes these signals, calculates the total amount, and triggers the servo motor accordingly.

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Arduino Uno	Microcontroller	System control
Piezo Sensor	Coin detection	Identify coin value
Servo Motor	180° rotation	Dispense pencil

6.0 CONCLUSION

EcoVend successfully delivers an automated solution that improves students' access to essential stationery in schools, addressing a common classroom challenge. The innovation contributes to enhanced learning efficiency, supports the advancement of smart education environments, and demonstrates practical applications of STEM concepts in real-world contexts. Despite its effectiveness, several limitations were identified, particularly in terms of sensor sensitivity and occasional coin misdetection, which require further refinement. Future developments will focus on integrating digital

payment systems and expanding the machine's capability to dispense multiple types of items. Overall, EcoVend exemplifies how simple yet purposeful technological innovations can bridge existing gaps in education, in line with the i-NEXTECH 2026 theme of "Bridging Ideas and Technology for a Resilient Future."

ACKNOWLEDGMENTS
The authors would like to express their sincere gratitude to their parents for their continuous moral support, encouragement, and understanding throughout the development of this project. Special appreciation is also extended to the teachers for their invaluable guidance, constructive feedback, and mentorship, which greatly contributed to the successful completion of EcoVend. The school is also acknowledged for providing the necessary facilities, resources, and a supportive environment that enabled the implementation and testing of this innovation.

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PROJECT ID: IN179

EQUITY

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ABSTRACT
Equity is an inclusive digital platform developed to support SDG 10: Reduced Inequalities by improving employment opportunities and accessibility for people with disabilities. The platform addresses challenges such as limited access to suitable jobs, accessibility barriers, and inadequate support services. Equity integrates accessible job listings, employer partnerships, assistive communication tools, accessibility information, and community support within a single platform. Designed using accessible digital technologies, the platform empowers users to connect with employment opportunities, essential services, and support networks. Equity has potential applications among job seekers, employers, government agencies, and non-governmental organizations. Future enhancements include AI-powered job matching and expanded accessibility features. Overall, Equity demonstrates how digital innovation can promote inclusion, reduce employment barriers, and create equal opportunities for people with disabilities.
Keywords: Disability Inclusion, SDG 10, Accessible Employment, Assistive Technology, Digital Innovation.

1.0 INTRODUCTION
According to the International Labour Organization (ILO, 2020), people with disabilities face significant employment barriers, with unemployment rates twice as high as non-disabled individuals. In Malaysia, only 1.5% of the disabled population is employed. These challenges highlight the need for a more inclusive employment ecosystem and reinforce the importance of SDG 10: Reduced Inequalities, which aims to ensure equal opportunities for all members of society.

2.0 OBJECTIVE
The main objectives of this project are:
a) To increase employment opportunities for people with disabilities.
b) To connect employers with qualified disabled job seekers.
c) To provide accessibility information and support services.
d) To promote social inclusion and equal opportunities.

3.0 NOVELTY & INVENTIVENESS
Equity combines employment services, accessibility information, assistive communication tools, and community support in a single platform. Unlike conventional job portals, Equity is specifically designed for the needs of persons with disabilities and follows accessibility standards.

Aspect	Existing Solutions	Equity
Employment Access	General job portals	Accessible job listings tailored for people with disabilities
Employer Engagement	Limited focus on disability hiring	Dedicated employer partnerships for inclusive recruitment
Accessibility Support	Minimal accessibility features	Text-to-speech and disability-friendly design
Accessibility Information	Information scattered across multiple sources	Centralized database of accessible facilities and services

4.0 PRACTICALITY & USEFULNESS
Equity can be used by job seekers, employers, NGOs, government agencies, and local communities. The platform is cost-effective because it leverages existing smartphone technologies, cloud-based infrastructure, and automated processes. Its adaptable design allows future expansion and customization.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The project followed a structured development process consisting of problem identification, research, interface design, feature development, testing, and deployment. Equity was developed as a web-based platform to improve employment accessibility and support services for people with disabilities.

Component	Specification	Purpose
Web Platform	Web-based	Employment access
Job Listings	Accessible listings	Job matching
Communication Tool	Text-to-Speech	Accessibility support
Information & Services	Location directory	Accessible facilities
Community Support	Online groups	Peer support

6.0 CONCLUSION

Equity demonstrates how digital innovation can reduce employment barriers and create a more inclusive society. By connecting people with disabilities to opportunities, resources, and support networks, Equity contributes towards a more equitable future.

ACKNOWLEDGMENTS

Special thanks to my teachers, family members, and supporters for their guidance, encouragement, and continuous support throughout this project.

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PROJECT ID: IN206

MUSHROOM HOUSE OBSERVATION & CONTROL (MHOC)

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ABSTRACT
The Mushroom House Observation and Control (MHOC) based on Internet of Things (IoT) was developed to address the challenges of manually monitoring and controlling mushroom house environments. Conventional methods often result in unstable temperature and humidity conditions, affecting mushroom growth and yield quality. This project integrates an ESP32 microcontroller with temperature, humidity, and light sensors to automate environmental monitoring and control in real time. Sensor data are displayed on an LCD and transmitted to cloud through Telegram platforms for remote monitoring. Based on sensor readings, ventilation fans, water pumps, and LED indicators are activated automatically to maintain optimal growing conditions. In addition, the system incorporates an intelligent lighting control mechanism using two yellow LEDs. Oyster mushrooms require a light intensity of approximately 200–500 lux with a photoperiod of 12 hours of light and 12 hours of darkness. Therefore, the system monitors light intensity from 7:00 a.m. to 7:00 p.m., and whenever the detected illumination during daytime falls below 200 lux, the yellow LEDs are automatically activated as an alternative light source to ensure sufficient illumination for mushroom growth. Experimental results showed that the system successfully maintained temperatures between 24°C and 30°C and relative humidity between 80% and 90%. The system reduces dependence on manual labour, improves resource efficiency, and lowers operational costs. Furthermore, the stable environmental conditions contribute to more uniform mushroom growth and increased harvest productivity. This innovation demonstrates the potential of IoT technologies in enhancing modern and smart agricultural management and supports Sustainable Development Goal (SDG 9) by promoting innovation and digital infrastructure in agriculture.
Keywords: Internet of Things (IoT), Modern and Smart Agriculture, Mushroom House, ESP32, Environmental Monitoring

1.0 INTRODUCTION
Mushroom cultivation requires a controlled environment with suitable temperature and humidity levels. Manual monitoring is time-consuming and often causes inconsistent environmental conditions, leading to reduced mushroom quality and productivity. Therefore, an automated monitoring and control system is needed to ensure optimal cultivation conditions while reducing labour requirements and operational costs.

2.0 OBJECTIVE
a) To develop an IoT-based system for real-time monitoring of mushroom house conditions.
b) To automate temperature and humidity control using sensors and actuators.
c) To enable remote monitoring through cloud and Telegram applications.

3.0 NOVELTY & INVENTIVENESS
The innovation integrates environmental sensors, ESP32 microcontroller, cloud technology using Telegram notifications into a single automated system. Unlike conventional methods, the system performs real-time monitoring and automatic environmental control, providing a low-cost and efficient solution suitable for small-scale mushroom farmers.

4.0 PRACTICALITY & USEFULNESS
The system can be implemented in mushroom farms to improve cultivation management and productivity. It reduces manual intervention, optimises water and electricity consumption, and provides continuous remote monitoring. The solution is affordable, scalable, and environmentally sustainable for modern agriculture applications.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system was developed using an ESP32 microcontroller integrated with temperature, humidity, and light sensors. Data collected from the sensors are displayed on an LCD and transmitted to cloud and Telegram platforms. Based on predefined thresholds, the system automatically activates ventilation fans, water pumps, and LED indicators to regulate environmental conditions.

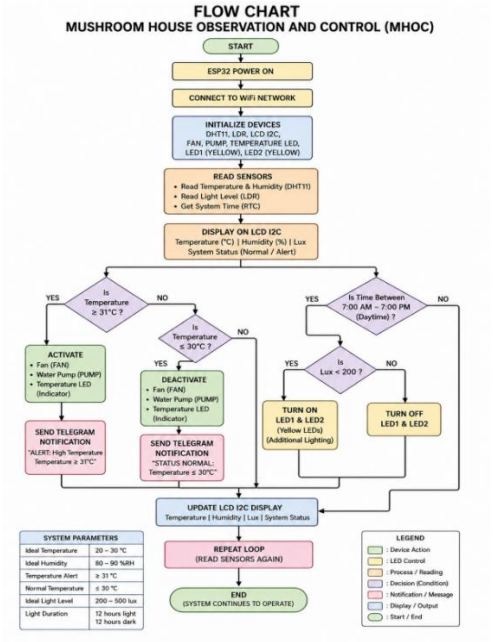


Figure 1: Flow Chart System MHOC

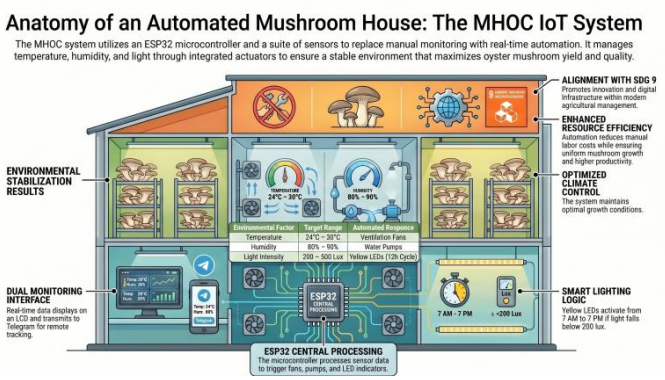


Figure 2: Anatomy of MHOC

6.0 CONCLUSION

Mushroom House Observation and Control (MHOC) successfully automated environmental monitoring and control for mushroom cultivation. The system maintained stable temperature and humidity conditions, improved cultivation efficiency, and reduced operational dependency on manual labour. This project highlights the potential of IoT technology in supporting smart agriculture and contributes towards sustainable and resilient agricultural development.

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PROJECT ID: IN210

EDUQUEST: A GAMIFIED WEB-BASED LEARNING ADVENTURE FOR PRIMARY SCHOOL STUDENTS

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ABSTRACT
EduQuest is a fully functioning gamified web-based learning application designed to support primary school students from Year 1 to Year 6 in English, Mathematics and Science. The project addresses the challenge of maintaining students' interest and confidence when learning is delivered mainly through traditional worksheets or one-way instruction. EduQuest proposes a kid-friendly space mission interface where students create a mission pass, choose their year and avatar, complete subject missions, receive instant feedback from AstroBuddy, an AI Learning Buddy, and earn stars, badges and a printable certificate. The innovation was developed as a responsive single-file HTML prototype using HTML, CSS and JavaScript, with a guided learning flow, question bank, scoring system, teacher dashboard and CSV result export. Functional validation showed that the main features operate on both desktop and mobile browsers, including profile creation, mission selection, adaptive Year 1-6 content, feedback prompts, progress tracking and certificate printing. EduQuest has the potential to increase learning motivation, support differentiated practice, assist teachers in monitoring student performance and promote meaningful digital learning in primary schools.
Keywords: gamified learning, web app, primary education, AI Learning Buddy, STEM

1.0 INTRODUCTION
Digital learning tools are increasingly used to make classroom activities more interactive and learner centred. However, many primary students still find practice activities less engaging when lessons depend mainly on worksheets, static quizzes or teacher-led explanations. This project addresses the need for a fun, structured and age-appropriate learning tool that can serve students from Year 1 to Year 6. EduQuest is significant because it combines game-based missions, responsive web design, instant feedback and teacher monitoring in one accessible platform. It benefits students by making practice enjoyable and supports teachers by providing a simple way to track scores and progress.

2.0 OBJECTIVE
a) To develop a responsive gamified learning web app for Year 1 to Year 6 students.
b) To provide interactive English, Mathematics and Science missions with level-based content.
c) To integrate AstroBuddy, stars, badges, certificate printing and a teacher dashboard to improve motivation and monitoring.

3.0 NOVELTY & INVENTIVENESS
EduQuest is novel because it packages a complete primary learning experience into a lightweight, responsive and browser-based application. Its key innovative features are: (i) guided student onboarding before mission access, (ii) Year 1-6 level selection, (iii) three subject galaxies, (iv) AstroBuddy instant hints and explanations, (v) reward-based learning through stars and badges, and (vi) a teacher dashboard with CSV export. The project has copyright potential for its interface design, learning content, name, visual layout and original source code.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	EduQuest
Learning approach	Static worksheets or basic quizzes	Space mission game with rewards and feedback
Accessibility	Often device- or app-dependent	Single browser-based app for PC, tablet and mobile
Monitoring	Manual checking by teachers	Dashboard, score summary and CSV export

4.0 PRACTICALITY & USEFULNESS

EduQuest can be used during classroom reinforcement, revision sessions, computer lab activities, home learning and innovation showcases. Its target users are primary school students, teachers and schools seeking a simple digital learning support tool. The system is technically feasible because it runs in a standard browser without installation. It is economically viable because no special hardware is required beyond existing computers, tablets or mobile phones. It is scalable because more subjects, questions, languages and real AI services can be added. Expected impacts include higher student engagement, quicker formative feedback, better teacher visibility of student scores and wider access to interactive learning.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development process involved identifying learning needs, designing the space mission interface, preparing Year 1-6 question sets, coding the responsive web app, integrating AstroBuddy feedback, testing core functions and refining the user flow. The technical architecture uses HTML for structure, CSS for responsive layout and visual design, and JavaScript for quiz logic, scoring, feedback, dashboard, CSV export and certificate printing. Validation focused on whether students could complete the flow from profile setup to mission completion on PC and mobile displays.

Figure 1: Development process flowchart

Needs Analysis	UI/UX Design	Web Coding	Function Testing	Final Prototype

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Frontend	HTML, CSS, JavaScript	Run the complete web app in browser
Content bank	Year 1-6, English/Math/Science	Provide level-based missions
AstroBuddy	Rule-based AI feedback engine	Give hints, explanations and motivation
Dashboard	Score table and CSV export	Support teacher monitoring
Certificate module	A4 single certificate print	Recognise mission completion

6.0 CONCLUSION

EduQuest successfully demonstrates a practical and engaging web-based education tool for primary students. It addresses the problem of low engagement by transforming practice into a space mission with instant feedback and rewards. The main contribution is a low-cost, device-friendly platform that links learning, motivation and teacher monitoring. Current limitations include the need for larger classroom testing and expansion of the question bank. Future work will include real AI integration, multilingual options, analytics and more subjects. EduQuest supports the i-NEXTECH 2026 theme by bridging creative learning ideas and accessible technology for a resilient future.

ACKNOWLEDGMENTS

The innovator acknowledges Sekolah Kebangsaan Paka 2, teachers, mentors, family members and peers who provided encouragement, ideas and feedback during the development of EduQuest.

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PROJECT ID: IN213

KIT BOBA M: AN INTERACTIVE LEARNING AID FOR MASTERING BASIC NUMBER WORDS

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ABSTRACT
Kit Boba M is an innovative and low-cost learning aid designed to help lower primary pupils master the spelling and writing of number words. The innovation was developed after identifying 22 pupils from Year 2 and Year 3 at SK Seri Mendapat who struggled to write numbers in words due to low engagement and short attention spans during Mathematics lessons. The kit uses colourful number cards, letter tiles, songs, velcro activities, and writing exercises to create a multisensory learning experience. The intervention was conducted over eight weeks through weekly 30-minute sessions. Findings showed significant improvement, where all pupils were eventually able to spell and write number words independently. Besides improving numeracy skills, the kit also increased pupils' confidence, participation, and interest in Mathematics. With a production cost of only RM6.23 per set, Kit Boba M is affordable, portable, and suitable for various learning environments including remedial classes, preschool, PPKI, and Year 1 classrooms. The innovation has also been shared with 17 schools in the Merlimau area, demonstrating its scalability and positive educational impact.
Keywords: numeracy skills, Mathematics, learning kit, innovation, early education

1.0 INTRODUCTION
Many lower primary pupils face difficulties in mastering basic numeracy skills, particularly writing numbers in words. At SK Seri Mendapat, 22 pupils from Year 2 and Year 3 were unable to spell number words correctly despite recognising numbers in digit form. This issue affected pupils' confidence and engagement during Mathematics lessons. Existing learning approaches lacked interactive and multisensory elements suitable for young learners. Therefore, Kit Boba M was developed as a fun, hands-on, and engaging learning aid aligned with the Malaysian Education Blueprint 2013–2025.

2.0 OBJECTIVE
The main objectives of this innovation are:
a) To help pupils spell and write number words from one to ten correctly.
b) To increase pupils' confidence and participation during Mathematics lessons.
c) To provide an affordable and engaging multisensory learning tool for teachers and pupils.

3.0 NOVELTY & INVENTIVENESS
Kit Boba M integrates visual, auditory, and kinesthetic learning through colourful cards, velcro letter arrangements, guided singing, and writing activities. Unlike traditional worksheets, the kit promotes active learning through games and repetition. The innovation is portable, reusable, and low-cost, making it suitable for classroom and remedial use. QR-linked songs and interactive activities further enhance pupil engagement.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Kit Boba M
Learning Method	Worksheets and memorisation	Interactive multisensory activities
Engagement	Passive learning	Game-based and hands-on
Cost	Moderate to high	RM6.23 per set
Accessibility	Limited	Portable and reusable

4.0 PRACTICALITY & USEFULNESS

The kit is practical for classroom teaching, remedial intervention, preschool learning, and special education settings. It benefits pupils, teachers, and parents by simplifying the learning process through enjoyable activities. Each set costs only RM6.23, making it highly affordable and easy to reproduce. Due to its effectiveness, the innovation has been expanded to 17 schools and adapted for preschool and PPKI pupils.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The intervention involved 22 pupils over eight weeks with weekly 30-minute sessions. Activities included recognising numbers, arranging letter tiles, singing number songs, rewriting number words, and repeated practice. Materials used include laminated glossy cards, velcro dots, mini whiteboards, marker pens, and zip-lock storage bags. Results showed an average improvement of 85% in pupils' ability to spell and write number words correctly. Teachers also observed increased confidence, participation, and enjoyment during lessons.

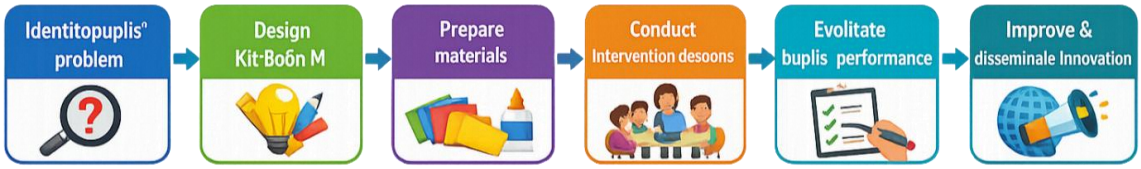


Figure 1: Development process flowchart

6.0 CONCLUSION

Kit Boba M successfully improved pupils' mastery of basic number words through an engaging multisensory approach. The innovation demonstrates that low-cost and teacher-driven interventions can significantly enhance learning outcomes when designed according to pupils' needs. Future improvements include expanding the content to other numeracy topics and integrating more digital learning elements. This innovation supports the i-NEXTECH 2026 theme, "Bridging Ideas and Technology for a Resilient Future," by promoting creative, inclusive, and sustainable educational practices.

ACKNOWLEDGMENTS

The authors would like to thank SK Seri Mendapat, Jabatan Pendidikan Negeri Melaka, participating teachers, parents, and pupils for their support and cooperation throughout the implementation of this project.

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PROJECT ID: IN215

SMART MANAGEMENT CLASSROOM SYSTEM

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ABSTRACT
S.M.A.C.S. is an IoT-based innovation developed to improve classroom management by integrating student participation tracking and classroom automation. Teachers often face challenges in monitoring participation systematically while manual control of classroom appliances may lead to inefficiency and energy wastage. The system utilizes Micro:bit, touch sensors, ESP8266 Wi-Fi modules, Telegram notifications, LEDs, and the Blynk platform. Students register participation through touch sensors, enabling real-time data collection and monitoring. Teachers receive instant notifications and can remotely control classroom appliances such as lights and fans. Prototype testing demonstrated accurate participation tracking, reliable notifications, and stable device control. The innovation promotes active learning, supports fair student assessment, improves classroom efficiency, and encourages sustainable energy usage. S.M.A.C.S. aligns with Education 4.0 by creating a smarter and more interactive learning environment.
Keywords: Internet of Things (IoT), Micro:bit, Smart Classroom, Student Participation Tracking, Blynk

INTRODUCTION
The integration of IoT technologies in education offers opportunities to enhance teaching and classroom management. However, participation monitoring is often conducted manually, and classroom appliances are still operated conventionally. S.M.A.C.S. was developed to address these challenges through an integrated system that combines participation tracking and classroom automation, providing teachers with real-time data and greater operational efficiency.

2.0 OBJECTIVE
a) To develop an IoT-based system for real-time student participation monitoring.
b) To provide instant participation notifications and analytics for teachers.
c) To automate classroom management for improved efficiency and energy sustainability.

3.0 NOVELTY & INVENTIVENESS
S.M.A.C.S. is unique because it combines student participation tracking and classroom automation within a single IoT ecosystem. The system integrates Micro:bit, Telegram, and Blynk platforms to provide real-time monitoring, instant notifications, and remote appliance control. Unlike conventional systems, it focuses on active participation rather than attendance alone, making classroom management more data-driven and effective.

4.0 PRACTICALITY & USEFULNESS
The innovation can be implemented in schools, TVET institutions, and training centres. It benefits teachers, students, and administrators by improving classroom management and reducing administrative workload. The system uses affordable and readily available components, making it cost-effective and scalable. In addition, automated appliance control promotes energy efficiency and sustainability.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
The development process involved problem identification, system design, hardware-software integration, prototype development, and testing. The system consists of Micro:bit controllers, touch sensors, LEDs, ESP8266 modules, relay modules, Telegram, and the Blynk IoT platform. Students interact with touch sensors to record participation, while teachers receive notifications and manage classroom appliances through mobile devices. Testing confirmed accurate participation recording, stable connectivity, and reliable real-time control.

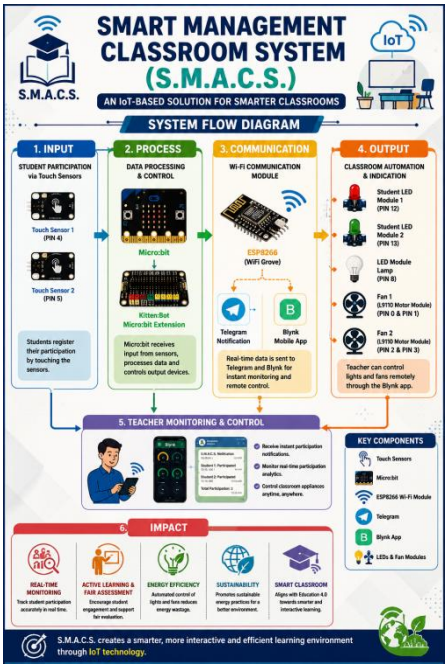


Figure 1: S.M.A.C.S system

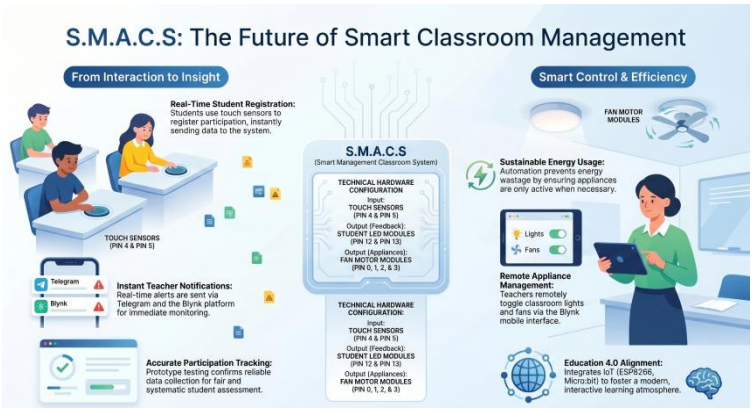


Figure 2: S.M.A.C.S pin out

CONCLUSION

S.M.A.C.S. successfully enhances classroom management by integrating participation monitoring and automation technologies. The innovation supports active learning, fair assessment, efficient classroom operations, and sustainable energy practices. Its affordability, scalability, and practical application make it a promising solution for future-ready smart classrooms aligned with Education 4.0 and the theme “Bridging Ideas and Technology for a Resilient Future”.

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PROJECT ID: IN217

KECAMBA AN INNOVATIVE READING STIMULUS MATERIAL TO IMPROVE YEAR 1 PUPILS' READING SKILLS

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ABSTRACT
Early literacy mastery is fundamental to pupils' academic achievement and future learning success. However, literacy screening conducted among Year 1 pupils at Sekolah Kebangsaan Seri Mendapat identified 17 pupils who were unable to recognise letters, decode syllables, or read simple sentences independently. To address this challenge, KECAMBA (KEnal–CAM–BAca) was developed as an innovative multisensory reading stimulus material that systematically guides pupils from letter recognition to sentence reading. The innovation integrates visual, tactile, and phonics-based learning through colourful stimulus cards, syllable modules, and structured reading activities. A quasi-experimental one-group pre-test and post-test design was employed to evaluate its effectiveness. Findings revealed significant improvements in letter recognition (35%–90%), syllable decoding (30%–85%), and sentence reading fluency (15%–80%). Constructed from affordable and recyclable materials costing only RM15.88, KECAMBA is reusable, scalable, and suitable for preschool, remedial, and mainstream education settings. The innovation has also been disseminated within and beyond the school, demonstrating its potential for wider educational impact. KECAMBA provides a practical and sustainable solution to literacy challenges while supporting the development of resilient and future-ready learners.
Keywords: Early Literacy, Reading Intervention, Multisensory Learning, Educational Innovation, KECAMBA

INTRODUCTION
Background: Reading proficiency is a foundational skill that significantly influences pupils' academic achievement and lifelong learning. In Malaysian primary schools, early literacy mastery is essential to ensure pupils can access and comprehend curriculum content effectively. However, literacy screening conducted among Year 1 pupils at Sekolah Kebangsaan Seri Mendapat identified a number of pupils who struggled with fundamental reading skills. Seventeen pupils were found unable to recognise letters consistently, identify phonemes accurately, blend syllables, or read simple words and sentences independently.

2.0 OBJECTIVE
The objectives of this innovation are:
a) To enhance pupils' skills in decoding syllables and constructing simple words.
b) To increase reading fluency and confidence in reading simple sentences.
c) To provide teachers with a low-cost and reusable literacy intervention tool.
d) To create an engaging multisensory learning experience that supports emergent readers.

3.0 NOVELTY & INVENTIVENESS
- Innovation Aspects:KECAMBA introduces a structured reading framework that integrates visual, tactile, and phonics-based learning elements within a single instructional material. Unlike conventional reading aids that focus on isolated literacy components, KECAMBA guides pupils systematically through three interconnected stages: recognising, decoding, and reading.
- Key Innovative Features:Progressive Learning Structure: The innovation follows a scaffolded sequence from letter recognition to sentence reading, enabling pupils to develop literacy skills gradually and systematically.
- Multisensory Learning Approach: KECAMBA combines colourful visuals, tactile manipulation, phonics activities, and interactive learning experiences to maximise pupil engagement.

- Cost-Effective Design: The innovation is produced using affordable materials such as coloured paper, adhesive plastic, and recycled boxes, resulting in a total production cost of approximately RM15.00.
- Reusable and Sustainable Materials: All components are laminated and durable, allowing repeated classroom use and reducing educational resource expenditure.

4.0 PRACTICALITY & USEFULNESS:

Real-World Applications: KECAMBA can be implemented in mainstream classrooms, remedial education programmes, preschool literacy instruction, and intervention classes for struggling readers. Target Users: Year 1 pupils, Preschool pupils, Remedial learners, Literacy intervention teachers, Special education support teachers

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Development Flowchart
Problem Identification → Needs Analysis → Material Design → Prototype Development → Classroom Implementation → Evaluation → Improvement

Materials and Components: Key Components and Specifications

Component	Specification	Purpose
Stimulus Cards	Colourful laminated cards	Letter and picture recognition
Syllable Cards	Modular syllable units	Decoding practice
Sentence Strips	Structured sentence cards	Reading fluency
Recycled Boxes	Durable storage system	Organisation and portability
Adhesive Plastic	Protective lamination	Reusability

Testing and Validation: A quasi-experimental one-group pre-test and post-test design was utilised involving 17 Year 1 pupils identified as having low literacy proficiency. Teachers employed observation rubrics and reading assessments to monitor progress. The results indicate substantial improvement across all literacy domains following implementation of KECAMBA.

