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INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

ORGANIZED BY:

Electrical Engineering Studies, College of Engineering
Universiti Teknologi MARA (UiTM) Cawangan Johor
Kampus Pasir Gudang

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A-ST038: INTELLIGENT FLOOD DETECTION AND ALERT SYSTEM

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ABSTRACT

Floods have become one of the most destructive natural calamities that cause life, property, and infrastructural losses. This project, therefore, is an Intelligent Flood Detection and Alert System built on a network of sensors, integrated with Google Sheets for real-time data logging and monitoring. The key objective will be to ensure there is a reliable and efficient system for the detection of water-level rise and forecasting floods in due time, which gives an early warning for flood impacts. This system uses an ultrasonic sensor for measuring the level of water, rain sensors to measure rainfall, and a flow sensor to monitor water movements. These sensors are connected to a microcontroller, which uploads the real time data readings on Google Sheets through a Wi-Fi module. Google Sheets can act like a web-based data management system by allowing access to live monitoring data from anywhere and at any time. This allows for further analysis of data and observation of trends over time for enabling early flood warnings. The system is enhanced further with the Blynk IoT platform for notifications directly to a mobile device and allows remote water pump control to give flexibility in its on and off operation. The results show that the system effectively provides real-time monitoring of water level variation and other environmental conditions, which trigger the local alert mechanism at a critical level. This provides increased access by users at an affordable and scalable measure; hence, it is deployable in flood-prone areas to support authorities and locals for better decision-making on time. This makes it a practical choice for both remote and urban applications due to the flexibility in data storage, remote control, and analysis added by the integration of Google Sheets and Blynk.

Keywords: IoT, ESP32, Data Logger, Flood Detection, Blynks

1. Product Description

The Intelligent Flood Detection and Alert System is the modern approach towards mitigating flood effects. It continuously monitors water level, rainfall, and flow based on IoT, using ultrasonic, flow, and rain sensors. Processing by a power microprocessor, on-the-spot and instant notification, with the possibility for remote control of all critical functions, including water pumps, by the Blynk platform; in real-time, data logs into Google Sheets for access and analytics.

The system comprises an automatic water level management water pump, a siren for immediate alerts, and LED indicators to visualize the status. Driven by solar energy, this

device is very environmentally friendly and cost-effective. It is designed to be extremely reliable and is applicable in any urban or rural flood-prone area. Cloud-enabled functionality helps the community and authorities make timely decisions based on data-driven insights. Its robust and modular design ensures longevity and easy maintenance. It is ideal for residential areas, farms, and critical infrastructures such as hospitals and schools, this smart system enhances flood preparedness. The Intelligent Flood Detection and Alert System empowers users to stay informed, take immediate action, and protect what matters most.

2. Pictures and diagrams

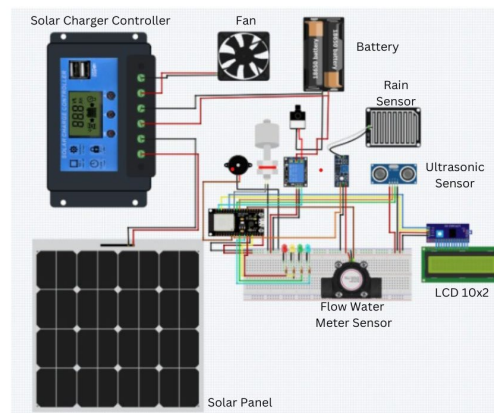


Figure 1. Circuit Diagram of the Intelligent Flood Detection and Alert System

The circuit diagram in **Figure 1** illustrates the integration of the ESP32 microcontroller with a range of sensors and actuators for intelligent flood detection. Key components include the ultrasonic distance sensor (TRIG: GPIO 5, ECHO: GPIO 18) for monitoring water levels, the rain sensor (GPIO 33) for detecting rainfall intensity, and the water flow rate sensor (GPIO 4) for measuring water movement. Additional components like the water float switch (GPIO 19) enhance the system's ability to assess critical water conditions. Actuators, including LEDs (GPIO 12, 13, and 26), provide visual indicators for different water levels. The water pump (GPIO 23) automatically activates during critical water levels to mitigate flooding. A 16×2 LCD with I2C interface (Address: 0x27) displays real-time data, enhancing user interaction and situational awareness.

