

TurtleAlert: An IoT-Based Device Capable of Predicting and Detecting Hatchling Emergence Using ESP32

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for the Degree of Bachelor of Science in Computer Engineering

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DESIGN PROJECT ABSTRACT

Title: **TurtleAlert: An IoT-Based Device Capable of Predicting and Detecting Hatchling Emergence using ESP32**

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ABSTRACT

Sea turtle populations across the globe are severely threatened, with hatchlings particularly exposed when they emerge from nests. Early intervention by humans can drastically raise their chances of survival. This study presents TurtleAlert, an IoT-Based device capable of predicting and detecting hatchling emergence events. The system includes the use of sensors such as temperature sensors (DS18B20), accelerometers (MPU6050), and passive infrared (PIR) motion sensors to monitor important indicators at sea turtle hatchery sites. The brain of

the system is ESP32 microcontroller, which reads data from a maximum of three smart sensors which consists of MPU6050, DS18B20, and HC-SR501 that are placed at different nests. The system was deployed and tested in collaboration with Project CURMA at a turtle hatchery in San Juan, La Union, Philippines. A sample of twenty-five participants, including volunteers and hatchers, hatchery manager and staff, marine conservation experts, and technical experts, are selected through purposive sampling. Ethical considerations prioritize participants consent, privacy, well-being, as well as the health of sea turtles and their nests are considered throughout the study. The system is developed to be low-cost and scalable making it suitable for hatchery. This research employed mixed method research design, the data gathering process for the research involves a systematic approach aligned with the study's objectives. It includes defining thresholds for smart sensors, designing TurtleAlert capable of monitoring multiple nests, developing the device using prototyping materials, and evaluating effectiveness and accuracy of TurtleAlert. The results revealed high effectiveness and accuracy with a Grand Mean of 4.25 that denotes "Excellent" showing the device's high potential for real-world application. The respondents showed high ratings highlighting the TurtleAlert effectiveness and accuracy in predicting and detecting hatchling emergence, which supports sea turtle conservation.

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DEDICATION

This design project is dedicated to the parents, relatives, and friends of the researchers, whose unrelenting support and encouragement sustained their tenacity amidst obstacles.

To Lorma Colleges – College of Computer Studies and Engineering family, the researchers dedicate their honors and success to providing the platform and opportunities that allowed them to showcase their project's potential.

To all the respondents and technical experts who used their time to contribute their valuable insights in the study, the researchers dedicate this project for your cooperation and guidance.

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This project is dedicated to all mentioned individuals whose support and inspiration contributed to its success.

**ADF
RJB
FJD
JMA**

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CHAPTER I

INTRODUCTION

This chapter presents the situational analysis and covers the objectives, scope and delimitation, and significance of the study.

Situational Analysis

The rising loss of marine species due to the various human-induced threats to populations has brought forward the global conservation of sea turtles as a critical environmental issue. Sea turtles are important to maintain the ecological balance among several species and thus are required for a healthy ocean. They participate in the function as a primary interactor in the evolution, structuring, and dynamics of many marine ecosystems. Sea turtles serve in various ways such as prey, consumers, hunters, competitors, and carriers or hosts for other organisms. Therefore, turtles are active participants in interspecific relations in marine environments. (Tavares et al., 2019).

The vulnerability of sea turtle species is especially well observed during their nesting and hatching phases, which are highly influenced by environmental factors and human activities. Turtles are characterized by very low parental care, maternal provisioning of the eggs, and female nesting behavior under strong selection. The outcome of when and where nests are laid is impacted by anthropogenic habitat disturbances that modify the area suitable for nesting, expose eggs to contaminants in the wild, and change the thermal and hydric conditions experienced by developing embryos, consequently, influencing the survival of



hatchlings. (Topping et al., 2021). Hatcheries are a widely used ex-situ conservation tool to mitigate the impacts of abiotic (e.g., tidal inundation, light pollution) and biotic (e.g., predation, illegal take) threats on sea turtle eggs and hatchlings. Eggs are removed from the nesting beach and taken to a protected area on or by the beach, where they are reburied in artificial nests for incubation. Once the hatchlings come out of the nest, they are escorted to the sea, which henceforth ends a cycle for sea turtle life (Nahill, 2020). Despite all these, hatcheries have a big problem in trying to predict when exactly the hatchlings will emerge, which sometimes has a disastrous effect on the survival rate of the hatchlings. Factors such as temperature fluctuations influence the sex ratio of the hatchlings and further subject hatchlings. The sex of sea turtles has been proven by research to be determined by Temperature-dependent sex determination (TSD), with higher temperatures producing females and lower temperatures resulting in males (Bentley et al., 2020). A study about olive ridley turtle clutches in Costa Rica showed that the success of olive ridley hatching demands optimal mean temperatures during incubation. Extreme temperatures negatively influence both the size of hatchlings and overall success. (Rutledge et al., 2024).

Technological advancements have been introduced to improve the monitoring of sea turtles during their nesting and hatching phases. An Arduino Uno technology-based monitoring system was also developed to track both temperature and moisture levels of sea turtle nests, obtaining real-time data necessary to achieve optimal incubation conditions (Santoso et al., 2021).



Temperature tracking ensures that an embryo gets proper thermal conditions and determines the sex ratio and hatchling success rates since sexing occurs by temperature-dependent sex determination. The moisture sensor ensures that the humidity falls within a favorable range and prevents desiccation of eggs. Similarly, TurtleAlert utilized a temperature sensor. This can monitor incubation conditions with a particular aim at finding hatchlings' sex.

The TurtleSense is a technology-driven method to delineate motion-related *Caretta caretta* hatching and emergence nest events created by The Nature Conservancy and North Carolina State University (Clabough et al., 2022). TurtleSense merges sensors that track both temperature and movement in the nests of sea turtles to instantaneously offer information on hatchlings' movement. The movement detection helps predict when hatchlings will emerge. Monitoring temperature is necessary because the incubating environment plays a role in the determination of hatchling sex depending on the nest temperature (Bentley et al., 2020).

Proactive conservation strategies in the Philippines are addressed in relation to the decline in sea turtle populations, particularly through strategic management at crucial nesting sites and efforts to minimize threats such as poaching and habitat destruction (Convention on Migratory Species, 2024). These practices are complemented by concerted community and government agencies, as well as non-governmental organization efforts that share an integrated approach to conservation.



The community has played an important role in raising awareness and education about the relevance of marine turtles and their ecological role. Community-based monitoring of turtle nesting sites empowered them to play an active role in protecting nesting sites, thereby reducing illegal poaching and human interference during critical periods of nesting and hatching. In addition, habitat restoration projects have been started to rehabilitate damaged coastal environments so that turtles will have safe and suitable nesting areas.

The Coastal Underwater Resource Management Actions numerous actions along the coast of the province of La Union, significantly boosting sea turtle conservation. The Coastal Underwater Resource Management Actions programme protects turtle nesting areas and empowers the local communities to become active stewards of marine biodiversity, transforming former turtle poachers into protectors. Community engagement in pursuing conservation efforts served to alleviate human-related threats to the populations of turtles while ensuring their long-term survival as keystone species (Ramones, 2023).

Coastal Underwater Resource Management Actions measures are taken to protect the nesting sites of the turtles against predators, natural dangers, and human disturbance. The unpredictability of hatchling emergence remains a hindrance to the conservation of these turtles. Hatchery workers, more referred to as hachers, were compelled to sit by the nests constantly, sometimes for longer periods, leading to tiredness and stress due to uncertainty in knowing when the hatchlings would emerge from the sand. The unpredictability also creates another



lethal effect of delaying the response to hatchling activity, which could expose them to predators or environmental threats before they can be safely released into the ocean. Along with this, the researchers intend to develop TurtleAlert.

Even though currently available systems such as TurtleSense and similar methods based on Arduino and other platforms have already been used to aid conservation efforts by tracking temperature and behavior of turtles that are nested in nests on beaches, such systems are primarily of beach-related interest and not related to hatcheries. Hatchery environments have different operational challenges and requirements which necessitate a device tailored to hatchery conditions.

The TurtleAlert aligns with Sustainable Development Goal 14: Life Below Water, which promotes the sustainable use of marine resources and the protection of marine ecosystems, and SDG 15: Life on Land, which emphasizes conservation and restoration of terrestrial and freshwater ecosystems. Through addressing the vulnerabilities of sea turtle conservation TurtleAlert makes a contribution towards improving hatchling survival, minimizing anthropogenic impact stress, and furthering biodiversity conservation.

The TurtleAlert primary function works with an accelerometer to detect movement 1 feet above the nest which predicts the emergence of hatchlings and a temperature sensor to determine the sex of hatchlings during incubation. Additionally, A passive infrared sensor on the surface is activated if movement from the nest has been detected, the sensor detects if hatchlings have reached



the surface. Hatchers receive alerts via website interface once there is an aggressive movement detected by the accelerometer allowing them to prepare for a potential hatchling emergence. Also, another notification is sent to the hatcher, when the Passive Infrared sensor on the surface detects that hatchlings have reached the sand surface.

Statement of Objectives

The main objective of the study was to design and develop the TurtleAlert, a device that predicts and detects hatchling emergence.

Specifically, this study achieved the following objectives:

1. Identified the optimal thresholds for predicting and detecting hatchling emergence;
2. Designed TurtleAlert with the capability to monitor multiple nests;
3. Developed TurtleAlert capable of predicting and detecting hatchling emergence in turtle hatcheries; and
4. Assessed the usability of the developed TurtleAlert through field deployment to evaluate its:
 - a. Effectiveness and;
 - b. Accuracy.

Significance of the Study

Hatcheries and conservation organizations benefit from the design project. The TurtleAlert device played an important function in promoting sea turtle conservation by providing a direct solution to sea turtle hatchling survival rate



issues. Prediction and detection of hatchling emergence guarantees timely intervention, reducing the risk of hatchlings exposure to environmental hazards specifically in hatcheries.

In this study, hatcheries and conservation organizations can gain from this new capability of monitoring and protecting hatchlings throughout this sensitive period. The use of real-time data and alerts in TurtleAlert facilitates more effective conservation efforts and thereby contribute to the overall well-being of sea turtle populations.

Scope and Delimitations

The TurtleAlert focuses on creating a device that can predict and detect the emergence of sea turtle hatchlings in hatcheries. It uses an accelerometer to detect movement within the nests and temperature to monitor nest conditions which determines the gender of the hatchlings through temperature-dependent sex determination (TSD). The device sends notification to registered users whenever it detects movements on the nests, informing them when hatchlings are about to emerge or have surfaced. The design project also involves field testing or deployment in turtle hatcheries to evaluate the effectiveness and accuracy of the device in predicting and detecting hatchling emergence to improve turtle hatchery operations. The project is closely aligned with sea turtle conservation efforts, such as those carried out by Coastal Underwater Resource Management Actions in La Union, Philippines.

The TurtleAlert is limited to sea turtle nests specifically within hatcheries,



focusing on predicting and detecting hatchling emergence and determining nest temperature to assess the sex of the hatchlings. The design project is only field-tested in hatcheries linked to the Coastal Underwater Resource Management Actions initiative in La Union, which might limit its adaptability to different geographical areas or varying environmental conditions. This project is not intended to create a universal solution for turtle conservation, but rather to improve prediction and detection of hatchling emergence within specific, controlled environments.

Definition of Terms

A7672s - A cellular module for sending SMS notifications to registered users. This module sends notifications to users whenever there is a movement detected from the nests through SMS.

DS18B20 - A sensor used in TurtleAlert to monitor nest temperature during the egg's incubation period. This sensor monitors the nest temperature, calculating the average temperature of the nest during nesting for gender determination of the hatchlings.

HC-SR501 - A sensor used in TurtleAlert to detect hatchlings movement on the surface of the nest. This sensor triggers the notification for hatchling emergence whenever it detects hatchling movements on the surface of the nest.

Hatchery - A protected area where sea turtle eggs are relocated for safer incubation, protecting them from natural and anthropogenic threats until they hatch.



Hatchling - A baby turtle that has recently emerged from its egg.

MPU6050- A sensor used in TurtleAlert to detect movement within the nest, which helps predict when hatchlings are about to emerge. This sensor triggers the notification for hatchling prediction whenever a movement is detected 1ft above the nest.

Real-Time Monitoring - Turtle Alerts feature continuously tracks nest conditions, including movement and temperature, providing timely data to hatchery workers for decision-making.

Temperature-Dependent Sex Determination (TSD) - A biological process in turtles where the temperature during incubation determines the sex of the hatchlings; warmer temperatures produce females, while cooler temperatures produce males.

TurtleAlert - A device designed to predict and detect the emergence of turtle hatchlings from their nests. It uses accelerometers and temperature sensors to monitor movement and nest conditions, sending alerts to hatchers for timely interventions.

Hatchling emergence prediction - an early warning alert designed to indicate that the hatchlings are likely to emerge within 1 to 3 days. This notification is triggered when certain thresholds are met.

Hatchling emergence notification - a real-time alert that signals the actual emergence of the nest. It is triggered when the HC-SR501 (Passive Infrared Sensor) detects rapid movements above the nest.



CHAPTER II

METHODOLOGY

This chapter presents the discussion on the procedures conducted in this study, presenting the respondents of the study, data gathering tools, and methods of analysis and development on the design project that was utilized.

Research Design

The study employed mixed method research design with a focus on quantitative analysis to evaluate the effectiveness and accuracy of the TurtleAlert device in predicting and detecting sea turtle hatchling emergence, specifically within the Coastal Underwater Resource Management Actions Sea turtle hatcheries. The system was equipped with sensors: accelerometer (MPU6050), PIR motion sensor (HC-SR501), and temperature sensor (DS18B20), to constantly track nest conditions, such as movements and changes in temperature. The sensors send alerts to hatchery workers when critical conditions signaling hatchling emergence have been observed.

Quantitative data are gathered using sensor readings, alert response time, and user response to assess the performance of the device. The researchers utilized statistical analysis to quantify the effectiveness and accuracy of the respondents using the device. This method sought to present evidence of the TurtleAlert capacity to enhance hatchling monitoring and be part of better conservation practices.



Population and Locale of the Study

The study was conducted at the turtle egg hatchery located in Project Coastal Underwater Resource Management Actions, San Juan, La Union, primarily focusing on hatchery workers, conservationists, and community volunteers who are actively engaged in the conservation of turtles.

Table 1. Distribution of Respondents

Respondents	Number of Respondents
Volunteers and Hatchers	12
Hatchery Manager and Staff	5
Marine Conservation Expert	3
Technical Expert	5
TOTAL	25

There are a total of twenty-five (25) respondents, as shown in Table 1. The data collected from twelve (12) volunteers and hatchers, five (5) hatchery managers and staff, three (3) marine conservation experts, and five (5) technical experts. Purposive sampling was used as there is a small population and the study needs certain qualities, the participants were selected according to their specific qualities, such as experience with turtle hatcheries, knowledge of turtle biology,



or availability of applicable data, and qualities to be qualified as technical expert. This guarantees that the sample specifically relates to the research objectives of observing and forecasting hatchling emergence, ensuring the data collected was relevant, efficient, and aligned with the project's goals to monitor and support hatchling emergence effectively. These respondents are selected based on their similar characteristics, which are of particular interest to the researchers.

Table 2. Qualifications of Technical Experts

TECHNICAL EXPERT	EDUCATION	AFFILIATE
1	Bachelor of Science in Information Technology	College of Information Technology, DMMMSU-MLUC
2	Bachelor of Science in Computer Engineering	Software Engineer, SUMISHO
3	Bachelor of Science in Computer Engineering	Software Engineer, Associate Infor
4	Bachelor of Science in Computer Engineering	College of Computer Science and Engineering, LORMA Colleges
5	Bachelor of Science in Computer Engineering	Associate Hardware Engineer, Universal Leaf

Table 2 outlines the qualifications of the technical experts involved in the design project for the "TurtleAlert" device. The first technical expert holds a Bachelor of Science degree in Information Technology and is currently working as an instructor at DMMMSU-SLUC. The second technical expert is a graduate of Bachelor of Science in Computer Engineering and serves as a software engineer in



Sumisho. The third technical expert is also a graduate of Bachelor of Science in Computer Engineering and is employed as software engineer at an international company in Manila named Infor. This expert also has teaching experience from the years 2022-2023. The fourth technical expert holds a Bachelor of Science degree in Computer Engineering and serves as an instructor at LORMA Colleges. The fifth technical expert holds a Bachelor of Science degree in Computer Engineering and is employed as associate hardware engineer in Universal Leaf.