6.0 CONCLUSION

Summary of Achievement: KECAMBA successfully addressed the literacy challenges experienced by Year 1 pupils through a structured and engaging intervention model. Significant improvements were recorded in letter recognition, syllable decoding, and sentence reading fluency.
Limitations and Challenges: The study involved a relatively small sample size and was conducted within a single school context. Broader implementation is required to establish wider generalisability.
Closing Statement: KECAMBA demonstrates how simple, low-cost educational innovations can effectively bridge literacy gaps among young learners. By integrating engaging multisensory learning experiences with systematic reading instruction, KECAMBA contributes meaningfully to the i-NEXTECH 2026 theme of “Bridging Ideas and Technology for a Resilient Future.”

ACKNOWLEDGMENTS

The authors would like to express sincere appreciation to the administration, teachers, pupils, and parents of Sekolah Kebangsaan Seri Mendapat for their support and cooperation throughout the development and implementation of KECAMBA.

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PROJECT ID: IN224

LAMAN AJAIB: PENGEMBARAAN CILIK – AN INTEARCATIVE AGRICULTURE LEARNING E-BOOK FOR YOUNG LEARNERS

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ABSTRACT
Agricultural education among children is often limited by the lack of engaging learning resources and reduced exposure to real-world gardening activities. To address this issue, *Laman Ajaib: Pengembaraan Cilik* was developed as an interactive agricultural learning e-book for children aged 5–12 years. The innovation integrates storytelling, QR-code audio narration, instructional videos and agricultural STEM concepts into a digital learning platform. The e-book follows the adventure of Hanna, a young character who explores science through interactive gardening experiences. The development process involved multimedia integration, QR-code implementation and digital publication. Learning activities were further reinforced through practical gardening tasks to promote experiential learning. Preliminary observations indicated positive engagement and active participation among children during the activities. By combining digital learning with hands-on experiences, the innovation enhances agricultural awareness, STEM learning and environmental responsibility. *Laman Ajaib: Pengembaraan Cilik* provides educational tool that supports technology-enhanced learning while fostering children's interest in agriculture and sustainability.
Keywords: Agriculture, E-book, STEM, Digital, Children

1.0 INTRODUCTION
Agriculture is essential for food security and environmental sustainability. However, many children today have limited exposure to agricultural knowledge due to urban lifestyles and increasing dependence on digital devices. Traditional educational resources often lack interactive elements that can effectively engage young learners (Hen et al., 2025). The lack of attractive agricultural learning materials reduces children's interest in understanding food production, plant growth and environmental stewardship. Digital storytelling and multimedia learning have been recognised as effective approaches for improving engagement and knowledge retention among children (Soydan et al., 2025). Therefore, *Laman Ajaib: Pengembaraan Cilik* was developed to provide an interactive learning platform that combines storytelling, multimedia technology, and agricultural STEM education. This innovation aims to cultivate agricultural awareness while promoting experiential and technology-enhanced learning.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To develop an interactive agricultural learning e-book for children age 5-12 years old.
b) To enhance children's interest in agriculture through storytelling and multimedia learning.
c) To promote STEM and environmental education through hands-on gardening activities.

3.0 NOVELTY & INVENTIVENESS
The innovation combines agricultural education, storytelling, QR multimedia technology and experiential learning within a single child-friendly digital platform which is comparable with existing solutions as in Table 1.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Laman Ajaib
Learning method	Text-based	Story-based interactive learning
Multimedia features	Limited	QR audio and video integration
Agricultural STEM content	Minimal	Integrated STEM and agriculture
Practical activities	Limited	Hands-on gardening activities

Key Innovative Features are interactive storytelling using a child character (Hanna), QR-code audio narration and instructional video, integration of agricultural STEM concept, hands-on learning activities linked to digital content and observation and reflection activities to reinforce learning.

4.0 PRACTICALITY & USEFULNESS

The innovation can be used in schools, homes, community gardening programmes, and STEM educational activities. Target users include children aged 5–12 years, teachers, parents, and educational institutions. The innovation is technically feasible using existing digital devices such as smartphones and tablets. It is economically viable due to its low development and distribution costs. The digital format enables easy scalability and adaptation for different educational settings. Expected impacts include increased agricultural awareness, improved digital literacy, enhanced STEM learning, and greater environmental responsibility among children.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Needs analysis → Content development → Storyboard design → Multimedia integration → QR audio development → QR Video development → E-book publication User evaluation

6.0 CONCLUSION

Laman Ajaib: Pengembaraan Cilik successfully combines storytelling, multimedia features, and agricultural STEM education into an interactive learning platform for children. The innovation enhances learning engagement by linking digital content with hands-on gardening activities. The e-book has strong potential to improve agricultural awareness, environmental responsibility, and STEM learning among young learners. Overall, this innovation supports the i-NEXTECH 2026 theme of *"Bridging Ideas and Technology for a Resilient Future.*

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PROJECT ID: IN226

ONE STOP PSS 2.0: A DIGITAL LIBRARY AND READING ENGAGEMENT PORTAL FOR ENHANCING SCHOOL-WIDE LITERACY

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ABSTRACT
The rapid advancement of digital technology has transformed educational practices, yet many schools continue to face challenges in promoting reading habits among students. At PSS Baitul Hikmah, SK Seri Mendapat, fragmented digital resources, limited accessibility, declining reading interest, and the absence of a centralized monitoring system hindered literacy development. To address these challenges, the One Stop PSS 2.0 Portal was developed as a digital resource centre integrating reading materials, literacy programmes, educational resources, student publications, online quizzes, and e-certificate rewards within a single platform. The portal utilizes QR-code accessibility and web-based technologies to provide users with convenient access to learning resources anytime and anywhere. Key features include a Virtual Bookshelf, themed reading modules, online NILAM activities, teacher resources, and interactive literacy assessments. Evaluation was conducted using portal access statistics and literacy participation records. Findings revealed substantial improvements in user engagement, with portal access increasing from 331 users in 2023 to 3,308 users in 2025. NILAM participation also increased from 137 participants in 2022 to 170 participants by August 2025. These results indicate that integrating digital resources with motivational elements such as quizzes and e-certificates can significantly enhance literacy engagement. The innovation provides a scalable, sustainable, and cost-effective model for digital school resource centres while supporting Malaysia's Digital Education Policy.
Keywords: Digital Library, Literacy Engagement, School Resource Centre, NILAM Programme, Educational Technology

1.0 INTRODUCTION
School Resource Centres play a crucial role in fostering literacy and lifelong learning. However, many schools continue to face challenges such as scattered digital resources, limited accessibility, low student engagement in reading activities, and inadequate monitoring mechanisms. At SK Seri Mendapat, these issues affected the effectiveness of literacy programmes and access to educational resources. To overcome these limitations, One Stop PSS 2.0 was developed as a centralized digital platform that consolidates reading materials, literacy activities, educational resources, and monitoring functions into a single accessible portal. The innovation supports digital literacy development while promoting a sustainable reading culture among students.

2.0 OBJECTIVES
a) To develop a centralized digital portal that integrates reading materials, educational resources, and literacy programmes.
b) To enhance accessibility to educational content anytime and anywhere through digital devices.
c) To increase students' reading engagement through interactive quizzes and e-certificate rewards.

3.0 NOVELTY & INVENTIVENESS
The uniqueness of One Stop PSS 2.0 lies in its integration of multiple literacy functions into a single digital platform.
Key Innovative Features:
- Virtual Bookshelf for digital reading materials.
- Online quizzes with automated e-certificates.
- Teacher monitoring and participation tracking.
- Student publication repository and community access.

Aspect	Existing Solution	One Stop PSS 2.0
Resource Access	Physical/location-based	Anywhere via Internet
Monitoring	Limited	Real-time monitoring
Motivation	Minimal incentives	Quizzes & e-certificates
Content Management	Fragmented	Centralized platform

4.0 PRACTICALITY & USEFULNESS

The portal benefits students, teachers, administrators, and the wider community. It supports digital reading programmes, online NILAM implementation, teacher resource sharing, and student publication activities. The system is cost-effective, scalable, and easy to implement using existing web technologies and QR codes. Impact data showed portal access increased from 331 users (2023) to 3,308 users (2025), while NILAM participation rose from 137 participants (2022) to 170 participants (August 2025), indicating improved literacy engagement.

5.0 METHODOLOGY

Development Process:
Problem Identification → Resource Collection → Portal Development → QR Integration → User Implementation → Evaluation

Usage Procedure:
Scan QR Code → Select Link → Access Virtual Bookshelf → Read Materials → Answer Quiz → Receive E-Certificate

6.0 CONCLUSION

One Stop PSS 2.0 successfully enhances literacy engagement by providing a centralized, accessible, and user-friendly digital platform. The integration of digital reading materials, interactive quizzes, and reward mechanisms has increased participation in reading activities while supporting the digital transformation of school resource centres. The innovation offers a sustainable and scalable model that can be replicated by other schools to strengthen literacy development and educational resource management.

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PROJECT ID: IN232

FUTURE TENSE HOT WHEEL

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ABSTRACT
This project will introduce an innovative and interactive learning tool known as the “Future Tense Hot Wheel” to improve Year 4 remedial pupils’ mastery of the future tense “be going to”. The project will address pupils’ difficulties in constructing accurate future tense sentences during English lessons. Diagnostic assessments will indicate that several pupils are performing below the targeted CEFR Mid-A1 proficiency level. Therefore, the intervention will utilise a rotating wheel mechanism combined with multimodal learning strategies to encourage active participation and improve sentence construction skills. The kit will integrate visual, tactile, and kinaesthetic learning experiences to support remedial learners with different learning styles. The implementation process will involve guided grammar activities, sentence construction tasks, and classroom-based exercises. The expected findings will show improvements in pupils’ grammar accuracy, confidence, and classroom engagement. The innovation is also expected to support differentiated instruction and strengthen pupils’ readiness to communicate effectively in English. Overall, the project will demonstrate the importance of creative and accessible teaching tools in enhancing grammar mastery among primary school learners.
Keywords: future tense, remedial pupils, English grammar, Hot Wheel Kit, sentence construction

1.0 INTRODUCTION
The mastery of English grammar, especially future tense structures, will continue to be a challenge for remedial pupils in primary schools. Many learners will face difficulties in constructing correct sentences using the structure “be going to”, which may affect their communication and writing performance. Diagnostic assessments conducted among Year 4 pupils at Sekolah Kebangsaan Seri Mendapat will identify a group of pupils who are still at the pre-A1 proficiency level. Existing teaching methods may not fully support low proficiency learners who require more interactive and engaging learning experiences. To address this issue, the Future Tense Hot Wheel will be developed as an innovative grammar learning tool. The innovation will help pupils generate sentences systematically through rotating sections consisting of subjects, auxiliary verbs, and action verbs. The project will align with CEFR-aligned curriculum standards and will support meaningful grammar learning through hands-on activities. The study is expected to benefit remedial pupils by improving grammar mastery, classroom participation, and confidence in English communication.

2.0 OBJECTIVE
The main objectives of this innovation are:
a) To improve Year 4 remedial pupils’ mastery of the future tense “be going to” through the Future Tense Hot Wheel.
b) To increase pupils’ engagement and participation during English grammar lessons.
c) To support differentiated learning by providing interactive and multimodal learning experiences for remedial learners.

3.0 NOVELTY & INVENTIVENESS
The Future Tense Hot Wheel will introduce an interactive and low-cost grammar learning approach that combines visual, tactile, and kinaesthetic learning elements. Unlike traditional worksheet-based grammar exercises, the innovation will allow pupils to physically rotate and combine sentence components to form grammatically correct future tense sentences.

Key Innovative Features

- Rotating sentence panels for interactive grammar construction.
- Colour-coded sections to guide sentence structure recognition.
- Hands-on learning activities to improve engagement and retention.
- Adaptability for different classroom proficiency levels.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Future Tense Hot Wheel
Learning Method	Worksheet-based exercises	Interactive rotating wheel
Student Engagement	Passive learning	Active hands-on learning
Learning Style Support	Limited	Visual, tactile & kinaesthetic
Accessibility	Teacher-dependent	Self-guided interaction

The innovation may also provide opportunities for further educational development and wider classroom implementation.

4.0 PRACTICALITY & USEFULNESS

The Future Tense Hot Wheel will be suitable for classroom implementation during English grammar lessons in primary schools. The tool will be used during guided activities, remedial interventions, and enrichment exercises. The main beneficiaries will be Year 4 remedial pupils and English teachers seeking engaging grammar teaching strategies. The innovation will be technically feasible because it will utilise simple and affordable materials such as corrugated board, laminated paper, screws, glue, and colour paper. The estimated cost per unit will remain affordable for schools. The innovation will also be scalable and adaptable for other grammar topics and language learning activities. The expected impact will include improved grammar accuracy, higher pupil motivation, increased classroom participation, and stronger confidence in using English sentences correctly

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Technical Explanation: The tool will consist of rotating panels segmented into subject, auxiliary verb, and action verb sections. Pupils will rotate the wheel to generate complete future tense sentences accurately.

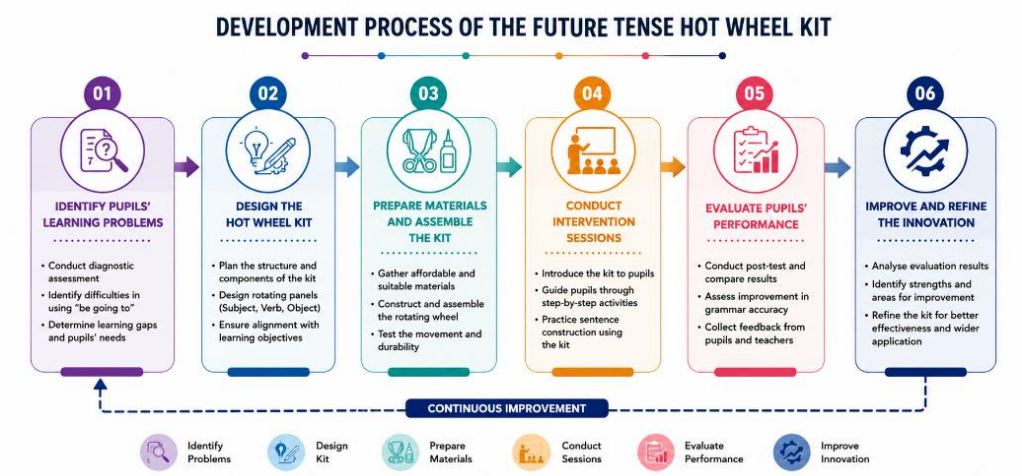


Figure 1: Development process flowchart

Testing and Validation: Testing and validation will involve classroom-based intervention sessions with Year 4 pupils. Pre-tests and post-tests will be conducted to measure improvements in sentence construction and grammar accuracy. The expected findings will demonstrate positive improvements in pupils' mastery of the future tense structure.

6.0 CONCLUSION

The Future Tense Hot Wheel will serve as an innovative, practical, and cost-effective teaching tool for improving future tense mastery among primary school remedial pupils. The innovation is expected to improve grammar performance, increase pupil confidence, and promote active learning during English lessons. The project will also support differentiated learning and align with current educational goals that emphasise creativity, inclusivity, and future-ready learning approaches. In the future, the innovation may be expanded and adapted for other grammar topics and broader classroom applications.

ACKNOWLEDGMENTS

The authors would like to express appreciation to the Melaka State Education Department, Pejabat Pendidikan Daerah Jasin, school administrators, teachers, and pupils of Sekolah Kebangsaan Seri Mendapat for their continuous support and cooperation throughout the development of this innovation project.

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PROJECT ID: IN233

MATHSTORM LEGENDS

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ABSTRACT
MathStorm Legends: An Interactive Mathematics Board Game is an educational board game designed to make mathematics learning fun, engaging, and interactive for primary school students. The game combines mathematical challenges with exciting gameplay, allowing students to practice essential skills such as addition, subtraction, multiplication, division, counting, and problem-solving. Players move across the game board by answering mathematics questions, overcoming obstacles, and earning rewards. Through active participation, the game promotes critical thinking, communication, teamwork, and confidence in mathematics. By integrating learning with play, MathStorm Legends creates a positive learning environment that motivates students to improve their mathematical abilities while enjoying a meaningful educational experience.
Keywords: mathematics, board game, primary school

1.0 INTRODUCTION
Mathematics is an important subject, but many primary school students find it difficult and less interesting. Traditional teaching methods may not fully engage students, and digital tools can be costly or require internet access (PISA,2023). Therefore, MathStorm Legends was created as a fun, interactive, and affordable learning tool to improve mathematics learning. The game helps students develop math skills, confidence, critical thinking, teamwork, and communication. It also supports teachers in creating an active and student-centered learning environment without needing digital devices. Ultimately, MathStorm Legends helps improve math literacy and 21st-century skills among young learners.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a) To improve students' basic mathematical skills through interactive and enjoyable gameplay.
b) To increase students' interest, motivation, and critical thinking in learning mathematics.

3.0 NOVELTY & INVENTIVENESS
MathStorm Legends transforms mathematics learning into an interactive board game by integrating curriculum-based math questions into gameplay. Unlike traditional methods, it combines learning, play, and social interaction to make math more enjoyable. The game encourages students to solve problems and actively participate in learning.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Learning Method	Traditional worksheets, textbooks, and lecture-based teaching that are often passive	Game-based learning where mathematics is embedded directly into gameplay activities
Student Engagement	Limited interaction and can be less motivating for students	High engagement through rewards, challenges, and fun competitive gameplay

4.0 PRACTICALITY & USEFULNESS
MathStorm Legends can be used in classrooms, remedial classes, and home learning to improve students' mathematics skills through interactive gameplay. It provides an affordable and engaging learning tool that supports better performance, teamwork, and communication skills.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

MathStorm Legends was created to solve the problem of low interest in mathematics among students. Math topics such as addition, subtraction, multiplication, and division were included in a board game format. A colorful prototype was designed with challenges, actions, dice, tokens, and question cards. The game was tested with students and showed increased engagement, enjoyment, and improved math skills. Players learn by moving on the board, answering math questions, and completing game challenges.

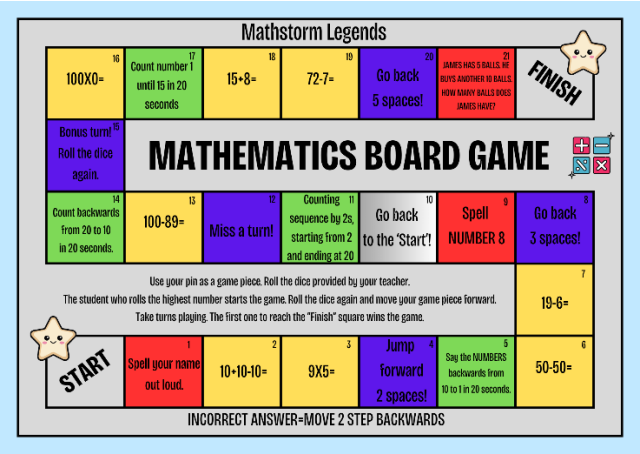


Figure 1: Mathstorm legends

6.0 CONCLUSION

MathStorm Legends improves mathematics learning through an interactive and affordable board game that increases students' skills, motivation, and teamwork. It provides a practical teaching tool for classrooms and home learning with potential for further improvement and expansion. This innovation supports "Bridging Ideas and Technology for a Resilient Future" by encouraging creative learning and future-ready skills.

ACKNOWLEDGMENTS

We would like to express our appreciation to Sekolah Kebangsaan Seri Mendapat for providing support, guidance, and resources throughout the development of the MathStorm Legends project.

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EXTENDED ABSTRACT

Category C2 (Secondary School)

PROJECT ID: IN13

WIRELAB: A PORTABLE, SAFE AND INTERACTIVE ELECTRICAL WIRING TRAINING KIT FOR TVET EDUCATION

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ABSTRACT
WIRELAB is an innovative portable electrical wiring training kit developed to improve practical learning experiences in TVET education. The innovation enables students to perform real domestic wiring activities through a compact, safe, and interactive learning platform. Integrated with QR code learning support, low-current operation, and power bank compatibility. WIRELAB encourages continuous hands-on practice beyond the classroom while promoting independent and experiential learning. The use of recycled materials also makes the innovation affordable, eco-friendly, and highly accessible for students in various learning environments.
Keywords: TVET Education, Electrical Wiring, Portable Learning Kit

1.0 INTRODUCTION
Practical mastery is essential in TVET education, especially in electrical wiring courses that require continuous hands-on training. However, many students have limited opportunities to practice outside workshop sessions due to safety concerns, lack of portable equipment, and dependency on fixed wiring bays. These limitations reduce students' engagement, confidence, and practical competency development.

2.0 OBJECTIVES
The objectives of this innovation/project are:
a. To increase students' access to practical wiring activities.
b. To support independent and experiential learning.
c. To provide a portable and safe electrical training kit.
d. To enhance students' competency and engagement in TVET learning.

3.0 NOVELTY & INVENTIVENESS
WIRELAB introduces a flexible and learner-centered approach to electrical wiring education through a portable training kit developed using recycled materials and real domestic wiring components. Unlike conventional wiring bays, WIRELAB allows students to practice electrical wiring anytime and anywhere in a safer and more controlled environment. The innovation integrates QR code learning support, power bank operation, low-current technology, and interactive practical activities that encourage continuous self-learning and skill exploration. Its affordable production cost and ecofriendly concept further increase accessibility for wider educational use.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	WIRELAB
Learning Space	Workshop-dependent	Portable learning
Accessibility	Limited shared usage	Individual flexible use
Safety	Requires supervision	Low-current safe operation
Learning Support	Traditional instruction	QR code interactive learning
Cost	High installation cost	Affordable low-cost design

4.0 PRACTICALITY & USEFULNESS

WIRELAB is suitable for schools, workshops, training centers, and home-based learning due to its lightweight and portable structure. The innovation is developed using affordable recycled materials, making it cost-effective and easy to implement in various educational settings. Classroom observations showed significant improvements in student participation, task accuracy, and confidence during practical activities. The innovation also encourages repeated practice, self-paced learning, and greater student engagement in electrical wiring education.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

WIRELAB was developed through several stages, including idea development, prototype construction, testing, and improvement. The system integrates electrical components such as switches, sockets, lighting systems, connecting wires, mini distribution boards, and QR code learning support into a recycled toolbox structure. The innovation operates using low-current technology and portable power sources to ensure safe and flexible practical learning. Testing sessions were conducted during wiring activities to evaluate usability, safety, student participation, and learning effectiveness.

6.0 CONCLUSION

WIRELAB is a practical, affordable, and student-friendly innovation that transforms electrical wiring education into a more flexible, interactive, and accessible learning experience. By promoting continuous hands-on practice and self-directed learning, WIRELAB contributes to the development of future-ready TVET education aligned with the i-NEXTECH 2026 theme.

ACKNOWLEDGMENTS

The authors sincerely thank SMK Tun Tijah, teachers, students, and colleagues for their support, encouragement, and valuable contributions throughout the development of WIRELAB.

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PROJECT ID: IN14

ELECTROLEARN: A PORTABLE, SMART AND LOW-COST ELECTRICAL WIRING LEARNING SYSTEM FOR TVET EDUCATION

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ABSTRACT
ElectroLearn is a smart portable teaching aid with real-time error detection technology that eenhances electrical wiring education through safe, hands-on, and self-directed learning. Powered by a low-current and power bank-operated system, the innovation enables students to identify and correct wiring errors independently while improving practical skills, confidence, and problem-solving abilities. ElectroLearn offers a safer, smarter, and more flexible approach to future-ready TVET learning.
Keywords: Smart Learning System, Real-Time Feedback, Electrical Wiring Education

1.0 INTRODUCTION
TVET is important in developing practical skills for future careers. However, electrical wiring students often face difficulties in identifying wiring errors due to limited practice, safety concerns, and dependence on teacher supervision, highlighting the need for a safer and smarter learning solution.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop a smart wiring learning board with real-time error detection.
b. To improve students' practical wiring skills through hands-on learning.
c. To provide a safe and portable learning tool for classroom and home use.
d. To enhance students' confidence and problem-solving skills.

3.0 NOVELTY & INVENTIVENESS
ElectroLearn is a smart portable wiring board with real-time error detection that enables independent learning through a safe, flexible, and user-friendly system for electrical wiring education.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Error Detection	Manual checking by teacher	Automatic real-time detection
Portability	Limited mobility	Compact and portable
Safety	Higher electrical risk	Low-current safe operation
Learning Method	Teacher-dependent	Self-directed learning
Home Learning	Limited	Suitable for home use

4.0 PRACTICALITY & USEFULNESS
ElectroLearn is a portable and user-friendly innovation suitable for TVET classrooms, workshops, training centers, and home-based learning. Using safe low-voltage technology and reusable materials, the system reduces training costs by approximately 30%, decreases wiring errors by up to 40%, and shortens troubleshooting time by 50%. The innovation also enhances students' practical skills, confidence, and independent learning.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
ElectroLearn was developed through circuit design, prototype construction, testing, and system improvement using components such as a portable wiring board, indicator LEDs, safety fuse, low-voltage power supply, switches, sockets, connecting wires, buzzer indicator, and a rechargeable power bank system. These components function as the main wiring platform, error and warning indicators, safety protection system, safe power source, wiring simulation components, and portable operating system. The innovation uses a real-time error detection circuit that automatically activates warning indicators when incorrect wiring occurs, enabling students to identify and correct mistakes independently while promoting more effective self-directed learning.

6.0 CONCLUSION

ElectroLearn is a smart, safe, and portable learning innovation that enhances electrical wiring skills through real-time feedback and self-directed learning. By integrating technology into TVET practical training, ElectroLearn supports smarter, safer, and more accessible future-ready education aligned with the i-NEXTECH 2026 theme.

ACKNOWLEDGMENTS

The authors sincerely thank SMK Tun Tijah, teachers, students, and colleagues for their continuous support, guidance, and valuable contributions throughout the development and success of ElectroLearn.

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PROJECT ID: IN16

LUMEERA: ECO-FRIENDLY MULTIFUNCTIONAL FUEL BLOCK FROM FOOD WASTE

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ABSTRACT
Food waste mismanagement causes environmental pollution and greenhouse gas emissions, while many commercial fire starters contain harmful chemicals. This project introduces LUMEERA, an eco-friendly fuel block made from organic food waste. The product uses dried orange peels, lemongrass, pandan leaves and beeswax as the main materials. The process involves drying, grinding, mixing, and moulding the materials into solid fuel blocks. Testing showed that one LUMEERA block can burn for about 30 minutes with a stable flame and minimal smoke. Besides functioning as a fire starter, LUMEERA also acts as a natural mosquito repellent and can generate small amounts of electrical energy using a thermoelectric system. This innovation helps convert waste into useful products, reduces dependence on chemical-based fuels and supports sustainable living, especially in outdoor and rural areas.
Keywords: food waste recycling, eco-friendly fuel, mosquito repellent, thermoelectric energy

1.0 INTRODUCTION
The increasing amount of food waste has become a serious environmental problem. At the same time, many fire starters contain harmful chemicals that can affect human health and the environment. There is a need for sustainable products that can turn waste into useful resources. Current waste management methods do not fully utilize organic food waste, causing more pollution. In addition, most fire starters only serve one purpose and use non-renewable materials. This innovation provides a low-cost and eco-friendly fuel alternative while encouraging recycling and reducing the use of chemical-based products. It also supports environmental protection and sustainable development.

2.0 OBJECTIVE
The main objectives of this project are to:
a. Develop a sustainable fuel block using organic food waste materials.
b. Evaluate its effectiveness as a fire starter and natural mosquito repellent.
c. Assess its capability to generate small-scale electrical energy using thermoelectric principles.

3.0 NOVELTY & INVENTIVENESS
LUMEERA uses a waste-to-energy concept by turning organic food waste into a multifunctional fuel product. It combines fire-starting, mosquito-repelling and energy-generating functions in one product. The use of natural and biodegradable materials makes it safer for the environment. LUMEERA also uses a simple thermoelectric system to convert heat into electrical energy. Its unique material combination and multifunctional design have potential for intellectual property protection.