The system is powered by a solar panel connected to a 12V rechargeable battery via a solar charge controller, ensuring sustainability and continuous operation, even in areas prone to power outages. This robust and efficient design integrates renewable energy with IoT-enabled monitoring for a reliable flood management solution.

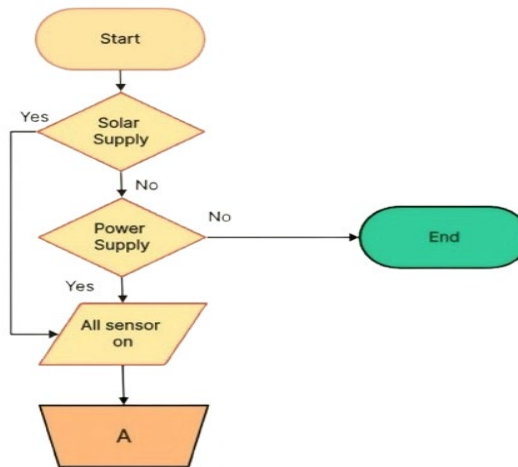


Figure 2: Flowchart of power supply

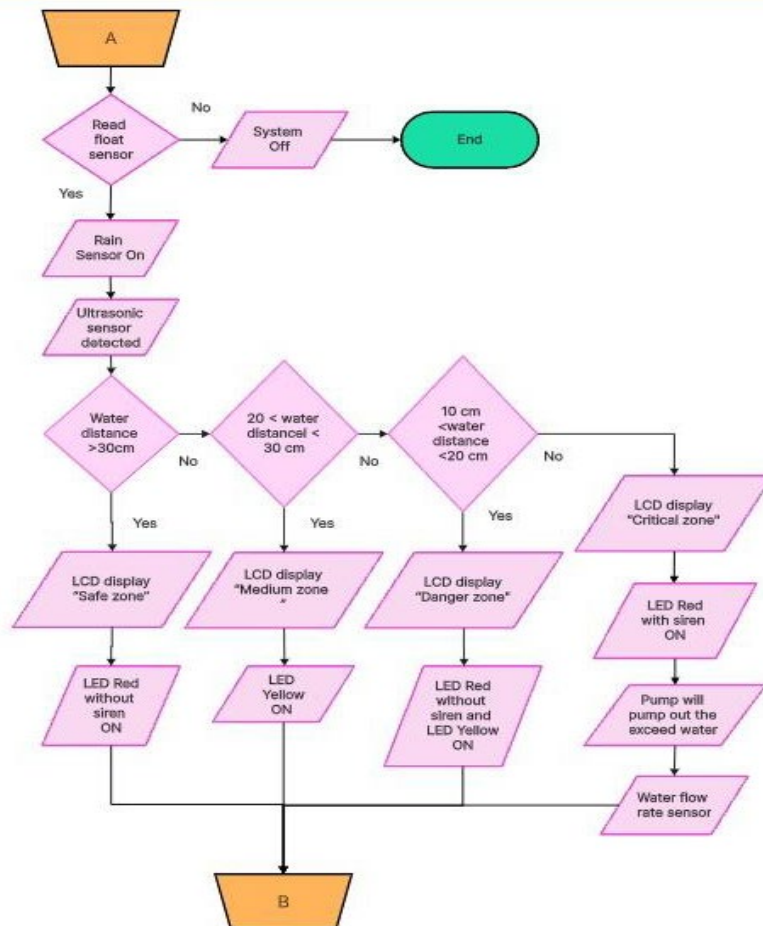


Figure 3. Flowchart of the sensor and actuator integration

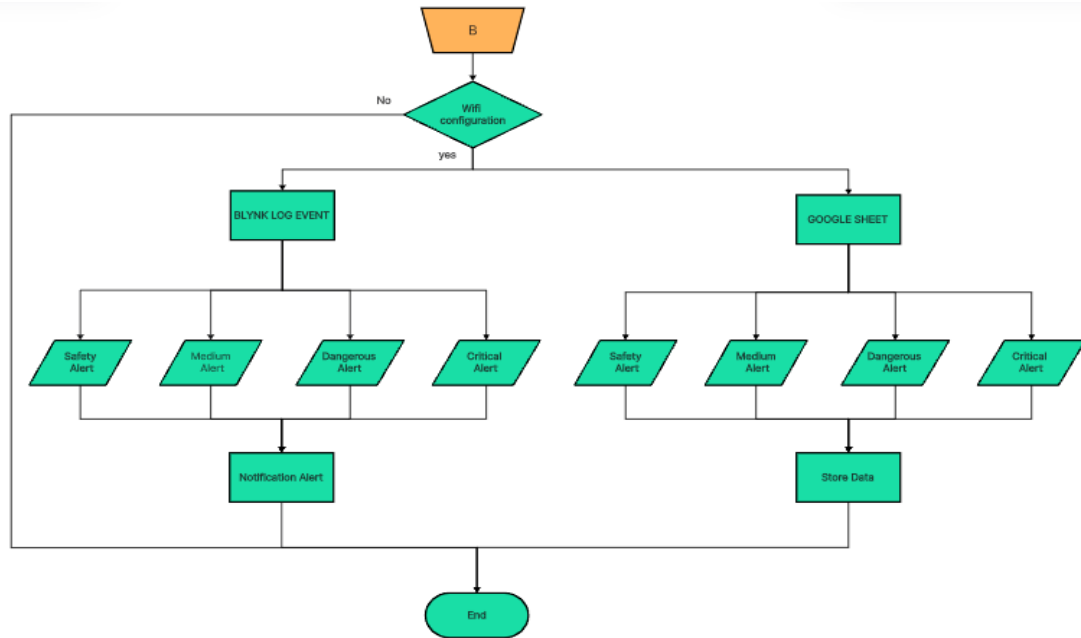


Figure 4. Flowchart of the IoT integrations

Figures 2,3 and 4 are the operational flowchart of the intelligent flood detection and alert system. The intelligent flood detection and alert system operates through three interconnected stages: power management, sensor and actuator integration, and IoT-based data monitoring. As shown in **Figure 2**, the system begins with power management using solar panels. It checks for solar supply and ensures sufficient power before activating. If power is available, the system turns on all sensors; otherwise, it waits for the battery to recharge. This sustainable energy solution makes the system environmentally friendly and reliable, especially for off-grid applications.

Once powered, the system moves to the next stage, as shown in **Figure 3**. The flood management system integrates multiple sensors and actuators to efficiently monitor and respond to water levels in real time. It starts by checking the water presence using a float sensor; if no water is detected, the system