Ethical Considerations

In this study, ethical considerations are maintained in the research process. The well-being and dignity of the individuals involved in the research are respected so that no form of harm or risk develops against them. The principle of anonymity is observed to ensure that sensitive information remains confidential and not to disclose any details that could be used to trace their identities. As part of open communication, their concerns are discussed in order to promote wellbeing throughout the study period. If data is being collected from workers, informed consent is taken that all participants are informed of what data is being collected and their rights.

Data handling adhered to principles of confidentiality, honesty, and objectivity. The collected data are then treated in the most confidential way possible to reduce the chances of unauthorized access or disclosure. The measures are then so strict in ensuring the security and integrity of the data themselves, therefore reducing the chances of data falsification.



The health of sea turtles and their nests are considered accordingly, so that TurtleAlert does not threaten or interfere with natural nesting activities during testing and operation.

The researchers committed themselves to upholding ethical standards while in the research process, with integrity, respect for the rights of participants, and commitment to dependable and trustworthy results as its core tenets.

Data Gathering Tools and Procedures

To identify thresholds for hatchling emergence prediction and detection, data are collected both through structured interviews (see appendix B) with Project Coastal Underwater Resource Management Actions president, through manual observations, and through a literature review of turtle nesting behaviors and sensor technology.

To design TurtleAlert to monitor multiple nests, information is gathered through interviews with technical experts, including engineers and conservationists, to determine the needs of the system for modularity and scalability. Testing procedures are focused on configuring the device to support multiple sensors sets wired to specific GPIO pins. Initial simulations verified the system's ability to detect and distinguish between active and inactive ports, ensuring seamless integration and accurate data allocation per nest. Technical expert feedback and a cycle of testing guided the refinement of the design.

The data for the third objective are obtained through a combination of literature review and prototyping with iterative design. A comprehensive literature



review provided insights into the necessary parameters for TurtleAlert development. Prototyping and iterative design processes are carried out to assess performance, make incremental improvements, and optimize the device's functionality. To ensure optimal component placement and design choices, there are expert consultations and investigations. By integrating the literature review and prototyping, the researchers obtained valuable data and refined TurtleAlert's design for predicting hatchling emergence. The simulations are exercised to validate and calibrate the accelerometer and Passive Infrared sensor. A motor is used to reproduce vibrations in order to calibrate the accelerometer's sensitivity (see figure 19) and the PIR sensor is tested for the detection of hatchling emergence (see figure 20).

The data for the fourth objective are collected through the implementation of user research methodology. Questionnaires (see appendix E) are distributed to respondents to gather their ratings. Mean scores are computed to evaluate the average ratings given by participants, providing insights into the perceived usability and accuracy of the TurtleAlert. This user-centric approach allowed for a thorough assessment of users' perspectives on the device's usability and accuracy.

Data Analysis

The researchers compiled the participant responses to determine the thresholds and evaluate the effectiveness and accuracy of TurtleAlert. The researchers organized the data collected using appropriate statistical tools for the analysis and interpretation of data as needed. The data are calculated in order to



determine the effectiveness and accuracy of TurtleAlert. Likert scale is utilized in computing both weighted mean and grand mean to ensure the result precision. All these computations were done using a data analysis tool.

For the interpretation of TurtleAlert device's evaluation and assessment on its effectiveness and accuracy rated from strongly disagree to strongly agree, table 3 served as guide.

Table 3. Likert Scale for Data Analysis

Point Value	Range of Mean Values	Descriptive Equivalent	Descriptive Equivalent
5	4.21-5.00	Excellent	Strongly Agree
4	3.41-4.20	Very Good	Agree
3	2.61-3.40	Good	Neither Agree nor Disagree
2	1.81-2.60	Fair	Disagree
1	1.00-1.80	Poor	Strongly Disagree

System Architecture

In figure 1 (see page 17), presents the system architecture of the TurtleAlert, illustrating its essential components and data flow. The architecture revolves around key elements such as Micro USB charger, ESP32, metal film



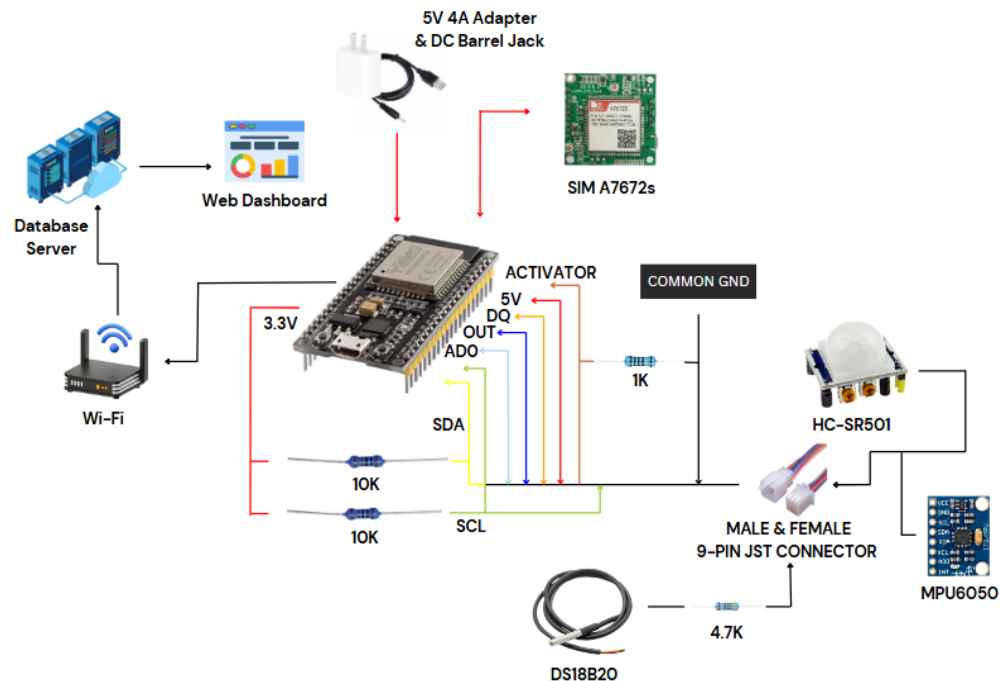


Figure 1. System Architecture of TurtleAlert

The DS18B20 (temperature sensor) continuously detects nest temperature conditions, providing data on the environment on the nest. Additionally, the data

from the MPU6050 and DS18B20 is displayed on a website where real-time graphs allow users to see emergence activity overtime.

DS18B20, a low-cost, good degree of precision, and operation stability. These are digital sensors that generate temperature values without having to calculate them from an analog signal and use a noise-sensitive analog-to-digital converter (Zaszewski et al. 2023). Compared to other digital sensors, they have a communication interface that allows data transmission over long distances from the recorder. DS18B20 sensors are used in engineering projects like environmental temperature (Wang et al., 2019).

The DS18B20 thermometer measures temperatures in the range of -55 to 125°C . The sensor allows the measuring of temperatures with a resolution of 9 to 12 bits (0.5 - 0.0625°C). Communication between the microcontroller and the sensor takes place through a 1-Wire interface. This is a hierarchical serial interface allowing the control of numerous sensors (in the slave rank) by one master device. The communication is maintained by one data line (DQ), to which voltage should be pulled up through a $4.7\text{k}\Omega$ resistor, and the ground line (GND), which is the voltage reference level. The maximal distance between the logger and the sensor may reach about 300 m in perfect conditions. Nevertheless, in the case of such long measurement lines, the values of pull-up resistors should be decreased to supply power with a required current of 1.5mA to the devices. Since the length of the wire of TurtleAlert is not more than 5m, a $4.7\text{k}\Omega$ resistor is utilized.

Passive Infrared Sensor is an electromagnetic radiation that has



wavelengths longer than visible light and shorter than radio waves (Drexel et al., 2023). It is invisible to human eyes, but we can feel it as heat. Every object/matter occupying space in the universe emits some level of infrared radiation. Passive infrared radiation (PIR) technology has been associated with smart technology, the Internet of Things (IoT) technology, cloud-based services such as; software as a service (SaaS), platform as a service (PaaS), and other cloud-based technology.

The study of Sobola et. al, designed a technology that is aimed at providing security to the environment and properties since it can detect movement at a certain angle and also give an alert. The system used a Passive infrared radiation (PIR) module HC-SR501 to detect motion and an Arduino Uno microcontroller unit (MCU) to process and control the sensor data. The PIR sensors detect infrared radiation emitted by moving objects, such as human beings or animals. Several tests showed that the system performed well under different conditions, with the PIR sensor able to detect motion at different sensitivities, distances, and angles.

The system utilizes FreeRTOS, an open-source real-time operating system (RTOS) designed for microcontrollers and small microprocessors that supports multiple tasks running simultaneously. FreeRTOS was applied to manage multiple tasks on the ESP32, allowing simultaneous execution of sensor readings, movement detection, SMS alerts, and web updates. This ensures real-time responsiveness and efficient operation, with each function running independently without interrupting the others.



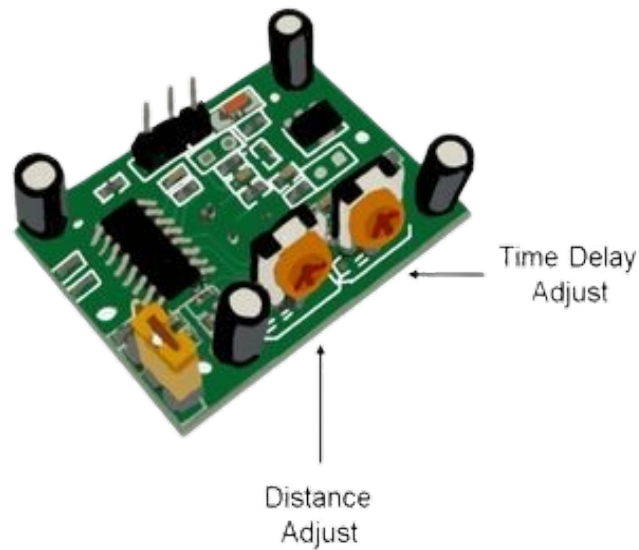


Figure 2. Time and Distance Adjustment of HC-SR501

The adjustment of the HC-SR501 is controlled using the onboard potentiometer as shown in figure 2. Turning the potentiometer clockwise extends the sensing range to a maximum value of 7 meters for distance and 1 second for time, and turning it counterclockwise extends it to a minimum level of 3 meters for distance, 3 minutes for time.



Figure 3. Japan Solderless Terminal Connector

In figure 3 (see page 20), Japan Solderless Terminal connectors are used to enable the detaching of smart sensors. The design is provided with a 9-pin male JST connector on each smart sensor and a 9-pin female JST connector on the main PCB. With this configuration, each smart sensor can be securely inserted or unplugged from the main PCB without soldering or rewiring. The incorporation of JST connectors increases the system's modularity and allows adding smart sensors in a modular way as required.

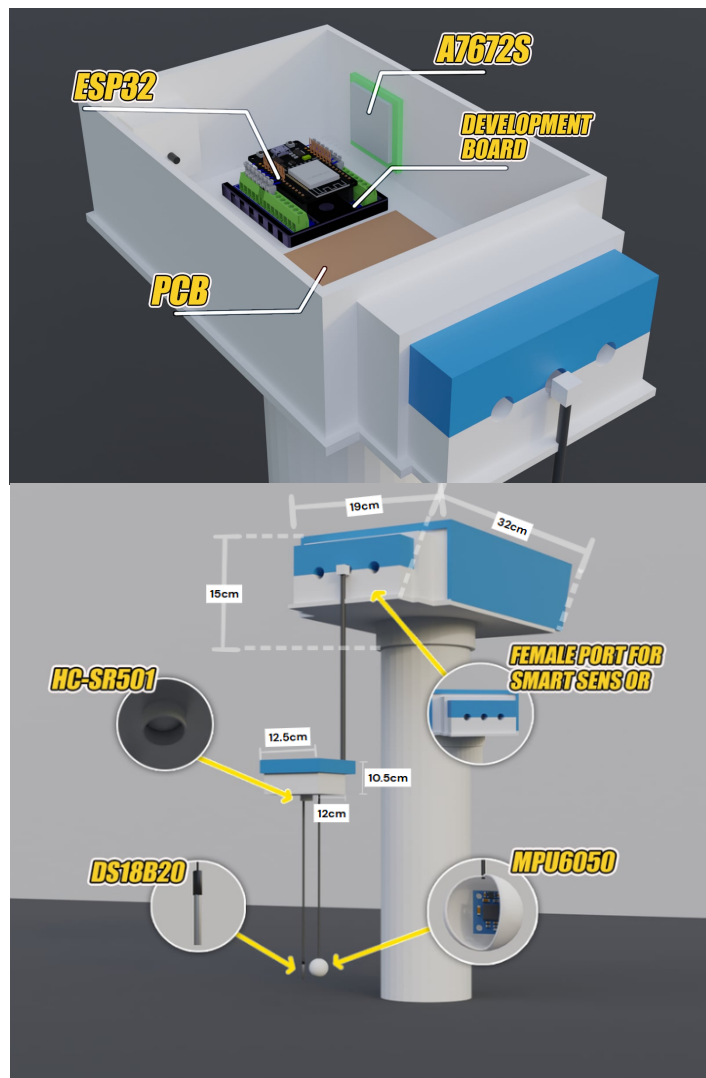


Figure 4. 3D Design of TurtleAlert

Figure 4 (see page 21) shows the 3D design of TurtleAlert. When MPU6050 (accelerometer) detects aggressive movements 1 feet above the nest, an alert is sent to notify the user to expect hatchling emergence through website, email, and SMS using SIM A7672s. If the MPU6050 detects these aggressive movements, the HC-SR501 motion sensor is activated to detect whether hatchlings have already emerged. The length of the Main Hub is 32cm, 19cm width, and its height is 15cm, while the length of each smart sensor is 12cm, 12.5cm wide, and a height of 10.5cm.

Hardware Methodology

Block Diagram

The block diagram shows the input, process, and output flow of the TurtleAlert system, providing a clear description of how data is received, processed, and transmitted, emphasizing the fundamental components and their role in the system.