Table 1: Comparison with Existing Solutions

Aspect	Existing Solutions	Your Innovation
Functionality	Single-purpose	Multifunctional
Materials	Chemical-based	Natural, biodegradable
Environmental Impact	Polluting	Eco-friendly, waste-reducing

4.0 PRACTICALITY & USEFULNESS
LUMEERA is suitable for camping, outdoor cooking, emergency use and rural energy needs. The target users include outdoor enthusiasts, rural communities, environmentally conscious users and households looking for sustainable alternatives. The product uses a simple production process with easily available waste materials, making the production cost low. LUMEERA can also be mass-produced or made at community level. It helps reduce food waste, lowers the use of chemical fuels, encourages sustainable practices and can generate small amounts of energy for small devices.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The process includes collection of food waste, drying, grinding into fine particles, mixing with melted beeswax and moulding into solid blocks. The fuel block produces heat during combustion, which is used by a thermoelectric module to generate small amounts of electrical energy. The main materials used are orange peels, lemongrass, pandan leaves and beeswax. The product was tested for burn duration, flame stability and smoke emission under controlled conditions. Results showed that each block can burn for about 30 minutes with a stable flame and minimal smoke. The heat produced during combustion is partially converted into electrical energy through the thermoelectric effect for small-scale power generation.

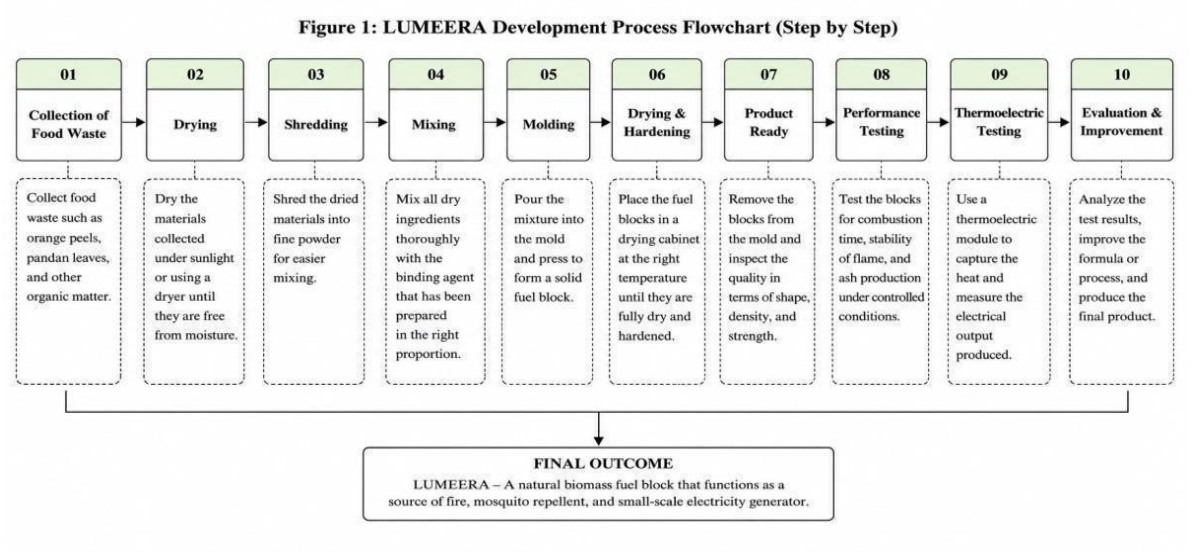


Figure 1: Development process

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Orange peels	Dried, ground	Fuel source
Lemongrass	Dried	Fragrance, repellent
Pandan leaves	Dried	Aroma, repellent
Beeswax	Binder	Binding agent
Thermoelectric module	Small-scale	Energy conversion

6.0 CONCLUSION

LUMEERA successfully shows that food waste can be turned into a multifunctional and eco friendly fuel block. The project supports sustainable innovation by combining waste management, energy generation and environmental protection in one product. However, the electrical energy produced is still limited and needs further improvement for practical use. Future improvements include increasing energy efficiency, improving the material composition and expanding production for commercial use. LUMEERA shows how creative ideas can turn waste into useful resources for a more sustainable future.

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PROJECT ID: IN18

MICROBIT BATTLE WAR ROBOT FOR STEM EDUCATION

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ABSTRACT
The lack of engaging and hands-on learning tools in STEM education, particularly in robotics and programming, has limited students' interest and mastery of technical skills. This project introduces the Microbit Battle War Robot, an innovative and affordable educational robotics system designed to enhance interactive learning through competitive gameplay. The system utilizes dual micro:bit microcontrollers, where one functions as the robot controller and the other as a remote control, enabling real-time wireless communication. The development methodology involves planning, hardware assembly, block-based programming using MakeCode, and iterative testing to optimize movement stability and response time. Key components include motors, chassis, and wireless communication.
Results show increased student engagement, improved problem-solving skills, and better understanding of robotics concepts. This innovation has strong potential for scalability as an educational kit and supports 21st-century learning.
Keywords: STEM Education, Micro:bit, Robotics, Coding, Innovation

1.0 INTRODUCTION
This project addresses the gap in engaging STEM learning tools. Traditional teaching methods lack hands-on experience, causing reduced student interest. This innovation provides an interactive robotics platform to enhance learning outcomes

2.0 OBJECTIVE
a. To develop an interactive robotics learning tool.
b. To enhance students' STEM skills.
c. To prepare students for robotics competitions.

3.0 NOVELTY & INVENTIVENESS
The innovation features dual micro:bit control, real-time wireless communication, and customizable robot design. It differs from existing tools by integrating competition-based learning with affordable hardware

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Learning Method	Learning is mostly theoretical with limited hands-on STEM activities	Provides hands-on learning using micro:bit and robotics, making lessons more interactive
Student Engagement	Low student engagement; students may feel bored and less motivated	Increases engagement through robot battle competitions that are fun and challenging
Skill Development	Focuses mainly on basic knowledge with limited practical application	Enhances skills in coding, robotics, teamwork, and problem-solving

4.0 PRACTICALITY & USEFULNESS
This innovation can be used in schools for STEM education. It is cost-effective, scalable, and suitable for competitions. It benefits students and educators by improving engagement and technical skills.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system includes micro:bit, motors, chassis, and radio communication. Development involved design, programming, testing, and optimization. Testing showed stable performance and responsiveness.



Figure 1: Development process flowchart *(Replace with your actual flowchart showing the step-by-step development process)*

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Micro:bit	Programmable microcontroller with Bluetooth/radio communication and input/output pins	Acts as the main controller to process commands and control the robot
DC Motors	Low-voltage DC motors (3V–6V) with wheels attached	Provide movement for the robot (forward, backward, turning)
Chassis	Custom-designed chassis made using 3D printing (PLA/ABS material), lightweight and durable	Serves as the robot structure to hold and organize all components securely

6.0 CONCLUSION

The Microbit Robot Battle successfully developed a functional and interactive robotics system that enhances STEM learning through hands-on experience. This innovation promotes critical thinking, creativity, and teamwork while providing practical value in education.

Despite minor challenges such as hardware limitations and stability issues, the system demonstrates strong potential for improvement and wider implementation. Future work will focus on enhancing performance and expanding its use in schools.

Overall, this project reflects the integration of innovation and technology in education, aligning with the theme “Bridging Ideas and Technology for a Resilient Future.”

ACKNOWLEDGMENTS

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PROJECT ID: IN23

TEDDY SAFETY ALERT

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ABSTRACT
Incidents of children left unattended in vehicles pose serious risks, often leading to heatstroke and fatalities. This project introduces the Teddy Alert Safety System, a smart detection solution using motion, temperature, and pressure sensors embedded in a teddy bear. Alerts are triggered via alarms and mobile notifications when a caregiver leaves a child behind. The system uses a microcontroller with Bluetooth connectivity and shows fast, reliable performance. It is affordable, user-friendly, and adaptable, aiming to reduce child fatalities and improve awareness.
Keywords: child safety, heatstroke prevention, smart sensors, vehicle safety, IoT

1.0 INTRODUCTION
Leaving children in vehicles can cause heatstroke within minutes. Interiors heat rapidly, putting children at high risk. Despite awareness, incidents still occur due to distraction. Existing systems are often costly or complex, highlighting the need for a simple solution.

2.0 OBJECTIVE
a. Design a sensor-based child detection system.
b. Develop an alert mechanism.
c. Provide an affordable safety solution.

3.0 NOVELTY & INVENTIVENESS
The system integrates sensors into a teddy bear, making it user-friendly. Features include multi-sensor detection, Bluetooth alerts, and dual alert systems.

4.0 PRACTICALITY & USEFULNESS
Applicable in vehicles and childcare transport. It is cost-effective, scalable, and improves safety awareness.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
Process: Design → Prototype → Testing. Uses Arduino, sensors, and Bluetooth. Testing shows accurate detection and fast alerts.

6.0 CONCLUSION
The system effectively prevents child neglect incidents. Future work includes GPS integration. It supports safer, technology-driven solutions.

ACKNOWLEDGMENTS
Thanks to SMK(M) Convent Bukit Mertajam for support

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PROJECT ID: IN24

SMART FLOOD MONITORING AND ALERT SYSTEM

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ABSTRACT
Flash floods often strike without warning because many high-risk areas lack the basic sensors needed to track rising water levels at critical river and drainage points. To solve this, we developed the Smart Flood Monitoring and Alert System, a low-cost IoT prototype designed to give residents and authorities the early information they need to stay safe. The system is built around an ESP32 microcontroller and a water level sensor that provides continuous, real-time data collection. The "brain" of the system classifies risk into three distinct stages: NORMAL, AMARAN (Warning), and BANJIR (Flood). When a threat is detected, it triggers a multi-layered alert mechanism combining an on-site OLED display, local sirens and LED signals with instant Telegram notifications sent directly to users' smartphones. Arduino IDE is used to develop and upload the programming code to the ESP32 microcontroller for the Smart Flood Monitoring and Alert System. Testing confirmed that the prototype successfully maintains Wi-Fi connectivity to deliver precise water-level alerts regardless of the user's location. This project demonstrates a reliable and scalable solution for bridging the communication gap in disaster management, providing a practical tool to enhance community resilience in flood-prone areas. This innovation has high commercialization potential as an educational kit (ABM) for RBT Form 2 under the Microcontroller topic. It provides hands-on IoT and AI learning, is cost-effective and suitable for STEM-based education.
Keywords: IoT, ESP32, Flood Monitoring, Telegram

1.0 INTRODUCTION
Floods shouldn't catch us by surprise. That's why Team SMK Kunak Jaya developed the Smart Flood Monitoring & Alert System. Our IoT and AI-powered solution addresses the critical need for real-time flood monitoring in Kunak's villages. AI models for early flood prediction. Instant alerts via Telegram Bot & local sirens. We're building community resilience, one smart solution at a time. Flood warnings are mostly manual or delayed, leaving communities unprepared with the advancement of Internet of Things (IoT) and Artificial Intelligence (AI), a smart, low-cost, and real-time flood monitoring system can be developed to provide early alerts for villagers and authorities. This system aims to reduce damages and save lives through timely and data-driven flood prediction.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop a real-time flood monitoring system using IoT sensors.
b. To implement AI models for early flood prediction based on water levels and rainfall patterns.
c. To notify villagers and authorities immediately through Telegram bot and local sirens.

3.0 NOVELTY & INVENTIVENESS
The system stands out by using multi-sensor data fusion to predict floods before they happen, rather than just reacting when water is already high. It features a fail-safe communication design that sends alerts even if the internet goes down ensuring 100% reliability. This shift from simple monitoring to autonomous, reliable alerting makes it smarter and faster than existing solutions, offering clear potential for patenting.

4.0 PRACTICALITY & USEFULNESS
1. Sustainable Cities and Communities
2. Climate Action
3. Industry, Innovation and Infrastructure

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Our system innovates by replacing manual observation with a low-cost, 24/7 autonomous network that detects and decides flood levels at the source. Unlike existing methods that rely on human reports, our ESP32-powered stations use real-time logic to instantly trigger both local alarms and remote Telegram alerts. This provides a high-speed, scalable fail-safe for high-risk areas and filling the critical gap in disaster monitoring with affordable automation.

6.0 CONCLUSION

The "Smart Flood Monitoring and Alert System" successfully designed, built and tested a fully functional Internet of Things (IoT) prototype. In conclusion, the Smart Flood Monitoring and Alert System is an effective, reliable prototype that meets all objectives and is ready for field implementation, enhancing the safety and resilience of the community in Kunak against flood disasters.

ACKNOWLEDGMENTS

We would like to express our sincere appreciation to all parties who have contributed to the successful development of the Smart Flood Monitoring and Alert System. Special thanks to our school administration for their continuous support and encouragement throughout this project. We are also grateful to our teachers and mentors for their valuable guidance, technical advice, and constructive feedback.

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Smart Flood Monitoring and Alert System using IoT, ESR Groups Journal - artikel yang membincangkan penyelesaian IoT untuk pemantauan banjir dan amaran awal

PROJECT ID: IN46

CENTRALIZED HEAT ALERT SYSTEM FOR SCHOOL STUDENT SAFETY

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ABSTRACT
The Centralized Heat Index Alert System for School Student Safety is developed to monitor temperature in real time and provide early warnings against heat-related risks such as dehydration and heat stroke. The system uses Arduino Uno integrated with a DHT22 sensor, LCD, LED indicators, and a buzzer to deliver visual and audio alerts based on three levels: safe, warning, and danger. Its uniqueness lies in the centralized and multi-layered alert mechanism, combined with hydration guidance (200–250 ml every 20–30 minutes for warning, and 250–300 ml every 15–20 minutes for danger). The system is low-cost, easy to use, and suitable for schools and public environments, with potential for IoT integration. Overall, it functions as both an alert system and a practical health education tool.
Keywords: Environmental Safety, Early Warning System, Heat Index

1.0 INTRODUCTION
The Centralized Heat Alert System for School Student Safety is developed to monitor temperature in real time and provide early warnings using visual and audio alerts, addressing heat-related risks such as dehydration and heat exhaustion in Malaysia's tropical climate. However, students often lack awareness of proper hydration, and existing systems rely mainly on visual information without continuous alerts or structured guidance. This study provides a practical solution by integrating real-time monitoring, multi-level alerts, and hydration guidance to improve safety awareness and support preventive action.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To monitor temperature in real time using Arduino.
b. To provide visual and audio alerts based on temperature levels.
c. To remind users to stay hydrated using a timed buzzer.

3.0 NOVELTY & INVENTIVENESS
This innovation presents a centralized heat alert system that integrates real-time temperature monitoring with visual and audio alerts, as well as hydration guidance. Unlike conventional systems that only display temperature, it combines monitoring, alerting, and user guidance in a single platform using a state-based approach. The system enhances user response through multi-level alerts and practical recommendations, while its integrated design also offers potential for future development and intellectual property protection.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Functionality	Display temperature only	Monitor + alert + guidance
Alert Mechanism	Visual only	Visual + audio alerts
User Guidance	No guidance	Hydration guidance

4.0 PRACTICALITY & USEFULNESS
This system is suitable for schools, sports areas, public spaces, and outdoor workplaces, benefiting students, educators, and the public. It is technically feasible using simple Arduino-based components, cost-effective (below RM100), scalable for wider implementation or IoT integration, and sustainable due to low power consumption. The system improves safety awareness and hydration behaviour, reduces heat-related risks, and offers up to 50–70% cost savings compared to advanced monitoring systems.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system was developed through conceptualization, design, implementation, and testing using Arduino Uno, DHT22 sensor, LCD, LED, and buzzer with a state-based programming approach. It was tested under different temperature ranges (safe, warning, danger) to validate accuracy and responsiveness, achieving a response time of 1–2 seconds. The system operates by reading temperature data, processing it against predefined thresholds, and activating LED, LCD display, and buzzer alerts accordingly.

Table 2: Temperature Thresholds and System Response

Temperature Range	System Status	LED	Buzzer Response
< 30ºC	Safe	Green	Off
30 - 35ºC	Warning	Yellow	Periodic
> 35ºC	Danger	Red	Frequent

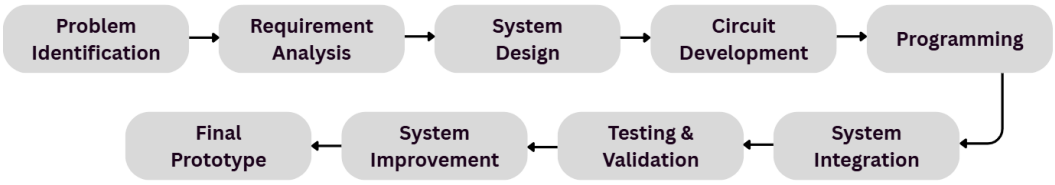


Figure 1: Development process flowchart

Table 3: Key components and specifications

Component/Material	Specification	Purpose
Arduino Uno	ATmega328P microcontroller	Data process
DHT 22	Temperature range -40ºC to 80ºC	Measures temperature
LCD 16x2 (12C)	16 x 2 display	Display Readings and status

6.0 CONCLUSION

This project successfully developed a centralized heat alert system with real-time monitoring, alerts, and hydration guidance to improve safety awareness. It offers a practical, low-cost solution, though currently limited to basic temperature monitoring. Future improvements include IoT integration and system expansion. Overall, the innovation demonstrates the role of simple technology in bridging ideas and technology for a resilient future.

ACKNOWLEDGMENTS

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PROJECT ID: IN54

NATURAL FLAVORING BY SOLANACEAE

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ABSTRACT
The widespread use of artificial flavourings raises long-term health risks due to excessive sodium and chemical preservatives. This project introduces Monosodium Tomato, an innovative, low-cost natural seasoning developed from local tomatoes, mushrooms, and onions to deliver a rich umami flavour without synthetic additives. The production involves washing, cutting, low-temperature drying, and grinding into a uniform powder. Sensory feedback and nutrient profiling indicate high user acceptance, rich antioxidant profiles, and affordable production costs. This innovation promotes healthier dietary choices and drives economic opportunities for Malaysian small and medium enterprises (SMEs).
Keywords: Natural seasoning, Umami flavour, Chemical-free, Food innovation, SME development

1.0 INTRODUCTION
As for the background, the modern food industry relies heavily on artificial flavourings and synthetic preservatives, raising consumer concerns over health risks. The core problem statement lies in the excessive consumption of these commercial flavourings, which is linked to long-term health issues, while current healthy market alternatives remain costly and lack nutritional value. To address this, the significance of this study introduces solanaceae (Monosodium Tomato), an innovative, low-cost natural seasoning that provides consumers with an antioxidant-rich dietary choice while driving economic opportunities for Malaysian small and medium enterprises (SMEs).

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop an all-natural, low-sodium seasoning powder from local tomatoes, mushrooms, and onions as a healthy substitute for synthetic MSG.
b. To evaluate the sensory acceptance and nutrient profile of the formulated seasoning through consumer testing.
c. To analyze the economic feasibility and production scalability of the product for local SMEs.

3.0 NOVELTY & INVENTIVENESS
Solanaceae's unique aspect lies in its all-natural formulation that synergizes local tomatoes, mushrooms, and onions to replicate a premium umami profile without chemical additives. Its key innovative feature utilizes a low-cost, low-temperature dehydration process that effectively preserves naturally occurring vitamins and antioxidants. For intellectual property potential, the specific ingredient ratio and proprietary blending methodology offer strong opportunities for a Trade Secret and Utility Innovation (UI) patent, which are currently pending further laboratory standardization.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Ingredients	High in synthetic additives, MSG, and chemical preservatives	100% natural local tomatoes, mushrooms, and onions.
Health Benefit	Associated with long-term health risks and high sodium intake.	Rich in naturally occurring antioxidants and vitamins with low sodium.
Cost Sourcing	Often relies on imported chemical precursors or costly organic alternatives.	Low production cost using highly accessible local raw materials.

4.0 PRACTICALITY & USEFULNESS
In real-world applications, solanaceae serves as a healthy seasoning alternative for household cooking and food industries, specifically targeting health-conscious consumers and local SMEs. Its feasibility and implementation are highly viable due to a low-cost, low-temperature manufacturing process that uses affordable, locally sourced raw materials. The expected impact includes a 30% reduction in

production costs for food businesses, significantly lower dietary sodium intake for consumers, and long-term sustainability for local agricultural supply chains.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development process involves a systematic procedure of washing, cutting, low-temperature dehydrating, and grinding raw tomatoes, mushrooms, and onions into a fine, uniform powder. Testing and validation were conducted via sensory evaluations and nutrient profiling to measure consumer acceptance in taste and aroma. The core technical mechanism relies on efficient moisture removal using an industrial food dehydrator and a high-speed blender, which prevents microbial growth while successfully preserving the naturally occurring vitamins, antioxidants, and rich umami compounds.

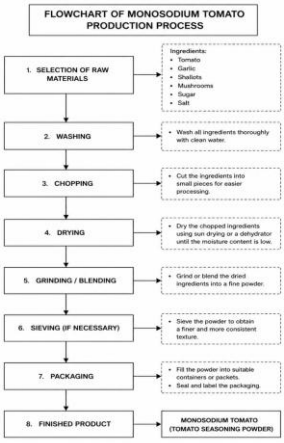


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Raw Ingredients	Dehydrated tomatoes, mushrooms, onions	Natural umami and antioxidant source.
Food Dehydrator	Low-temperature control	Removes moisture while preserving nutrients.
High-Speed Blender	Fine mesh powdering	Ensures uniform texture and fast solubility.

6.0 CONCLUSION

In summary, solanaceae (Monosodium Tomato) has successfully achieved its objective by offering a low-cost, all-natural, and antioxidant-rich seasoning powder that addresses the health risks of synthetic additives. This innovation significantly contributes to society and local food industries by reducing dietary sodium dependence and empowering small and medium enterprises (SMEs). While currently limited by its small-scale laboratory production and moisture sensitivity, future work will focus on shelf-life optimization, commercial nutritional labeling, and automated packaging systems. Ultimately, solanaceae stands as a competitive, eco-friendly food solution, perfectly embodying the spirit of "Bridging Ideas and Technology for a Resilient Future" for i-NEXTECH 2026.

ACKNOWLEDGMENTS

The authors wish to express their sincere gratitude to our supervisor, Mohamad Hilmi Bin Abdul Wahab, for the invaluable guidance and support throughout this project. Special thanks are also extended to College Vocational Labuan for providing the necessary facilities and resources to successfully develop this innovation.

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PROJECT ID: IN57

ECOBIN GENIUS

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ABSTRACT
EcoBin Genius is an innovative smart recycling system designed to improve waste management in schools. Many recycling efforts fail because of improper waste segregation caused by limited awareness and human error. To solve this issue, EcoBin Genius uses a camera sensor to identify and sort waste into five categories: plastic, paper, glass, aluminium, and others. This improves recycling accuracy and reduces contamination of recyclable materials. The project also encourages sustainable habits and environmental awareness among students through interactive learning. EcoBin Genius supports SDG 4 (Quality Education), SDG 9 (Industry, Innovation and Infrastructure), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) for a greener future.
Keywords: Waste Management, Automated Segregation, Green Technology

1.0 INTRODUCTION
Malaysia produces approximately 38,000 tonnes of solid waste daily, but only about 28% is recycled. In schools, plastics, paper, glass, and aluminium are often mixed together, causing contamination of recyclable materials and increasing landfill waste. Traditional recycling bins provide little guidance, making proper waste sorting difficult for students. To solve this issue, Tech Eco Squad developed EcoBin Genius, a smart recycling bin equipped with a camera sensor that automatically detects and sorts the waste into five categories: plastic, paper, glass, aluminium, and others. The system improves recycling accuracy and reduces human error. EcoBin Genius also promotes environmental awareness and encourages sustainable habits among students for a greener future.

2.0 OBJECTIVE
To design a smart bin capable of sorting waste into five categories (plastic,paper,glass,aluminium, others) using a camera sensor, to promote environmental awareness and educate students about recycling practices to create a cost-effective and scalable solution for schools and communities and to reduce landfill waste and support the achievement of United Nations Sustainable Development Goals (SDGs).

3.0 NOVELTY & INVENTIVENESS
EcoBin Genius is designed using environmentally friendly and low-cost materials such as cardboard, plastic for the prototype, bamboo, coconut charcoal, and netting. The smart bin consists of five compartments with automatic sorting flaps and a rotating sensor system that helps separate waste efficiently. The innovation integrates advanced technology through the use of a camera sensor, which is trained with image recognition to identify different types of waste. A microcontroller, such as Arduino or Raspberry Pi, processes the sensor data and activates the sorting flaps automatically. In addition, a display screen shows the type of waste detected to guide users during the recycling process. The system was tested using common school waste items such as plastic bottles, paper, cans, and glass to improve detection accuracy and sorting speed.

4.0 PRACTICALITY & USEFULNESS
The implementation of EcoBin Genius has shown positive results in both functionality and environmental impact. During school pilot tests, the camera sensor successfully identified and sorted waste into five categories: plastic, paper, glass, aluminium, and others. Incorrect waste disposal was reduced by up to 80%, improving recycling efficiency and supporting SDG 12 (Responsible Consumption and Production). Students also demonstrated greater awareness and understanding of proper recycling practices after using the smart bin. The display screen and indicators made waste sorting more interactive, fun, and educational, increasing student

participation and supporting SDG 4 (Quality Education). In addition, recyclable waste collection increased, reducing the amount of mixed waste sent to landfills and helping to create a cleaner environment.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of EcoBin Genius began with brainstorming sessions to identify issues such as odour, contamination of recyclables, and poor waste separation in schools. The team explored solutions including colour cues and smart vision systems before choosing a design with a bamboo body, coconut charcoal base, camera sensor recognition, and multiple compartments. Research involved interviews with students, teachers, and cleaners, along with observations of recycling habits and common mistakes. During the design stage, cardboard was selected for recyclability, bamboo for reducing heat and odour, and coconut charcoal for absorbing smells and moisture. The camera sensor identifies waste and sorts it into the correct compartment automatically.

6.0 CONCLUSION

Before the introduction of EcoBin Genius, school waste bins often mixed plastics, paper, glass, aluminium, and other waste together. This resulted in ineffective recycling, increased landfill waste, and low awareness of sustainability among students. After EcoBin Genius was introduced, waste could be automatically identified and sorted into five compartments using a camera-sensor system. This improved recycling accuracy, reduced contamination of recyclable materials, and decreased landfill waste. EcoBin Genius transformed waste management into a more interactive, educational, and eco-friendly process, supporting sustainable schools and promoting a greener future for the environment.

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PROJECT ID: IN61

PLAY-BASED LEARN KIT

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ABSTRACT
The Play-Based Learn Kit is an innovative and sustainable educational tool designed to enhance students' mastery of English grammar, particularly Past Tense, Present Tense, and Past Participle. This innovation addresses students' low motivation and difficulties in understanding grammatical structures through traditional instruction. Using recycled pizza boxes, colour-coded cards, and interactive activities, students actively identify, classify, and construct grammar concepts through play-based learning. Findings indicate improved engagement and meaningful learning experiences. The Play-Based Learn Kit demonstrates that sustainable classroom innovations can transform recycled materials into impactful educational resources with potential for widespread implementation.
Keywords: Play-Based Learning, English Grammar, Sustainable Education, Interactive Learning

1.0 INTRODUCTION
Mastery of English grammar, particularly Past Tense, Present Tense, and Past Participle, remains challenging among secondary school students due to teacher-centred and memorisation-based approaches that often reduce engagement and meaningful understanding (OECD, 2022). Interactive and hands-on grammar learning opportunities are limited, resulting in passive learners with low confidence (UNESCO, 2023). To address these issues, the Play-Based Learn Kit was developed using recycled pizza boxes and colour-coded cards to provide an affordable, engaging, and collaborative learning experience. Grounded in constructivist theories (Piaget, 1976), the innovation enhances grammar mastery, develops 21st-century skills, and supports SDG 4, SDG 12, and SDG 13 through sustainable educational practices (United Nations, 2015).

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. Enhance English grammar mastery.
b. Increase students' motivation and participation.
c. Promote environmental awareness through recycled materials.

3.0 NOVELTY & INVENTIVENESS
The Play-Based Learn Kit combines play-based learning, sustainability, and affordable instructional design to enhance English grammar mastery. Using recycled pizza boxes and colour-coded cards, students learn grammar through interactive activities that promote collaboration and critical thinking. This reusable innovation offers an engaging alternative to traditional methods while supporting SDG 4, SDG 12, and SDG 13 (OECD, 2022; United Nations, 2015).

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Teaching Approach	Teacher-centred, worksheet-based, and focused on memorisation.	Student-centred, play-based, and promotes active learning through hands-on activities.
Learning Materials	Commercial teaching aids are often costly, non-reusable, and lack sustainability elements.	Utilises recycled pizza boxes and reusable colour-coded cards, making it affordable and environmentally friendly.
Student Engagement and Skills Development	Limited interaction and lower student motivation, with minimal emphasis on 21st-century skills.	Promotes communication, collaboration, critical thinking, creativity, and self-confidence through interactive gameplay.