remains off. When water is present, the rain sensor activates, and an ultrasonic sensor measures the water level to classify it into zones. If the water distance is greater than 30 cm, the system indicates a "Safe Zone" on the LCD and turns on a red LED without a siren. For water levels between 20 and 30 cm, it displays "Medium Zone" and lights up a yellow LED. If the water distance falls between 10 and 20 cm, it switches to a "Danger Zone," activating both yellow and red LED without a siren. For critical water levels below 10 cm, the system displays "Critical Zone" on the LCD, activates a red LED with a siren, and automatically turns on a water pump to drain excess water until the level returns to a safer range. A water flow rate sensor ensures the pump operates efficiently, providing a responsive and reliable solution for flood management.

The final stage, illustrated in **Figure 4**, focuses on IoT integration for data monitoring and logging. The system checks for Wi-Fi connectivity, as both Google Sheets and Blynk require

an active connection to log sensor data and provide alerts. If Wi-Fi is available, the system logs real-time sensor data into Google Sheets for tracking and analysis, while Blynk displays alerts such as safety, medium, dangerous, and critical conditions to notify users promptly. However, if no Wi-Fi connection is detected, the IoT system shuts off, and the process moves to the end. This ensures the system operates efficiently when connectivity is available while maintaining a clear and fail-safe process during offline conditions.