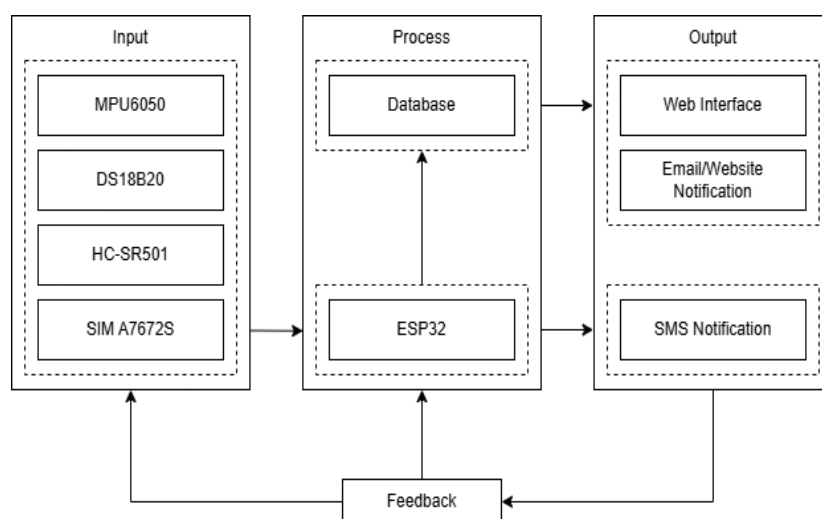


Figure 5. Design Block Diagram



Schematic Diagram

The diagram illustrates the wiring for a U14 ESP32 Development Board connected to an A7672s 4G gps module. The connections are as follows:

- Power and Ground:**
 - ESP32 Pin 1 (3.3v) is connected to the GPS module's VIN (Pin 1).
 - ESP32 Pin 19 (5v) is connected to the GPS module's VIN (Pin 1).
 - ESP32 Pin 20 (GND) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 26 (GND) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 27 (D19/MISO) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 28 (D18/SCK) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 29 (D5) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 30 (D17/TX2) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 31 (D16/RX2) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 32 (D4) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 33 (D0/BOOT) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 34 (D2) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 35 (D15) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 36 (SD-D1) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 37 (SD-D0) is connected to the GPS module's GND (Pin 2).
 - ESP32 Pin 38 (SD-CLK) is connected to the GPS module's GND (Pin 2).
- Data and Control:**
 - ESP32 Pin 21 (D23/MOSI) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 22 (D22/SCL) is connected to the GPS module's RX (Pin 5).
 - ESP32 Pin 23 (D1/TX0) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 24 (D3/RX0) is connected to the GPS module's RX (Pin 5).
 - ESP32 Pin 25 (D21/SDA) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 27 (D19/MISO) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 28 (D18/SCK) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 29 (D5) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 30 (D17/TX2) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 31 (D16/RX2) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 32 (D4) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 33 (D0/BOOT) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 34 (D2) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 35 (D15) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 36 (SD-D1) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 37 (SD-D0) is connected to the GPS module's TX (Pin 4).
 - ESP32 Pin 38 (SD-CLK) is connected to the GPS module's TX (Pin 4).
- Resistors:**
 - R9 (2.2k) is connected between the GPS module's TX (Pin 4) and GND (Pin 2).
 - R11 (2.2k) is connected between the GPS module's RX (Pin 5) and GND (Pin 2).
 - R12 (2.2k) is connected between the GPS module's TX (Pin 4) and GND (Pin 2).
 - R13 (10k) is connected between the GPS module's TX (Pin 4) and GND (Pin 2).
 - R14 (10k) is connected between the GPS module's RX (Pin 5) and GND (Pin 2).
- Other Components:**
 - U1 (Power) is connected to the GPS module's VIN (Pin 1) and GND (Pin 2).
 - U14 (ESP32 Development Board) is connected to the GPS module's TX (Pin 4) and RX (Pin 5).
 - U15 (A7672s 4G gps) is connected to the GPS module's TX (Pin 4) and RX (Pin 5).

Figure 6. Schematic Diagram

The schematic diagram illustrates the connection of the sensors on the ESP32. The device can handle three smart sensors which contain HC-SR501 for hatchling emergence detection, MPU6050 for movement detection, DS18B20 for temperature monitoring, SIM A7672s for SMS notification, 4.7k Ω pull-up resistor for DS18B20, and lastly, activator pin for automatic detection if a smart sensor is plugged into the device.

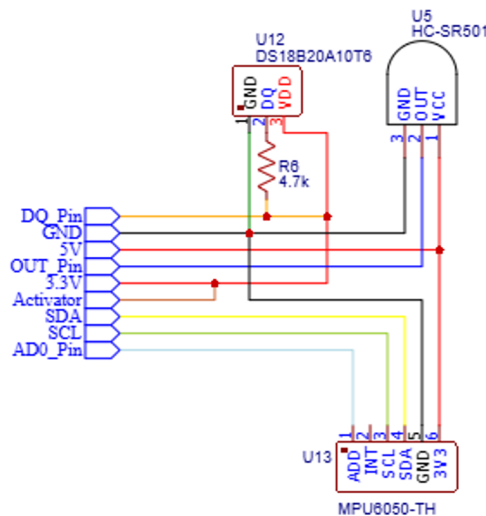


Figure 7. Smart Sensor Schematic Diagram

As shown in figure 7, each smart sensor consists of HC-SR501 for hatchling emergence detection, MPU6050 for movement detection, DS18B20 for temperature monitoring, 4.7k Ω pull-up resistor for DS18B20, a connection for 5V, GND and 3.3V, and lastly, activator pin for automatic detection if a smart sensor is plugged into the device.

Flowchart

The flowchart of the TurtleAlert, shows a visual representation of the sequential process involved in its functionality. The flowchart defines the sequence

of activities and decision nodes, directing the user through the process of prediction and monitoring of hatchling emergence.

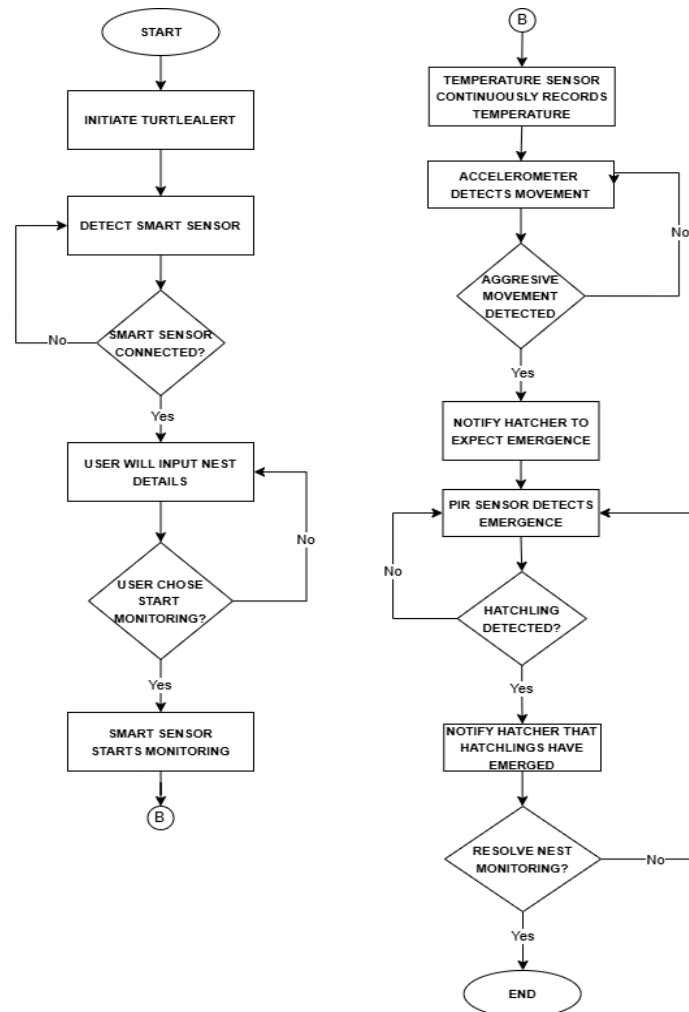


Figure 8. Flowchart of TurtleAlert

Figure 8 illustrates the flow and process of the device. The device detects smart sensors through plugging the smart sensors on its corresponding ports, the user is then asked for details before it starts to monitor the nest. The connected smart sensor starts operating and sends data to the website, when the sensors' threshold is triggered, a notification is sent to registered users.



Use Case Diagram

The use case diagram presents an overview of the interactions between the actors and the TurtleAlert system. It outlines the system's functionalities, highlighting the role of actors performed by staff, administrators, and the device itself.

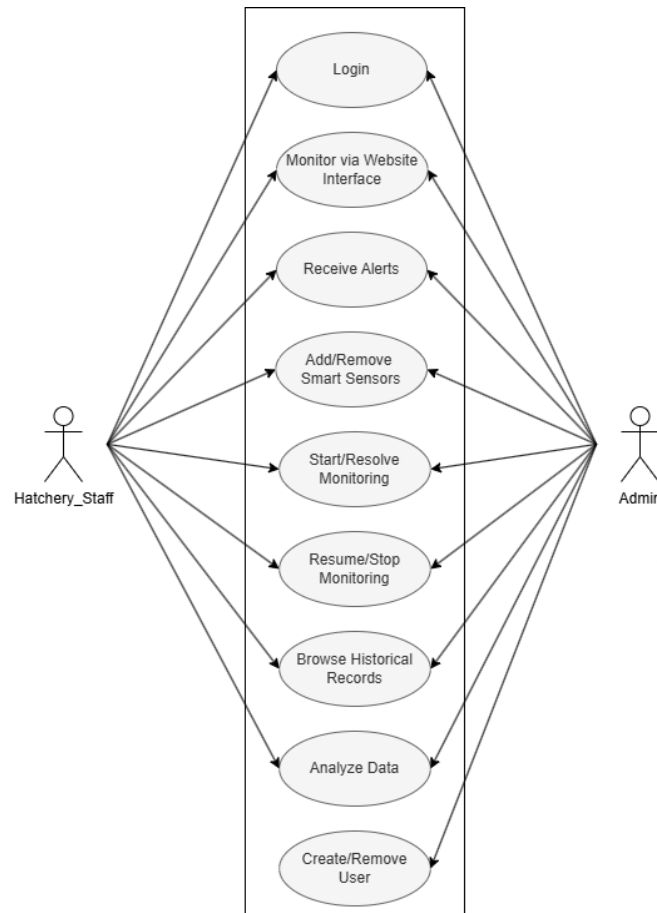


Figure 9. Use Case Diagram

Figure 9 illustrates the hatchery staff and the facility administrator as the intended users of the TurtleAlert system. Both can log in on the website to track significant data continuously, including nest movements and temperature in real time. Alerts are sent through SMS, email, and on the website during significant

events such as aggressive movements or hatchling emergence, facilitating quick responses. In addition to real-time tracking, the website allows users to view historical records for further analysis. The administrator can analyze processed data from the sensors and ESP32. Additionally, both users can add or remove smart sensors depending on the number of nests that needed to be monitored and users can resume or stop monitoring. Lastly, the administration can create or delete user accounts for hatchery staff and other administrator if necessary.

Functional Requirement

Hatchling Emergence Prediction

Basic Flow:

1. The 6-axis accelerometer determines whether there are movements 1 feet above the nest.
2. A graphical representation of the accelerometer data is displayed on the website.
3. If aggressive movement is detected, a notification is sent to the user to expect hatchling emergence and HC-SR501 is activated.

Hatchling Emergence Detection

Basic Flow:

1. The HC-SR501 is activated if the potential emergence threshold is exceeded.
2. The HC-SR501 determines if hatchlings have emerged.
3. The user is notified through the website and email.



Nest Temperature Monitoring

Basic Flow:

1. The DS18B20 continuously detects nest temperature.
2. The user is updated through website visualization.

Attach Smart Sensor on Ports

Basic Flow:

1. The smart sensors are plugged into any of the ports.
2. The activators are powered, indicating that a smart sensor has been plugged.
3. The sensors starts sending data.

Data Real-Time Display

Basic Flow:

1. The user needs to attach a smart sensor on the device.
2. The system reads the attached sensor.
3. The user inputs details about the nest and initiates the device to start monitoring the selected port.
4. The ESP32 processes the data coming from the smart sensor.
5. The processed data is displayed through the website.

Sending Notifications to Users

Basic Flow:

1. Notifications are sent and displayed on the website, via email, and SMS.



Hardware Components

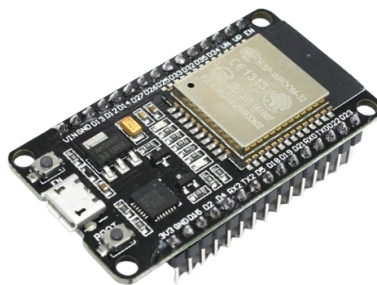


Figure 10. ESP32

It is the primary component in the project. It collects and processes data from all connected sensors.

Table 4. Specifications of ESP32

Indicators	Specifications
Clock Speed	Up to 240MHz
Flash Memory	Up to 16 MB (external or embedded)
SRAM	520 kB
Wireless Connectivity	Wi-Fi 802.11 b/g/n and Bluetooth 4.2 (Classic and BLE)
Operating Voltage	3.3V
Temperature Range	-40°C to +125°C



Figure 11. DS18B20

It is used to monitor temperature data from the nest to determine the average temperature on the nest after they emerge.

Table 5. Specifications of DS18B20

Indicators	Specifications
Operating Voltage	3.0V to 5.5V
Operating Current	1.5mA
Temperature Range	-55°C to 125°C
Resolution	Programmable from 9 to 12 bits
Interface	1-Wire® digital communication
Accuracy	0.5°C from -10°C to +85°C
ESD Protection	Up to 2kV human body model
Sampling interval	0.75s





Figure 12. HC-SR501

It is used to detect hatchling emergence on the surface after the MPU6050 detects a movement on the nest.

Table 6. Specifications of HC-SR501

Indicators	Specifications
Operating Voltage	5V to 20V
Field of view (FOV)	- 50 degrees to 50 degrees
Sensing Range	7 meters
Operating Temperature	-30°C to 70°C
Spectral Response	5-15um
Detection Angle	Approximately 120°
Output Signal	Digital TTL (3.3V high / 0V low)
Current	65mA

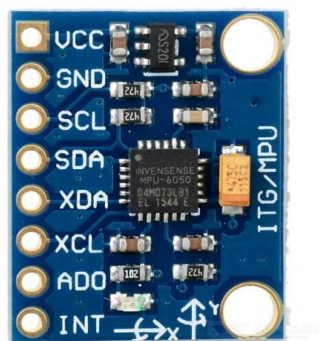


Figure 13. MPU6050

It is used to detect movements 1ft above the nest for hatchling emergence prediction.

Table 7. Specifications of MPU6050

Indicators	Specifications
Operating Voltage	5V
Current	4mA
Accelerometer Range	$\pm 2g$, $\pm 4g$, $\pm 8g$, $\pm 16g$
Gyroscope Range	$\pm 250^\circ/s$, $\pm 500^\circ/s$, $\pm 1000^\circ/s$, $\pm 2000^\circ/s$
Temperature Range	-40 to +85°C
Absolute Maximum Acceleration	Up to 10,000g
Dimensions	25.5mm x 15.2 x 2.48mm



Figure 14. SIM A7672s

It is used to send SMS notifications when thresholds of the sensors were triggered.

Table 8. Specifications of SIM A7672s

Indicators	Specifications
Power supply	VBAT: 3.4V ~4.2V, Recommended VBAT: 3.8V
Power saving	Current in sleep mode: <2mA
SMS	MT, MO, CB, Text, PDU mode Short Message (SMS)
USIM interface	Support identity card: 1.8V/ 3V
Temperature Range	Normal operating temperature: - 30°C to +75°C



Price Listing

Table 9. Component Prices for TurtleAlert System Complete Set

Components	Quantity	Unit Price	Amount
ESP32	1	₱439.00	₱439.00
MPU6050	3	₱84.00	₱252.00
HC-SR501	3	₱120.00	₱360.00
DS18B20	3	₱65.00	₱195.00
SIM A7672s	1	₱1,324.00	₱1,324.00
SIM Card	1	₱40.00	₱40.00
22 AWG Silicone Coated Wires	3 sets	₱329.00	₱987.00
Main PCB	1	₱68.00	₱68.00
4.7k Resistors	3	₱6.00	₱18.00
10k Resistors	2	₱3.00	₱6.00
2.2k Resistors	3	₱5.00	₱15.00



Terminal Block	25	₱35.00	₱875.00
Connector			
Smart Sensor PCB	3	₱18.00	₱54.00
TOTAL			₱4,633.00
Hosting (Optional)	1	₱5,000.00	₱5,000.00
TOTAL			₱9,633.00

The price listing provided shows the cost breakdown of the components required for a complete set of smart sensors of the TurtleAlert system. The total amount sums up to ₱9,633.00.

The list includes essential components such as the ESP32 (₱439.00), MPU6050 for movement detection (₱252.00), HC-SR501 for hatchling emergence detection (₱360.00), DS18B20 for temperature monitoring (₱195.00), SIM A7672S (₱1,324.00), SIM card (₱40.00), and hosting (₱5,000.00), if there is no device that can be used to host a server. Other components include connection wires (₱987.00), main PCB (₱68.00), 4.7k resistors (₱18.00), 10k resistors (₱6.00), 2.2k resistors (₱15.00), terminal block connector (₱875.00), and Smart Sensor PCB (₱54.00). These components are the foundation of the TurtleAlert, enabling its functionality in predicting and detecting hatchling emergence.