4.0 PRACTICALITY & USEFULNESS

The Play-Based Learn Kit can be implemented in secondary school English classrooms and remedial programmes to enhance grammar learning. Benefiting students and teachers, it is affordable, reusable, and easy to replicate using recycled materials. The innovation supports sustainable practices, reduces teaching costs, and improves student engagement, participation, and grammar mastery through interactive learning experiences.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Developed using the ADDIE model, the Play-Based Learn Kit utilises recycled pizza boxes and colour-coded cards to facilitate interactive grammar learning. Testing with 30 secondary students through pre- and post-tests, observations, and feedback showed improvements in grammar mastery, participation, and engagement. The findings highlight the kit's practicality, affordability, and effectiveness in promoting meaningful learning experiences.

6.0 CONCLUSION

The Play-Based Learn Kit effectively improved students' English grammar mastery through interactive and sustainable learning experiences using recycled materials. The innovation fostered 21st-century skills while providing an affordable and reusable teaching aid. Despite limitations in implementation scale, future enhancements may include digital integration and broader application. This innovation demonstrates how sustainable educational practices can contribute to developing future-ready learners in line with the i-NEXTECH 2026 theme, "Bridging Ideas and Technology for a Resilient Future.

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PROJECT ID: IN62

VENTINOVA
ENVIRONMENTALLY FRIENDLY VENTILATION BLOCKS MADE FROM WATER TREATMENT PLANT SLUDGE AND WORKSHOP BRICK WASTE

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ABSTRACT
Ventinova is a sustainable building material innovation based on green technology and circular economy developed as an alternative separating block for structural and landscape applications. This innovation utilizes industrial waste such as sludge from Wastewater Treatment Plants and brick waste as the main material, thus addressing the issue of increasing solid waste that has a negative impact on the environment and the country's disposal system. This study aims to develop a sustainable building material that can reduce dependence on conventional cement-based materials and reduce carbon emissions. The methodology involves the process of pre-treatment of materials, crushing of brick waste, mixture formulation according to a certain ratio, moulding, and controlled drying and curing processes. Physical tests were conducted to evaluate the compressive strength, durability and usability of the product. The results of the study showed that Ventinova produces blocks that are lightweight, strong, durable and environmentally friendly. This innovation has the potential to significantly reduce industrial waste, support circular economy practices and have high commercial value due to low production costs and the increasing demand for green building materials. In addition, Ventinova supports SDG 11, SDG 12 and SDG 13, and has the potential to be patented as a new generation of alternative building materials.
Keywords: Green and sustainable construction, Industrial waste, Brick waste

1.0 INTRODUCTION
Ventinova is a sustainable building material innovation developed based on the concepts of green technology and the circular economy to support environmental preservation efforts in the construction industry. This innovation utilizes two types of industrial waste materials, namely sludge from Water Treatment Plants and brick waste from educational institution workshops, as the main materials in producing environmentally friendly partition blocks. The use of these waste materials not only helps reduce solid waste accumulation but also adds value to materials that were previously considered unusable and discarded without further processing. The development of Ventinova was carried out as an alternative to conventional building materials, which mostly rely heavily on cement and contribute to increased carbon dioxide emissions. In the modern construction sector, the use of sustainable materials is essential to reduce environmental pollution and ensure natural resources are preserved for future generations. Therefore, this innovation emphasizes the production of materials that are more eco-friendly, lightweight, practical, and cost-effective without compromising durability, quality, and functionality in construction and landscaping applications. In addition, Ventinova was also developed to support sustainable development initiatives through the transformation of waste into high-value products that can be applied in landscaping and light construction applications. Throughout the development process of this innovation, various samples were produced and tested to evaluate the density, strength, and suitability of the materials used. Several tests and observations were also conducted to ensure the product met the required standards and performance expectations. The test results obtained show that Ventinova has strong potential to be introduced as an innovative and sustainable alternative building material capable of benefiting both the environment and society while supporting greener construction practices in the future.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To develop a sustainable ventilation block using water treatment sludge and recycled brick waste as alternative construction materials to reduce dependency on conventional raw materials and promote green construction practices.

b. To minimize industrial and construction waste disposal through waste-to-resource innovation by transforming sludge and workshop waste into functional and value-added engineering products.
c. To enhance passive building ventilation and thermal comfort through an innovative ventilation block design that improves natural airflow and supports energy-efficient building systems.
d. To provide a low-cost and practical sustainable construction solution suitable for educational institutions, community infrastructure, and green building applications.
e. To support Sustainable Development Goals (SDG 11, SDG 12, and SDG 13) by promoting environmental sustainability, circular economy practices, and climate-resilient construction technology.

3.0 NOVELTY & INVENTIVENESS

Ventinova introduces a sustainable ventilation block manufactured using water treatment sludge and recycled brick waste from vocational workshop activities. Unlike conventional ventilation blocks, Ventinova integrates waste-to-resource engineering with passive ventilation technology to reduce environmental impact while maintaining functional building performance.

3.1 Key Innovative Features

3.1.1 First Innovative Aspect – Waste-Based Composite Material
Ventinova utilizes treated water treatment sludge combined with crushed brick waste as partial replacement materials in ventilation block production. This approach reduces dependency on virgin raw materials while minimizing industrial waste disposal.
3.1.2 Second Innovative Aspect – Passive Cooling Ventilation Design
The block is designed with engineered airflow openings that improve indoor air circulation and reduce heat accumulation in buildings. This contributes to passive cooling and energy efficiency.
3.1.3 Additional Innovative Aspect – Low-Cost Green Construction Material
The innovation offers an affordable alternative suitable for TVET training, low-cost housing, and sustainable community infrastructure. The manufacturing process is simple and feasible for small-scale production.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Raw Materials	Conventional ventilation blocks use cement, sand, and natural aggregates which require high consumption of natural resources.	Ventinova utilizes recycled water treatment sludge and brick waste as sustainable alternative materials.
Environmental Impact	Generates high carbon emissions and contributes to construction waste and landfill issues.	Reduces industrial waste disposal, supports circular economy practices, and lowers environmental pollution.
Ventilation Function	Provides basic airflow mainly for decorative or standard ventilation purposes.	Engineered ventilation design improves passive cooling and indoor air circulation for better thermal comfort.
Production Cost	Higher production costs due to dependence on virgin construction materials.	Lower production cost through the use of low-cost recycled waste materials.

4.0 PRACTICALITY & USEFULNESS

Ventinova is a practical and environmentally friendly innovation that can be applied in various real-world construction projects, particularly in tropical climate regions that require efficient natural ventilation systems. The product is suitable for residential houses, educational institutions, green buildings, community facilities, and low-cost infrastructure development. By functioning as a passive ventilation block, Ventinova improves indoor airflow circulation and reduces heat accumulation, contributing to better thermal comfort and energy efficiency in buildings. This innovation primarily benefits the construction industry, educational institutions, green technology developers, local communities, and Technical and Vocational Education and Training (TVET) students. It also provides hands-on learning opportunities for students in sustainable construction technology and waste management practices. From a technical perspective, Ventinova is feasible to implement using existing workshop facilities and standard masonry production methods. The materials used, including water treatment sludge and recycled brick waste, are easily obtainable and require minimal processing before production. Economically, the innovation is cost-effective because it utilizes waste materials that are readily

available at low or no cost, reducing dependency on expensive conventional raw materials. In terms of scalability, Ventinova has strong potential for expansion into industrial manufacturing and community-based production. The design can also be modified to suit different architectural and environmental requirements. Furthermore, the innovation supports long-term sustainability by reducing industrial waste disposal, lowering carbon emissions, and promoting circular economy practices within the construction sector. The expected impact of Ventinova includes reducing environmental pollution, lowering construction material costs, improving natural building ventilation, and increasing awareness of sustainable engineering solutions. The innovation also contributes to Sustainable Development Goals (SDG 11, SDG 12, and SDG 13) by supporting sustainable cities, responsible consumption, and climate action initiatives.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The development of Ventinova began with a preliminary study and problem analysis focusing on thermal discomfort and poor air circulation in buildings. A review of existing passive ventilation systems and sustainable building approaches was conducted to identify suitable design concepts that could improve indoor airflow while reducing dependency on mechanical cooling systems. The study also considered current issues related to energy consumption and sustainable construction practices. Following the initial analysis, the design phase was carried out through several conceptual sketches and prototype planning processes. The design of Ventinova was developed to optimize natural airflow and improve thermal comfort within indoor spaces. Suitable construction materials were selected based on durability, practicality, and compatibility with sustainable building applications. The prototype fabrication process involved the construction of a modular ventilation structure and the preparation of a mock-up wall installation. The prototype was assembled and tested under controlled observation to evaluate its airflow performance and practical applicability within building environments. Product testing was conducted through observational analysis of airflow movement, indoor ventilation performance, and thermal comfort conditions. Comparative observations between conventional wall systems and the Ventinova prototype were carried out to evaluate the effectiveness of passive ventilation. Feedback from lecturers, technical experts, and users was also collected to support product evaluation and improvement. Finally, the collected observations and feedback were analyzed to identify the strengths, limitations, and potential improvements of the product. Several refinements were implemented to enhance the design efficiency, functionality, and overall sustainability value of Ventinova.

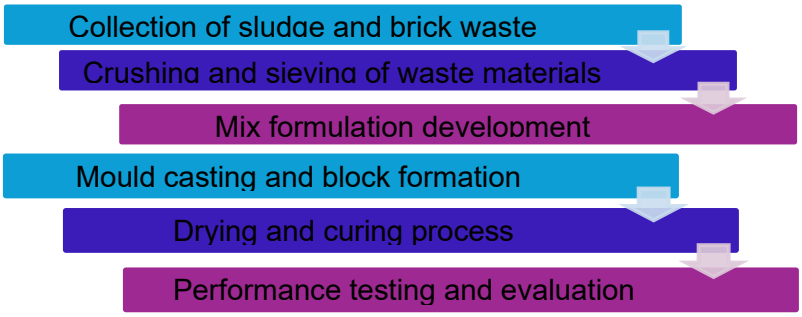


Figure 1: Development process flowchart

Table 2. Physical and Functional Performance Test of Ventinova

Test Parameter	Standard / Requirement	Ventinova Result	Performance Evaluation
Compressive Strength Test	Commercialization Potential	11.6 N/mm²	Exceeded Standard
Moisture Content Test	≤ 10%	6.2%	Satisfactory
Airflow Circulation Performance	Passive Ventilation System	Improved Natural Airflow	Effective
Thermal Comfort Observation	Reduced Heat Accumulation	Positive Improvement	Good
Structural Durability	Construction Application Suitability	Durable and Stable	Satisfactory
Installation Method	IBS Compatibility	Modular and Easy Installation	Good

Environmental Sustainability	Waste-Based Material Utilization	Eco-Friendly Product	Excellent
Commercialization Potential	Sustainable Construction Industry	High Potential	Highly Promising

6.0 CONCLUSION

Ventinova successfully addresses issues related to industrial waste disposal and unsustainable construction materials through an innovative green ventilation block system. The project demonstrates how recycled sludge and brick waste can be transformed into functional engineering products with environmental, economic, and educational value. The innovation contributes significantly to sustainable construction technology, circular economy implementation, and TVET-based green engineering education. Despite limitations related to large-scale industrial testing and long-term durability evaluation, the project has strong commercialization and research expansion potential. Future improvements include advanced structural testing, optimization of airflow efficiency, and integration with smart green building systems. Ventinova represents a meaningful innovation that bridges sustainability, engineering, and technology towards a resilient future aligned with the theme *"Bridging Ideas and Technology for a Resilient Future."*

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The authors would like to express their sincere appreciation to Kolej Vokasional Taiping for providing facilities, technical support, laboratory equipment, and continuous guidance throughout the development of the Ventinova innovation project. Special appreciation is also extended to the management and technical staff of Kampung Senawar Water Treatment Plant for their cooperation and assistance during the sludge collection and material preparation processes used in this research. The authors would also like to thank all lecturers, students, technical experts, and individuals who contributed directly or indirectly to the fabrication, testing, evaluation, and improvement of Ventinova. Their commitment, expertise, and encouragement played an important role in ensuring the successful completion of this project. This innovation project reflects the commitment toward sustainable construction development, green technology innovation, circular economy implementation, and the strengthening of Technical and Vocational Education and Training (TVET) through practical sustainable engineering applications.

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PROJECT ID: IN81

CARE CARD: STUDENT PREPAREDNESS FOR MEGATHRUST EARTHQUAKE MITIGATION

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ABSTRACT
Padang, the capital of West Sumatra, Indonesia, is highly vulnerable to megathrust earthquakes that can trigger tsunamis and cause severe destruction. However, disaster preparedness among adolescents, especially secondary school students, remains relatively low. To address this issue, the Care Card game was developed as an interactive learning tool to improve understanding of megathrust disaster mitigation. The game helps students learn how to respond and reduce disaster impacts through fun and collaborative activities. The instrument consists of 60 cards, including 30 question cards and 30 answer cards, designed to promote active engagement and discussion. Findings show that the Care Card significantly improves students' knowledge, awareness, and motivation related to disaster preparedness. Most students demonstrated improved readiness, particularly in simulation and evacuation activities, indicating effective learning of practical mitigation concepts. Overall, the results suggest that Care Card is an innovative, interactive, and participatory educational medium suitable for enhancing disaster education at the secondary school level.
Keywords: interactive game, megathrust earthquake, disaster mitigation, student preparedness

1.0 INTRODUCTION
Padang, West Sumatra, Indonesia, is highly vulnerable to megathrust earthquakes and tsunamis, with a population of about 965,100 (BPS, 2025). Problem Statement: Students' disaster preparedness remains low, and disaster education is largely theoretical with limited engagement. Significance of the Study: Care Card improves students' awareness and preparedness for megathrust disaster mitigation.

2.0 OBJECTIVE
The objectives of this innovation are:
a. To develop a game-based educational tool for megathrust disaster mitigation.
b. To assess its effectiveness in enhancing students' preparedness for megathrust disasters.
c. To support the development of creative and effective disaster education programs in high-risk regions.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: This educational tool promotes megathrust disaster mitigation awareness. Key Features: It increases students' interest and engagement through an interactive learning approach. Comparison with Existing Solutions: Current methods rely on briefings, posters, and simulations with limited active participation, reducing effectiveness in preparedness. Intellectual Property Potential: Care Card is not yet registered but has strong potential for IP protection due to its unique game-based learning design.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	This Innovation
Method	Rely on briefings, posters, and simulations.	Improves students' understanding through play-based learning.

4.0 PRACTICALITY & USEFULNESS
Real-World Applications: The card game can be used in schools and by disaster agencies. Target Users: Secondary school students and communities. Feasibility and Implementation: Low-cost, scalable, sustainable. Expected Impact: Promotes disaster preparedness among students.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
Design and Development Process: Care Card was created from four A3 carton boards cut into 60 question-and-answer cards (57 × 89 mm) to support active learning on megathrust preparedness.

Materials and Methods: Students were split into two groups, each receiving 30 cards, and arranged face-to-face to promote interaction and matching activities. Testing and Results: Over 85% of students reported increased knowledge, 92.6% enjoyed the activity, and 96.3% felt more motivated. Technical Explanation: Care Card is a Q&A card game where students collaborate to match answers, improving understanding of disaster preparedness through discussion.

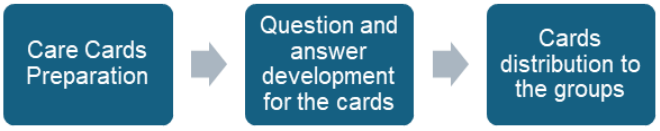


Figure 1: Development process flowchart

6.0 CONCLUSION

Summary of Achievement: Care Card improves students' preparedness and awareness of megathrust disaster mitigation. Contributions and Impact: It enhances disaster literacy and emergency decision-making. Limitations and Challenges: It mainly covers megathrust earthquakes and basic response. Future Work and Recommendations: Broaden content and strengthen real-life preparedness applications. Closing Statement: Care Card is an interactive tool promoting disaster preparedness and response awareness.

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PROJECT ID: IN103

D'-ROPE-LET: RECYCLED VERTICAL GARDENING SYSTEM WITH INTEGRATED WATER FILTRATION AND SLOW-RELEASE IRRIGATION

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ABSTRACT
Rapid urbanisation, limited household space, unreliable access to clean water, and rising food costs present significant challenges to household food security in many communities. D'-ROPE-LET addresses these interconnected issues through a low-cost vertical gardening system constructed from recycled materials, incorporating an integrated water filtration unit and rope-based slow-release irrigation. The system accepts untreated or greywater, which passes through an embedded filtration medium before being absorbed by natural fibre ropes. The ropes deliver moisture gradually to plant root zones, maintaining optimal soil hydration without waterlogging. This gravity-fed, passive irrigation mechanism eliminates the need for pumps or continuous manual watering. Prototype evaluation confirmed effective filtration, consistent moisture delivery, and successful cultivation of leafy vegetables in confined vertical configurations. By utilising readily available waste materials and enabling cultivation with non-potable water sources, D'-ROPE-LET supports multiple Sustainable Development Goals (SDG 2: Zero Hunger; SDG 6: Clean Water and Sanitation; SDG 9: Industry, Innovation and Infrastructure; SDG 11: Sustainable Cities and Communities; SDG 12: Responsible Consumption and Production). The design offers an accessible, scalable solution for urban households, schools, and community gardens seeking sustainable food production under spatial and resource constraints.
Keywords: vertical gardening, water filtration, slow-release irrigation, recycled materials, urban agriculture

1.0 INTRODUCTION
Background: Urban households frequently face constraints in available growing space, access to clean irrigation water, and time for plant maintenance. Conventional vertical gardening systems often require treated water and active irrigation infrastructure, limiting adoption in low-resource settings.
Problem Statement: Existing solutions typically depend on potable water supplies, electrical pumps, or frequent manual intervention, creating barriers for communities experiencing water scarcity, spatial limitations, or economic constraints.
Significance: A passive, low-cost vertical system capable of utilising filtered greywater or untreated sources can enhance household food production, reduce water demand, and promote circular material use in urban environments.

2.0 OBJECTIVE
The main objectives are:
a. To design and construct a vertical gardening unit from recycled materials incorporating integrated filtration and rope-based irrigation
b. To evaluate filtration efficiency, moisture delivery consistency, and plant growth performance under controlled condition
c. To demonstrate feasibility for household-scale food production using non-potable water sources.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: D'-ROPE-LET integrates water filtration and passive irrigation within a single vertical recycled-material structure, enabling cultivation without reliance on clean water or powered systems. Key Features: Gravity-driven filtration followed by natural fibre rope absorption and controlled release to soil; modular vertical configuration maximising space efficiency. Comparison: Unlike conventional hydroponic or drip-irrigation vertical systems requiring treated water and infrastructure, this design operates passively with filtered greywater or surface water. IP Potential: The combined filtration-irrigation mechanism using low-cost recycled components offers potential for utility model protection in appropriate jurisdictions.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	D'-ROPE-LET
Water source	Requires potable or treated water	Accepts greywater or untreated sources via filtration
Irrigation method	Active pumping or frequent manual watering	Passive rope-based slow-release system
Space requirement	Often horizontal or large footprint	Compact vertical configuration for limited spaces
Material cost	Specialised components, higher cost	Recycled materials, low-cost construction

4.0 PRACTICALITY & USEFULNESS

Applications: Suitable for urban balconies, school gardens, community plots, and households with limited space or water access. Target Users: Urban residents, students, low-income households, and community organisations seeking affordable, sustainable food production methods. Feasibility: Constructed from readily available recycled containers, natural fibre ropes, and simple filtration media, enabling local assembly with minimal tools or technical expertise. Expected Impact: Supports household food security, reduces demand on potable water supplies, diverts waste materials from landfills, and promotes sustainable urban agriculture practices.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development: Recycled plastic containers were arranged vertically with integrated filtration chambers. Natural fibre ropes were threaded through perforations to connect the filtered water reservoir with planting compartments. Materials: Recycled PET bottles or containers activated charcoal or sand-based filter media, cotton or jute ropes, potting soil, and seedling plugs. Testing and Validation: Filtration performance was assessed using turbidity and contaminant reduction metrics; irrigation consistency was monitored through soil moisture sensors over multiple cycles; plant growth trials evaluated biomass accumulation and health indicators. Technical Explanation: Untreated water enters the upper filtration unit, passes through layered media removing particulates and impurities, then collects in a reservoir. Capillary action draws water into the ropes, which transport and release moisture slowly to the soil below, maintaining consistent hydration without saturation.

6.0 CONCLUSION

Summary: D'-ROPE-LET successfully demonstrates a passive vertical gardening system integrating filtration and slow-release irrigation using recycled materials, meeting objectives of space efficiency, water conservation, and low-cost implementation. Contributions: Provides an accessible solution for urban food production under resource constraints while advancing multiple Sustainable Development Goals. Limitations: Long-term durability of rope materials and filtration media replacement intervals require further evaluation. Future Work: Continued development will focus on optimising filter longevity, scaling to community-level units, and documenting yield improvements across diverse crop types, contributing to resilient urban food systems aligned with the i-NEXTECH 2026 theme.

ACKNOWLEDGMENTS

The authors acknowledge MRSM Alor Gajah for providing laboratory facilities, workshop resources, and guidance throughout the development of this project.

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PROJECT ID: IN104

THE OCTET QUEST

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ABSTRACT
The Octet Quest is a chemistry learning innovation that combines hands-on activities, digital resources and gamification to enhance students' understanding of atomic structure. With a physical atom modeling kit, QR code-enabled content and game-based activities, students will explore electron configurations and atomic stability engagingly and interactively. The platform emphasises active learning, enhances conceptual understanding and will increase student motivation. As a practical and scalable educational innovation, Octet Quest has the potential to add value to the teaching and learning of chemistry in the digital age.
Keywords: Hands-on, Digital, Gamification

1.0 INTRODUCTION
Chemistry is known as one of the basic sciences that can explain the composition, properties, and interactions of a substance (Annisa & Laksono, 2021). Unfortunately, many students consider chemistry as a difficult subject to master because of the variety of concepts, such as atomic structure and electron configuration, which are abstract and cannot be directly observed (Woldemanuel et al., 2014). Traditional teaching relies heavily on textbook illustrations and single explanations from the teacher (Suyo-Vega et al., 2024). This limits students' ability to visualise and understand the arrangement of electrons in atoms. Students find it difficult to memorise electron configurations because they do not master the basic concepts (Rophi et al., 2024). This learning innovation aligns with the current wave of education that focuses on the integration of practical learning, digital technology, and games that enhance student engagement and conceptual understanding (Kelley & Knowles, 2016).

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To enhance students' understanding of atomic structure and electron configuration through an interactive and integrated learning approach.
b. To provide students with immediate access to reliable chemistry learning resources through web content
c. To increase learning engagement through gamified challenges that promote active participation and problem-solving skills.

3.0 NOVELTY & INVENTIVENESS
Traditional learning methods separate physical and digital learning, but The Octet Quest combines them into a unified ecosystem. It combines live atom modelling kits, QR code links to digital multimedia, and an interactive gaming system. This multi-sensory approach can benefit visual, auditory, and kinesthetic learners.

4.0 PRACTICALITY & USEFULNESS
The Octet Quest is a practical, affordable and user-friendly tool that can be incorporated into STEM lessons, labs and programs. By combining physical, digital and game-based learning, it can transform passive teaching into active exploration. In addition, the QR code feature allows access without time and place constraints and effectively supports classroom and self-directed learning.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
The kit integrates physical modelling, digital resources, and gamification into a single platform featuring three components. First, the physical kit provides an atomic shell board and removable electron tokens. Second, a web portal accessed via QR codes, displaying videos and information about electron configurations. Third, the gamification platform reinforces learning through interactive games related to atomic and electron configurations.

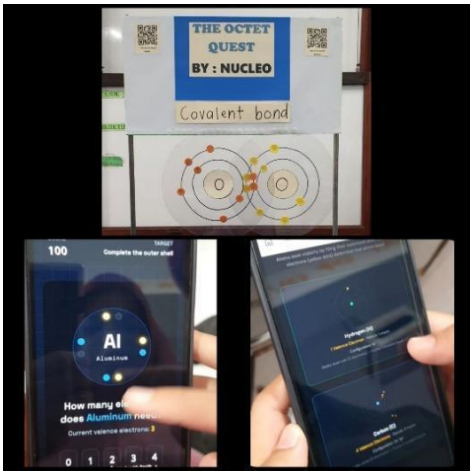


Figure 1: The Octet Quest

6.0 CONCLUSION

The Octet Quest is a chemistry platform kit that provides an engaging interactive experience. By combining physical learning activities, QR coded digital resources and gamification, it provides students with a variety of interactive methods to master the topics of electron configuration and atomic stability. The prototype has successfully fostered active learning and student motivation and has prospects planned such as the introduction of augmented reality, mobile applications and expanded syllabus content.

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PROJECT ID: IN108

HANG-IT-DRY: MULTIFUNCTIONAL FOLDING HANGER WITH INTEGRATED DRYING SYSTEM

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ABSTRACT
Boarding school students and frequent travellers often face challenges related to limited living space, high electricity costs for drying appliances, unpredictable weather, and the environmental burden of disposable plastic hangers. HANG-IT-DRY addresses these issues through a multifunctional, foldable hanger constructed from durable waterproof laminated wood. The design incorporates hooks on both sides for accessories, a rotational axle enabling continuous spinning for accelerated air-drying, a central hinge allowing compact folding for storage or travel, and an integrated heating mesh with fans in the lower section for thorough garment drying without excessive heat. Activation via a simple button initiate both the spinning motion and gentle heating, providing an efficient, user-friendly alternative to conventional drying methods. The use of sustainable wood materials also contributes to reducing the estimated 8 billion plastic hangers discarded annually into landfills. Prototype testing confirmed reliable mechanical performance, effective moisture removal, and ease of use in confined spaces. HANG-IT-DRY offers a practical, eco-conscious solution for students, travellers, and households seeking space-efficient, energy-saving garment care.
Keywords: multifunctional hanger, foldable design, integrated drying, sustainable material, space-saving

1.0 INTRODUCTION
Background: Students in boarding schools and travellers frequently encounter constraints in living space and access to conventional drying facilities. Reliance on electric dryers increases energy costs, while outdoor drying is subject to weather variability. Additionally, the widespread use of single-use plastic hangers contributes significantly to landfill waste.
Problem Statement: Existing solutions either occupy excessive space, require high energy input, or rely on non-biodegradable materials, leaving unmet needs for compact, low-energy, and environmentally responsible garment drying options.
Significance: A foldable, multifunctional hanger with integrated low-energy drying capability can reduce electricity consumption, minimise plastic waste, and improve convenience for students and mobile users.

2.0 OBJECTIVE
The main objectives are:
a. To design a durable, foldable wooden hanger incorporating rotational drying and integrated low-energy heating
b. To ensure the device operates effectively in confined or unconventional spaces while remaining portable
c. To evaluate mechanical reliability, drying performance, and user convenience through prototype testing.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: HANG-IT-DRY combines multiple functions—hanging, spinning, folding, and gentle heating—within a single compact wooden device, eliminating the need for separate appliances. Key Features: Waterproof laminated wood construction, dual-side accessory hooks, continuous 360° rotational axle, central folding hinge, and fan-assisted heating mesh providing even airflow. Comparison: Unlike conventional plastic hangers or bulky electric dryers, this design offers portability, energy efficiency, and material sustainability in one unit. IP Potential: The integrated mechanical and heating system offers scope for utility model or design protection.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	HANG-IT-DRY
Material	Plastic or basic wood, often non-durable	Waterproof laminated wood, sustainable source
Drying method	Passive air or high-energy electric dryers	Low-energy integrated heating mesh with fans
Storage/Portability	Fixed shape, bulky for travel	Folds compactly via central hinge
Additional functions	Single-purpose hanging only	Spinning, accessory hooks, and gentle heating

4.0 PRACTICALITY & USEFULNESS

Applications: Ideal for boarding school dormitories, hostel rooms, small apartments, and travel use where space and energy efficiency are priorities. Target Users: Students, backpackers, frequent travellers, and households seeking compact, sustainable laundry solutions. Feasibility: Constructed from readily available laminated wood with simple mechanical and low-voltage electrical components, supporting local or small-scale manufacturing. Expected Impact: Reduces reliance on energy-intensive dryers and disposable plastic hangers, lowering both operational costs and environmental footprint for users.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development: The hanger body was fabricated from waterproof laminated wood, fitted with a rotational axle mechanism, central folding hinge, dual-side hooks, and a lower heating mesh containing small fans. Materials: Laminated hardwood, stainless steel hardware, low-voltage heating elements, and compact DC fans. Testing and Validation: Mechanical durability, folding repeatability, spinning smoothness, and drying performance were evaluated using standard garment samples under controlled humidity conditions. Technical Explanation: Button activation simultaneously engages the rotational axle for air circulation and powers the fan-assisted heating mesh, ensuring even moisture removal while the foldable design allows compact storage when not in use.