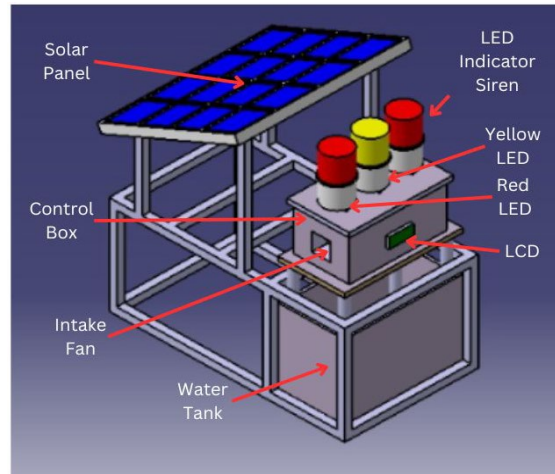


Figure 5. Project Design of the Intelligent Flood Detection and Alert System

With an emphasis on environmental durability and performance, the Intelligent Flood Detection and Alert System depicted in **Figure 5** provides a workable and effective solution. A solar panel at the top of the building provides the primary power source, guaranteeing continuous operation even in the event of power interruptions, which frequently occur during floods. Utilizing renewable energy allows the system to continue operating independently of outside electricity. The solar panel's high placement maximizes sunshine exposure for steady electricity output while preventing water damage. In contrast to conventional designs, the control box in this system is placed next to the solar panel instead of directly underneath it. There are a number of benefits to this deliberate positioning. Protecting delicate parts like the ESP32 microcontroller, relays, and sensors require better airflow and heat dissipation, which is achieved by positioning the control box next to the solar panel. Due to inadequate ventilation, heat accumulation may occur directly beneath the panel, which might have an impact on durability and performance. Heat management is improved, and the chance of overheating is greatly decreased by setting it aside.

This position also improves accessibility for maintenance. Instead of needing to labor beneath the solar panel, which might be dangerous and time-consuming, technicians can quickly examine, fix, or replace parts. The electronics of the system are further protected by the side location, which also lessens the possibility of water dropping onto the control box during periods of intense downpour. Hollow steel beams are used in the construction of the building itself, giving it a strong yet lightweight framework. The system is dependable under challenging environmental circumstances since these beams are strong and corrosion-resistant. The system can be swiftly installed in flood-prone locations thanks to its modular design, which makes installation, disassembly, and movement easier.

Overall, robustness, security, and operational effectiveness are given top priority in the system's architecture. The Intelligent Flood Detection and Alert System guarantees dependable operation during floods by combining renewable energy, a prominent control box, and a sturdy frame. It is a reliable option for early flood detection and catastrophe preparedness because of its creative layout, which enables improved heat management, simple maintenance, and increased protection against environmental obstacles.

	A	B	C	D	E	F	G	H	I	J
1	Date	Time	Sensor Reading Status	Distance (cm)	Led Indicator	Water Level	Water Flow (L/min)	Switch	Water Pump	Rain (Wet/Dry)
1397	08/01/2025	22:06:17	Success	19	Red1	Danger Zone	0.00	On	Off	Wet
1398	08/01/2025	22:10:11	Success	19	Red1	Danger Zone	0.00	On	Off	Wet
1399	08/01/2025	22:11:33	Success	19	Red1	Danger Zone	7.20	On	Off	Wet
1400	08/01/2025	22:12:53	Success	22	Yellow	Medium Zone	13.07	On	Off	Wet
1401	08/01/2025	22:20:27	Success	17	Red1	Danger Zone	0.00	Off	Off	Wet
1402	08/01/2025	23:03:13	Success	31	Green	Safe Zone	0.00	On	Off	Wet
1403	08/01/2025	23:04:34	Success	29	Yellow	Medium Zone	0.00	On	Off	Wet
1404	08/01/2025	23:05:55	Success	26	Yellow	Medium Zone	0.00	On	Off	Wet
1405	08/01/2025	23:07:17	Success	26	Yellow	Medium Zone	0.00	On	Off	Wet
1406	08/01/2025	23:08:39	Success	26	Yellow	Medium Zone	0.53	On	Off	Wet
1407	08/01/2025	23:10:01	Success	26	Yellow	Medium Zone	0.00	Off	Off	Wet
1408	08/01/2025	23:13:50	Success	31	Green	Safe Zone	0.00	On	Off	Wet
1409	08/01/2025	23:15:11	Success	31	Green	Safe Zone	0.00	On	Off	Wet
1410	08/01/2025	23:17:59	Success	31	Green	Safe Zone	0.00	On	Off	Wet
1411	08/01/2025	23:19:24	Success	30	Yellow	Medium Zone	0.00	On	Off	Wet
1412	08/01/2025	23:20:50	Success	29	Yellow	Medium Zone	0.00	On	Off	Wet
1413	08/01/2025	23:22:13	Success	29	Yellow	Medium Zone	0.00	On	Off	Wet
1414	08/01/2025	23:23:34	Success	27	Yellow	Medium Zone	0.00	On	Off	Wet
1415	08/01/2025	23:24:56	Success	27	Yellow	Medium Zone	0.00	On	Off	Wet
1416	08/01/2025	23:26:18	Success	26	Yellow	Medium Zone	0.00	On	Off	Wet
1417	08/01/2025	23:27:39	Success	23	Yellow	Medium Zone	0.00	On	Off	Wet
1418	08/01/2025	23:29:00	Success	22	Yellow	Medium Zone	0.00	On	Off	Wet
1419	08/01/2025	23:30:41	Success	19	Red1	Danger Zone	0.00	On	Off	Wet
1420	08/01/2025	23:32:02	Success	17	Red1	Danger Zone	0.00	On	Off	Wet
1421	08/01/2025	23:34:55	Success	15	Red2	Critical Zone	0.00	On	On	Wet
1422	08/01/2025	23:36:42	Success	15	Red2	Critical Zone	0.00	On	On	Wet
1423	08/01/2025	23:39:22	Success	12	Red2	Critical Zone	0.00	On	On	Wet