Table 10. Component Prices for TurtleAlert's Main Hub

Components	Quantity	Unit Price	Amount
ESP32	1	₱439.00	₱439.00
SIM A7672s	1	₱1,324.00	₱1,324.00
SIM Card	1	₱40.00	₱40.00
22 AWG Silicone Coated Wires	1 set	₱329.00	₱329.00
Main PCB	1	₱68.00	₱68.00
10k Resistors	2	₱3.00	₱6.00
2.2k Resistors	3	₱5.00	₱15.00
Terminal Block Connector	10	₱35.00	₱350.00
TOTAL			₱2,396.00

The price listing provided shows the cost breakdown of the components required for a complete set of smart sensors of the TurtleAlert system. The total amount sums up to ₱2,396.00.

The list includes essential components such as the ESP32 (₱439.00),



MPU6050 for movement detection (₱84.00), HC-SR501 for hatchling emergence detection (₱120.00), DS18B20 for temperature monitoring (₱65.00), SIM A7672S (₱1,324.00), SIM card (₱40.00), and hosting (₱5,000.00), if there is no device that can be used to host a server. Other components include connection wires (₱987.00), main PCB (₱68.00), 4.7k resistors (₱6.00), 10k resistors (₱3.00), 2.2k resistors (₱5.00), terminal block connector (₱35.00), and Smart Sensor PCB (₱54.00).

Table 11. Component Prices for Smart Sensor

Components	Quantity	Unit Price	Amount
MPU6050	1	₱84.00	₱84.00
HC-SR501	1	₱120.00	₱120.00
DS18B20	1	₱65.00	₱65.00
22 AWG Silicone Coated Wires	1 set	₱329.00	₱329.00
4.7k Resistors	1	₱6.00	₱6.00
Terminal Block Connector	5	₱35.00	₱175.00



Smart Sensor PCB	1	₱18.00	₱18.00
TOTAL			₱797.00

The price listing provided shows the cost breakdown of the components required for a smart sensor of the TurtleAlert system. The total amount sums up to ₱797.00.

The list includes essential components such as the MPU6050 for movement detection (₱84.00), HC-SR501 for hatchling emergence detection (₱120.00), and DS18B20 for temperature monitoring (₱65.00). Other components include connection wires (₱329.00), 4.7k resistors (₱6.00), terminal block connector (₱175.00), and Smart Sensor PCB (₱18.00).



CHAPTER III

RESULTS AND DISCUSSIONS

In this chapter, the results and discussion of the study on the TurtleAlert are presented. The chapter is structured around the objectives outlined in the previous chapter, which includes defining the threshold for TurtleAlert, designing TurtleAlert with the capability to monitor multiple nests, developing TurtleAlert capable of predicting and detecting hatchling emergence in turtle hatcheries, and evaluating the effectiveness and accuracy of TurtleAlert. These objectives were successfully achieved through the implementation and testing of TurtleAlert.

Defining Thresholds for TurtleAlert

Before defining the threshold for TurtleAlert, the researchers followed a procedure to ensure accuracy and reliability. This procedure includes interviews with field experts, field observation, and reviewing existing literature.

Threshold for Turtle Hatchling Emergence

Based from the interview with Project CURMA, one of the most important indicators used in hatcheries to monitor turtle hatchling emergence is the change in the shape of the sand placed above the nest. After a mother turtle lays her eggs in the wild, hatchery staff carefully collect and relocate the eggs to a designated hatchery area for protection as shown in figure 15 (see page 40). The eggs are then reburied at a depth of about two feet. As part of standard hatchery practice, an extra layer of sand is added on top of the nest, shaped intentionally into a small



mound. This "mountain-like" sand serves a practical purpose, it gives caretakers a visual reference point that helps them detect signs of activity beneath the surface.



Figure 15. Hatchery Nest Setup

Along with the change in the sand's shape, hatchlings produce faint vibrations as they move and push upward through the nest chamber. These movements are often gentle too soft to be felt casually but for someone who has been monitoring nests regularly, even small, repeated tremors can indicate that the hatchlings are becoming active. Conservationists describe this stage as the moment the nest "comes alive," even though nothing is visibly emerging yet.

Typically, a single nest contains around 90 to 100 eggs, and once the hatchlings are ready, they tend to push toward the surface collectively. This group movement is strong enough to disturb the compacted sand above them, causing the mound to collapse and settle to ground level.

Threshold for Turtle Hatchling Gender Determination

During the interview with Project CURMA, the temperature threshold of hatchlings' nests is 28°C-32°C. Warmer temperature produces females, colder temperature produces males, and the temperature within the threshold produces both males and females this was recorded and proven by using their device that utilizes DS18B20 for nest temperature monitoring.

Table 12. Threshold for Turtle Hatchlings Gender

Gender	Temperature (°C)
Male	< 27.5
Female	> 32

In table 12, the study about loggerhead turtle incubation produced 10 males at 27.5 °C and 10 females at 32 °C (Tezak et al., 2020). The threshold for identifying the gender between the hatchlings aligns with the interview between the researchers and Project CURMA and the literature review.

With the collected information from the literature review and Project CURMA, the sex determination of hatchlings by temperature is identified, which is between 27.5°C and 32°C.

Designing TurtleAlert with the Capability of Monitoring Multiple Nests

Designing TurtleAlert required extensive research to ensure it could efficiently monitor multiple nests simultaneously. The researchers spent time reading and watching plenty of resources, including YouTube videos, articles, and research.



Automatic Detection of Plugged Smart Sensor Mechanism

To improve usability and provide reliable operation, a supplemental detection mechanism has been implemented to determine whether a smart sensor is connected on the device. Each of the smart sensors carries an activator pin connected to the corresponding GPIO pin of the ESP32 microcontroller. If a smart sensor is plugged in, the GPIO pin on the ESP32 is powered, indicating that the smart sensor is plugged in.

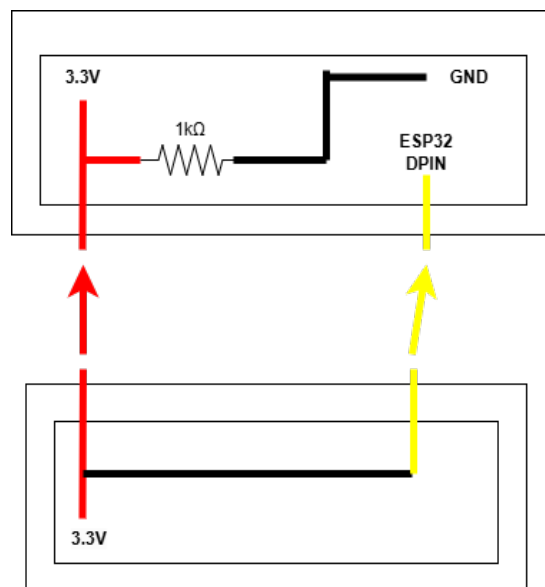


Figure 16. Pin Activator

The main PCB, shown in figure 16 includes an activator detection circuit which consists of a GPIO pin allocated to the 3.3V, GND, and an activator. When a smart sensor is plugged in, the GPIO pin is activated, confirming the sensor has been plugged in. Using this mechanism, the port state on the web interface is updated, enabling the system to seamlessly initiate nest monitoring. The connection between the PCB and the smart sensor is established using 9-pin JST

(Japan Solderless Terminal) connectors (see page 20). The purpose of this pin is to make it easier to set up the three sensors (MPU6050, DS18B20, and HC-SR501) in runtime.

FreeRTOS for Optimized Multi-tasking

The freeRTOS was utilized to optimize the device's multitasking process. As shown in Figure 17, thread 1 focuses on powering the MPU6050 (accelerometer), DS18B20 (temperature sensor), and HC-SR501 (Passive Infrared Sensor). Thread 2 sends data every second to the local server. Lastly, thread 3 focuses on checking the device's ports.

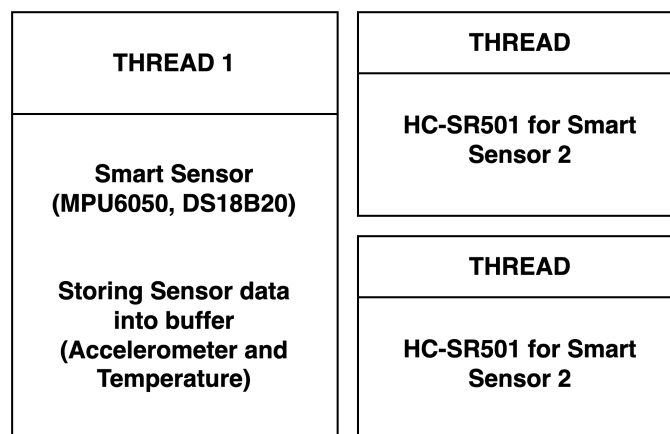


Figure 17. Threads for Sensor Operations

When the accelerometer (MPU6050) in a smart sensor detects an aggressive movement, the program dynamically creates a separate thread dedicated to processing data from the corresponding HC-SR501 for motion detection above the nest, ensuring that emergence detection is handled independently for each activated smart sensor.

This part focuses only on monitoring emergence without affecting other



sensor operations. It is to ensure that each sensor's response is separately handled by executing threads concurrently to prevent delays or interference between different sensors.

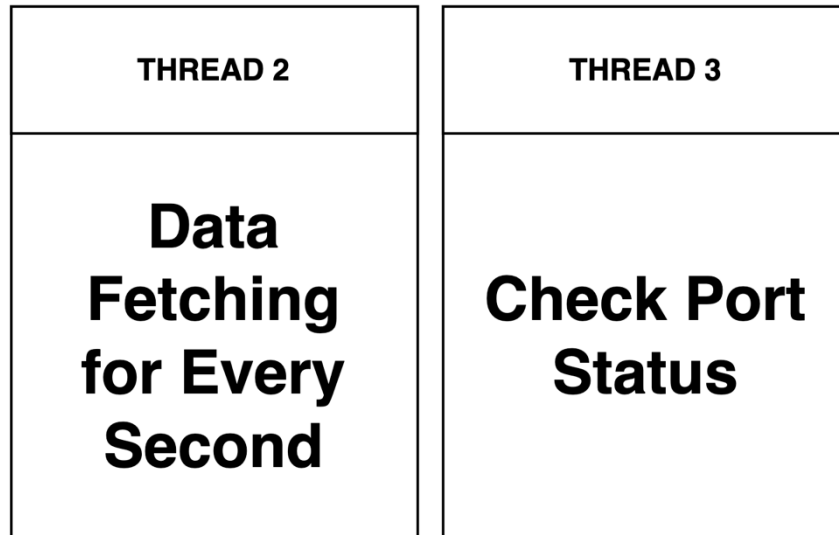


Figure 18. Threads for Data Fetching and Port Status

Thread two and three focuses on data fetching and checking device's ports. After storing the temperature and acceleration data in each smart sensor's buffer, the program calculates the average of the gathered data for each smart sensor and sends it to the local server every second.

Placement the Sensors

Sensors position in the TurtleAlert smart sensor has been thoroughly considered to establish best performance and data reliability refer on figure 4 (see page 21). The smart sensor case, consisting of an HC-SR501 PIR motion sensor, MPU6050 accelerometer, and DS18B20 temperature sensor, is positioned 0.5ft to 1ft above the sand. In the smart sensor case, the HCSR501 is placed in the middle



of the case bottom while facing the sand surface where the hatchlings emerge. The MPU6050 and DS18B20 sensors are placed at the opposite ends of the case, both provided with long wire cables to allow their respective placements in the nesting space. The temperature sensor DS18B20 (attached to a 3ft wire) is placed at the center of the nest. The accelerometer, MPU6050, attached to the wire 2 feet long, is located 1ft above the nest.

Development of TurtleAlert

To achieve the third objective, the development of TurtleAlert was carefully refined to optimize its functionality. The process involves a comprehensive approach addressing the hardware and software improvements of TurtleAlert and enhancements of user interface. In the preparation stage, the researchers selected and purchased all the necessary components that are used to calibrate and program the device. The researchers delved through various resources, such as tutorials, articles, forums, and academic papers, to find out and understand how each component contributes to the system.

Subtle Movement Detection for Accelerometer

To detect subtle movement using the MPU6050, a literature review, structured interview with Project CURMA, and simulation using a motor are conducted.

The MPU6050, a widely used sensor, allows detecting acceleration in three dimensions. Its high sensitivity and accuracy make it ideal for detecting subtle movements. Subtle movements such as the vibrations caused by hatchlings



attempting to dig through the sand produce accelerations that the sensor captures. The MPU6050 converts these movements into digital signals, which are processed and analyzed by the ESP32.

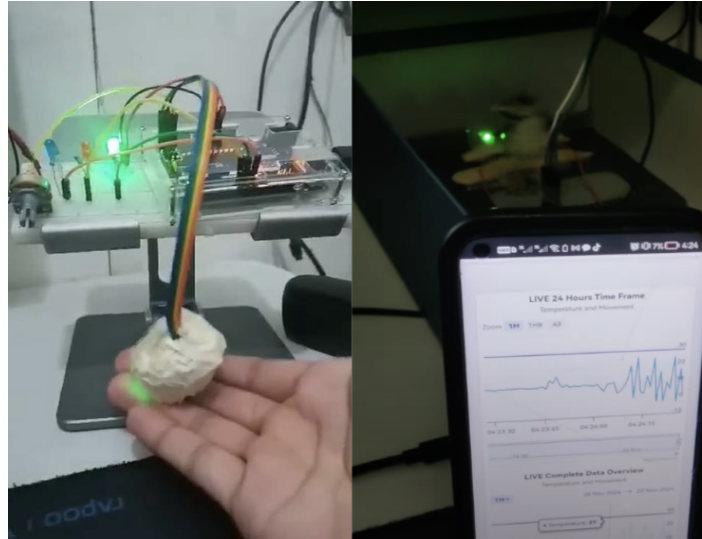


Figure 19. Initial Testing of Accelerometer Through Simulation

During the development and calibration phase, testing through simulation using motors to mimic movement was conducted to calibrate the accelerometer. The accelerometer was tested first in Arduino Uno and then transferred into ESP32 with a live graph display. As shown in figure 19, if an aggressive movement is detected, a spike is shown on the graph.

For threshold-based triggering determination, movement detection is based on predefined acceleration thresholds. These thresholds are determined through simulations and testing, replicating the expected intensity of hatchling movements.

To identify the sensitivity of the accelerometer, an interview with Project CURMA is conducted. Based on the interview, the hatchlings incubate for 40 - 60 days, 55 days on average. When the hatchlings hatch, they dig their way up to the

surface taking 1 - 3 days. This means hatchlings' movements are too gentle to make aggressive movements when digging up.

The number of eggs laid by turtles normally is 90-100, and the dimension of the net cover of each nest site is 31.7 x 47.5 cm. With this, to lessen the readings from the sensor, only the acceleration of the x-axis is calculated and displayed on the website:

$$avgAccX = \frac{Total\ of\ AccX}{nAccX}$$

Formula 1. Average Acceleration on X-Axis

The researchers tested the accelerometer sensitivity by burying it 1ft below sand aiming to determine its acceleration or sensitivity, the researchers walked onto the surface where the accelerometer was to determine whether it can detect movements on the surface which can cause false alerts. A counter is added to prevent false triggers, the system only sends notifications after the accelerometer reaches the specific number of counts of aggressive movement.

The threshold for aggressive movement readings is $\pm 2g$, where g is the acceleration due to gravity, with $1g$ being 9.81 meters per second squared. By setting the sensor to a $\pm 2g$ range, the system can measure acceleration between $-2g$ and $+2g$ (about -19.62 to $+19.62$ m/s²), which improves the capability to track even the slightest movements. This range provides high-resolution measurements, which are advisable for detecting the subtle and low-frequency motion patterns that correspond to hatchling activity under the sand.



Hatchlings Emergence Detection

This step helped the researchers to understand the emergence detection using HC-SR501.

In the TurtleAlert system, the HC-SR501 detection is set to the highest limit of 7 meters and the time delay is set to the lowest limit of 1 second to provide accurate hatchling emergence detection. The smart sensor is placed above the nest net, 1ft above the sand surface. Based on this positioning, the sensitivity of the HC-SR501 is set intentionally at the highest possible range and lowest time delay with each detection occurring in the direct vicinity of the nest in order to minimize the number of false positives and to maintain the accuracy of the emergence detection.