6.0 CONCLUSION

Summary: HANG-IT-DRY successfully integrates folding, spinning, and low-energy heating functions into a single durable wooden hanger, meeting the objectives of space efficiency, portability, and reduced environmental impact. Contributions: Offers a practical, sustainable alternative to plastic hangers and high-energy dryers for students and travellers. Limitations: Battery life optimisation and scaled manufacturing processes require further refinement. Future Work: Continued development will focus on improved energy storage, material sourcing certification, and broader market adaptation, supporting the theme of bridging ideas and technology for a resilient future.

ACKNOWLEDGMENTS

The authors acknowledge MRSM Alor Gajah for laboratory facilities, workshop access, and guidance throughout the development of this project.

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PROJECT ID: IN109

ALGE-PACK: EDIBLE ALGINATE-BASED FOOD WRAPPING FOR SUSTAINABLE PACKAGING

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ABSTRACT
Plastic pollution from single-use food packaging remains a pressing environmental challenge, with conventional wrappers persisting in landfills for centuries. ALGE-PACK addresses this through an edible, biodegradable wrapping formulated from natural polymers. Sodium alginate from brown algae is blended with vegetable oil for flexibility, then immersed in calcium chloride solution to induce ionic cross-linking, forming a stable, cohesive film. Laboratory tests confirmed adequate tensile strength, elasticity, and moisture resistance while remaining safe for consumption or natural decomposition. Performance trials showed reliable protection for biscuits, snacks, and sandwiches. ALGE-PACK supports responsible consumption aligned with sustainability targets and offers practical benefits for school canteens, households, and food vendors seeking affordable, environmentally sound packaging.
Keywords: alginate, edible film, biodegradable packaging, food wrapping, sustainable material

1.0 INTRODUCTION
Background: Single-use plastic films dominate food packaging despite long environmental persistence and microplastic accumulation. Existing bio-based alternatives often lack mechanical robustness or cost-effectiveness for everyday use.
Problem Statement: Current edible wrappers frequently suffer from brittleness, poor moisture barrier properties, or high production costs, limiting adoption in routine food service settings.
Significance: A viable edible wrapping reduces plastic waste at source and aligns with institutional efforts to minimise environmental impact.

2.0 OBJECTIVE
The main objectives are:
a. To formulate a stable, edible film using sodium alginate and vegetable oil meeting food-contact requirements.
b. To evaluate mechanical strength, flexibility, and moisture resistance through standardised testing.
c. To demonstrate practical application for dry and semi-moist food items.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: The formulation employs simple ionic cross-linking without synthetic additives or complex equipment. Key Features: Alginate-vegetable oil blend yields improved elasticity; calcium chloride dip creates rapid, uniform curing at ambient temperature. Comparison: Unlike starch- or gelatine-based wrappers that become brittle when dry, ALGE-PACK maintains flexibility and moisture tolerance while remaining fully consumable. IP Potential: The low-cost process offers scope for utility model or process patent protection.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	ALGE-PACK
Material source	Synthetic polymers or limited natural bases	Sodium alginate from brown algae plus vegetable oil
Edibility	Rarely edible	Fully edible and safe for consumption
Moisture resistance	Often poor or requires additional coatings	Achieved through oil incorporation and cross-linking
Processing	Energy-intensive or multi-step	Ambient-temperature ionic gelation

4.0 PRACTICALITY & USEFULNESS
Applications: Suitable for wrapping snacks, biscuits, and sandwiches in school canteens, home kitchens, and small retail outlets. Target Users: Students, households, and micro-enterprises seeking affordable, plastic-free packaging. Feasibility: Uses widely available food-grade reagents and basic

mixing/dipping equipment, supporting low-cost local production. Expected Impact: Replacement of conventional plastic wrappers can reduce packaging-related plastic waste while maintaining food protection standards.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Process: Sodium alginate dissolved, blended with vegetable oil, cast into thin layers, and immersed in calcium chloride solution to form cured film. Materials: Food-grade sodium alginate, refined vegetable oil, calcium chloride dihydrate, distilled water. Testing: Tensile strength, elongation at break, and water vapour transmission assessed using standard protocols. Technical Explanation: Ionic cross-linking between alginate chains and calcium ions produces a gel network incorporating oil droplets, imparting flexibility and reduced water permeability while preserving edibility.

6.0 CONCLUSION

Summary: ALGE-PACK demonstrates a practical edible wrapping meeting objectives of strength, flexibility, and moisture resistance using a simple, scalable process. Contributions: Provides a functional, zero-waste packaging option supporting sustainable consumption. Limitations: Remaining work includes film thickness optimisation and shelf-life studies. Future Work: Continued refinement can expand its role in reducing plastic dependency across educational and commercial food settings, advancing the theme of bridging ideas and technology for a resilient future.

ACKNOWLEDGMENTS

The author acknowledges MRSM Alor Gajah for providing laboratory facilities and guidance during project development.

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PROJECT ID: IN110

ALGEBRIK: ALGAE-DERIVED DIY MOLDING SYSTEM FOR SUSTAINABLE SENSORY PLAY

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ABSTRACT
Plastic pollution from petroleum-derived polymers has created persistent environmental reservoirs of microplastics that bioaccumulate through aquatic food webs. The early-childhood sector remains dominated by non-biodegradable play materials offering limited sensory richness and failing to model circular-economy principles. There is a notable absence of child-safe play products that simultaneously employ food-grade biopolymers, provide dynamic hands-on moulding experiences for toddlers, and demonstrate verifiable end-of-life biodegradation without hazardous residues. ALGEBRIK introduces an algae-derived DIY moulding system that converts a pourable algal biogel into cohesive, malleable play elements on demand, enabling strands, cast shapes, and tactile forms in a single kit. Through controlled ionic curing with a benign activator and tuned plasticization, the material balances shear-thinning pourability, rapid surface set, and a hydrated elastic network that retains shape under play forces. Formulation variables were optimised to maximise tactile appeal, structural integrity, and process repeatability. Prototype evaluation demonstrates consistent moldability, reproducible texture, robust shape retention during toddler handling, and rapid biodegradation under standard composting conditions, positioning ALGEBRIK as a pedagogical, low-impact alternative to conventional toy plastics.
Keywords: biodegradable, biopolymer, sensory toy, algae-derived, moulding system

1.0 INTRODUCTION
Background: Petroleum-based plastics dominate toy manufacturing despite contributing to microplastic pollution and lacking sensory engagement. Existing bio-based alternatives rarely combine child safety, moldability, and verified biodegradability in one product. Problem Statement: Current sensory toys are predominantly non-biodegradable, offer limited tactile variety, and fail to demonstrate sustainable material cycles to young users and caregivers. Significance: A safe, algae-derived moulding system can reduce plastic waste, enhance early childhood sensory development, and introduce circular-economy concepts through hands-on play.

2.0 OBJECTIVE
The main objectives are:
a. To formulate a food-grade algal biogel with controlled ionic curing suitable for toddler play
b. To optimise polymer concentration, plasticizer fraction, and curing parameters for tactile appeal and structural integrity
c. To validate moldability, shape retention, batch consistency, and composting behaviour under standard conditions.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: ALGEBRIK employs a single-kit system where a pourable biogel transforms on demand into mouldable play elements via benign ionic activation, eliminating pre-formed plastic components. Key Features: Shear-thinning formulation enables easy pouring and extrusion; rapid surface set prevents mess while maintaining internal plasticity; hydrated elastic network provides satisfying tactile feedback. Comparison: Unlike conventional sensory toys or DIY kits using synthetic polymers or requiring complex equipment, ALGEBRIK uses only food-grade, compostable materials with no synthetic additives. IP Potential: The optimised formulation and activation method offer potential for process or composition patents.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	ALGEBRIK
Material source	Petroleum-derived or synthetic polymers	Food-grade sodium alginate from brown algae
Biodegradability	Non-biodegradable or slow composting	Rapid biodegradation under home composting
Child safety	May contain plasticisers or additives	Food-grade, no synthetic additives
Play format	Pre-formed shapes with limited variability	On-demand molding into strands, shapes, forms

4.0 PRACTICALITY & USEFULNESS

Applications: Designed for home, preschool, and therapy settings as a sustainable alternative to plastic sensory toys. Target Users: Toddlers (18 months+), parents, early childhood educators, and occupational therapists seeking eco-friendly sensory tools. Feasibility: Uses widely available food-grade reagents and simple mixing/activation steps suitable for small-scale or community production. Expected Impact: Reduces plastic toy waste, supports sensory development, and models sustainable material use for young learners and families.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Process: Sodium alginate dissolved in water, blended with food-grade plasticiser, then activated with calcium-based ionic solution to form elastic gel network. Materials: Food-grade sodium alginate, glycerine (plasticiser), calcium chloride or citrate (activator), distilled water. Testing: Moldability trials, shape retention under handling, batch-to-batch texture consistency, and composting rate under controlled conditions. Technical Explanation: Controlled ionic cross-linking creates a hydrated polymer network with tuneable elasticity; plasticiser reduces brittleness while maintaining shear-thinning behaviour for easy extrusion and moulding.

6.0 CONCLUSION

Summary: ALGEBRIK successfully demonstrates a safe, algae-derived moulding system meeting objectives of child-safe play, tactile engagement, and verified biodegradability using a simple, scalable formulation. Contributions: Provides the first fully compostable, on-demand sensory moulding kit suitable for toddlers while advancing biomaterial education. Limitations: Shelf-life optimisation and packaging for liquid components require further development. Future Work: Continued refinement will expand accessibility and demonstrate broader applications in early childhood education and sustainable product design, supporting the theme of bridging ideas and technology for a resilient future.

ACKNOWLEDGMENTS

The authors acknowledge MRSM Alor Gajah for laboratory facilities and guidance and thank participating families for prototype feedback during development.

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PROJECT ID: 112

SENSARIDE

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ABSTRACT
This innovation was developed specifically to help hearing-impaired drivers drive more safely. The system can detect loud sounds such as vehicle horns and warn the driver through a combination of visual and vibration.
Keywords: hearing impaired drivers, horn detection, road safety

1.0 INTRODUCTION
Background: Within regional automotive landscapes, such as Malaysia, thousands of Deaf and Hard of Hearing (DHH) motorists hold legal driving licenses and actively utilize public roadways. Problem Statement: When an emergency vehicle or overtaking motorist sounds an audio horn from a blind spot, a deaf driver remains unaware of the critical audio cue until the vehicle physically enters their immediate line of sight. Significance of the Study: This innovation removes the psychological anxiety of missing critical road cues, thereby increasing the confidence of Hard Hearing individuals to commute safely for employment, logistics, and daily mobility.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To design and develop a smart steering wheel integration capable of detecting and isolating vehicular horn sounds within a specific radius (e.g., 15 meters) with at least 90% accuracy, to be completed by the end of the prototyping phase.
b. To improve road safety by translating detected audio cues into localized haptic (vibration) feedback on the steering wheel, aiming to reduce the driver's hazard reaction time to under 1.5 seconds during simulation testing.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: Its functional transition from a passive, mechanical driving control to an active sensory communication hub. Conventional vehicle design isolates deaf drivers because critical road alerts are transmitted almost exclusively through audio (horns and sirens).
Key Innovative Features: The system automatically notifies the driver of the presence of a horn sound coming from angles hidden from the eyes (blind spots).
Intellectual Property Potential: Upon completing the final software build, a Copyright Voluntary Notification will be submitted to legally document ownership of the software asset.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
System Nature	Driver must manually look for the source of danger.	The system automatically notifies the driver of horns from the blind spot.
Information Delivery	Random vibrations or flashing without direction.	Lights activate according to the exact direction of the horn.

4.0 PRACTICALITY & USEFULNESS
Real-World Applications: Operating a vehicle within congested city centres, multi-lane roundabouts, or heavy highway traffic where vehicles frequently occupy blind spots. Target Users/Beneficiaries: Persons with Disabilities (PWD) community who experience mild to profound hearing loss. Feasibility and Implementation: Technical Feasibility: The technology is highly implementable using currently accessible, mature resources. Economic Viability: By utilizing affordable micro-components and leveraging existing mobile/tablet screens for the visual interface, the manufacturing cost is kept low. Scalability: The system can transition from an aftermarket steering wheel wrap/tablet widget setup to a factory-standard, direct-to-OEM (Original Equipment Manufacturer) integration built straight into the

assembly line of future smart vehicles, Sustainability: The physical components conform to RoHS compliance guidelines, prioritizing recyclable polymers for the steering casing to minimize future electronic waste impact. Expected Impact: The system fundamentally builds driving confidence among PWD drivers. By converting a chaotic audio environment into an intuitive visual stream.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: The system needed to capture ambient sound from the front and rear bumpers, process the signal strength, provide a visual readout, vibrate the steering wheel to alert the driver, and transmit data wirelessly to a smartphone. Technical Architecture/System Design: The system architecture comprises hardware components, interfaces with mobile software developed using MIT App Inventor. Materials and Methods: Arduino UNO, an LM3915 IC control unit, front and rear bumper-mounted condenser microphones, an amplifier circuit, a sound level indicator circuit, a variable resistor, left and right steering wheel vibration motors, an HC-05 Bluetooth module, and a 12V DC battery. Results and Performance: Testing confirmed that SensaRide successfully bridges the gap between external audio hazards and driver awareness.

Technical Explanation: *Refer to Figure 1*

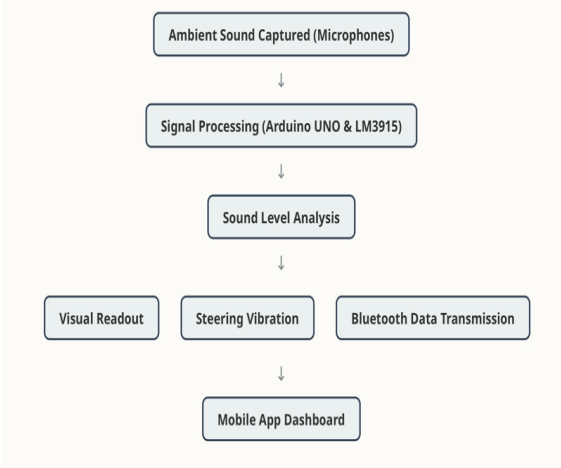


Figure 1: SensaRide System Workflow

6.0 CONCLUSION

Summary of Achievement: This project successfully developed an integrated audio-haptic driver assistance system designed to bridge the gap between external vehicular auditory cues and driver awareness. Contributions and Impact: This system provides a life-changing solution for deaf or hard-of-hearing drivers, translating crucial auditory data (like sirens, horns, or approaching vehicles) into intuitive physical and visual alerts. Limitations and Challenges: The wiring and placement of the vibration motor on the steering wheel is currently optimized for the mock-ups and requires more testing for everyday automotive vehicles. Future Work and Recommendations: Expanding the MIT App Inventor program into a fully background-compatible Android/iOS application that can overlay visual alerts on top of active navigation apps like Waze or Google Maps. Closing Statement: By turning sound into touch and sight, this system paves the way toward a more inclusive, adaptable, and resilient automotive future where road safety is truly accessible.

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PROJECT ID: IN116

FISH CATAPPA

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ABSTRACT
Fish Catappa is a blend of finely ground Ketapang leaves with several nutritious nutrients in a tea bag designed for fish keepers who find it difficult to manage the responsibilities of maintaining their aquatic pets. Fish Catappa offers an all-in-one solution that keeps your fish healthy and stress-free. To enhance this experience, the Aqua Companion app offers smart support by tracking aquarium conditions and fish health. This combination makes maintaining a thriving aquarium easier than ever.
Keywords: Fish's health, aquarium, smart monitoring

1.0 INTRODUCTION
Background: Fish keeping requires consistent monitoring of water quality, feeding, and maintenance, which many owners struggle to manage due to time constraints and limited knowledge. Problem Statement: Existing methods, such as untreated Ketapang leaves, cause unstable pH, residue buildup, and poor aquarium's aesthetics. Therefore, Fish Catappa highlights the need for an integrated, efficient, and user-friendly aquarium care solution. Significance of the Study: By simplifying water management and feeding, it improves fish health and reduces user effort. The integration of natural materials and smart technology promotes sustainable practices aligned with SDG 14.

2.0 OBJECTIVE
a. The main objectives of this innovation/project are:
b. To develop an aquarium care product using Ketapang leaves, blue salt, and nutrient flakes that can improve water quality and support fish health.
c. To reduce the pH level of a 5-liter aquarium effectively while maintaining cleaner and clearer water conditions.
d. To promote sustainable and intelligent fish-keeping practices that support Sustainable Development Goal 14 (Life Below Water).

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: Fish Catappa combines natural aquarium treatment and smart technology in a single ecosystem. The innovation uses shredded Ketapang leaves in biodegradable tea bags and is supported by the AquaCompanion mobile application for smarter aquarium management. Key Innovative Features: Prevents residue buildup and simplifies maintenance. Combine Ketapang leaves, blue salt, and nutrient flakes in one product. Monitors pH levels, provides reminders, and tracks aquarium conditions. Estimates tea bag replacement based on aquarium capacity. Comparison with Existing Solutions: Shredded ketapang leaves packed in biodegradable tea bags for cleaner uses compared to whole leaves placed directly into tanks will cause residue buildup. Smart monitoring through AquaCompanion compared to manual monitoring and maintenance in existing solutions. Intellectual Property Potential: The originality of Fish Catappa has been recognized through MyIPO registration for its documentation and literary work. The innovation also has future potential for patent and trademark protection to support commercialization and market expansion.

4.0 PRACTICALITY & USEFULNESS
Real-World Applications: Fish Catappa serves as a convenient all-in-one water conditioner and feeder for home aquariums, commercial breeding centers, and office tanks. Target Users/Beneficiaries: The primary beneficiaries are busy fish hobbyists, commercial breeders, and marine researchers who need an efficient way to maintain fish health. Technical Feasibility: The product is highly feasible to implement as it uses accessible natural ingredients and a simple preparation process, supported by a user-friendly mobile app. Economic Viability: It is highly cost-effective by combining water treatment and premium nutrition into a single affordable product, reducing the need for separate, expensive supplements. Scalability: The production can easily be scaled up from manual packing to automated mass production,

with tea bag sizes adaptable for various tank volumes. Sustainability: The product is environmentally sustainable as it utilizes natural, biodegradable materials that mimic a realistic swamp habitat without chemical waste. Expected Impact: It significantly reduces the time and energy spent on aquarium maintenance while improving fish survival rates through smart monitoring and immunity-boosting nutrients.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Key components and specifications:
5g of Ketapang leaves: To mimic the fish's natural habitat and neutralize ammonia that is released by fish's feces.
2g of blue salt: To neutralize the yellowish colour from the Ketapang leaves and anti-fungal.
1g of nutrient flakes: To provide essential nutrients and vitamins for fish.
1 piece of floater: To keep the tea bag afloat and easier to replace.

6.0 CONCLUSION

Summary of Achievement: Fish Catappa successfully simplifies aquarium care by combining natural Ketapang leaves, blue salt, and nutrient flakes into a biodegradable tea bag. Paired with the AquaCompanion app for real-time pH and temperature tracking, this innovation provides an all-in-one aquatic management solution. Contributions and Impact: By merging eco-friendly materials with smart technology, it delivers an impactful solution that enhances fish immunity and ensures user convenience. Limitations and Challenges: The main limitations are the manual preparation process of the tea bags and the need to upgrade the AquaCompanion app to support a wider variety of ornamental fish species. Future Work and Recommendations: Future improvements will focus on mass scaling and upgrading the app with advanced sensors to provide more precise water parameter analysis. Closing Statement: Fish Catappa perfectly aligns with the i-NEXTECH 2026 theme, by successfully merging natural ecological benefits with modern technology for a sustainable future in aquatic care

ACKNOWLEDGMENTS

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PROJECT ID: IN124

BRAINBOOST: BRIDGING EDUCATION AND MOTIVATION THROUGH DIGITAL APPLICATIONS AND PERSONALIZED STUDY GOALS

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ABSTRACT
BrainBoost is an educational app to assist and motivate students in their studies, and it is crafted to address the pressing issue of student mental health and motivation in Malaysia. 26.9% of Malaysian teenagers reported experiencing depression. The app was developed due to lack of motivation and ineffective practices. We selected 4 MVP: search engine, study materials, quiz mode and focus mode. The user interface is developed using Visily and the app through Thunkable. BrainBoost provides 6 features: integrated search engine allows students to access a vast library of educational content, materials include the MOE syllabus' textbooks and explanatory videos, interactive quizzes with immediate feedback to improve memory retention, focus mode to tackle the issue of motivation and an exam countdown feature.
Keywords: Malaysian Students, Teenagers, Education, Educational Application, Study Session

1.0 INTRODUCTION
BrainBoost is an educational app designed to aid students in Malaysia with their studies. BrainBoost was conceived to address the pressing mental health crisis among students in Malaysia. Traditional learning techniques are insufficient to keep up. Modern problems require modern solutions, and BrainBoost is uniquely positioned to flip the academic landscape upside down.

2.0 OBJECTIVE
a. To design a user interface and fully develop a functional 4-MVP mobile application (Search Engine, Study Materials, Quiz Mode, Focus Mode) using Thunkable within a two-month development cycle.
b. To evaluate the Thunkable prototype through a user testing session with targeted groups, adolescents, using their feedback to implement features upgrades.

3.0 NOVELTY & INVENTIVENESS
Table 1: Problem Identification and Proposed Solution

Aspect	Existing Solutions	BrainBoost
Study material	Lack integration of Malaysian syllabus	Integrate study materials based on KSSM
Quizzes	Variety of syllabus	Quiz based on Malaysian syllabus
Motivations	Focus mainly on content delivery	Includes gamification and tracking

4.0 PRACTICALITY & USEFULNESS
BrainBoost improves academic performance and motivation. By reducing procrastination, increasing study engagement, and providing personalized learning support, BrainBoost serves as a comprehensive digital learning companion for students and teachers.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
5.1 Design and Development Approach

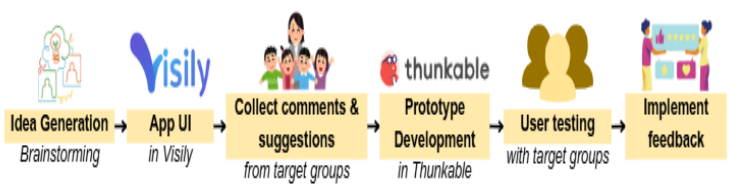


Figure 1: Development Flow of BrainBoost

5.2 Technical Architecture

Table 3: Key components and specifications

Component/Material	Specification	Purpose
Article & Search Engine	Wikipedia API	Fetch information about various topics.
Focus Mode & Countdown	TinyDB, Local database	Store continuous time data.
Quiz Mode	Sheets, Cloud database	Allows quiz materials to be updated.

5.3 Materials and Methods

Blockout and prototypes made in Visily. Additional user interface elements were designed in Figma. The app is made entirely in Thunkable exclusively using public domain assets.

5.4 Testing and Validations

User testing is conducted with 10 adolescents, Feedback form was distributed and fine tuning was done.

6.0 CONCLUSION

BrainBoost was successfully developed as a mobile app addressing issues among Malaysian students, with user testing conducted for feedback. However, the study is limited to prototype development, so long-term results are not yet available. Overall, BrainBoost shows how technology can support both academic performance and student well-being, aligning with the theme of i-NEXTECH 2026.Triple Helix Model highlights potential collaborations to enhance BrainBoost through academia, industry and government. In the future, we hope to expand the content library, introduce gamified learning experiences, explore the integration of artificial intelligence assistants and explore collaboration with local shops for rewards features.

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We sincerely thank Madam Kiew Hui Yee for her guidance and support.

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PROJECT ID: IN125

PATROL WASP

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ABSTRACT
The problem addressed in this project that was inspired by developing an Arduino based vacuum cleaner is high cost and unavailability from the conventional vacuum cleaners especially to students and families. To solve this problem, the innovation involves the development of a mini vacuum cleaner prototype that utilizes an Arduino microcontroller coupled with a motor, fan, power source, and dust holding chamber. The approach used included the design of the vacuum cleaner prototype, assembly of the components used, programing of the Arduino UNO board, and test performance of the product in various cleaning activities. The principle of operation entails the generation of suction power by a DC motor operated by the microcontroller to collect dust and other small particles. Test results showed the effectiveness of the product in collecting lightweight debris such as dust, paper, and hair with the use of low electric energy consumption. This invention can motivate students to apply themselves in making innovations of cost-effective smart products and to develop interest in engineering and programming.
Keywords: Arduino, Vacuum cleaner, Innovation Smart Technology, Energy Efficiency

1.0 INTRODUCTION
Robotic vacuum cleaners are popular because they save time, but most are expensive and hard to repair, which creates more electronic waste. Arduino makes it easier for students to build low-cost robots using simple and reusable parts.This project builds a Smart Sensor Vacuum Robot using Arduino and recycled materials to make a cheaper and more eco-friendly cleaning robot. Problem Statement: Most vacuum robots are expensive and not repairable, so people usually throw them away when broken, increasing e-waste. Many DIY robots also lack good cleaning performance. So, a low-cost and repairable cleaning robot is needed, using simple parts and recycled materials. Significance of Study: This project helps reduce e-waste by reusing materials and shows how Arduino can be used for simple automation. It also helps students learn coding, electronics, and promotes awareness of sustainability.

2.0 OBJECTIVE
The main objectives of this innovation are:
a. To design and build an Arduino-based cleaner robot that can move automatically within a small test area within the given project period.
b. To use an ultrasonic sensor to help the robot detect obstacles and change direction when needed.
c. To develop a simple coding that allows the robot to pick up light dust or small particles during movement.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: This project is unique because it changes how a robotic vacuum cleaner is built and used. Unlike big-brand commercial vacuums that are expensive and closed to changes, our project provides a cheap and open platform. The new approach here is combining low-cost electronics with an open-source design, making smart cleaning technology easy to reach and change for everyone. Key Innovative Features:Feature 1: Very Cheap and Easy to Fix: our robot uses a simple Arduino UNO and normal sensors. If a part breaks, we can buy a cheap new part online and fix it ourselves. Commercial vacuums are too expensive to fix. Feature 2: Easy to Change the Code: The code for this robot is open to everyone. Anyone can open the Arduino software on their computer to change how the robot moves, make it turn faster, or add new features easily. Feature 3: Light and Simple Body: We made the body of the vacuum using simple and light materials that are easy to find. Because it is very light, the robot can move fast, and the battery can last longer.

Table 1: Comparison between existing solutions and proposed innovations

Aspect	Existing Solutions	Your innovation
Cost	Very high price (often hundreds of dollars).	Very low price (built with cheap, basic parts)
System Type	Closed-source. Users cannot see or change the software.	Open-source. Anyone can rewrite the code easily.
Repair & Upgrades	Must be sent to a professional shop; parts are expensive.	Easy to fix at home by replacing single cheap parts.
Customization	Fixed shape and features. Cannot be modified	High. Users can print new parts or add new sensors

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: This Arduino cleaner robot is made for simple cleaning in daily life. It can clean dust, small rubbish like paper bits, and light dirt on flat surfaces. In school, it can be used after class to help clean classrooms, especially under tables and corners where dust usually stay. At home, it can be useful for places that are hard to clean like under the bed or sofa. It also can be used in small offices to help keep the place tidy without doing full manual cleaning all the time. Target Users / Beneficiaries: The users of this robot are students, school cleaners, teachers and also families. In school, cleaners can use it to reduce their workload. Students also can benefit because cleaning duty becomes easier and faster. For families, especially busy parents or elderly people, this robot can help with light cleaning, so they don't need to spend so much energy or time. Small office workers can also use it for simple cleaning in their working space. Feasibility and Implementation: Technical Feasibility: This project is quite possible to build because it uses normal Arduino parts like Arduino board, ultrasonic sensor, DC motors and motor driver. The coding is not very difficult, mostly just basic movement and obstacle detection. So, it can be done using school lab tools or cheap electronic kits. That is why it is suitable for student project. Economic Viability: The cost is quite low because most parts are not expensive and can be found easily online or in electronics shops. Some parts maybe already available in school. Compared to real cleaning robots, this project is much cheaper but still can-do basic cleaning tasks. So, it is affordable for school or personal use. Scalability: This robot can be improved later if needed. For example, we can add Bluetooth so it can be controlled using a phone. We also can add stronger motor or suction fan to make cleaning better. Another idea is adding automatic charging so it can go back to charge when battery is low. The design also can be changed depending on where it is used. Sustainability: This robot is quite environmentally friendly because it uses rechargeable batteries instead of throwaway batteries. It also helps reduce human effort in cleaning, so people don't need to do repeated manual work. In long term, it shows how machines can help with daily tasks and save time. Expected Impact: This robot can reduce cleaning time about 20% to 40% in small areas like classrooms or rooms. It also helps reduce tiredness for cleaners or students who need to clean. It is cheaper compared to commercial cleaning robots, so it can save money. Overall, it helps make cleaning easier and faster in daily situations

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

a) Design and Development Process: We made our Arduino vacuum cleaner by following these 4 simple steps:
b) Planning: We chose the cheapest and best parts for our project, like the Arduino UNO and an ultrasonic sensor.
c) Making the Body: We cut light plastic sheets by hand to build a simple and light body for the robot.
d) Wiring: We connected all the parts, like the motors, sensors, and battery, to the Arduino board using jumper wires.
e) Testing: We wrote the code on the computer, put it into the Arduino, and tested if the robot could move and suck dust.