Figure 6. Real-Time Data Logger in Google Sheets

To track water levels and spot possible flood hazards, the Intelligent Flood Detection and Alert System logs data in real-time in Google Sheets. Important information such as the date and time, water distance (in centimeters), water levels classified as Safe, Medium, Danger or Critical Zones, and water flow rates (in liters per minute) are all recorded in each entry. Along with the state of flood control devices, water pump activity, and rain detection (Wet/Dry), the system also keeps an eye on the LED status, which is Green for safe circumstances, Yellow for caution, Red1 for danger zone and Red2 for critical scenarios. The data logger offers a comprehensive overview of the system's operation, as seen in **Figure 6**. As seen in **Figures 7** and **8**, a graphical user interface (GUI) was created using Blynk to improve the intelligent flood detection system's monitoring and user experience. This dashboard provides a single platform for real-time monitoring of important water level metrics and system conditions. Its goal is to provide proactive flood control and decision-making by giving users an easy-to-use, interactive interface for assessing water level data and system activities.

Figure 7 shows Current Water Level Readings on Blynk Dashboard The Blynk dashboard has indicated current water level readings in an easy-to-read style. The color indicators - red

led with siren for Critical zone, red led without siren and yellow led for danger, yellow for medium, and green for safe-of the primary gauge highlighted the current water level distance which was 31 cm. A live line graph indicated the water level trends changing in pre-set time intervals such as 15 minutes, 30 minutes, and 1 hour among others. It can show the users where the water level has fluctuated in the past, draw patterns, and predict when floods would occur well in advance. It also contains a "Water Pump" toggle; if necessary, it turns the pump on or off. **Figure 8** depicts how the system connectivity status is monitored over time. In this dashboard view, a clear picture of network reliability is provided using timestamps when the system was online (in green) and offline (in gray). This would ensure that consumers are continuously informed of any IoT connectivity interruptions. Right after restoration of the network, the system starts recording data and updating it in real time; it stops upon loss of a Wi-Fi connection. Due to such features, the Blynk dashboard is a reliable gadget in the detection of flooding for assurance of ongoing monitoring.