Figure 20. Testing HC-SR501 Detection

To verify that the HC-SR501 can detect hatchlings, the researchers participated in releasing hatchlings. The researchers made a simple casing as shown in figure 20 (see page 48) for HC-SR501 together with a power bank, LED, resistor, and ESP32 to test the sensor. The LED is the indicator if the hatchling can be detected; high if detected and low if not. This step helped the researchers to verify the functionality of the HC-SR501 hatchling emergence.

The researchers tested the HC-SR501 if it can detect wires, nets, sand, and other things that could give false notifications. With the use of the same testing device used for hatchling detection testing, the researchers verified that the HC-SR501 cannot detect the wires, sand, and leaves, but only movement made by humans and animals.

In response to movement from above, the HC-SR501 PIR sensor sends an emergence notification according to the distance and delay settings that can be changed with an onboard potentiometer. As long as the HIGH condition is maintained by the sensor, a count is added for every millisecond of activity. The system sets a threshold of 50 counts for major motion detection.

Hatchling Emergence Prediction Notification

When the accelerometer (MPU6050) detected 2 consecutive subtle movements 1ft above the nest, a notification is sent to the registered user.

Hatchling Emergence Notification

This function is only activated when the accelerometer hatchling emergence



prediction is triggered. When the HC-SR501 detects rapid movements above the nest, a notification is sent to the registered user.

Hatchlings Temperature Determination

This step helped the researchers to understand the range of the temperature in determining the sex of the hatchlings using DS18B20.

The TurtleAlert computes the average temperature during the incubation of the eggs, starting from day 0 to the emergence of the hatchling, the average temperature is computed by getting the total temperature readings during the nesting period and dividing it by the number of readings:

$$\text{Avg temperature} = \frac{\text{Sum of Temperature Readings}}{\text{Number of Readings}}$$

Formula 2. Average Temperature

DS18B20 in Comparison with a Digital Thermometer



Figure 21. DS18B20 Readings in Comparison with Digital Thermometer

The readings between the DS18B20 and the digital thermometer are almost the same. The researchers conducted a comparison between DS18B20 and a

digital thermometer to get the accuracy of DS18B20. The comparison was tested with hot water, cold water, and sand.

Table 13. DS18B20 and Digital Thermometer Comparison

Test Environment	DS18B20	Digital Thermometer	Accuracy
Hot Water	57.84°C	57.9°C	99.90%
Cold Water	17.63°C	17.4°C	98.68%
Sand	39.66°C	39.8°C	99.65%

Table 13 presents the comparison of the DS18B20 sensor readings with a digital thermometer in three different test environments; hot water, cold water, and sand to show the sensor's high degree of accuracy. In hot water, the DS18B20 recorded 57.84°C compared to the digital thermometer's 57.90°C, resulting in an accuracy of 99.90%. In cold water, the DS18B20 measured 17.63°C, and the digital thermometer measured 17.40°C, which gives an accuracy of 98.68%. Finally, DS18B20 measured 39.66°C while a digital thermometer measured 39.80°C resulting in 99.65% accuracy in a sand environment. The findings indicate the reliability of the DS18B20 sensor in the changing temperature range and the use of different materials, where accuracy is over 98.5% on average. Its precise readings in sand, in particular, confirm its suitability for applications like TurtleAlert, where accurate sand temperature monitoring is crucial.



HC-SR501 Activation and Detection Testing

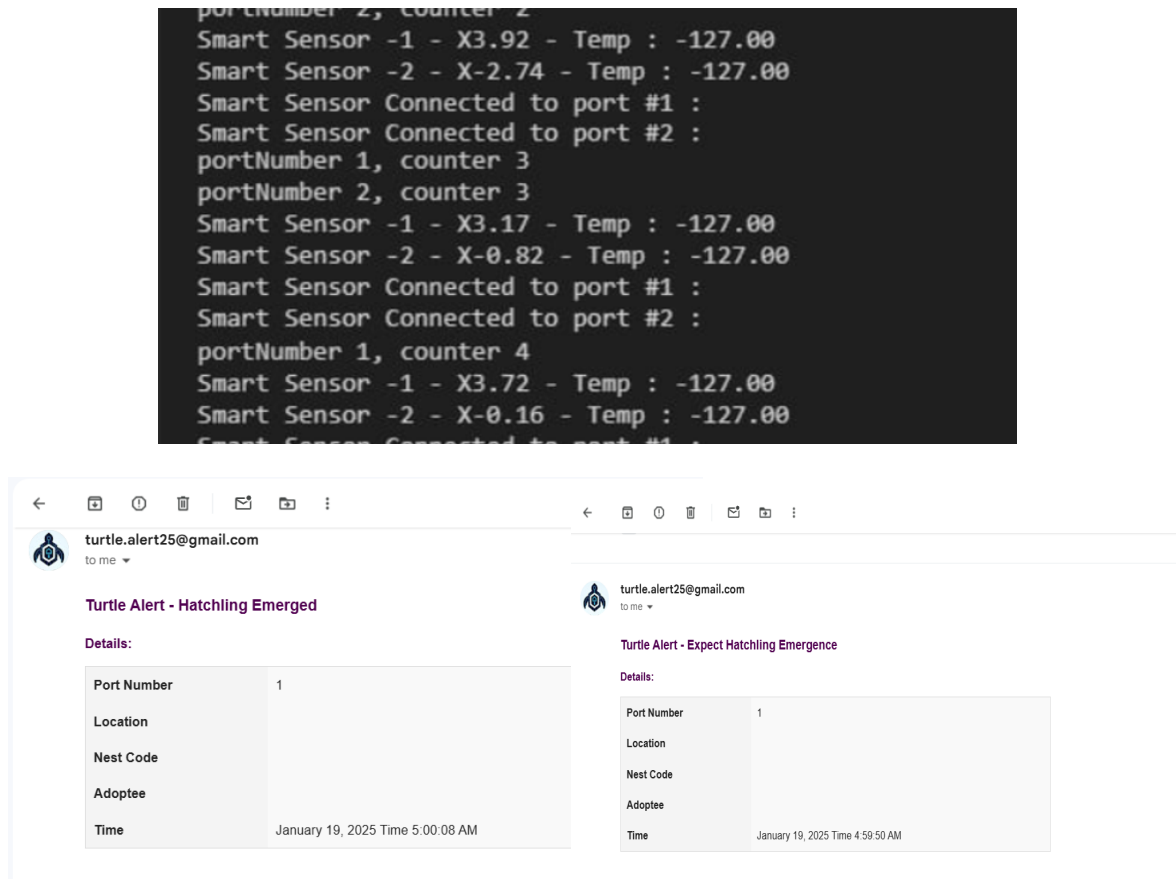


Figure 22. HC-SR501 Activation and Detection

The activation testing of HC-SR501 aimed to test its capability to detect and activate when the MPU6050 detected rapid movements below the sand. The testing examines the HC-SR501's sensitivity, detection, accuracy, and its robustness. Simulated hatchling emergence and environmental factors are employed to confirm the reactivity of the system and to reduce the number of false positives. This guarantees the HC-SR501 is robust as an integral part of the TurtleAlert system's combined movement sensing system.

Table 14. Truth Table of TurtleAlert's Prediction and Detection

MPU6050	HC-SR501	DS18B20	Hatchling Emerged
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

Table 14 shows the truth table of TurtleAlert's prediction and detection. The HC-SR501 is only triggered by detecting an interrupt or movement on the accelerometer. When a motion below the sand is observed, a warning is sent to the user. Once an alert is sent to the user, HC-SR501 begins to detect motion on the surface, and another hatchling emergence warning is sent through email, SMS, and on the website.





Figure 23. Accelerometer Calibration

The accelerometer was buried one foot below ground level to verify whether the accelerometer could sense motion from the surface. The process of testing this helped researchers to determine the sensitivity and reliability of the accelerometer in detecting movement below the sand. By gradually changing the threshold for movement detection, the researchers ensured that the sensor would accurately detect movements that originated below the surface while filtering out irrelevant movements from above. This calibration procedure enhanced the detection accuracy of movement and thus the system's performance for monitoring hatchling activity.



Figure 24. Developed TurtleAlert

Figure 24 shows the developed TurtleAlert prototype. It includes the fully assembled components. The TurtleAlert consists of one main hub containing the ESP32, SIM A7672s, and the main PCB of the device, and three smart sensors. Each smart sensor contains MPU6050 for hatchling emergence prediction, DS18B20 for nest temperature monitoring, and HC-SR501 for hatchling emergence detection.

Website Interface

The TurtleAlert web interface acts as a platform that allows one to monitor and manage data obtained from the smart sensors. The TurtleAlert utilized a Template titled Paper Dashboard 2 (Creative Tim, n.d.) and highcharts (Sage R., 2025). This system gives live updates on the sand temperature and movement of



hatchlings, hence ensuring that critical events are sent to users in real-time. The interface offers charts making it possible for users to understand trends and patterns easily. In addition, hatchling activity alerts are sent as instant notifications to make sure responses happen on time. The web interface is accessible through Wi-Fi and easy to use, interactions are seamless and the management of device settings and monitoring tasks very efficient.

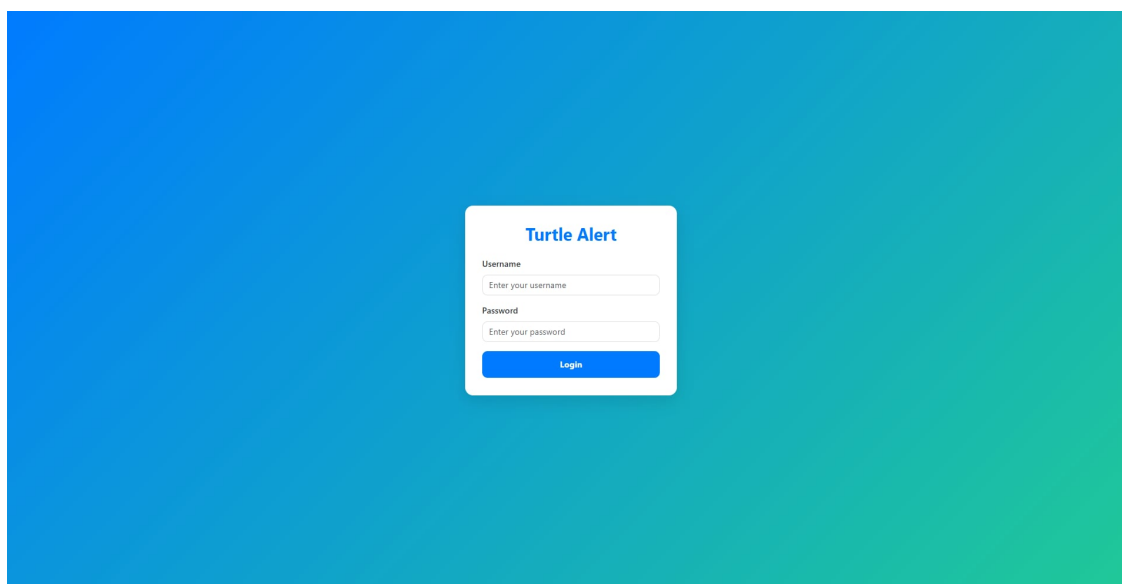


Figure 25. Web Interface (Login)

The website requires users to login in order to access it as shown in figure 25. There are two types of users: admin, and normal users. The real-time data coming from the sensor and the records from the previous nests are accessible by the admins and the users. While logging in as admin and user has the same feature on the website, non-admin cannot create, remove, update accounts, and access "Archive".



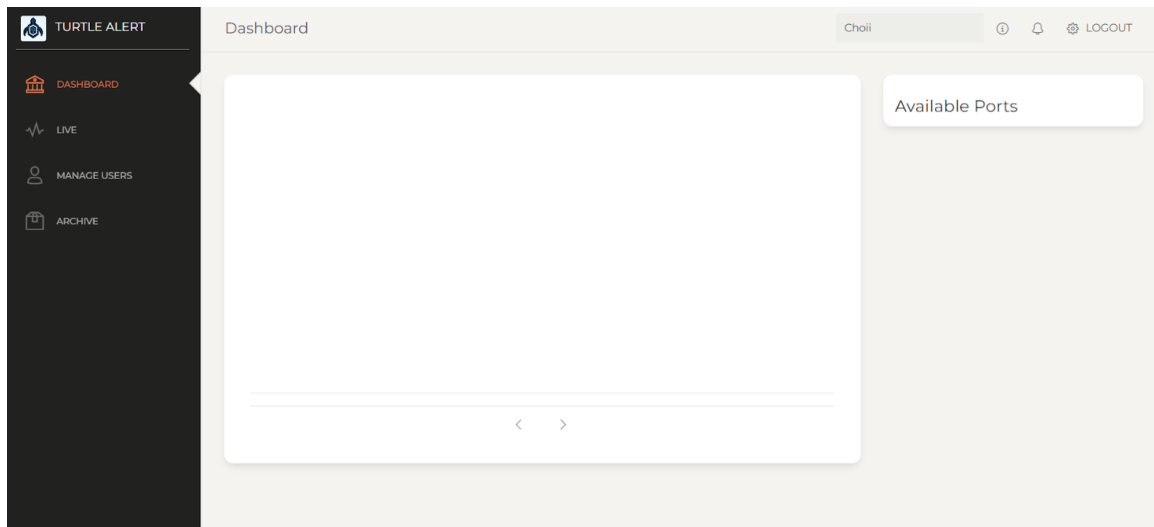


Figure 26. Web Interface (Dashboard)

The TurtleAlert web dashboard is the core interface of the system for real-time monitoring and controlling the device when to monitor. Major functions are organized on the sidebar.

The "Dashboard" is the main entry page when a user logs in, the "Live" section displays all the active ports, showing the graph and the condition of the nest whether there is a potential emergence or hatchlings have already emerged.

The "Manage Users" section is limited to the administrator, the administrator has the option to manage user accounts for safe access to the system. Lastly, the "Archive" section provides the users access to historical data. The central content area is a placeholder for the system data visualizations.

On the "Available Ports" panel, it indicates whether there is a connected smart sensor and is ready to be monitored. This feature underlines the modularity of the system and its ability to manage multiple sensor inputs. The logged-in user name is at the top of the interface, and the notification panel keeps the user



informed about hatchling activities. A logout button ensures secure access management. In general, the design of the dashboard emphasizes functionality and ease of use.