Materials and Methods

Here is the list of important parts we used to build our robot and what they do:

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Arduino UNO	Main controller board	The "brain" of the robot to control all parts
Ultrasonic Sensor	HC-SR04	To "see" walls and obstacles in front of the robot.

DC Motors and Wheels	5V motors	To make the vacuum cleaner move around the room.
Motor Driver	L298N module	To control the speed and direction of the wheels.
Suction Fan	Small 5V/12V fan	To suck dust and hair into the rubbish box.
Battery	Rechargeable battery	To give power to the Arduino and motors.
Body Material	Plastic/Acrylic	The main frame to hold all the components together.

6.0 CONCLUSION

Summary of Achievement: This project successfully designed an Arduino-based vacuum cleaner that addresses the high cost and accessibility barriers of commercial robotic cleaning solutions. By integrating budget-friendly hardware with effective ultrasonic obstacle-avoidance algorithms, the prototype accomplished its core objective of delivering a fully standalone, affordable, and self-navigating indoor floor maintenance system. Contributions and Impact: this work is proving that open-source hardware can be leveraged to create low-cost domestic automation that operates independently of local network infrastructure. It offers practical value by saving users 3 to 5 hours of manual labor weekly, reducing electronic waste through its modular architecture. Limitations and Challenges: limitations encountered regarding the suction power of the low-voltage DC motor on thick carpets and the lack of wireless connectivity, which prevents remote control or real-time status monitoring by the user. Future Work and Recommendations: Future development will focus on upgrading the device's navigation logic using basic encoders for systematic grid-pattern cleaning, testing higher-efficiency vacuum impellers to improve suction, and exploring biodegradable materials to enhance environmental friendliness. Closing Statement: In conclusion, this Arduino vacuum cleaner stands as a practical testament to how accessible, everyday components can be engineered into meaningful automated solutions. By turning a complex consumer luxury into a highly affordable, offline, and repairable utility for inclusive and sustainable grassroots.

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PROJECT ID: IN129

D-TENDER

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ABSTRACT
This project develops a sustainable, zero-waste meat tenderizer paste from date pulp and seeds. The paste uses natural enzymes to tenderize meat safely and effectively without altering its flavour or requiring hazardous cooking methods. Results show a 40% reduction in marination time while maintaining the meat's natural texture. It provides a healthy, clean label solution that enhances kitchen safety for both households and the culinary industry.
Keywords: meat tenderizer, cooking, enzymes

1.0 INTRODUCTION
Background: This project introduces D-Tender, a 100% natural meat tenderizer paste made from date pulp and date seeds. Problem statement: It addresses the limitations of conventional tenderizing methods, including chemical additives, manual pounding injuries, and pressure cooker hazards. Significance of the Study: By utilizing the natural enzymes in date pulp and the beneficial properties of processed date seeds, D-Tender effectively breaks down tough muscle fibres and collagen while preserving meat quality. The innovation promotes a zero-waste, circular economy by transforming discarded date seeds into a valuable resource. In addition, it enhances flavour, reduces cooking time and energy consumption, improves kitchen safety, and provides a clean-label solution for both households and the hospitality industry.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To formulate a standardized, all-natural meat tenderizer paste utilizing optimized ratios of processed date fruit flesh and pulverized date seeds
b. To evaluate the structural, textural, and sensory tenderization efficiency of the formulation of tough meat cuts as a direct substitute for mechanical pressure cooking.
c. To minimize household kitchen hazards by reducing the reliance on high-pressure appliances through an effective biochemistry-based solution.

3.0 NOVELTY & INVENTIVENESS
Innovative Aspects: D-Tender is an innovative date-based paste that combines processed date pulp and seeds into a single high-performance product. Key Innovative Features: It uses the synergistic action of natural proteolytic enzymes from the pulp and organic acids from the seeds to tenderize meat evenly and in a controlled manner without making it mushy. The paste also functions as a natural curing agent and texture enhancer while maintaining a neutral flavour. As a zero-waste solution, DTender provides a safer, more efficient, and environmentally friendly alternative to conventional meat tenderizers.

Table1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions (Pressure Cooker/ Chemical Tenderizer)	Your Innovation (D-Tender)
Safety Profile	High risk of physical explosion, severe steam burns, and structural mechanical malfunction.	100% safe; operates completely under ambient pressure and normal room temperatures.
Environmental Impact	Consumes high electrical or gas energy to maintain extreme pressure environments.	Eco-friendly; actively upcycles industrial agricultural waste (discarded date seeds).

Texture & Quality	Chemical tenderizers can cause meat to become overly mushy and leave metallic or bitter aftertastes.	Maintains optimal muscle fiber integrity, offering superior mouth feel and enhanced natural juiciness.

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: D-Tender is a practical and eco-friendly meat tenderizer paste designed for households and large-scale festive cooking. Economic Viability, Feasibility and Implementation: Made from affordable date pulp and upcycled date seeds, it is easy to produce using simple, low-cost methods and is packaged for convenient use. Expected Impact: By eliminating the need for hazardous pressure cookers and labour-intensive meat pounding, D-Tender enhances kitchen safety while reducing marination and cooking time by up to 40%. Sustainability: It supports a 100% zero-waste food upcycling approach, making it a sustainable and cost-effective solution for modern cooking.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Materials and Methods: To use D-Tender, simply pat the meat dry, measure out 2 tablespoons of the paste per 1 kg of meat (the equivalent of 2 date seeds), and rub it uniformly over all surfaces. Place the coated meat in a covered container and let it marinate in the refrigerator for 30 to 60 minutes, depending on the thickness and toughness of the cut. There is no need to rinse the paste off prior to cooking. Results and Performance: The 100% natural date components will safely remain on the meat, activating under heat to accelerate the breakdown of tough fibres, reduce cooking time, and enhance the final savoury flavour of your dish.

6.0 CONCLUSION

Summary of Achievement: D-Tender successfully meets its objectives by transforming date pulp and discarded date seeds into an eco-friendly meat tenderizer paste. Contributions and Impact: The optimized formulation effectively tenderizes meat while providing a safer alternative to pressure cookers. Limitations and Future Work Recommendations: Although further commercial testing and shelf-life evaluation are needed, future improvements include developing a cube-form product for easier storage and obtaining organic preservation certifications. Closing statement: Overall, DTender is a sustainable and practical food innovation that converts agricultural waste into a valuable resource, aligning with the i-NEXTECH 2026 theme of building a resilient future through technology and innovation.

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PROJECT ID: IN132

CHITIZ
VALORIZATION OF SHRIMP SHELL WASTE BY UTILIZING NUTRIENT CHITIN IN FERTILIZER

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ABSTRACT
The accumulation of shell waste and the excessive use of chemical fertilizers pose significant environmental and agricultural challenges. In the dining hall of Sekolah Menengah Sains Pasir Puteh, discarded prawn and clam shells contribute to organic waste generation, while prolonged reliance on synthetic fertilizers may degrade soil quality and contaminate water bodies. To address these issues, CHITIZ was developed as an eco-friendly biofertilizer derived from chitin extracted from shell waste. CHITIZ employs a waste valorization approach by transforming discarded shells into a value-added product that supports sustainable agriculture. Chitin, a natural biopolymer found in crustacean shells, possesses properties that enhance soil fertility and stimulate plant growth. Through the incorporation of natural additives, the resulting biofertilizer offers a sustainable alternative to conventional chemical fertilizers. By promoting the circular economy, CHITIZ reduces food waste and encourages responsible resource utilization. Furthermore, it minimizes nutrient runoff that can negatively affect aquatic ecosystems and helps preserve soil biodiversity. Consequently, the innovation contributes to more sustainable farming practices and environmental conservation. CHITIZ supports the United Nations Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land). In conclusion, CHITIZ demonstrates how shell waste can be transformed into a sustainable agricultural solution that benefits both the environment and society.
Keywords: chitin, sustainable framing 2, SDG 13.

1.0 INTRODUCTION
During our observations at the dining hall of Sekolah Menengah Sains Pasir Puteh, we noticed that large amounts of prawn and clam shells were discarded daily despite being rich in chitin, a valuable natural biopolymer. Simultaneously, the excessive use of chemical fertilizers continues to contribute to soil degradation and environmental pollution. These challenges revealed the need for a sustainable solution that addresses both waste management and agricultural sustainability. Inspired by the concept of waste valorization, we developed CHITIZ, an eco-friendly biofertilizer that transforms shell waste into a value-added product, promoting circular economy practices and supporting sustainable agriculture. Problem Statement: 1. Large amounts of shell waste from the SM Sains Pasir Puteh dining hall are discarded daily, contributing to environmental pollution and inefficient waste management.2. Excessive use of chemical fertilizers degrades soil quality and causes harmful impacts on ecosystems and water resources.3. Chitin-rich shell waste is underutilized despite its potential to be converted into sustainable biofertilizers for agriculture. Significance of the Study: This study introduces CHITIZ, a sustainable bio-fertilizer that converts shell waste into a valuable agricultural product. The innovation benefits farmers by providing an eco-friendly alternative to chemical fertilizers, while promoting efficient waste management and reducing environmental pollution. Furthermore, CHITIZ supports sustainable agriculture and contributes to the advancement of green technology and the circular economy, aligning with SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

2.0 OBJECTIVE
a. To convert chitin-rich shell waste into an eco-friendly bio-fertilizer (CHITIZ) through sustainable waste valorization.
b. To evaluate the effectiveness of CHITIZ in improving soil fertility and supporting plant growth as an alternative to chemical fertilizers.
c. To promote sustainable agriculture and contribute to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

3.0 NOVELTY & INVENTIVENESS

CHITIZ is a unique and original biofertilizer that utilizes the nutrient-rich chitin found in shell waste rather than merely treating waste as a disposal problem. Through a controlled fermentation process, valuable nutrients are extracted and transformed into a sustainable fertilizer. Unlike many existing waste-based fertilizers that focus mainly on waste reduction, CHITIZ specifically harnesses the benefits of chitin to enhance soil fertility and plant growth. This targeted approach demonstrates a deeper utilization of natural resources, making CHITIZ an innovative solution that combines waste valorization with nutrient optimization for sustainable agriculture.

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: CHITIZ can be applied in agriculture as an eco-friendly alternative to chemical fertilizers for growing vegetables, fruits, and ornamental plants. It can also be used in home gardening and community farming projects, while simultaneously providing a sustainable solution for managing shell waste from school dining halls and food industries. Target Users/Beneficiaries: The primary beneficiaries of CHITIZ are farmers, home gardeners, and agricultural communities seeking sustainable farming practices. Food industries and institutions that generate shell waste can also benefit through waste valorization, while society and the environment benefit from reduced pollution and improved resource efficiency. Sustainability: CHITIZ provides a sustainable and cost-effective use for shell waste, reducing reliance on chemical fertilizers. By minimizing waste and promoting soil health, it supports long-term environmental sustainability and contributes to a circular economy efficiency improvement.

5.0 METHODOLOGY

Collection and Preparation of Materials: Chitin-rich shrimp shells were collected, cleaned, and crushed. Other ingredients, including seaweed extract, molasses, fermented washed rice water, banana peels, and eggshell powder, were prepared.
Fermentation Process: The ingredients were mixed and subjected to controlled fermentation to enhance nutrient availability and utilize the beneficial properties of chitin.
Production of CHITIZ: The fermented mixture was processed into CHITIZ, an organic biofertilizer.
Application and Evaluation: CHITIZ was applied to plants to assess its effectiveness in improving soil fertility and promoting plant growth.

6.0 CONCLUSION

Summary of Achievement: We were recognised by the Terengganu International Science Fair for CHITIZ earning us four international awards, gold award, global environmental award, jury's choice award, 4th place category environmental science. Limitations and Challenges: We had a hard time formulating CHITIZ to ensure it's not too strong and causes root burn. We then decided it's only suitable for root drenching. We are also in the process of formulation to ensure it's suitable for hydroponic agriculture. Future Work and Recommendations: We hope to be able to find strategic sponsor partner and support to help with official lab research Closing Statement: CHITIZ FROM WASTE TO WEALTH "Bridging Ideas and Technology for a Resilient Future" - the theme of i-NEXTECH 2026.

ACKNOWLEDGMENTS

SM Sains Pasir Puteh

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PROJECT ID: IN133

ENHANCING BREAST CANCER CLASSIFICATION FROM MAMMOGRAPHY IMAGES WITH ALPHA CUT-PASTE AUGMENTATION (ACPA)

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ABSTRACT
Breast cancer is the most common cancer among women in Thailand, with approximately 19,500 new cases reported each year. This situation highlights the urgent need to develop diagnostic tools that are both accurate and efficient. Currently, deep learning technology plays a significant role in medical image classification. However, developing a high-performance model requires a diverse dataset. In practice, mammogram datasets are often limited due to the need for expert annotation and concerns regarding patient privacy. As a result, both the quantity and diversity of available data are restricted. Data augmentation techniques are therefore employed to increase data variability through various image transformations. Although many augmentation methods exist, it remains unclear which technique is most suitable for mammogram images, which possess unique structural characteristics and often contain small abnormal regions. This study proposes an Alpha Cut-Paste Augmentation (ACPA) method, which extends the traditional Cut-Paste approach by integrating patch placement with controlled alpha blending. This strategy reduces patch boundary discontinuities while randomly selecting patch size and location within a predefined range. Experiments were conducted on the CBIS-DDSM dataset using CNNs and compared with conventional techniques. The results demonstrate that ACPA achieved the highest performance across all evaluation metrics, with an Accuracy of 97.6%, Sensitivity of 98.8%, and an AUC of 99.7%. These findings indicate that the proposed method significantly enhances model performance.
Keywords: Data Augmentation, Cut Paste, Breast Cancer, Convolution Neuron Networks (CNN), Mammogram Ima

1.0 INTRODUCTION
Breast cancer is the leading cancer among women worldwide and the second cause of cancer-related mortality, showing a continuously increasing trend. Although early diagnosis yields a 70–80% cure rate, the disease frequently metastasizes to the bone, liver, lung, brain and others. Screening mammography currently remains the primary diagnostic tool, reducing mortality by 20–40%; thus, widespread access to these screening services is critical to improving patient outcomes [1, 2]. Currently computer-based technology, particularly Convolutional Neural Networks (CNNs), are widely used in breast cancer screening and diagnosis. Designed to process grid-structured data like images, CNNs extract spatial features by applying convolutional filters to local regions. Consequently, they are exceptionally well-suited for medical image analysis because they automatically learn critical features directly from raw image data. Numerous studies show that CNNs performance improves with larger and diverse datasets. However, acquiring annotated medical images remains difficult, time-consuming, and costly. While data augmentation mitigates data scarcity, conventional techniques fail to diversify lesion locations and shapes, and risk disrupting clinical context. To address these limitations, this study proposes an Alpha Cut-Paste Augmentation (ACPA) framework. By integrating patch placement with controlled alpha blending, ACPA generates diverse synthetic datasets while fully preserving critical, clinically relevant features [4].

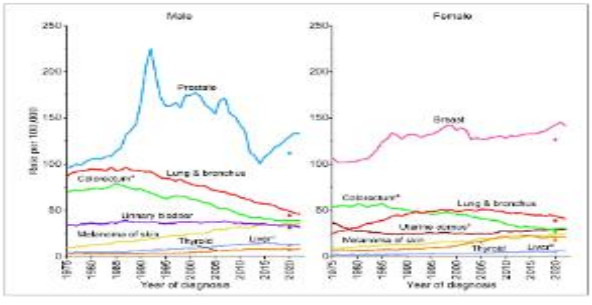


Figure 1. Trends in US Cancer Incidence Rates (1975–2022) [3]

2.0 OBJECTIVE

a. To enhance the efficiency and accuracy of breast cancer diagnosis by increasing the diversity of mammogram datasets.
b. To evaluate the effectiveness of the proposed Alpha Cut Paste Augmentation method in improving CNN-based breast cancer classification performance.

3.0 NOVELTY & INVENTIVENESS

This study introduces the Alpha Cut paste Augmentation (ACPA) framework, an advancement over traditional Cut-Paste methods. The core novelty lies in integrating Alpha Blending to smooth patch boundaries, effectively eliminating edge artifacts that otherwise introduce model bias and lead to false learning of sharp edges as pathological features. Furthermore, this research adopts a machine-learning-centric approach; although the augmented images may appear non-realistic to humans, they reduce background noise and force the model to focus strictly on the intrinsic features of actual masses. Evidently as demonstrated in Table 1, the proposed ACPA method significantly enhances classification accuracy.

Table 1: Model's Performance Comparison

Method	Accuracy	AUC	Sensitivity
Cut-Paste	0.946±0.029	0.987±0.019	0.956±0.025
ACPA	0.976±0.010	0.997±0.002	0.988±0.013

4.0 PRACTICALITY & USEFULNESS

The proposed ACPA process begins with patch selection, where the system randomly samples the patch size ratio within a range of 10% to 30% of the original image dimensions to define the dimensions of the rectangular region to be extracted. Following size definition, source and destination sampling are executed; the system randomly samples source coordinates (x_1, y_1) to extract a sub-patch and destination coordinates (x_2, y_2) to determine its final placement. This simultaneous random sampling of both positions significantly enhances the spatial variability of abnormalities within the dataset. To mitigate excessive contrast discrepancies and boundary artifacts caused by direct patch placement, an Alpha Blending technique is subsequently applied. The final augmented image is computed using the following equation:

$$Image=\alpha*Image_{pasted}+(1-\alpha)*Image_{original}$$

Here, the blending coefficient is empirically set to $\alpha = 0.7$ to control patch transparency. This mathematical blending effectively reduces abrupt intensity transitions, ensuring a smoother integration with the original image surface and minimizing boundary discontinuities. Consequently, it prevents CNNs from exploiting sharp edge artifacts as a shortcut for classification, thereby forcing the model to learn true semantic features.

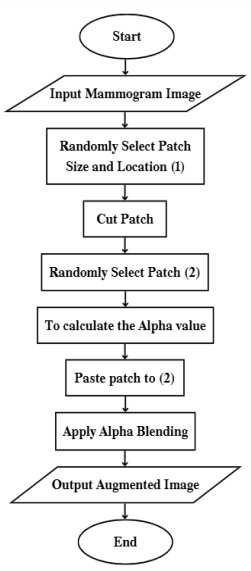


Figure 2 ACPA Method Flowchart

5.0 CONCLUSION

Table 1. Model's Performance Comparison

Method	Accuracy	AUC	Sensitivity
No	0.955 ± 0.013	0.992 ± 0.005	0.923 ± 0.034
Cut Out	0.916 ± 0.030	0.976 ± 0.010	0.918 ± 0.053
Negative Image	0.945 ± 0.015	0.980 ± 0.019	0.953 ± 0.027
Cut-Paste	0.946±0.029	0.987±0.019	0.956±0.025
CPRA	0.949 ± 0.014	0.989 ± 0.004	0.954 ± 0.021
CPPA	0.911 ± 0.016	0.982 ± 0.008	0.862 ± 0.019
ACPA	0.976±0.010	0.997±0.002	0.988±0.013

*CPRA = Cut Paste with Rotate Augmentation
*CPPA = Cut Paste with Pixel Jitter Augmentation

Table 1 summarizes the performance comparison against various image augmentation methods. Cut-Paste with Alpha Blending technique achieved the highest performance with an accuracy of 97.96%, AUC of 99.7% and Sensitivity of 98.8%. This superior performance occurs because alpha blending seamlessly integrates the pasted patch with the background. Furthermore, this approach enhances data diversity by simulating lesion-like patterns across diverse spatial locations without altering original image labels. The proposed method demonstrates significant potential as an effective alternative data augmentation strategy for mammogram image classification.

ACKNOWLEDGMENTS

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PROJECT ID: IN141

ATTENDIFY: AN AI-DRIVEN AUTOMATED ATTENDANCE SYSTEM USING GROUP IMAGE CAPTURE

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ABSTRACT
Attendify is an AI-powered attendance management system that uses facial recognition technology to identify multiple participants simultaneously from a single group image. Facial features are matched against a pre-registered database, while attendance records are automatically synchronized with Google Sheets for real-time monitoring and management. This enables Attendify to reduce administrative workload, minimize human errors, and streamline attendance management. The system has potential applications in schools, seminars, conferences, and organizational events, supporting smarter and more scalable digital attendance management solutions.
Keywords: Artificial Intelligence (AI), Facial Recognition, Attendance Management System, Real-Time Data Synchronization, Digital Transformation

1.0 INTRODUCTION
Conventional methods in attendance management are often time-consuming and prone to human error [1][2]. Existing attendance systems may also require individual check-ins, resulting in operational inefficiencies when managing large groups. Therefore, Attendify was developed as an AI-powered attendance system that combines facial recognition technology with real-time Google Sheets synchronization.

2.0 OBJECTIVE
The objectives of this project are
a. To develop an AI-powered facial recognition attendance system
b. To reduce attendance recording time by at least 50% compared to manual methods
c. To improve attendance accuracy through automated identification and cloud synchronization.

3.0 NOVELTY & INVENTIVENESS
Attendify combines group facial recognition with cloud-based synchronization to automate attendance recording from a single group image. Unlike conventional attendance systems that require individual check-ins, the system enables simultaneous participant identification and instant attendance updates, reducing administrative workload.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Recording Method	Individual check-in	Group image recognition
Data Management	Manual updates	Real time synchronization
Accessibility	Dedicated hardware	Mobile device based

4.0 PRACTICALITY & USEFULNESS
Attendify simplifies attendance management through a single group image, offering a practical and scalable solution for educational and organizational environments.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
Attendify was developed through requirement analysis, database development, system integration, and prototype testing. The system captures a group image, identifies participants using facial recognition, and synchronizes attendance records with Google Sheets for real-time monitoring.

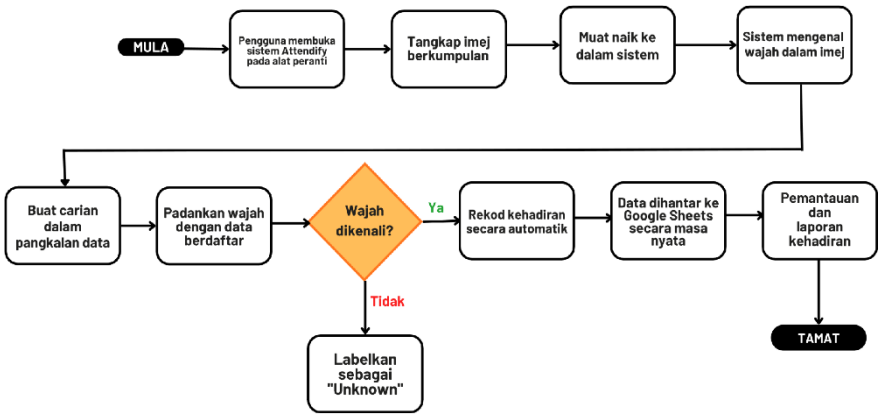


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Mobile Device	Android/iOS device	Image capture
Cloud Platform	Google platforms	Data processing & synchronization
AI Recognition Model	OpenCV, face_recognition	Face detection & identification

6.0 CONCLUSION

Attendify was successfully developed as an AI-powered attendance management system that utilizes group facial recognition and real-time Google Sheets synchronization. The system improves efficiency, reduces administrative workload, and supports digital transformation in educational and organizational settings. Future improvements may focus on enhancing recognition accuracy, security, and system integration. Overall, Attendify reflects the vision of i-NEXTECH 2026 by transforming artificial intelligence into a practical solution for smarter and more efficient attendance management.

ACKNOWLEDGMENTS

The authors gratefully acknowledge MRSM Mukah, teachers, and students for their support and contributions to the development and testing of Attendify.

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PROJECT ID: IN145

KIKIWA: A STUDENT-LED GAME DEVELOPMENT COMMUNITY FOR AI-POWERED EDUCATIONAL GAMES

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ABSTRACT
Kikiwa is a student-led game development community designed to encourage students make educational games while improving learning outcomes through gamification and artificial intelligence (AI). Gen Alpha Students today find traditional revision methods boring, leading to low motivation and confidence in academic competitions. To address this issue, Kikiwa combines game development, educational quizzes, and AI-powered recommendations into its solution. Various genre games, and story-driven adventures with integrating educational content

1.0 INTRODUCTION
Students struggle to stay motivated during revision and often lack confidence when participating in academic competitions. Traditional learning methods such as textbooks and worksheets may not provide enough engagement for Generation Alpha learners.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To increase student engagement in learning through educational games.
b. To improve confidence in STEM competitions using AI-powered recommendations.
c. To establish a student-led game development community in schools.

3.0 NOVELTY & INVENTIVENESS
Kikiwa combines game dev community and educational gaming. It also uses AI Decision Tree recommendations to guide students. Compared to existing solutions like Pandai, they have limited AI recommendation, limited storyline and no merchandise collectible for funding. As for Kikiwa? We have it all. We also have our BRAND to be our centre stage.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	PANDAI APP	KIKIWA
Learning Method	Quiz-based	Quiz + Gameplay + Creation
AI Recommendation	Limited	Personalized Decision Tree
Storyline	Limited	Multiple Genres

4.0 PRACTICALITY & USEFULNESS
Our project is for STEM competition preparation. We target the welfare community for high school student (13-17 years old) that has problems with STEM competition. We have the computer lab in school where we can develop and test our solution for funding, we will attach ourselves with a Malaysian Award-winning Game Dev (GIGABASH) or PANDAI. We also will self-fund with making merchandise for the Brand. We want more Malaysians to love STEM.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS
Problem Identification → Data Collection → Decision Tree Design → Game Development → Testing → Improvement. Frontend: HTML, CSS, JavaScript Game Engine: Web-based platform AI Model: Decision Tree Database: Quiz and performance data.The prototype was tested with students using science quiz questions.

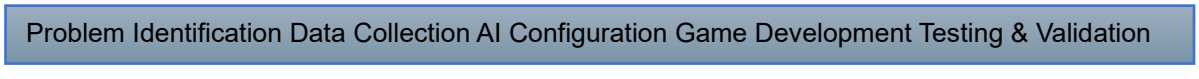


Figure 1: Development process flowchart

Table 2: Key components and specifications

Component/Material	Specification	Purpose
AI Decision Tree	ML Algorithm	Student recommendation
Quiz Database	Science Questions	Learning content
Game System	Tower Defense/RPG	Gamification
Admin Panel	Web Dashboard	Question management

6.0 CONCLUSION

Kikiwa is a student-led game development community that empowers students to create educational games while using AI and game-based learning to make education more engaging, creative, and accessible. Turning STEM learning into a Confidence Building Adventure

ACKNOWLEDGMENTS

We would like to thank our parents for their support, my mentor and myself

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National Sciences Challenge - https://www.akademisains.gov.my/nsc/
Online Learning App - https://my.pandai.org/
Game Developer Company - https://passionrepublicgames.com/

PROJECT ID: IN164

GREENQUEST

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ABSTRACT
Improper waste disposal and low recycling awareness among students contribute to environmental pollution and landfill waste. GreenQuest is a mobile app that promotes recycling through AI technology and gamification. Students scan items to identify recyclable materials and earn points on class leaderboards. The app also includes an AI chatbot, tutorials, badges, and achievements. GreenQuest aims to improve recycling awareness, encourage sustainable habits, and support environmental sustainability.
Keywords: Recycle, mobile app, AI technology

1.0 INTRODUCTION
Recycling participation among students remains low due to limited motivation and engagement. Traditional initiatives such as posters and announcements often fail to encourage recycling. GreenQuest addresses this issue by combining AI technology, gamification, and environmental education (Merriam-Webster. (2026) [1]). The app promotes sustainable habits through points, leaderboards, and AI-powered recycling detection, with benefits extending beyond schools to communities and workplaces (Environmental Protection Agency, 2026 [2]). This leads to a reduced waste output and a lower carbon footprint (United Nations. (2025) [3]).