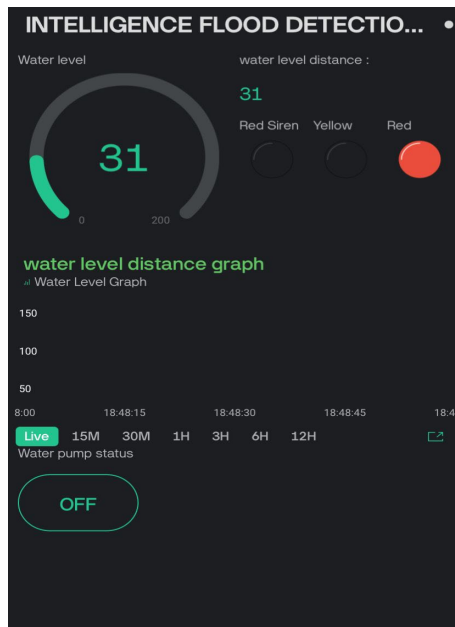


Figure 7. User Dashboard using Blynk

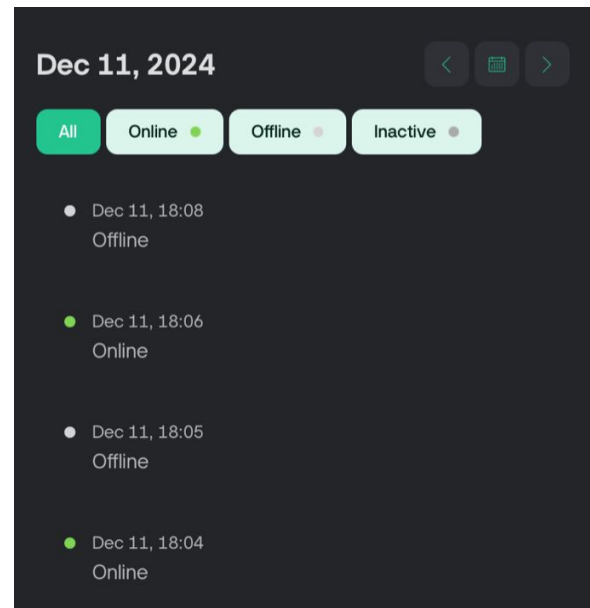


Figure 8: Shows the connection status of Blynk

3. Novelty and Uniqueness

What makes the Intelligent Flood Detection and Alert System so new and unique is that it brings together IoT technologies, renewable energies, and real-time data management in one cost-effective, scalable solution for flood detection and prevention. Unlike other systems, this project integrates ultrasonic, rain, and flow sensors with an ESP32 microcontroller, using Google Sheets for real-time data logging and Blynk IoT for mobile notifications. This two-way approach will ensure accessibility and remote control, timely alerts, and critical decision-making.

It also integrates renewable solar energy for improved sustainability and operational reliability, both in areas that are completely off-grid or prone to floods. The design of the modules allows for ease of installation, relocation, and maintenance, thus applicable in urban

and rural areas. This system, by addressing the shortcomings of existing systems that include limited data parameters, high costs, and patchy coverage, provides accurate flood forecasts and comprehensive environmental monitoring. The solution also stresses proactive flood management through trend analysis and dynamic user dashboards supported by color-coded alerts and automated actions, such as activating water pumps. The synergy of different advanced sensor technologies, IoT platforms, and renewable energy makes this system unique and a key game-changing intervention in flood preparedness and management.

4. Benefit to Mankind

The Intelligent Flood Detection and Alert System offers huge advantages to humanity in terms of community resilience against devastating floods. IoT-based real-time monitoring with the alert mechanism provides timely warnings about evacuating people and saving lives. Advanced sensors together with renewable solar energy make this device eco-friendly and dependable, especially for the most remote, flood-prone areas. It is designed to be cost-effective and scalable, hence affordable for both urban and rural areas, reducing dependence on expensive infrastructure. Besides remote monitoring using Blynk and real-time data logging using Google Sheets, it brings transparency and efficiency in disaster management. Moreover, automatic water pump control prevents excess water accumulation, which reduces damage to property.

This allows the community and authorities to take informed action through proactive decisions. Its potential to cut down casualties, protect assets, and ensure environmental sustainability underlines its importance as a key tool for disaster preparedness and climate adaptation.

5. Innovation and Entrepreneurial Impact

The Intelligent Flood Detection and Alert System encompasses innovation and entrepreneurial impact, putting together IoT technologies, renewable energy, and real-time monitoring in one affordable solution. This uniquely integrates Google Sheets for data logging and the Blynk IoT platform for mobile notifications, thus being assured of accessibility and proactive flood management. The solar-powered design enhances sustainability, making it suitable for off-grid and rural areas, hence addressing a critical gap in disaster preparedness. This system is scalable and can be tailored for different markets, from urban infrastructure to agriculture and residential uses. Moreover, this invention incentivizes environmentally friendly technologies. Inexpensive and modular in design, these units can be deployed in massive quantities across regions prone to flooding by entrepreneurs to enable local manufacturing and jobs.

Therefore, this innovation-empowering community early warnings to actionable insights-scientists believe can help mitigate flood impacts and also spur economic growth by fostering resilience with sustainable disaster management solutions.