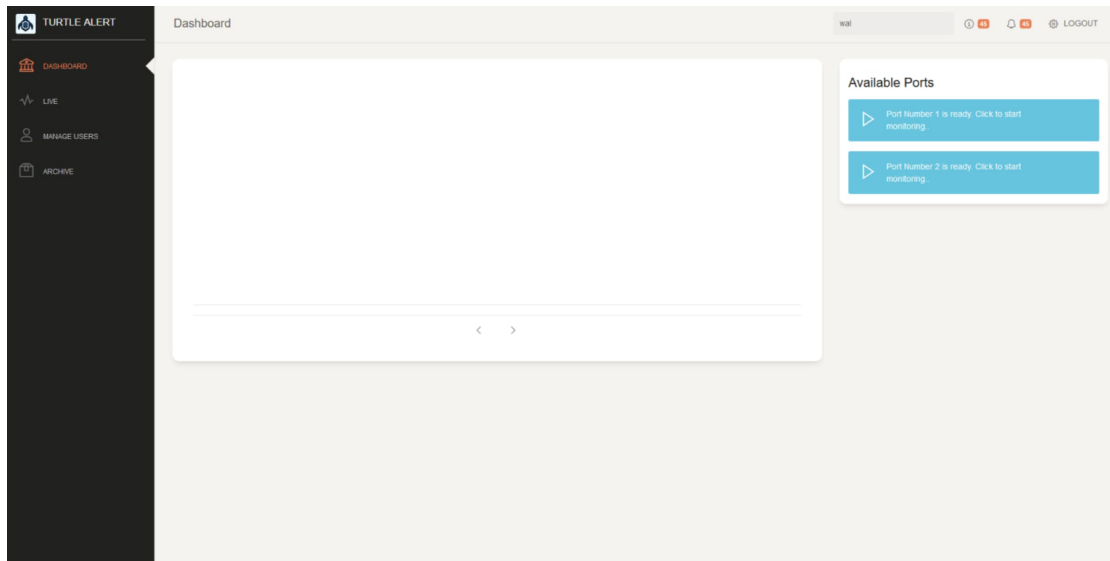


Figure 27. Web Interface (Port Status)

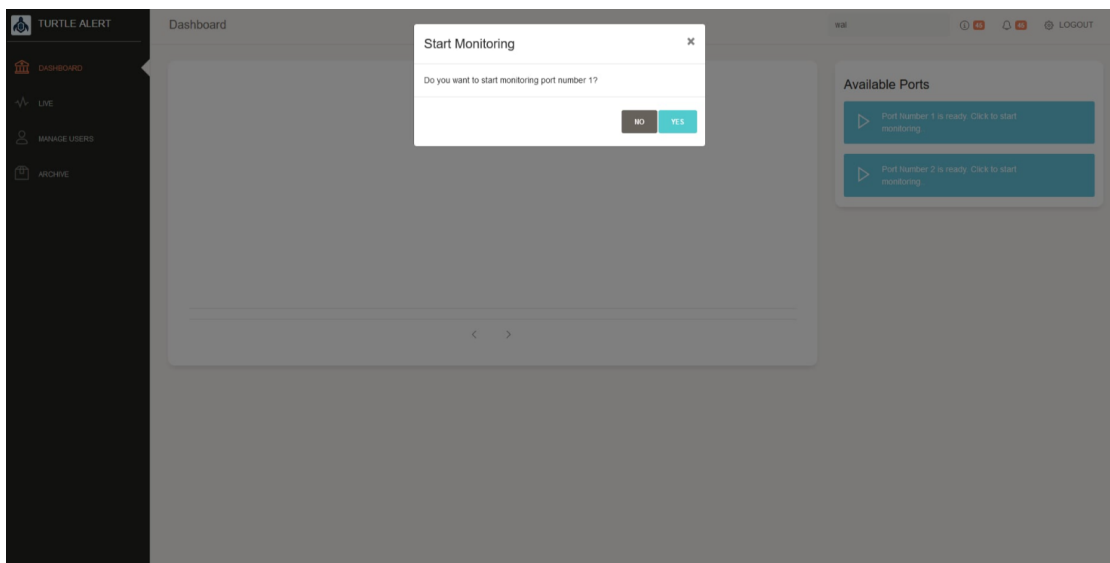


Figure 28. Web Interface (Port Selection)

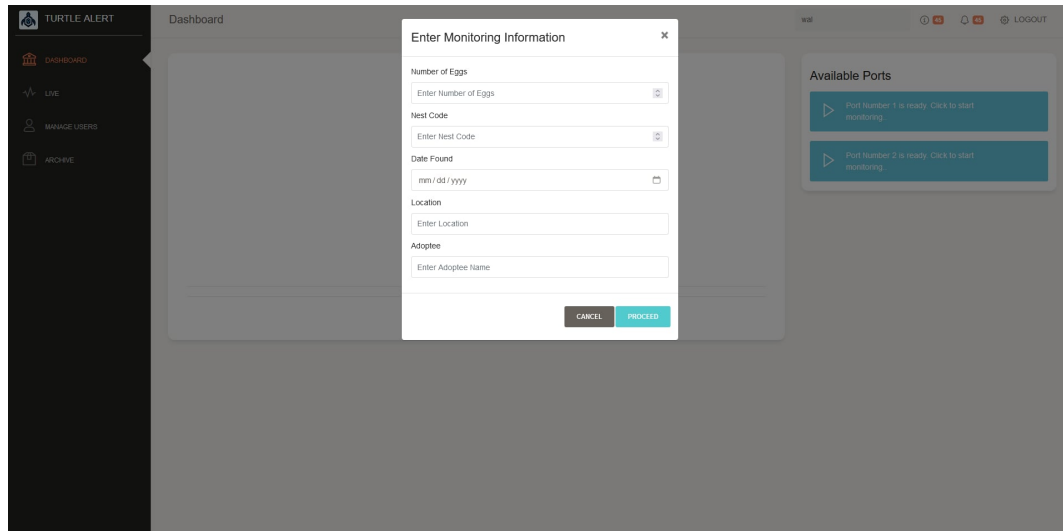


Figure 29. Web Interface (Nest Information)

The website includes the status of each port. In figure 27 (see page 58), the active ports are shown on the "Available Ports" on the website, users can select which active port to start monitoring as shown in figure 28 (see page 58). In figure 28, After the user selects which port to start, the user is required to insert turtle nest details, the system then proceeds on sending data from the database and displays real-time data.

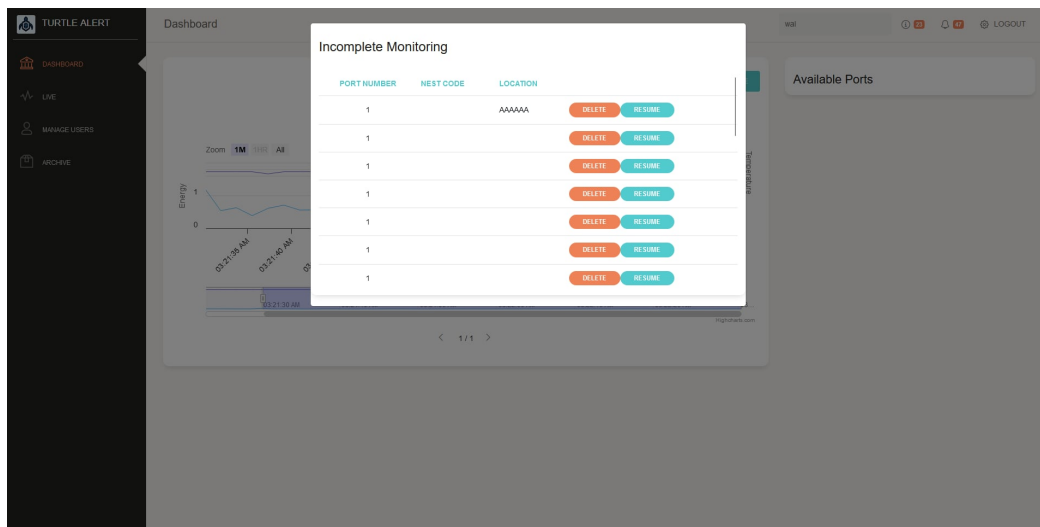


Figure 30. Web Interface (Incomplete Monitoring)

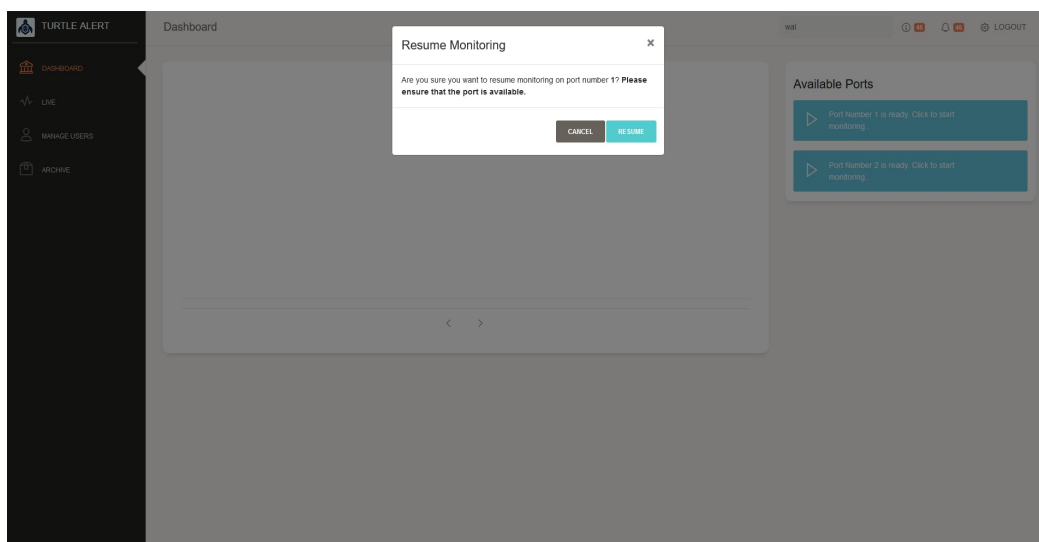


Figure 31. Web Interface (Resume Monitoring)

In case of problems such as power interruption, accidental removal of smart sensors, and the device, the user can continue to resume monitoring the nests by using the resume feature as shown in figure 31. All incomplete processes are displayed on “Incomplete monitoring” as shown in figure 30 (see page 59) giving the user the ability to resume or delete monitoring.

Notification



Figure 32. Notification (Website)



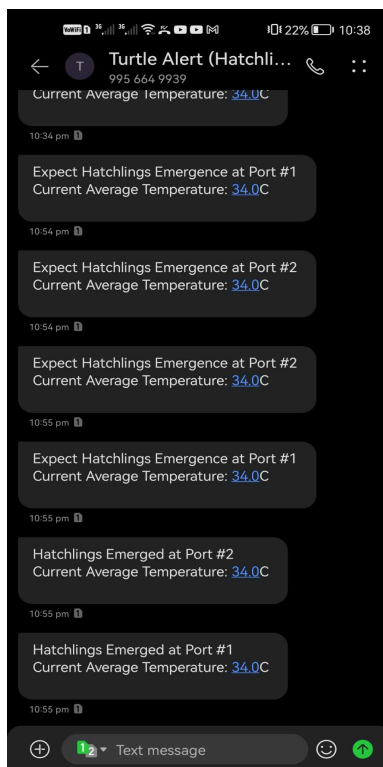


Figure 33. Notification (SMS)

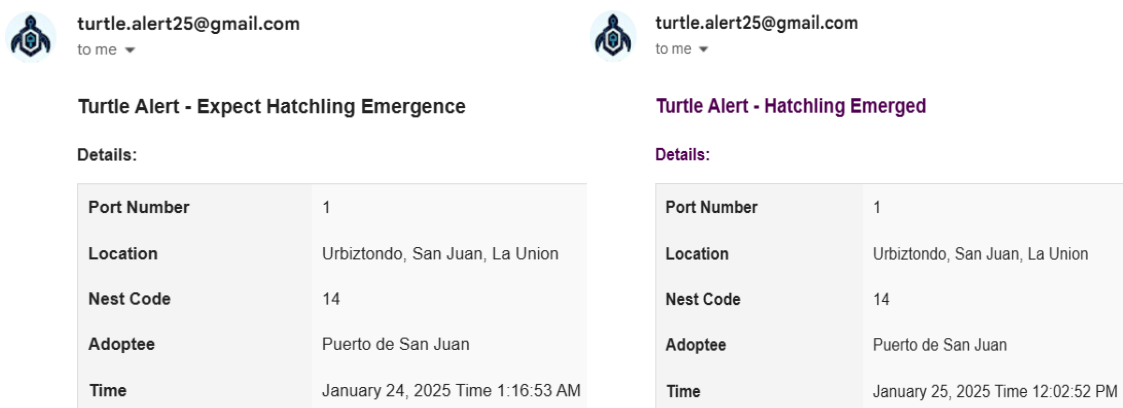


Figure 34. Notification (Email)

The TurtleAlert platform features a successful notification system aimed at keeping the users updated through two primary means, email, website alerts, SMS. In the event of an occurrence like hatchlings' aggressive movements for the

possible emergence of hatchlings and hatchling emergence, the registered users receive automatic notification through emails. Furthermore, a website notification is implemented where users can view updates and alerts about the nests conditions, all notifications are displayed in the notification panel. An SMS notification is only activated if the system is not connected to WiFi by manually uploading the code on the ESP32.

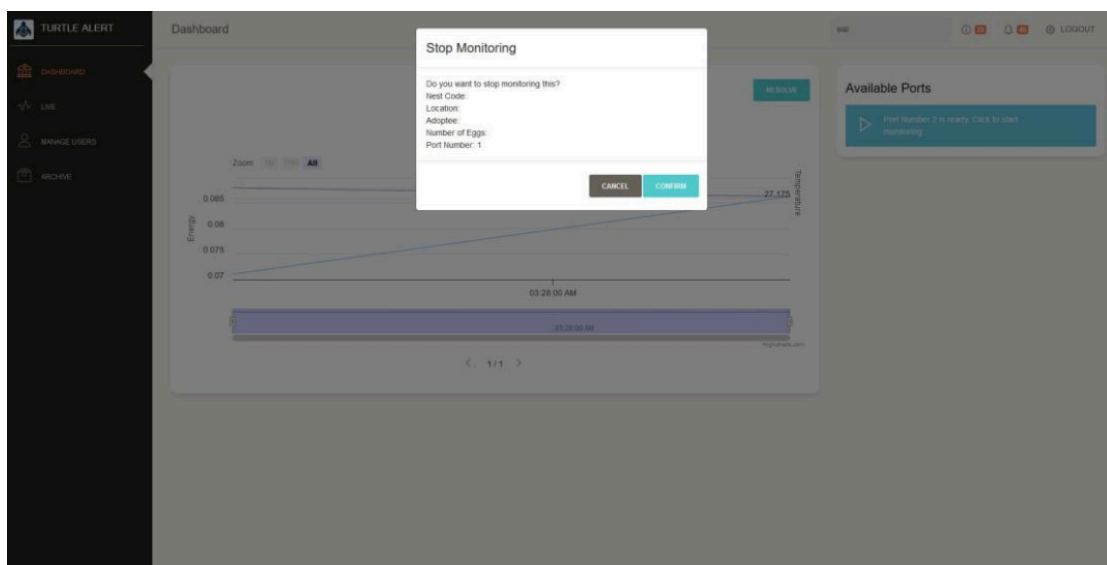


Figure 35. Resolve Nest Monitoring

In figure 35, the "Resolve" button enables users to complete the monitoring of a nest when hatchlings successfully emerge from the nest. The option is made specifically for marking the completion of active monitoring of a nest. When the user clicks on the "Resolve" button, all the relevant data including average temperature reading, movement patterns, and event logs, are saved and transferred to the "Archive" section.

This mechanism maintains the nest data that remains accessible for future analysis. The resolved nests are saved in the archive section, this helps the system keep a clean and organized workflow. Additionally, this mechanism keeps pending nests apart from resolved nests. The stored data is available and accessible in the Archive section, where users can access and analyze it anytime.

MPU6050 and DS18B20 Graphical Representation

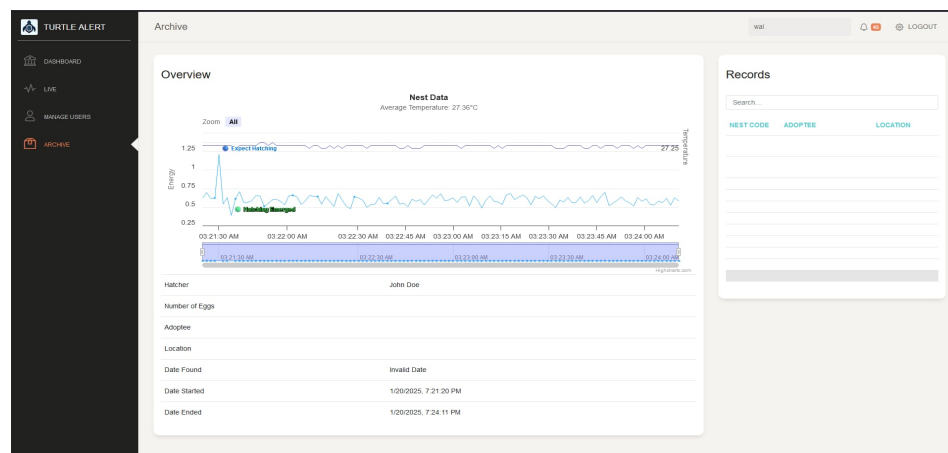


Figure 36. Archive (Nest Data)

The "Archive" area of TurtleAlert provides users with an extensive means of accessing previous data and records of the turtle nests. The center panel presents a line chart, which plots significant data trends over time, such as movement and temperature. Additionally, it indicates significant events like "Expect Hatchling Emergence" and "Hatchling Emerged". Through the use of the slider on the bottom of the graph, users can zoom for specific periods for a detailed analysis. Above the chart, the average of nest temperature during the nesting phase until the turtle emerges is displayed.