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To increase student participation in recycling by 25% within 12 months.
b. To achieve 80% accuracy in recyclable item identification using AI scanning.

3.0 NOVELTY & INVENTIVENESS

Table 1: Comparison between Existing Solutions and GreenQuest

Aspect	Existing Solutions	GreenQuest
Recyclable Item Detection	Relies on a human's judgment, may lead to mistakes and contamination in recycling bins.	GreenQuest's AI-powered scanner provides instant, accurate detection on whether an item is recyclable.
Engagement and Motivation	Posters or announcements with minimal motivation. Recycling feels like a chore.	A Gamified system with points, leaderboards, and achievements makes recycling feel enjoyable and competitive.
Impact on Community	Focuses on individual responsibility, with little collaboration and cooperation.	Class-level leaderboards and competitions encourage teamwork between students

4.0 PRACTICALITY & USEFULNESS
GreenQuest promotes recycling by integrating with school activities and campaigns. The platform helps users identify recyclable items and can be expanded to universities and communities. It benefits students, teachers, environmental clubs, and local communities. GreenQuest is technically feasible as it uses existing AI image recognition, smartphone scanning features, and established app-building platforms. Key components and specifications are shown in Table 2.

Table 2: Key components of GreenQuest and Specifications

Component/Material	Specification	Purpose
Chatbot	AI question-answer feature	Help students learn
AI Detection System	Image recognition	Identify recyclable items
Database system (Firebase)	Store user information and points	Saves user data
Leaderboard system	Ranking algorithm	Encourage competition

GreenQuest is a cost-effective and scalable platform that promotes recycling habits, environmental awareness, and student participation through gamification. It also improves recycling knowledge, introduces AI technology, and has potential for integration with recycling centres and community waste management.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Testing evaluates scanning accuracy, leaderboard functionality, and user feedback. Performance is measured through detection accuracy, participation, and user satisfaction. The AI identifies scanned items, awards points, stores data, and updates the leaderboard. Figure 1 shows the GreenQuest development process.

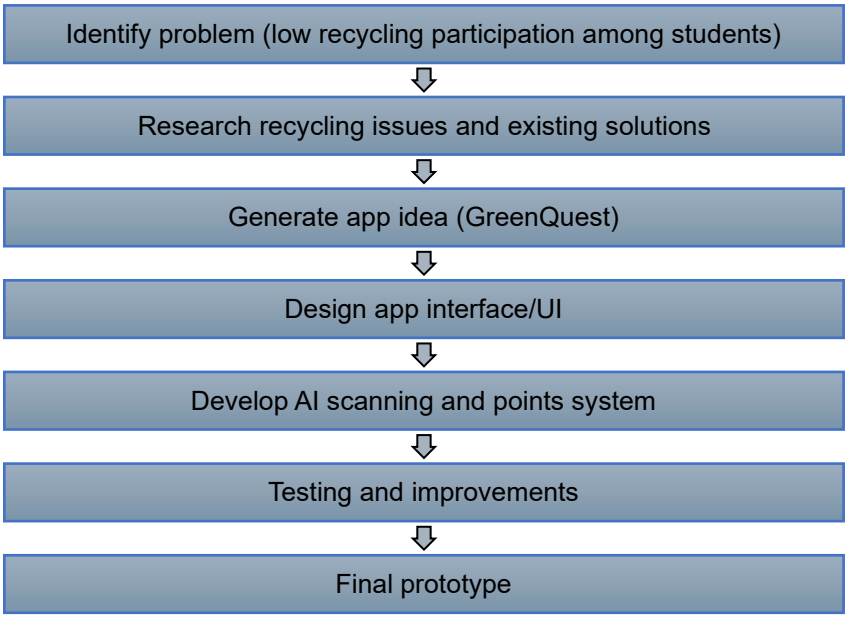


Figure 1: Development Process of GreenQuest

6.0 CONCLUSION

GreenQuest combines artificial intelligence, education, and gamification to encourage recycling among students. Through points, leaderboards, and AI technology, the app promotes environmental awareness and sustainable habits. Despite challenges in ensuring accessibility, GreenQuest has the potential to create a positive impact on schools and communities while contributing to a cleaner and greener future.

ACKNOWLEDGMENTS

We thank our supervisor, team members, school, and everyone who provided guidance, support, and feedback throughout the development of GreenQuest.

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PROJECT ID: IN165

GUPPYGROW: AQUAPONIC SOLUTION

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ABSTRACT
GUPPYGROW is an aquaponic innovation designed to address two environmental challenges simultaneously: mosquito breeding in stagnant water and the need for sustainable agricultural practices. The system integrates guppy fish and vegetable cultivation within a single ecosystem. Guppy fish consume mosquito larvae, reducing mosquito populations naturally, while their waste provides essential nutrients for plant growth. This eliminates the need for chemical fertilizers and promotes environmentally friendly farming. The project was developed to provide a practical, low-cost, and sustainable solution for communities seeking better mosquito control and agricultural productivity. Testing demonstrated that guppy fish effectively reduced mosquito larvae while supporting the healthy growth of mustard greens through nutrient recycling. The innovation highlights the potential of aquaponics as a sustainable approach to food production and environmental management. By combining biological mosquito control with natural plant fertilization, GUPPYGROW contributes to healthier communities and greener agricultural practices.
Keywords: Aquaponics, Guppy Fish, Mosquito Control, Sustainable Agriculture, Eco-Friendly Farming

1.0 INTRODUCTION
Background: Mosquito-borne diseases remain a significant public health concern, particularly in areas with stagnant water. At the same time, conventional farming often depends on chemical fertilizers that may negatively impact the environment. Aquaponics offers a sustainable alternative by integrating fish culture and plant cultivation in a mutually beneficial system. Problem Statement: Stagnant water provides ideal breeding conditions for mosquitoes, increasing the risk of mosquito-borne diseases. Additionally, chemical fertilizers can be costly and environmentally harmful. Many small-scale farming systems lack a natural and sustainable method for mosquito control and plant nutrition. Significance of The Study: This project provides an innovative solution that addresses mosquito control and sustainable agriculture simultaneously. It benefits households, schools, and communities by promoting environmental awareness, reducing dependence on chemical fertilizers, and encouraging eco-friendly farming practices.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To reduce mosquito breeding by introducing guppy fish that consume mosquito larvae.
b. To provide natural nutrients for plant growth through fish waste in an aquaponic system.
c. To promote sustainable and environmentally friendly agricultural practices among communities.

3.0 NOVELTY & INVENTIVENESS
Innovation Aspects: Innovation Aspects GUPPYGROW combines biological mosquito control and sustainable crop production in a single integrated system. Unlike traditional methods that address these issues separately, this innovation creates a self-sustaining ecosystem. Key Innovative Features:
- Use of guppy fish as natural mosquito larvae predators.
- Recycling of fish waste as organic nutrients for plants.
- Reduced reliance on chemical fertilizers and pesticides.
- Low-cost and easy-to-maintain design suitable for schools and households.

Comparison with Existing Solutions. Intellectual Property Potential: Existing solutions often rely on chemical fertilizers and separate mosquito control methods. GUPPYGROW integrates both functions within one sustainable ecosystem, making it more environmentally friendly and cost-effective.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Mosquitoes	Avoid stagnant water around the house.	The guppies are a prey for mosquito larvae, that way the larvae cannot grow.
Fertilizer	Using chemical fertilizers as a source of nutrient for mustard greens.	The guppies waste (poop) is a natural fertilizer that will supply the needs of nutrients.
Sustainable	Using hydroponic solutions to grow crops and using chemicals to banish the mosquito larvae.	Using natural way to grow crops and avoid using harmful chemicals on the crops.

4.0 PRACTICALITY & USEFULNESS

Real-World Applications: The system can be implemented in schools, homes, community gardens, and urban farming projects. Target Users/Beneficiaries: Students and educational institutions, home gardeners, local communities and small-scale farmers. Feasibility and Implementation: Technical Feasibility: The materials required are affordable and widely available, the system is simple to operate and maintain. Economic Viability: Uses low-cost materials and guppy fish, reduces spending on chemical fertilizers, affordable for homes, schools, and small communities. Scalability: Can be implemented in homes, schools, and urban gardens, easily expanded by increasing the number of plants and fish, adaptable to different crops and growing environments. Sustainability: Utilizes natural fish waste as plant nutrients, reduces chemical fertilizer usage and environmental pollution, Promotes water recycling and long-term sustainable farming practices. Expected Impact: Reduction in mosquito breeding, improved plant growth through natural fertilization, Increased awareness of sustainable agriculture, reduced dependence on chemical fertilizers.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: • Construct the aquaponic container. • Introduce guppy fish into the water tank. • Install plant holders and grow mustard greens. • Monitor fish health, plant growth, and mosquito larvae presence. • Record observations and evaluate performance.

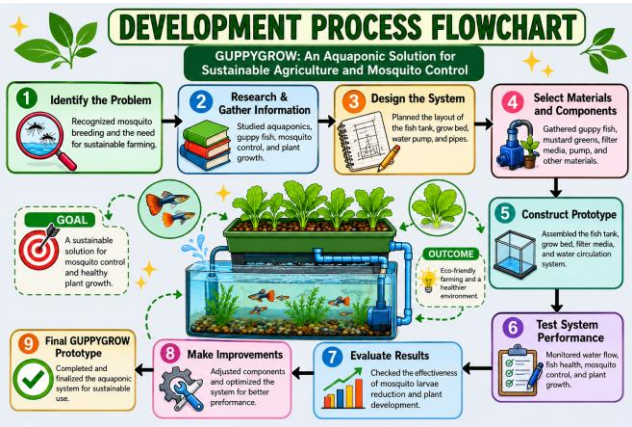


Figure 1: Development process flowchart *(Replace with your actual flowchart showing the step-by-step development process)*

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Grow Bed	40cm x 20cm x 10cm = **8000cm³**	Holds the Green Mustards in place.
Filter Media	40 × 20 × 5 = **4,000 cm³**	Traps solid waste and clean the water.
Water Pump	8cm × 6cm × 10cm = **480 cm³**	Circulate the water from the fish tank to the grow bed.
Fish Tank	40cm × 20cm × 25cm =	Holds Guppy Fish.

	20,000 cm³	
Guppy Fish	15 Guppy Fish	Control mosquito larvae and produce waste for nutrients.
Green Mustards	8 Green Mustards	Absorb nutrients from the water and grow healthy.
Water Flow Pipes	2cm x 50cm = **100cm Diameter x Length**	Water is pumped to the grow bed and returns to the fish tank.

6.0 CONCLUSION

Summary of Achievement: GUPPYGROW successfully demonstrated how aquaponics can address mosquito control and sustainable agriculture within a single system.
Contributions and Impact: The project promotes environmentally friendly farming while providing a natural method of mosquito control.
Limitations and Challenges: The system requires regular monitoring of water quality and fish health to maintain effectiveness.
Future Work and Recommendations: Future improvements may include larger-scale implementation, automated water circulation systems, and testing with different plant species.
Closing Statement: GUPPYGROW demonstrates how innovative thinking can bridge environmental sustainability and public health, supporting the i-NEXTECH 2026 theme of “Bridging Ideas and Technology for a Resilient Future.”

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PROJECT ID: IN177

LIFER 2.0

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ABSTRACT
LIFER 2.0 is an interactive digital platform developed to support Sustainable Development Goal (SDG) 14: Life Below Water by increasing awareness and knowledge of ocean conservation among students and the wider community. The platform addresses issues such as marine pollution, habitat destruction, and public awareness regarding marine ecosystems. LIFER 2.0 integrates educational content, quizzes, games, conservation information, and an AI chatbot to provide an engaging learning experience. The project was developed using web technologies and designed to be accessible across devices. Through gamification and interactive learning, users are encouraged to adopt environmentally responsible behaviours. The platform has potential applications in schools, environmental organizations, and community awareness programmes. Future enhancements include a mobile application, reward systems, and broader collaboration with stakeholders. Overall, LIFER 2.0 demonstrates how digital innovation can support environmental education and inspire positive action towards protecting marine life.
Keywords: Ocean Conservation, SDG 14, Marine Protection, AI Chatbot, Digital Innovation

1.0 INTRODUCTION
Oceans are essential for biodiversity and human life, but they are increasingly threatened by plastic pollution, overfishing, and habitat destruction. According to UNEP, approximately 11 million tonnes of plastic waste enter the oceans annually, while one-third of global fish stocks are overfished. Despite various awareness initiatives, public engagement in ocean conservation remains limited, particularly among younger generations. Therefore, more engaging approaches are needed to promote marine conservation and support SDG 14: Life Below Water**.**

2.0 OBJECTIVE
The main objectives of this project are:
a. To increase awareness of ocean conservation among students and the community.
b. To promote engagement in marine conservation through interactive learning activities.
c. To support SDG 14: Life Below Water through digital education and awareness.

3.0 NOVELTY & INVENTIVENESS
LIFER 2.0 combines ocean conservation education, gamified learning, and an AI chatbot within a single platform. Unlike conventional awareness websites, users can learn, play, test knowledge, and interact with an AI assistant for additional guidance on marine conservation topics.

Aspect	Existing Solutions	LIFER 2.0
Engagement	Static content	Games and quizzes
Learning	Passive	Interactive
Support	Limited guidance	AI chatbot assistance

4.0 PRACTICALITY & USEFULNESS
LIFER 2.0 can be used by students, schools, environmental organizations, and local communities to support ocean conservation education and awareness programmes. The platform is technically feasible as it is developed using existing web technologies and can be accessed through computers and mobile devices. It is also cost-effective as it does not require specialized hardware. The platform can be easily expanded with additional content, languages, and features to reach a wider audience. By promoting awareness and responsible environmental behaviour, LIFER 2.0 contributes to long-term environmental sustainability. The expected impact includes increased knowledge of marine conservation, greater engagement in environmental activities, and stronger support for SDG 14: Life Below Water.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The project followed a structured development process: problem identification, research, interface design, feature development, testing, and deployment. Technologies used include WordPress, web-based content management tools, and AI chatbot integration.

Component	Specification	Purpose
Website Platform	Web-based	Learning access
Quiz Module	Interactive quizzes	Knowledge assessment
Games	Educational games	Engagement
AI Chatbot	Conversational AI	Learning support

6.0 CONCLUSION

LIFER 2.0 successfully demonstrates how digital innovation can enhance ocean conservation awareness. By integrating educational content, gamification, and AI-assisted learning, the platform provides an engaging approach to environmental education. Future development will focus on mobile expansion, reward systems, and wider community collaboration.

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PROJECT ID: IN180

VISIONVOICE: SEE THE SIGNS, HEAR THE MESSAGE

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ABSTRACT
In this era of technology, translation applications like Google Translate have made it easy to convert spoken languages, yet an option for sign language remains unavailable. This lack of accessibility often creates a communication barrier, discouraging individuals from learning or understanding sign language. To bridge this gap, we propose developing an application that translates sign language gestures into words so that we (non-deaf) can actually understand the deaf. This innovation aims to make communication much easier and faster than typing, while helping everyone better understand those who rely on gestures to communicate.
Keywords: Sign language translation, mobile app, communication barrier, Deaf community.

1.0 INTRODUCTION
Some people find it difficult to understand hearing-disabled individuals when they communicate using signs and gestures in American Sign Language (ASL) (IEOM Society, 2022). To address this problem, it is important to find ways to make understanding the Deaf community much easier and investigate why current translation technologies have limitations in including sign language. Developing a sign language translator would allow hearing individuals to understand gestures instantly without a formal learning curve, making it easier to build closer social connections with deaf individuals. Ultimately, anyone who wants to understand, support or build meaningful friendships with the hearing-disabled community can greatly benefit from this application.

2.0 OBJECTIVE
The main objective of this innovation are:
a. To help deaf and non-deaf people to understand each other easily and clearly.
b. To make it easier to have a real time conversation.

3.0 NOVELTY & INVENTIVENESS
It tracks actual movement of hands and can be translated easily to words. (Key innovative features) The system is a web-based application that uses AI that have been trained to recognise hand gestures through a standard webcam and convert them into text in real time (Great Learning Team, 2023). This system requires no other specialised equipment, making sign language communication more convenient and accessible.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Input Modality	Text, voice, or static images only	Live video capturing hand tracks, face, and body language.
Processing Latency	High lag due to cloud-dependent data pipelines.	Instantaneous translation using edge AI processing on-device.
Environmental Reliability	Fails under low light or moving backgrounds.	Robust spatial filtering optimized for variable mobile environments.

4.0 PRACTICALITY & USEFULNESS
In the real world, this application can be practically used in daily situations, such as interacting with a waiter, talking to customer service, or speaking with an information assistant. The primary target users and beneficiaries are hearing-disabled individuals and anyone who wishes to translate sign language, allowing both sides to understand each other better. Technically, the project is highly feasible to implement in this current day and age because the necessary technological resources are readily available (SINTEF, 2025). Economically, the app will be free and open-source, allowing people to modify

and improve how it works on their own. In terms of scalability and sustainability, the system can eventually expand to include other sign languages for worldwide access and can sustain itself for a long time, permanently transforming how people communicate with the Deaf community. Ultimately, the expected impact of this system is to create a more convenient and accessible way for deaf individuals to translate their sign language for hearing people.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

We use JavaScript to make our product function. The system is designed with a beginner friendly interface to translate sign languages into words. The system uses multiple models to be trained to recognise signs during the user's translation. We tested the system multiple times to ensure the model it trained off had correctly fed the right answers. The results have shown that the system is able to consistently recognise signs to words such as 'Thank You' or 'Hello'.

6.0 CONCLUSION

This project successfully developed a real-time, two-way sign language translation application designed to bridge the everyday communication gap between the deaf and hearing communities. By leveraging mobile computer vision and edge AI technology, the system converts complex, fluid hand gestures and facial expressions into spoken text instantly. The primary contribution of this work is providing an independent, accessible communication tool that removes the absolute necessity for human interpreters in routine daily interactions, extending its practical impact across healthcare, customer service, and educational sectors to offer the deaf community greater independence, improved social inclusion, and equal access to essential public services. However, several challenges were encountered during the development phase, such as variable lighting conditions where dimly lit environments occasionally degraded hand landmark tracking precision, as well as processor throttling because running continuous on-device AI computer vision pipelines caused battery drain and thermal build-up on older mobile devices. To address this, future iterations will focus on expanding the application's vocabulary database to include regional sign dialects and complex technical jargon, while integrating advanced spatial mapping techniques to stabilize tracking in crowded backgrounds and optimizing the machine learning models to reduce device battery consumption. Ultimately, by directly transforming physical gestures into universally understood speech, this innovation embodies the core theme of i-NEXTECH 2026, "Bridging Ideas and Technology for a Resilient Future," standing as a vital technological stepping stone toward a truly inclusive world where communication barriers no longer limit human potential.

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PROJECT ID: IN185

HYDROGUARD: AN AI-ENABLED AUTONOMOUS RIVER CLEANING AND FLOOD PREVENTION SYSTEM FOR SUSTAINABLE WATERWAY MANAGEMENT

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ABSTRACT
Malaysia faces growing environmental challenges from river pollution, floating waste, and clogged drainage causing flash floods. Current manual, reactive cleaning efforts are limited in managing real-time risks. This project introduces HydroGuard, an AI-enabled autonomous floating robot integrating robotics, AI, IoT, and environmental sensing for sustainable river management. It autonomously detects, collects, and categorizes floating waste while monitoring water quality and drainage blockages in real time. Featuring AI object recognition, ultrasonic navigation, and IoT connectivity, HydroGuard enables proactive waste interception, early flood mitigation, and remote monitoring for local authorities. Its low-cost, scalable platform uniquely unifies waste collection, environmental monitoring, and flood prevention. The innovation promotes cleaner waterways, reduces flood risks, fosters public waste awareness, and aligns with SDGs 6, 11, 13, and 14 to advance smart, resilient communities.
Keywords: Artificial Intelligence (AI), Smart River Management, Flood Prevention, Environmental Sustainability.

1.0 INTRODUCTION
River pollution and flash floods remain major environmental challenges in Malaysia, particularly in rapidly urbanising areas where population growth and increased human activities place greater pressure on waterways. Floating waste such as plastic bottles, food containers, plastic bags, and domestic rubbish frequently accumulates in rivers, drains, and canals, obstructing water flow and degrading water quality. During periods of heavy rainfall, these blockages can significantly increase the likelihood of flash floods, causing damage to property, disrupting transportation, and threatening public safety. In addition to environmental and economic impacts, polluted rivers also affect aquatic ecosystems by reducing oxygen levels, harming aquatic life, and disrupting natural habitats. Despite various river-cleaning campaigns and government initiatives, many waterways continue to experience recurring pollution due to improper waste disposal and insufficient real-time monitoring systems. Current river-cleaning activities are often labour-intensive, costly, and dependent on periodic inspections, making it difficult to detect pollution and drainage blockages before they become serious problems. As Malaysia moves towards smart city development and sustainable environmental management, there is an increasing need for innovative technologies that can provide continuous monitoring, autonomous waste collection, and early flood detection. Such solutions can help improve river conservation efforts while reducing the burden on local authorities and environmental agencies.

2.0 OBJECTIVES
The project was developed based on the following four (4) main objectives:
a. To develop an autonomous AI-powered floating robot capable of detecting and collecting floating waste in rivers.
b. To monitor environmental conditions including water quality, water level, and drainage blockages in real time.
c. To provide an early warning system that supports flood prevention and environmental management.
d. To promote sustainable river conservation through affordable and scalable smart technology.

3.0 NOVELTY & INVENTIVENESS
HydroGuard combines three critical environmental functions within a single platform:
- Autonomous waste collection using AI object recognition.
- Real-time environmental monitoring through IoT sensors.
- Early flood detection and warning capability.

Unlike conventional river-cleaning systems that focus solely on waste removal, HydroGuard integrates prevention, monitoring, and intervention into one smart solution.

Table 1: Comparison between Existing Solutions and HydroGuard

Aspect	Existing Solutions	HydroGuard
Waste Collection	Manual operation	Autonomous AI-*based* collection
Monitoring	Periodic inspection	Real-time monitoring
Flood Prevention	Reactive response	Early warning capability
Data Collection	Limited	IoT-enabled live data
Cost Efficiency	High operational cost	Low-cost scalable system

HydroGuard has strong potential for patent protection due to its integrated AI-IoT architecture combining autonomous river cleaning, environmental sensing, and flood prevention capabilities within a single platform.

4.0 PRACTICALITY & USEFULNESS

Table 2: Practicality, Beneficiaries, and Expected Impact

Category	Details
Real-World Applications	Rivers and drainage canals; Urban flood-prone areas; Smart city initiatives; Schools and community environmental projects
Target Beneficiaries	Local authorities; Department of Irrigation and Drainage (DID); Environmental agencies; Communities living near rivers; Educational institutions
Expected Impact	Reduction in floating waste accumulation; Improved River cleanliness and water quality; Earlier detection of drainage blockages; Reduced risk of flash floods; Increased environmental awareness among communities

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

HydroGuard operates as an autonomous floating platform powered by a microcontroller. AI image recognition identifies floating waste, while ultrasonic sensors assist navigation and obstacle avoidance. A collection mechanism captures waste and stores it within an onboard compartment. Environmental sensors continuously monitor water quality and water level. Data are transmitted via IoT technology to a monitoring dashboard for real-time observation and decision-making.

Table 3: Key Components and Specifications

Component	Specification	Purpose
ESP32 Controller	WiFi-enabled microcontroller	System control
Ultrasonic Sensor	Distance measurement	Obstacle detection
Water Level Sensor	Real-time monitoring	Flood detection
Camera Module	AI image recognition	Waste identification

6.0 CONCLUSION

HydroGuard successfully addresses the challenges of river pollution and flood risks through an innovative combination of AI, IoT, and autonomous robotics. The system demonstrates how smart technologies can transform traditional environmental management into a proactive and sustainable solution. Beyond waste collection, HydroGuard serves as an intelligent environmental guardian capable of monitoring waterways and supporting early flood prevention. Future improvements may include solar-powered operation, larger-scale deployment, and predictive AI analytics for enhanced environmental forecasting. In line with the theme "Bridging Ideas and Technology for a Resilient Future", HydroGuard represents a practical, innovative, and sustainable solution that contributes towards cleaner rivers, safer communities, and smarter cities.

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PROJECT ID: IN186

ECO-BRICKS: A STEP TOWARDS A GREENER COMMUNITY

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ABSTRACT
Single-use plastic pollution remains a critical environmental challenge, frequently overflowing landfills and polluting local ecosystems. The GreenShift Eco-Brick project presents an innovative, low-cost building material created by densely compacting non-recyclable plastic waste into standardized PET bottle molds. Unlike traditional community-made eco-bricks, this innovation introduces a digital tracking system via embedded QR codes. This integration allows project managers, builders, and environmental agencies to scan each block to monitor the precise volume, origin, and type of sequestered plastic within a centralized database. Preliminary testing for campus landscaping applications demonstrates high compressive strength, excellent thermal insulation, and complete water resistance. Ultimately, this solution reduces municipal landfill burdens while providing accessible, verifiable materials for sustainable, small-scale construction projects.
Keywords: Eco-brick, plastic upcycling, sustainable construction, digital tracking, waste management

1.0 INTRODUCTION
Modern consumer habits generate massive volumes of non-recyclable soft plastics. Conventional waste management systems in urban centers frequently struggle to process these materials efficiently, leading to environmental leakage. While traditional eco-bricks (plastic bottles stuffed with plastic waste) exist, they lack standardization, quality control, and impact-tracking mechanisms. Builders cannot easily verify the density or the environmental contribution of the bricks they use. By standardizing the production and digitizing the impact data of eco-bricks, this innovation transforms a grassroots environmental activity into a quantifiable, scalable resource for green construction and corporate sustainability reporting.

2.0 OBJECTIVE
The main objectives of this innovation are:
a. To manufacture standardized, high-density eco-bricks using 100% locally sourced, repurposed plastic waste.
b. To develop and integrate a digital ledger system to track the lifecycle, source, and total plastic weight of each brick.

3.0 NOVELTY & INVENTIVENESS
The primary novelty lies in bridging physical waste management with digital data collection. The system provides a tangible building material coupled with an invisible digital footprint for environmental auditing. Features include standard density-weight thresholds (ensuring structural integrity), weather-resistant exterior QR etching, and a companion cloud database for impact visualization. The methodology for cataloging and digitally syncing the physical waste data to the cloud holds potential for software copyright and utility model registration.

4.0 PRACTICALITY & USEFULNESS
These digitally tagged eco-bricks can be utilized for non-load-bearing architectural elements, such as campus community garden walls, modular seating, and decorative landscaping. This innovation is suitable for environmental NGOs, university sustainability offices, and rural communities seeking zero-cost building materials.This innovation is also highly feasible as it requires minimal technical machinery for physical production. The digital database leverages standard, low-cost cloud architecture and significant reduction in local plastic pollution, alongside the creation of a transparent, gamified system that encourages community participation in waste collection.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

Design and Development Process: (1) Material sourcing and sanitization, (2) High-density manual/mechanical compaction into standard 1.5L PET molds, (3) Weight verification and QR code assignment, (4) Database synchronization. Technical Architecture: The physical brick acts as the hardware, while a serverless NoSQL database hosts the scanning application, logging the time of creation, material weight, and contributor ID.

6.0 CONCLUSION

The GreenShift Eco-Brick successfully modernizes a grassroots recycling method by introducing strict quality control and digital traceability. It offers an empirical blueprint for converting problematic environmental waste into a measurable, verifiable community asset. The manual compaction process is currently labor-intensive, which may bottleneck rapid large-scale production. Future iterations will explore semi-automated compaction presses and the potential to coat the bricks in a fire-retardant, eco-friendly sealant for expanded architectural use. By merging physical recycling with digital accountability, this innovation embodies the core theme of "Bridging Ideas and Technology for a Resilient Future."