6. Potential Commercialization

This system has great commercialization potential due to its cost-effectiveness, scalability, and functionality. The Intelligent Flood Detection and Alert System can be commercialized through the exploitation of IoT technologies and renewable energy sources for urban planners, disaster management agencies, and community organizations in flood-prone regions worldwide.

This is because it would appeal to both developed and developing markets with its modular design, real-time data logging through Google Sheets, and user-friendly Blynk interface. This, together with the integration of solar-powered sensors, would make it sustainable for long-term use and perfect for areas where electricity is unstable. It could also be tailored for industrial facilities, agricultural lands, or residential areas, creating diverse streams of revenue. This solution puts itself at the frontline in mitigating flood damages with increased focus by countries on disaster preparedness and climate resilience, hence bringing huge economic, environmental, and social benefits.

7. Acknowledgment

The authors express their sincere gratitude to Dr. Roshakimah Mohd Isa of Universiti Teknologi MARA, Shah Alam, for her invaluable guidance, encouragement, and constructive feedback throughout the project. Her expertise and support significantly contributed to the success of this research. Appreciation is also extended to the College of Engineering for providing essential facilities, resources, and technical support, which were critical to the project's execution.

The authors are deeply thankful to their peers for their collaboration and insights, which fostered a spirit of innovation and excellence. Gratitude is further extended to their families for their unwavering support, understanding, and encouragement, which served as a source of inspiration during this journey. This project, conducted as part of Final Year Project 2, reflects the authors' commitment to exploring IoT and renewable energy solutions to enhance disaster management, particularly for mitigating the effects of natural disasters like flooding. Finally, the authors acknowledge everyone, directly or indirectly involved, whose contributions, regardless of scale, made this endeavor successful and memorable.

8. Authors' Biography



A motivated student of mechatronics engineering at Universiti Teknologi MARA (UiTM) Shah Alam, Muhammad Amirul Naim Bin Ma'ti has a knack for sustainable technology, IoT applications, and circuit design. For projects like the Intelligent Flood Detection and Alert System, his practical approach and problem-solving abilities have been crucial in designing and refining circuits. Amirul is adept in combining sensors, microcontrollers, and Internet of Things platforms to create dependable and effective systems. Having a solid foundation in PCB design, programming (C++, Python), and debugging, he is enthusiastic about applying his knowledge to create useful and creative solutions. Amirul wants to address contemporary engineering problems by emphasizing intelligent and environmentally friendly solutions.



Putera Amirul Hakim Rosli is a dedicated student of mechatronics engineering at Universiti Teknologi MARA (UiTM) Shah Alam, with a focus on sustainable technology, IoT applications, and solar energy integration. Using his knowledge in Python, C++, IoT platforms, and system architecture, he creates solutions that have an impact and use solar energy to increase energy efficiency. Putera is committed to maximizing solar energy systems using cutting-edge designs and intelligent technology as part of its mission to advance renewable energy. His art embodies a vision of a sustainable future in which intelligent systems and solar energy solve contemporary issues and encourage responsibility toward the environment.



Nur Irsalina Huda Nazri is a final-year student at Universiti Teknologi MARA (UiTM) Shah Alam, pursuing her Bachelor of Mechanical Engineering with Honours. As a female student excelling in a male-dominated field, Irsalina is dedicated to advancing IoT technology and sustainable solutions through her projects and research. Her academic journey includes assisting in the development of a smart flood monitoring system, improving an electronic automatic jar opener, and designing an IoT-controlled popcorn machine for her Integrated Design Project. She is determined to sharpen her skills by involving herself in many more innovative projects, driven by her love for sustainable innovation and her eagerness to make a meaningful impact in the field of engineering.



Muhammad Rasyid Rosli is a student of Mechanical Engineering at University Technology MARA (UiTM) Shah Alam, with a growing expertise in data analysis using MATLAB and Python. With 5 years of experience, he has developed a strong foundation in programming languages such as Python, C++, Arduino IDE, and MATLAB, alongside machine learning and EEG data analysis. Muhammad Rasyid successfully completed a Smart Flood Detection mini-project using Blynk and email integration for advanced warning alarms. His contributions demonstrate a keen ability to integrate IoT and data-driven solutions into engineering challenges, reflecting his potential to bridge academic learning with real-world applications. His work underscores his dedication to innovating within mechanical and digital engineering fields, aiming to contribute to advancements in smart systems and data analysis technologies.