Below the chart, a table provides nest-specific information consisting the name of the hatcher, number of eggs, adoptee, location of the nest, and relevant dates when the nest was found, monitoring began, and ended. Ensuring an all-inclusive record for every nest, useful for documentation and review purposes. On the right side of the interface, there is a list of records searchable to let the user browse or locate any particular nest easily. Each record includes attributes like nest code, adoptee, and location that allows easy navigation between data sets.

User Management

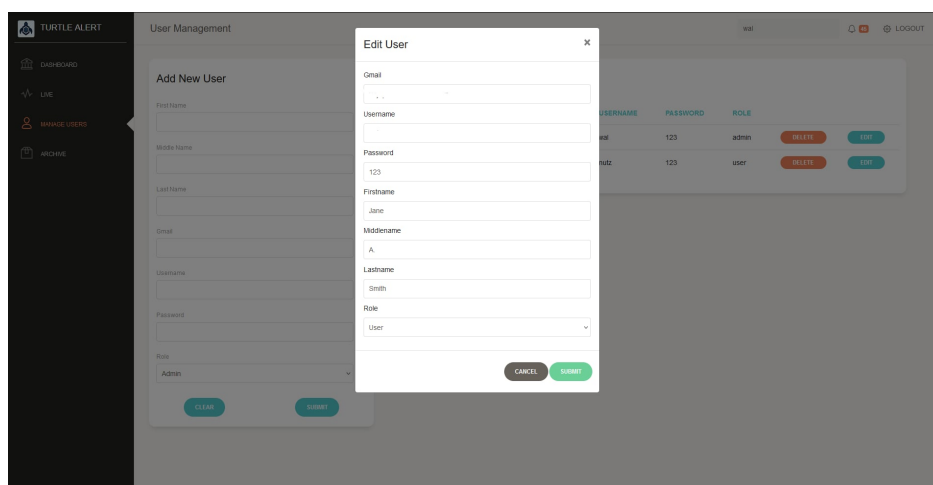


Figure 37. Add, Create, Edit Account

Figure 37 enables the administrator to manage user accounts effectively. The admin can create new accounts for users, allowing them to log in on the website and let them access the TurtleAlert web interface functionalities. The admin can input necessary user details and assign roles when creating an account. The admin can also update information for existing users and remove accounts. Through this feature, only authorized individuals can log in and interact with the system, ensuring proper access control.



As part of the pre-final defense recommended improvements, SMS notification was incorporated into the system. The user has to manually upload the SMS-only code to the ESP32. During implementation, the researchers encountered an issue of enabling the system to automatically default to SMS-only mode when no WiFi connection was present. A conflict occurred between checking for WiFi availability for SMS-only mode and the system's ability to maintain a stable connection to the website when WiFi is available. The feature was implemented, but only lasted for a brief time, the system started developing problems after a while and occasionally experienced errors causing it to crash.

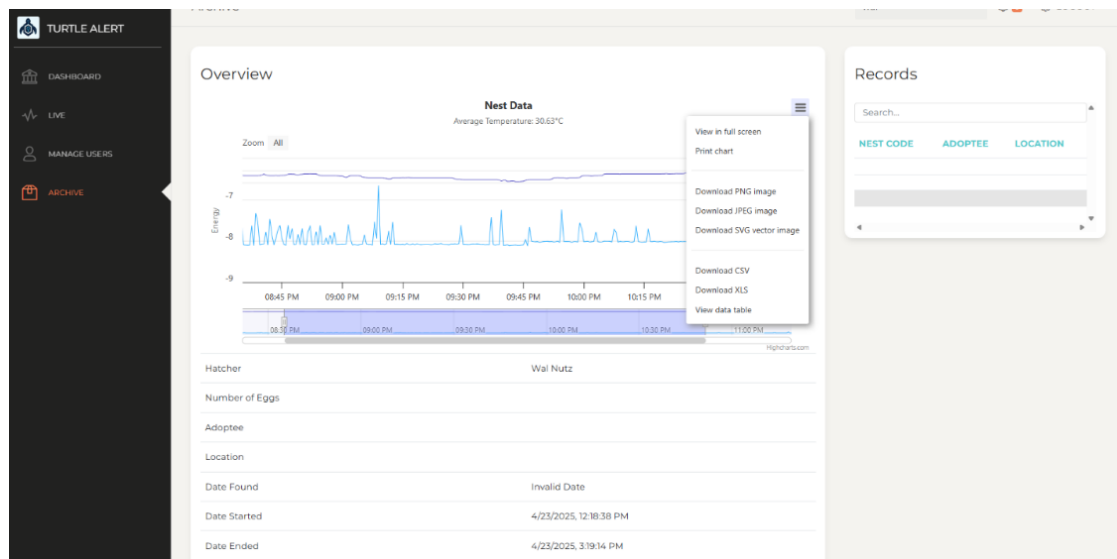


Figure 38. Export Data

As shown in figure 38, the export function allows the user to export graph as PNG, PDF, JPEG, or SVG vector. Additionally, the user can also export raw data from the sensors in CSV, XLS, or Json file. This function can be seen when the user selected a record.

Assessment of TurtleAlert

Table 15. Effectiveness and Accuracy Assessment of TurtleAlert

Indicator	Weighted Mean	Descriptive Equivalent Range (DER)
1.1 Effectiveness		
TurtleAlert can detect hatchling emergence accurately.	4.24	Excellent
The system sends notifications on time when hatchlings emerge.	4.4	Excellent
The device reduces the need for manual nest monitoring.	4.44	Excellent
The device provides consistent performance without frequent errors.	4.04	Very Good
The TurtleAlert improves the monitoring process.	4.52	Excellent
1.2 Accuracy		
The system reliably predicts and detect hatchling emergence.	4.2	Excellent
Temperature readings are precise and reliable.	4.2	Excellent
The movement detection system of the accelerometer accurately detects hatchling movements	4.16	Very Good



The motion detection system of passive infrared sensor accurately distinguishes hatchling movements.	4.12	Very Good
The system's calibration ensures precise monitoring with minimal errors.	4.16	Very Good
Grand Mean	4.25	Excellent

The table provides insights into the effectiveness and accuracy of the TurtleAlert system based on the respondents' perceptions. The respondents agreed that the device can predict and detect hatchling emergence accurately, with a weighted mean of 4.24, which falls within the "excellent" descriptive equivalent range. They also strongly agreed that the system of TurtleAlert can send notifications on time when hatchlings emerge, with a weighted mean of 4.4, also classified as "excellent" descriptive equivalent range. Furthermore, the respondents strongly agreed that the device reduces the need for manual nest monitoring, with a weighted mean of 4.44, also within the "excellent" range. Additionally, they agreed that the device provides consistent performance without frequent errors, with a weighted mean of 4.04, which falls within the "very good" descriptive equivalent range. Lastly, for the effectiveness of the device, they strongly agreed that the TurtleAlert improves monitoring process, with a weighted mean of 4.52, falling within the "excellent" descriptive equivalent range.

In the accuracy section, the respondents strongly agreed that the system is reliable in predicting and detecting hatchling emergence, with a weighted mean of



4.2, which falls within the “excellent” descriptive equivalent range. They also strongly agreed that the temperature readings are precise and reliable, with a weighted mean of 4.2, also falling within the “excellent” descriptive equivalent range. Additionally, the respondents agreed that the movement detection system of the accelerometer accurately detects hatchling movement, with a weighted mean of 4.16, falling within the “very good” descriptive equivalent range. Furthermore, they agreed that the motion detection system of the passive infrared sensor accurately distinguishes hatchling movements, with a weighted mean of 4.12, also falling within the “very good” descriptive equivalent range. Lastly, the respondents agreed that the system’s calibration ensures precise monitoring with minimal errors, with a weighted mean of 4.16, also classified within “very good” descriptive equivalent range.

Overall, with a grand mean of 4.25, the respondents strongly agreed that the TurtleAlert is an efficient solution for sea turtle conservation especially within hatcheries. The system's simplicity, cost-effectiveness, reduced resource requirements, and manageable maintenance contribute to its perceived effectiveness.



CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

This chapter offers the conclusions from the findings of the study and recommendations based on the results. The conclusions outline the major findings and implications of the research, while the recommendations provide practical recommendations for future action and possible improvements.

Conclusions

This study offers a thorough analysis of TurtleAlert, measuring its accuracy and effectiveness as a prediction and detection device for the emergence of turtle hatchlings during nesting and hatching season. Substantial information was gathered through thorough analysis and systematic review, indicating TurtleAlert's ability to significantly assist in the conservation of turtles. This section offers the major findings of the study, offering a comprehensive overview of the device's functionality as well as making strategic recommendations for future studies and its applicability. From the findings of this study, the researchers can confidently state that:

The objectives set forth in this study are aimed to define thresholds, design, develop, and assess the TurtleAlert's system.

The first goal established systematic procedures to determine TurtleAlert threshold parameters. A Literature reviews along with structured interviews with Project CURMA and extensive testing worked together to determine the thresholds for TurtleAlert. The temperature threshold range for sex determination



was determined between 27.5°C and 32°C from scientific research and expert opinion. In addition, the gentle but insistent motions below the sand, particularly if accompanied by the collapse of the mound-shaped sand covering the nest, were found to be important physical signs. The accelerometer threshold was calibrated to record small collective movements, and the passive infrared sensor validated emergence at the surface. Such thresholds assist in giving early, humane warnings to hatchery staff to enhance hatchling survival without interrupting normal behavior. The set thresholds improve TurtleAlert's capacity to track and notify hatchling movement more correctly which aids in sea turtle conservation initiatives.

Secondly, objective 2 was to design TurtleAlert capable of monitoring multiple nests. For efficiency and reliability, TurtleAlert was designed to monitor multiple nests at the same time. JST connectors enable the smart sensors to be easily added and removed without rewiring. Additionally, an automatic detection mechanism by adding an activator pin to each smart sensor made it easy to detect connected sensors in real time. FreeRTOS was used to make multiple processes run smoothly by multitasking. Sensor placement within the smart sensor case was critical for data collection, each component was positioned to capture hatchling movement, temperature changes, and emergence events. The web interface was designed to manage multiple nests, real-time monitoring, user interaction, and data visualization. By these design considerations, TurtleAlert meets its objective of monitoring multiple nests and helps sea turtle conservation.

Thirdly, TurtleAlert was fine tuned to work optimally, to have a reliable and



efficient monitoring system for sea turtle nests. Hardware and software improvements and user interface enhancements were done to meet real time monitoring and notification needs. The threshold for motion detection using the MPU6050 accelerometer was set to detect subtle movements of the hatchling and avoid false alarms due to extraneous movement, with an aggressive movement threshold of $\pm 2g$. Additionally the mpu6050 has a 2 counter for aggressive movement detection, the system only sends a notification if the counter exceeds 2 counts, this counter serves as the notification threshold for hatchling emergence prediction. The PIR sensor (HC-SR501) is calibrated to its highest sensitivity setting and shortest delay time to achieve precise hatchling detection without producing unnecessary alerts. The robust casing protects internal components from the environment while smart sensors ensures accurate data collection and hatchling detection. Component testing was done including DS18B20 accuracy validation, HC-SR501 activation logic and MPU6050 movement sensitivity. The web interface further enhances usability of TurtleAlert by providing real time data visualization, user management and instant notifications via email and dashboard alerts. Features like incomplete monitoring resumption and data archiving makes the system practical and operates uninterrupted and long term data accessible. However, during implementation, the researchers encountered an issue of enabling the system to automatically default to SMS-only mode when no WiFi connection was present. A conflict occurred between checking for WiFi availability for SMS-only mode and the system's ability to maintain a stable connection to the



website when WiFi is available. The feature was implemented, but only lasted for a brief time, the system started developing problems after a while and occasionally experienced errors causing it to crash.

Lastly, TurtleAlert helps effectively and accurately in predicting and detecting hatchling emergence. The system got a grand mean of 4.25 (excellent), the positive feedback received from experts affirms the device's user friendliness, robustness, and potential to contribute to sea turtle conservations within hatcheries.

In conclusion, the successful completion of these objectives' underscores TurtleAlert potential as a valuable tool in sea turtle hatcheries, offering an effective solution in uncertainty of turtle hatchlings emergence.

Recommendations

Relative to the results and conclusions of this study, below are the recommendations:

1. Integrate a camera on the surface of the nest for live visuals of the hatchlings confirming that they already emerged.
2. Incorporate a battery or solar power for power supply optimization.
3. Integrate a system to automatically switch to SMS-only notification when there is no Wi-Fi connection.

Implementing these recommendations would significantly enhance the study's effectiveness and contribute to its overall impact.



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View of Rancang Bangun Sistem Monitoring Kelembaban dan Suhu Pasir Sarang

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APPENDIX A

Acceptance Sheet



LORMA COLLEGES
College of Computer Studies and Engineering
 City of San Fernando, La Union
 www.lorma.edu

Tel. No. (072) 700-2500 loc. 325 and FAX No. (072) 242-3628
 Center of Development for Excellence in I.T Education in Region I



ACCEPTANCE SHEET

This is to certify that we have supervised the preparation of the Design Project and read the manuscript prepared by **ADRIAN DAVE C. FORTE, FRANCIS JAY C. DESIERTO, JOSE MARIE A. ABUDA, RYNE JOSHUA O. BOADO** entitled **TURTLEALERT: AN IOT-BASED DEVICE CAPABLE OF PREDICTING AND DETECTING HATCHLING EMERGENCE USING ESP32** and that the said design project has been submitted for proposal defense by the Oral Examination Committee.

Engr. Brianne Mark T. Aquino, MIS
 Design Project Adviser

Engr. Shekiro R. Raposas, MTS
 Design Project Teacher-in-Charge

As members of the Oral Examination Committee, we certify that we have examined this Design Project and manuscript, presented before the committee on **November 20, 2024**, and hereby recommended that it be accepted in partial fulfillment of the Design Project requirements for the degree in **Bachelor of Science in Computer Engineering**.

Janeli M. Mendez, DIT
 Chairperson

Engr. Daniel John C. Tarinay
 Member

Engr. Lou Benedic C. Valle, M.A-Math
 Member



Appendix B

Interview Guide

1. Is it possible to deploy TurtleAlert in your hatchery?
2. How long does it take for turtle hatchlings to reach the surface after they hatch?
3. On average, how many days does it take for turtle hatchlings to emerge?
4. What are the signs that indicate the turtle hatchlings are about to emerge?
5. Have you encountered any recent challenges in the hatchery?
6. Why is it important to transfer the turtle hatchlings immediately after they emerge?
7. Do all the turtle hatchlings emerge at the same time?
8. How many eggs are typically found in a single nest?
9. What is the temperature range that determines the sex of turtle hatchlings?



APPENDIX C

Transcript of Interview

Is it possible to deploy TurtleAlert in your hatchery?	Yes, pero ang season for nesting of turtle is from September to April
How long does it take for turtle hatchlings to reach the surface after they hatch?	Usually 1-3 days bago makalabas ang mga hatchlings sa kanilang nest, then after that need silang itransfer agad habang wala pang isang oras.
On average, how many days does it take for turtle hatchlings to emerge?	Ang pinaka late na emergence dito sa CURMA is 82 days, pero in average, 50-60 days ang emergence nila.
What are the signs that indicate the turtle hatchlings are about to emerge?	After kasing maihukay yung mga eggs 2 feet below at matabunan ng sand, nilalagyan pa namin ng sobrang sand sa ibabaw like pyramid para yun yung maging sign of hatching and emergence ng hatchlings. For example, yung sand is lumubog or naging flat na, it means may nag hatch na or may paakyat nang hatchlings. Pero ang nagiging problem namin dyan is kapag umuulan, lumulubog kasi yung sand kapag nababasa.
Have you encountered any recent challenges in the hatchery?	Ang nagiging problema lang talaga namin is yung uncertainty ng emergence ng hatchlings, which is nag cacaue ng death ng turtle hatchlings and pagkapuyat ng mga hatches.
Why is it important to transfer the turtle hatchlings immediately after they emerge?	Yung mga hatchlings kasi is prone to dehydration and predation. Now, kung hindi maitratransfer si hatchling within an hour, possible silang maging dehydrated at mamatay.
Do all the turtle hatchlings emerge at the same time?	May chances na hindi sila mag sabay sabay. Minsan may nahuhuling mag emerge.
How many eggs are typically found in a single nest?	90-100 eggs mandalas ang laman ng isang nest. pero may mga time din na mas maliit and meron din yung mas madami.
What is the temperature range that determines the sex of turtle hatchlings?	28°C - 32°C. pag nasa threshold na yan yung temperature, meaning hati hati yung sex nila, male and female yung mag hahatch. Pag below 28°C, meaning lalaki lahat yung mag hahatch na eggs sa nest. Then pag above 32°C, female hatchlings yung mga mag eemerge.