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PROJECT ID:IN188

EVALUATING THE EFFICACY OF *CYMBOPOGON NARDUS*, *CARICA PAPAYA*, AND *ALLIUM SATIVUM* EXTRACTS AGAINST *GRYLLUS* SP. ON *CAPSICUM CULTIVARS*

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ABSTRACT
Capsicum cultivation faces significant yield losses from *Gryllus* sp. (field crickets), which aggressively damage young seedlings. Current reliance on chemical pesticides raises environmental concerns. This study presents an eco-friendly, synergistic biopesticide combining essential oils of citronella *(Cymbopogon nardus*), garlic (*Allium sativum*), and papaya leaf (*Carica papaya*) extract. Oils were extracted via steam distillation and formulated as a liquid spray. In controlled trials using *Capsicum* plants and cricket specimens, treated enclosures exhibited high insect mortality and strong repellency, with negligible feeding damage compared to controls. The synergy of citronellal (repellency), sulfur compounds (toxicity), and papain enzymes (digestive disruption) effectively disrupts cricket activity. Crucially, no adverse effects on host plants were observed. This low-cost, biodegradable, and easily replicable formulation offers local farmers a sustainable alternative, reducing reliance on harmful synthetic pesticides and supporting resilient food production.
Keywords: Biopesticide, Gryllus sp., Steam Distillation, Experimental Design, Sustainable Agriculture

1.0 INTRODUCTION
Capsicum (pepper) seedlings in East and Southeast Asia are highly vulnerable to field crickets (*Gryllus* sp.), causing major crop losses. While synthetic pesticides control these pests, they leave behind toxic residues and harm the environment. Commercial biopesticides are a safer alternative, but they are often too expensive or hard to find for small farmers. To bridge this gap, this study tests an affordable, homemade biopesticide mixing citronella oil, garlic, and papaya leaf extract. By combining citronellal (to repel), sulfur (to act as a natural toxin), and papain enzymes (to disrupt the cricket's digestion), this biodegradable formula gives farmers a low cost, sustainable way to protect their crops.

2.0 OBJECTIVE
The main objectives of this innovation/project are:
a. To repel *Gryllus* sp. infestations from Capsicum cultivars effectively.
b. To formulate a biodegradable and eco-friendly biopesticide derived from natural botanical extracts.
c. To develop a cost-effective pest management solution using easily accessible, locally sourced raw materials.

3.0 NOVELTY & INVENTIVENESS
This innovation is unique in its synergistic combination of three distinct botanical extracts, citronella, garlic, and papaya leaf, to create a multi mechanism biopesticide. Unlike traditional single-ingredient botanical extracts or existing commercial biopesticides, this formulation offers
enhanced efficacy through combined repellency, toxicity, and physiological disruption. It provides a cost-effective and easily replicable solution for smallholder farmers, overcoming accessibility barriers of commercial alternatives.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing Solutions	Your Innovation
Ingredients	3 separated ingredients which is	Combining the 3 ingredients
Enviroment	Chemical residues	Close environment, no chemical residues
Plant variety	Capsicum annuum L.(merah)	Capsicum annuum (cabe ungu) and Capsicum annuum L.(merah)

4.0 PRACTICALITY & USEFULNESS

This biopesticide protects three-week-old *Capsicum* seedlings from cricket damage right when they are most vulnerable. Because it requires no lab equipment, farmers can easily make it in their backyards using local ingredients. At an estimated cost of just 30 Ringgit, it is significantly cheaper than commercial options. It is also fully biodegradable and leaves zero chemical residue, offering remote farming communities an affordable, scalable way to cut crop losses and stay self-reliant.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

To test this botanical biopesticide, an emulsifiable concentrate was formulated using ethanol extraction and steam distillation, combining citronella oil (*Cymbopogon nardus*, 2.5%), garlic (*Allium sativum*, 1.5%), and papaya leaf extract (*Carica papaya*, 1%) diluted in 95% water. The formulation utilizes a three-pronged defense mechanism against field crickets (Gryllus sp.) citronellal and terpenes cause olfactory disruption and antenna overstimulation, allicin and sulfur compounds induce neurotoxic oxidative stress leading to paralysis, and papain enzymes break down the insect's midgut, causing digestive disruption. For demonstration, four three-week-old chili seedlings (Capsicum cultivars) infested with 50 crickets each were isolated inside 20×20×40 cm plastic containers under controlled room conditions. Half of the plants were treated using a 500 mL micro-sprayer, while the remaining half served as untreated controls. Overnight observation revealed that treated plants sustained negligible feeding damage compared to the controls, confirming the formula's effective synergistic repellency and antifeedant activity without causing physical or reproductive harm to the crops.



Figure 1: Development process flowchart

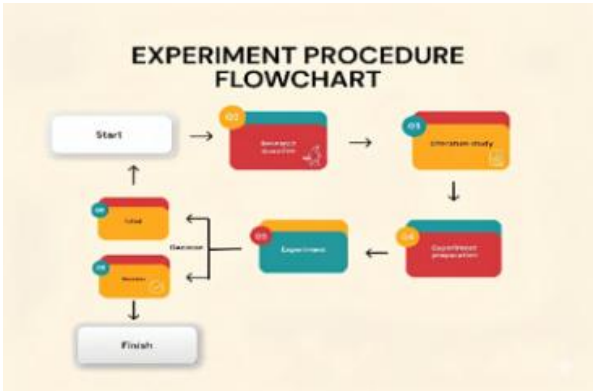


Figure 2: Example of the experiment

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Gryllus sp.	Field crickets 2-3cm	As a pest
Capsicum cultivars	3 week old capsicums	As a crop
Mixed *Cymbopogon nardus*, *Carica papaya*, and *Allium sativum*	100% natural essential oil	As a pesticide

6.0 CONCLUSION

In conclusion, this research successfully addresses the agricultural threat of Gryllus sp. on Capsicum cultivars by developing a low cost, synergistic biopesticide from *Cymbopogon nardus, Allium sativum*, and *Carica papaya* extracts, fulfilling the core objective outlined in the introduction. The controlled experimental methodology validated that the chemical synergy of citronellal, sulfur compounds, and papain enzymes provides high repellent efficacy and insect mortality without damaging the host plants. While the volatile nature of these botanical compounds presents a limitation in long term residual efficacy, future work will focus on optimizing formulation stability for open-field implementation. Ultimately, this innovation offers a highly practical, biodegradable alternative for smallholder farmers, reducing reliance on toxic synthetic chemicals and perfectly embodying the i-NEXTECH 2026 theme of "Bridging Ideas and Technology for a Resilient Future".

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PROJECT ID: IN192

LIMO-WAX: A SUSTAINABLE MULTI-INSECT REPELLENT BAR UTILIZING UP-CYCLED WAX AND A SYNERGISTIC DEHYDRATED THREE-CITRUS BLEND FOR GREEN DOMESTIC PEST MANAGEMENT

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ABSTRACT
Mosquitoes and household insects remain a persistent nuisance and health concern, yet most repellents (sprays, coils, liquid vaporisers) rely on synthetic chemicals, evaporate quickly, and generate packaging waste. LIMO-WAX is an eco-friendly solid wax bar that traps the natural essential oils of three citrus leaves (lemon, calamansi, kaffir lime) within a wax binder and releases the citrus aroma gradually through a slow-release mechanism, acting as both a natural insect repellent and an air freshener. Picked leaves are dehydrated for 3–5 days until crisp (zero moisture) to prevent mould and spattering, then chopped and blended into melted wax and cast into bars. A weekly evaporation test showed minimal mass loss while the scent stayed strong, indicating high efficiency and an estimated shelf life of 3–6 months. The product costs about RM4.00 per unit to produce and can retail at RM8–RM12 (50–67% gross margin). By repurposing readily available citrus leaves, LIMO-WAX reduces reliance on chemical repellents, minimises waste, and offers an affordable, sustainable, market-ready solution.
Keywords: insect repellent, mixed citrus leaves, citronellal, slow-release mechanism, eco-friendly

1.0 INTRODUCTION
Insects such as mosquitoes are a year-round problem in tropical climates, and households, schools, and offices commonly rely on chemical repellents—sprays, coils, and vaporisers—to keep them away.
These products contain synthetic compounds that may irritate the airways, lose effectiveness quickly, and create single-use waste. Natural alternatives such as dried-leaf sachets lose scent within days, while liquid sprays spoil or grow mould. A long-lasting, stable, natural repellent is needed. LIMO-WAX addresses this gap by converting an abundant, low-cost by-product (citrus leaves) into a stable, attractive repellent bar for households, students, and eco-conscious consumers, promoting sustainable resource use.

2.0 OBJECTIVE
The main objectives of this innovation are:
a. To develop a natural, eco-friendly insect-repellent wax bar that uses a blend of three citrus-leaf oils (lemon, calamansi, kaffir lime) as the active ingredient.
b. To apply a slow-release mechanism so that the citrus aroma lasts an estimated 3–6 months, longer than liquid sprays or dried-leaf sachets.
c. To produce an affordable, market-ready product (production cost ≤ RM4.00 per unit) suitable for commercialisation by students

3.0 NOVELTY & INVENTIVENESS
Unlike sprays or sachets, LIMO-WAX uses wax as a binding agent that physically traps citrus-leaf essential oils and releases them slowly into the air. Key innovative features are: (1) a synergistic blend of three citrus leaves (lemon, calamansi, kaffir lime) for broader-spectrum repellency; (2) a slow-release wax matrix for long-lasting scent; (3) a compulsory leaf-dehydration step achieving zero moisture, preventing mould and ensuring a long shelf life; and (4) a premium, market-ready form using food-grade silicone moulds and soy/bees wax for a non-toxic finish.
The formulation and dehydration-based process have potential for protection as a trade secret or utility innovation; no IP has been filed to date.

Table 1: Comparison between existing solutions and the proposed innovation

Aspect	Existing Solutions (spray / coil / sachet)	LIMO-WAX (proposed)
Active ingredient	Synthetic chemicals	Blend of 3 citrus-leaf oils (synergistic)
Longevity	Hours to days; evaporates fast	3–6 months via slow-release wax
Stability	Liquid spoils; sachet loses scent / moulds	Stable solid; aroma kept until wax melts
Sustainability	Chemical + single-use packaging	Repurposes leaf waste; eco-friendly

4.0 PRACTICALITY & USEFULNESS

LIMO-WAX can be used in homes, offices, classrooms, and cupboards as a natural repellent and air freshener, releasing its aroma gradually and reducing reliance on chemical repellents. It can be used among households, students, schools, offices, and eco-conscious consumers. The product is simple and safe to make with basic tools and economically viable: total material cost is about RM40 for 10 units (≈ RM4.00 each, covering wax, silicone mould, packaging, label, and electricity). It is scalable to larger batches and sustainable, repurposing citrus leaves, using biodegradable wax, and operating passively without electricity. This product also can be marketed at RM8–RM12 per unit (≈50–67% gross margin), it is affordable, sustainable, and commercialisable while reducing chemical use and waste.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The materials involves fresh leaves of three citrus types (lemon, calamansi/limau kasturi, kaffir lime/limau purut), soy/paraffin wax, a saucepan/heat source, scissors, silicone moulds, and packaging boxes.The process starts with leaves of three citrus types (lemon, calamansi, kaffir lime) are picked and dried separately in shade for 3–5 days until crisp, then chopped, blended into melted wax, cast in silicone moulds, cooled (~10 minutes), and packaged. The full process is shown in Figure 1. The process of drying removes moisture and breaks the leaf cell walls, releasing the essential oil (citronellal). The solidifying wax traps this oil and releases it slowly at room temperature for a lasting effect. Fresh leaves are avoided as trapped water causes mould and spattering. Each wax bar was weighed weekly (evaporation test). Mass dropped only slightly while the citrus scent stayed strong, confirming efficient, low-waste slow release and a stable product over time.



Figure 1: Step-by-step development process of LIMO-WAX

6.0 CONCLUSION

LIMO-WAX turns citrus leaves into a stable, long-lasting insect-repellent wax bar, meeting its objectives of a natural active ingredient, slow-release longevity, and a low RM4.00-unit cost. The innovation is an affordable, eco-friendly alternative to chemical repellents that repurposes agricultural waste. Limitations include reliance on drying weather and standardised repellency testing; future work includes lab testing and refined branding. LIMO-WAX aligns with ESG (Environmental, Social, Governance) principles and supports SDG 12 (Responsible Consumption and Production) and SDG 3 (Good Health and Well-being), proving that domestic waste can be transformed into a premium, safe, and high-impact space-protection product. As a passive product that needs no electricity to operate—unlike electric vaporisers—it also supports Malaysia's National Energy Transition Roadmap (NETR) and the national shift toward new and renewable energy. It thus contributes to "Bridging Ideas and Technology for a Resilient Future" through a sustainable, practical, and scalable everyday solution.

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INTELLINEX EDU

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ABSTRACT
The lack of a suitable medium for students to directly and systematically acquire essential skills within the learning process limits their development. The shortage of platforms such as communication activities and debates reduces opportunities to consistently build student's character. Besides, the rapid advancement of technology has influenced students' learning styles, making them more dependent on instant information and less engaged in deep thinking, and face-to-face interaction, which ultimately affects their soft skills. Therefore, INTELLINEX EDU was developed as an innovative educational ecosystem focused on communication, critical thinking, and debate-based learning. Debates enhance students' problem-solving skills and character development because they expose them to a wide range of topics, including politics, economics, social issues, education, and public awareness and a deeper understanding about real-world challenges. The project empowers students through structured debate activities that promote active participation and student engagement. Debate is an oral exchange of opposing views to support or reject an issue, aimed at sharpening thinking, communication, and rational argumentation skills, while strengthening critical thinking and reasoning abilities. However, many students are still unaware of its benefits and are discouraged by stereotypes that debate is complex and only suitable for naturally fluent speakers. The methodology involved observations, student feedback, and participation analysis, followed by the implementation of debate-based communication and critical thinking activities. Student progress was assessed through participation levels, confidence indicators, communication performance, and achievement in debate competitions. The findings showed noticeable improvements in students' confidence, communication skills, and critical thinking abilities. In conclusion, INTELLINEX EDU demonstrates strong potential in transforming student learning by enhancing soft skills, academic performance (especially SPM), information evaluation abilities, emotional intelligence, and leadership development. Overall, this innovation contributes to shaping more confident, critical, and future-ready students capable of expressing ideas effectively in real-world situations.
Keywords: Communication Skills, Critical Thinking, Soft Skills Development, Debate-Based Learning (INTELLINEX EDU), Student Confidence & Engagement

1.0 INTRODUCTION
Background: The current education system still places a strong emphasis on academic achievement and examinations rather than the development of students' communication skills, critical thinking and self-confidence. As a result, many students face difficulties speaking in public, lack confidence in expressing their opinions and remain passive during the learning process. In the era of globalization and the Industrial Revolution 4.0, students are not only expected to excel academically, but also to possess communication, leadership, collaboration and critical thinking skills to face real-world challenges. However, the development of these skills has yet to be systematically integrated into school education. Debate activities have proven effective in improving students' confidence, communication skills, critical thinking and character development. Nevertheless, participation is still limited to certain groups and has not been widely integrated into the education system. Therefore, the INTELLINEX EDU project was developed as an innovative educational ecosystem based on communication and critical thinking, using debate-oriented learning, student voice and character development approaches to produce students who are more confident, critical, competitive and prepared for the future. This innovation supports SDG 4: Quality Education by promoting future-ready communication and critical thinking skills among students.

2.0 OBJECTIVE

a. To help students improve critical thinking and problem-solving skills through structured debate activities, discussions and collaborative learning.
b. To encourage active participation and student voice among students by increasing student involvement in communication and learning activities by at least 50%.
c. To develop soft skills such as leadership, teamwork and emotional regulation among students through communication activities based on interaction and teamwork.

3.0 NOVELTY & INVENTIVENESS

Innovation Aspects: The Subject Debate Innovation is a next-generation educational platform designed to enhance critical thinking, communication skills, and knowledge acquisition through structured debates on academic and real-world topics. Most existing debate platforms and classroom debate activities focus primarily on conducting debates and determining winners. They often rely heavily on teachers or moderators to select topics, manage discussions, and evaluate participants. The innovation introduces a data-driven and AI-assisted debate learning framework that enhances both participation and learning outcomes. The first key innovative feature is the integration of artificial intelligence to evaluate debate performance in real time. The system analyses participants' arguments based on criteria such as logical reasoning, evidence support, relevance to the topic, clarity of communication, and rebuttal effectiveness. Specific features include Automated scoring of debate performance. Real-time feedback and performance insights. The second innovative feature is an intelligent recommendation system that suggests debate topics and matches participants based on their interests, academic subjects, knowledge levels, and debating experience. This ensures balanced and engaging discussions while promoting deeper learning. Specific features include personalized debate topic recommendations. Performance Analytics Dashboard, the platform records and analyses user performance over time, allowing participants and educators to monitor progress in critical thinking, communication, and argumentation skills through visual reports and performance metrics. Existing solutions mainly focus on debate competitions or public speaking activities involving selected students. They often lack a structured system to develop and assess communication, critical thinking and character development. INTELLINEX EDU integrates communication, critical thinking, debate-based learning and student voice into one structured ecosystem. It also includes systematic assessment methods and can be implemented for all students. INTELLINEX EDU has potential for copyright and trademark protection, particularly for its modules, assessment tools and brand identity. Currently, no intellectual property application has been filed. However, future registration may be considered to protect the originality of the innovation.

Table 1: Comparison between existing solutions and proposed innovation

Aspect	Existing solutions	INTELLINEX EDU
Learning approach	Focused mainly on debate competitions and public speaking	Integrates communication,critical thinking,student voice and character development
Skill development	Emphasizes speaking skills only	Develops communication,critical thinking,leadership,teamwork and self - confidence simultaneously
Student participation	Limited to selected students in debate clubs or competitions	Open all students through a structured educational system

4.0 PRACTICALITY & USEFULNESS

INTELLINEX EDU is a debate-based learning platform that can be directly integrated into the teaching and learning process in educational institutions to help develop students' communication skills, critical thinking, and self-confidence. Through a systematic implementation, teachers introduce the topic, divide students into the pro and con groups, and act as facilitators and evaluators throughout the debate session. By leveraging digital technology, the platform can be used by teachers and students in various debate-based learning activities while promoting active student participation in the learning process and the development of essential soft skills.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

INTELLINEX EDU was developed to address the lack of a structured learning platform that supports the development of soft skills such as communication, critical thinking, and self-confidence, as well as the impact of technological advancement that reduces students' active participation in discussions. It

introduces a debate-based learning ecosystem where teachers present current topics, students are divided into pro and con groups to conduct structured debate sessions, and teachers act as facilitators and evaluators using debate modules, current issue materials, assessment rubrics, and continuous feedback. Its effectiveness is assessed through observation, participation levels, confidence, communication skills, and involvement in debate competitions, which ultimately show significant improvements in students' communication skills, critical thinking, self-confidence, and active engagement in learning.

Table 2: Key components and specifications

Component/Material	Specification	Purpose
Debate Module	Structured debate framework with pro & con format, guided speaking structure, and timing system	To guide students in conducting organized and structured debate sessions
Learning Content (Current Issues	Curated articles, news topics, and discussion prompt relevant to	To provide meaningful and up-to-date topics that encourage critical thinking
Teacher Dashboard / Facilitator Tools	Monitoring system for tracking participation, scoring, and feedback input	To enable teachers to manage sessions, evaluate students, and provide continuous feedback

6.0 CONCLUSION

INTELLINEX EDU was successfully developed to address students' lack of confidence, communication skills and critical thinking. Through debate-based learning and student voice activities, the project improved students' participation, communication and confidence. The innovation promotes communication, critical thinking and character development in a structured way. It helps students become more confident, articulate and future-ready while supporting educators in developing student's soft skills. Challenges included limited implementation time, varying student participation levels and a small sample size. These factors may affect the generalisation of the findings. Future improvements include expanding the project to more schools and integrating digital tools such as online platforms and AI-assisted feedback systems to enhance learning and assessment. INTELLINEX EDU demonstrates the potential of debate-based education in developing confident, critical and resilient students. In line with the theme of i-NEXTECH 2026, it bridges education, innovation and future skills to prepare students for a rapidly changing world.

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NEXTGEN CAREER: AI-POWERED CAREER DISCOVERY SYSTEM

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ABSTRACT
NextGen Career is an AI-powered career discovery system developed to reduce career confusion and anxiety among secondary school students aged 15 to 19. Many students are uncertain about suitable academic pathways, courses and future occupations because existing guidance is often manual, generic and highly dependent on counsellor availability. This innovation introduces an interactive web application that combines secure registration, strict demographic targeting, AI-based profiling and instant multi-tiered career recommendations. Through ten smart assessment questions, the system captures students' interests, personality tendencies, learning styles and future skills inclination before matching them with six main career categories, including science, health and research, engineering, education, community service, technology and AI. The workflow consists of four stages: eligibility screening, student profiling, career match generation and assessment report production. The system provides a permanent record for discussion with parents, school counsellors and mentors. NextGen Career has strong potential to transform career anxiety into informed confidence while supporting schools with scalable, data-driven career guidance.
Keywords: NextGen Career, artificial intelligence, career discovery, secondary school students, digital counselling

1.0 INTRODUCTION
Career selection is a critical decision for students aged 15 to 17 because it influences subject choice, post-school planning and future employability. However, many students are unsure which career, course or education pathway suits their interests and strengths. This innovation addresses the gap by offering a structured AI-assisted platform that supports early self-discovery and guides students toward relevant career categories.

2.0 OBJECTIVE
a. To develop an interactive career discovery web application for students aged 15-19.
b. To profile students using smart questions related to interests, personality and learning tendencies.
c. To generate instant career recommendations and an assessment report for counselling support.

3.0 NOVELTY & INVENTIVENESS
The novelty of NextGen Career lies in its integration of AI-based matching, targeted eligibility, structured pathway scoring and official report generation. Unlike conventional career talks or paper-based counselling forms, it converts student responses into actionable recommendations that can be used immediately by students, parents, teachers and counsellors.

Aspect	Existing Solutions	NextGen Career Innovation
Assessment approach	Manual forms or generic counselling	Interactive AI profiling with smart questions
Output	General advice, limited record	Instant career match and printable report
Scalability	Depends on counsellor availability	Web-based system scalable across schools

4.0 PRACTICALITY & USEFULNESS
The system is practical for schools because it can be deployed as a web application without complex hardware. Target users include students, school counsellors, parents and education institutions. For students, it improves self-understanding and decision confidence. For schools, it provides structured evidence for counselling sessions. At ecosystem level, it supports early talent identification and future workforce readiness.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The system follows four sequential modules. First, students register their demographic details and pass an eligibility gate limited to the 15-19 age group. Second, they answer ten smart profiling questions. Third, the AI engine analyses the responses and ranks suitable career categories. Fourth, the system generates a downloadable or printable report for further discussion with parents, counsellors and mentors.

Component	Specification	Purpose
Student information module	Name, age, school and eligibility gate	Ensures target-group accuracy and privacy
AI profiling engine	10 smart assessment questions	Captures interests and learning tendencies
Career matching dashboard	6 career categories with ranking	Provides instant pathway recommendations
Assessment report	Printable or downloadable record	Supports counselling and parental discussion

6.0 CONCLUSION

NextGen Career demonstrates how artificial intelligence can support early career discovery in schools. By combining student profiling, AI matching and structured reporting, the system offers a practical, scalable and student-centred solution for career guidance. Future work may include validation with larger student samples and counsellor feedback to strengthen accuracy and adoption.

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PROJECT ID: IN236

SUSTAIN

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ABSTRACT
SUSTAIN, an award-winning innovation supports SDG 2 by promoting sustainable food production through a smart hydroponic farming system. This project allows vegetables such as pak choy to be grown efficiently in limited urban spaces while using less water compared to traditional farming methods. By integrating automation and resource-saving technology, SUSTAIN helps increase food accessibility, reduce food waste, and encourage self-sufficient agriculture. The system also provides a cleaner and more sustainable way to produce fresh vegetables, contributing towards long-term food security and a healthier community. The system utilizes an ESP32 microcontroller and is equipped with pH, EC, and TDS sensors to continuously monitor the nutrient solution and growing conditions. Real-time data is transmitted to a web-based monitoring platform, allowing users to remotely track plant conditions and make informed decisions. To enhance sustainability, the water circulation pump is powered by a solar panel, reducing energy consumption from conventional sources. In addition, AI-assisted analysis is incorporated to improve monitoring efficiency and support smarter crop management. By combining IoT technology, renewable energy applications, automation, and sustainable farming practices, SUSTAIN offers an innovative solution to modern urban agriculture challenges. Recently, the efficacy of this innovation was proven after being recognized and awarded two gold medals and Platinum Special Grand Award for SDGs in IWC 2026 and I3C 2026 in Jakarta, Indonesia.

1.0 INTRODUCTION
The increasing demand for food and limited farming space have created challenges for sustainable food production [1] & [2]. Traditional farming requires significant land, water, and labour, while many existing hydroponic systems are costly, energy-intensive, or require frequent monitoring [4]. SUSTAIN was developed to address these challenges through a solar-powered hydroponic system that supports efficient vegetable cultivation in limited spaces with real-time monitoring through website [3].

2.0 OBJECTIVE
The main objectives of this innovation/project are
a. To maximize the usage of resources and space for maximum productivity
b. To encourage eco-friendly farming to sustain cities long-term
c. To increase sustainable food production while meeting the growing demand as well as to enhance food security by reducing imports and ensuring stable local supply.

3.0 NOVELTY & INVENTIVENESS
SUSTAIN combines hydroponic farming, solar energy, and smart monitoring in a compact system for urban agriculture. Unlike conventional hydroponic systems that require regular manual checks and grid electricity, SUSTAIN uses a solar-powered water circulation system and automatically monitors pH, EC, and TDS sensors. Its vertical PVC pipe design maximizes limited space while supporting healthy plant growth. These features make SUSTAIN a practical and sustainable solution for growing vegetables in urban environments. The system also has potential for future intellectual property protection due to its unique design and technology integration.

4.0 PRACTICALITY & USEFULNESS
SUSTAIN can be used in homes, schools, community gardens, and urban farming projects where space is limited. Built using readily available materials such as PVC pipes, solar panels, and standard electronic components, the system is cost-effective and suitable for implementation. Its modular design allows easy adaptation to different locations and needs. By utilizing solar energy and efficient water circulation, SUSTAIN promotes sustainable farming, reduces resource consumption, improves access to fresh produce, and enhances space and water efficiency compared to conventional farming methods.

5.0 METHODOLOGY & TECHNICAL SPECIFICATIONS

The prototype was built using a two-tier PVC hydroponic structure supported by hollow steel frames, with a storage box as the main water tank. An electrical box was installed to house and protect the sensors and control components, including pH, EC, and TDS sensors. A float pump was used to regulate water level, while a solar-powered water pump circulated water through the PVC pipes. The system consists of PVC pipes, storage tank, sensors, ESP32 control system, float mechanism, and a web-based monitoring platform (Figure 1). The system operates by pumping water from the tank to plant roots while sensor data is transmitted to a web platform for monitoring and control.

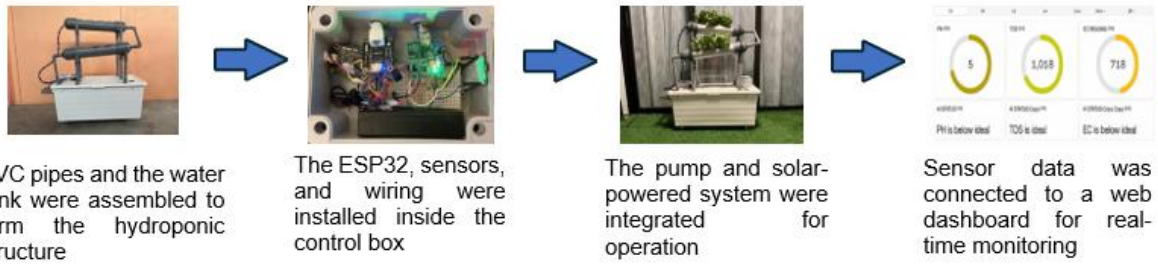


Figure 1. Components and installation steps of SUSTAIN

6.0 CONCLUSION

SUSTAIN successfully addresses the challenges of limited farming space and resource-intensive food production through a solar-powered hydroponic farming system. By integrating automation, real-time monitoring, and sustainable farming practices, the project promotes efficient vegetable cultivation in urban environments. Future developments may include enhanced automation, support for a wider variety of crops, and improved data analysis capabilities. Overall, SUSTAIN represents a practical step towards sustainable agriculture, supporting the i-NEXTECH 2026 vision of bridging ideas and technology for a more resilient and sustainable future.

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