APPENDIX D

Certification of Deployment



Project CURMA
374 Saint Jude, San Juan, La Union

Certificate of Deployment

This is to certify that the 4th Year Bachelor of Science in Computer Engineering students enrolled in Cpe Practice and Design at Lorma Colleges who are currently conducting a study entitled **"TurtleAlert: A IoT-Based Device Capable of Predicting and Detecting Hatchling Emergence using ESP32"** accepted for deployment on January 23, February 15, and April 07, 2025 at 374 Saint Jude, San Juan, La Union.

This certification is issued for all legal intent and purposes it may serve.
Issued this 21st day of **APRIL, 2025** at 374 Saint Jude, San Juan, La Union.


Carlos Bhima L. Tamayo
CURMA President



APPENDIX E

Efficiency and Accuracy Assessment of TurtleAlert



Lorma Colleges
COLLEGE OF COMPUTER STUDIES AND ENGINEERING
CLI Bldg. Urbiztondo, San Juan La Union



USABILITY QUESTIONNAIRE

Dear Respondent,

Greetings with Lormanian smile!

We, the 4th Year Computer Engineering students of Lorma Colleges, are conducting research titled **"TurtleAlert: An IoT-Based Device for Predicting and Detecting Hatchling Emergence using ESP32,"** as part of our CpE Practice and Design II requirement. We kindly request your participation in this survey to collect data for our study. Your responses will remain confidential and will be used solely for academic purposes.

Thank you so much and God bless.

Respectfully,

ADRIAN DAVE C. FORTE

FRANCIS JAY C. DESIERTO

JOSE MARIE A. ABUDA

RYNE JOSHUA O. BOADO

Researchers

Noted by:

ENGR. BRIANNE MARK AQUINO, MIS

Research Adviser

Name: _____ Date: _____

Occupation/Background: _____

Direction: Put a check (✓) mark on the line that corresponds to your choice.

5 – Excellent 4 – Very Good 3 – Good 2 – Fair 1 – Poor

EFFECTIVENESS	SCALE				
	1	2	3	4	5
TurtleAlert can detect hatchling emergence accurately.					
The system sends notifications on time when hatchlings emerge.					
The device reduces the need for manual nest monitoring.					
The device provides consistent performance without frequent errors.					
The TurtleAlert improves the monitoring process.					
ACCURACY					
	1	2	3	4	5
The system reliably predicts and detect hatchlings.					
Temperature readings are precise and reliable.					
The movement detection system of the accelerometer accurately detects hatchling movements.					
The motion detection system of passive infrared sensor accurately distinguishes hatchling movements.					
The system's calibration ensures precise monitoring with minimal errors.					



APPENDIX F**Validation Letter**

Lorma Colleges
COLLEGE OF COMPUTER STUDIES AND ENGINEERING
CLI Bldg., Urbiztondo, San Juan La Union



Dear Validator,

The undergraduate students of Bachelor of Science in Computer Engineering at Lorma Colleges are currently designing and developing a Design Project entitled **"TurtleAlert: An IoT-Based Device Capable of Predicting and Detecting Hatchling Emergence using ESP32"**, in partial fulfillment of our requirement in CpE Practice and Design II. This project involves validating the questionnaire to comprehensively understand the effectiveness and accuracy of the TurtleAlert device in predicting and detecting sea turtle hatchling emergence.

The content validation instrument is attached for your review. Please find time to go over it for content validity. The undergraduate researchers will be very thankful for your generous assistance in completing this academic work.

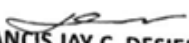
Rest assured that all the data for this purpose will be treated professionally and with utmost confidentiality.

Thank you very much and God bless.

Respectfully,

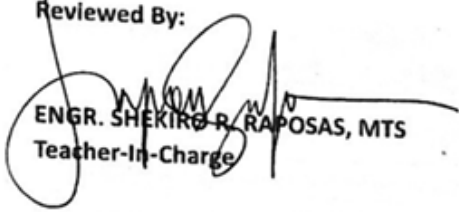

ADRIAN DAVE C. FORTE


JOSE MARIE A. ABUDA


FRANCIS JAY C. DESIERTO


RYNE JOSHUA O. BOADO

Reviewed By:


ENGR. SHEKIRE R. RAPOSAS, MTS
Teacher-In-Charge


ENGR. BRIANNE MARK AQUINO, MIS
Research Adviser

Noted by:


JEFFREY B. LAYCO, MIS
Dean, CCSE





Lorma Colleges
COLLEGE OF COMPUTER STUDIES AND ENGINEERING
CLI Bldg. Urbiztondo, San Juan La Union



USABILITY QUESTIONNAIRE

Dear Respondent,

Greetings with Lormanian smile!

We, the 4th Year Computer Engineering students of Lorma Colleges, are conducting research titled **"TurtleAlert: An IoT-Based Device for Predicting and Detecting Hatchling Emergence using ESP32,"** as part of our CpE Practice and Design II requirement. We kindly request your participation in this survey to collect data for our study. Your responses will remain confidential and will be used solely for academic purposes.

Thank you so much and God bless.

Respectfully,

ADRIAN DAVE C. FORTE

FRANCIS JAY C. DESIERTO

JOSE MARIE A. ABUDA

RYNE JOSHUA O. BOADO

Researchers

Noted by:

ENGR. BRIANNE MARK AQUINO, MIS

Research Adviser

Name: _____

Date: _____

Occupation/Background: _____

Direction: Put a check (✓) mark on the line that corresponds to your choice.

5 – Excellent 4 – Very Good 3 – Good 2 – Fair 1 – Poor

EFFECTIVENESS	SCALE				
	1	2	3	4	5
TurtleAlert can detect hatchling emergence accurately.					
The system sends notifications on time when hatchlings emerge.					
The device reduces the need for manual nest monitoring.					
The device provides consistent performance without frequent errors.					
The TurtleAlert improves the monitoring process.					
ACCURACY					
	1	2	3	4	5
The system reliably predicts and detect hatchlings.					
Temperature readings are precise and reliable.					
The movement detection system of the accelerometer accurately detects hatchling movements.					
The motion detection system of passive infrared sensor accurately distinguishes hatchling movements.					
The system's calibration ensures precise monitoring with minimal errors.					





Lorma Colleges
COLLEGE OF COMPUTER STUDIES AND ENGINEERING
CLI Bldg. Urbiztondo, San Juan La Union



**CONTENT VALIDATION FORM FOR EFFECTIVENESS AND ACCURACY
QUESTIONNAIRE**

Instructions for Content Validators: Please review the validation instrument for the proposed design project to comprehensively understand the effectiveness and accuracy of the TurtleAlert device in predicting and detecting sea turtle hatchling emergence. Evaluate the instrument's content based on the following criteria.

5 (Very High Validity)

4 (High Validity)

3 (Moderate Validity)

2 (Poor Validity)

1 (Very Poor Validity)

Criteria for Content Evaluation:	1	2	3	4	5
The survey questions are organized, clear, and specific to gather related information for the study.					
The survey questions lead to specific and direct answers.					
The survey questions are free from any grammatical errors.					
The survey questions are clear and specifically made to fit the respondents' understanding.					
Generally, the questionnaire measures what it intends to measure.					

Validator's Signature over Printed Name



APPENDIX G**Letter of Research Ethics Committee**



LC-REC Form #024
APPROVAL LETTER

REC Reference #: 2025-114

March 28, 2025

To: Jose Marie A. Abuda, Ryne Joshua O. Boado, Francis Jay C. Desierto and Adrian Dave C. Forte
LORMA Colleges, College of Computer Science and Engineering

Subject: Approval of the Research Study "TURTLEALERT: AN IOT-BASED DEVICE CAPABLE OF PREDICTING AND DETECTING HATCHLING EMERGENCE USING ESP32" by the Research Ethics Committee (REC).

Dear Researchers,

The Research Ethics Committee (REC) has reviewed your application to conduct the above-mentioned research study in the LOCALE OF STUDY with you as the Principal Investigators within the duration of March 28, 2025 to March 28, 2026.

The Following documents have been reviewed and approved:

1. Letter of Intent to Conduct the Study
2. Endorsement of the Research Technical Panel
3. Title and Statement of the Problem/ Objective
4. Literature Review
5. Methods and Procedures
6. Population and Locale
7. Exclusion/Inclusion Criteria
8. Data Analysis
9. Ethical Considerations

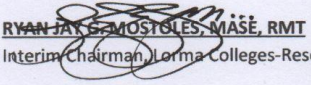
We approve the study to be conducted in the presented form provided the following are integrated in the final research protocol:

1. Indicate the funding of the study and specify the estimated duration of the interview.
2. All the information in the Informed Consent Form should be included in Chapter 2 and state the ICF as if the researchers are directly communicating with the respondents.

None of the Investigators participating in this study took part in the decision making and voting procedure for this study.

The Institutional REC expects to be informed about the progress of the study, any revision in the protocol before implementation and participants'/respondents' information/informed consent. Likewise, you are required to provide the Board a copy of the final report.

Yours Sincerely,


RYAN JAY C. MOSTOLES, MAEd, RMT
Interim Chairman, Lorma Colleges-Research Ethics Committee



APPENDIX H

User Manual

Preliminaries: First time use

The user must install these applications:

1. Nodejs – search Nodejs on the internet:

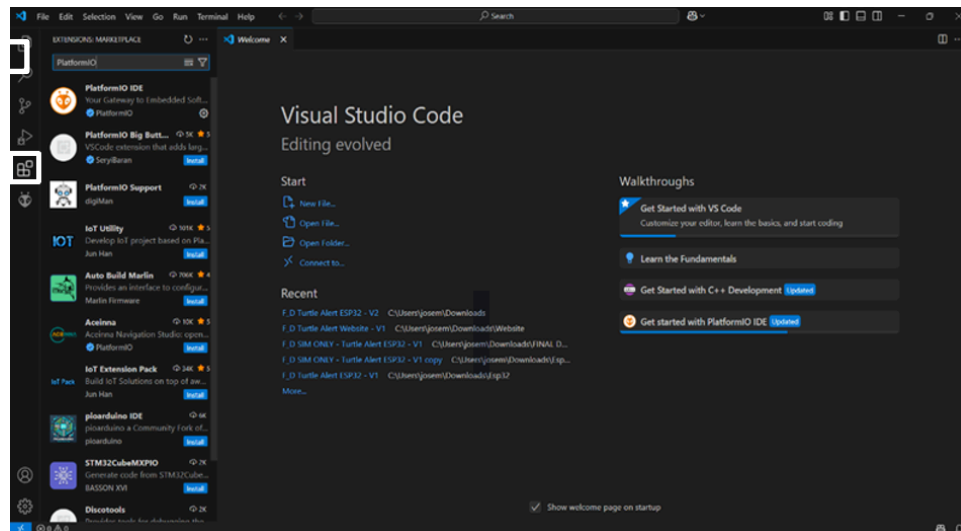
<https://nodejs.org/en>

2. VsCode – search VSCode on the internet:

<https://code.visualstudio.com/>

3. Platform.io – To install PlatformIO, follow these steps:

- Open VsCode and click extensions marked on the figure and search PlatformIO, then install.



4. Download and install CP210x USB to UART Bridge VCP Drivers in this link:

<https://www.silabs.com/developer-tools/usb-to-uart-bridge-vcp-drivers>



APPENDIX I

User Manual for Setting up IP Address for Website and Email Notification

1. Go to Turtle Alert Folder > Website > Turtle Alert.
2. Open the application named "TurtleAlert IP setup."



TurtleAlert IP
setup

This application allows users to:

- Configure the server IP address and port number
- Set or update ESP32 WiFi SSID and password
- Reset all configuration settings to default
- Run the server with current settings
- Exit the Application

NOTE: Do not turn off the **Host Device** or the Computer hosting the website.



Menu Options

1. **SET LOCAL HOST** - Allows the User to change the IP address and Port Number of the Server. See "**How to find your IP Address**" for guide.



```
-> 1
ENTER IP ADDRESS : 192.168.100.3
ENTER PORT NUMBER (4 DIGIT) : 8080
```

2. **SET ESP WIFI** - Lets the user configure the ESP32 Wi-Fi credentials:

```
-> 2
ENTER SSID      : pldthome
ENTER PASSWRD   : 12345
```

Make sure that the esp32 and server are connected to the same network.

3. **RESET** - Perform a full reset of Configuration Ip Address, Port Number, Wifi SSID and Password;

```
1. SET LOCAL HOST
2. SET ESP WIFI
3. RESET
4. RUN
5. EXIT
-> 3

The following changes will be made during reset:
1. The IP address and Port Number will be reset.
2. The 'Data' folder containing the database will be deleted.
3. The ESP WiFi Settings will be reset.
Are you sure you want to reset to default? [Y/N]: |

LOCAL HOST SETTINGS
IP ADDRESS : 0.0.0.0
PORT NUMBER : 0

ESP32 WIFI SETTINGS
SSID      : N/A
PASSWORD  : N/A
```

Let's set the local host settings again.

```
LOCAL HOST SETTINGS
IP ADDRESS : 192.168.100.3
PORT NUMBER : 8080
```

4. **RUN** - Starts the server using Node.js via the command:

```
-> 4
Server running on http://192.168.100.3:8080
```

NOTE: Make sure that **Node.js** is installed on your machine before running the server and do not close the application when running the server.

5. **EXIT** - Exits the application.

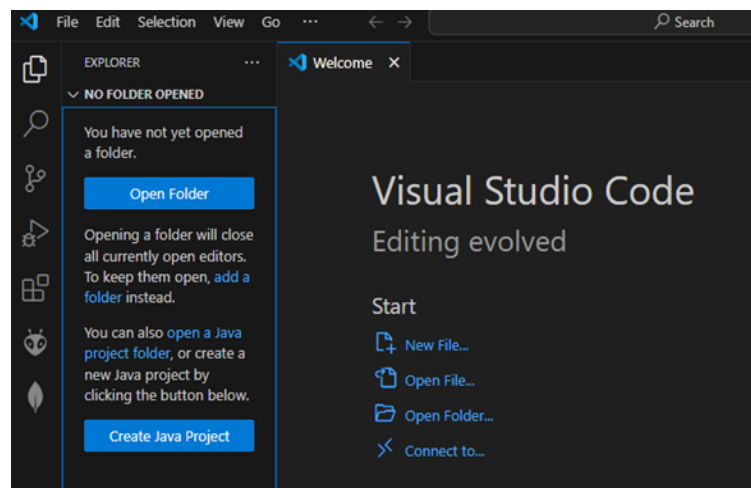


After the setup, the user must upload the Code to ESP32:

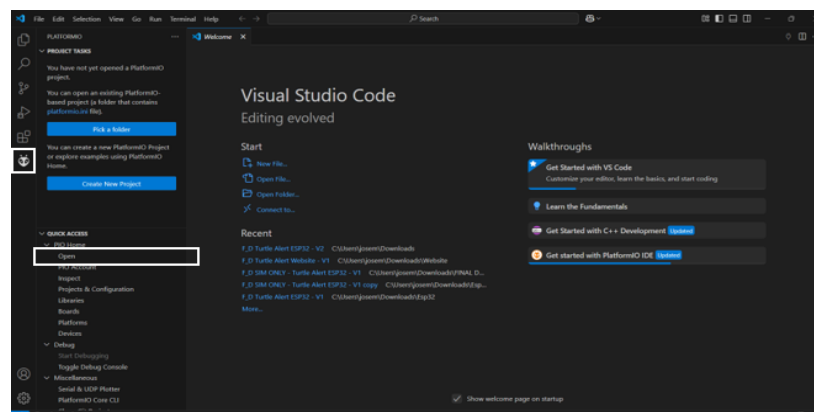
1. Plug the ESP32 into the device.



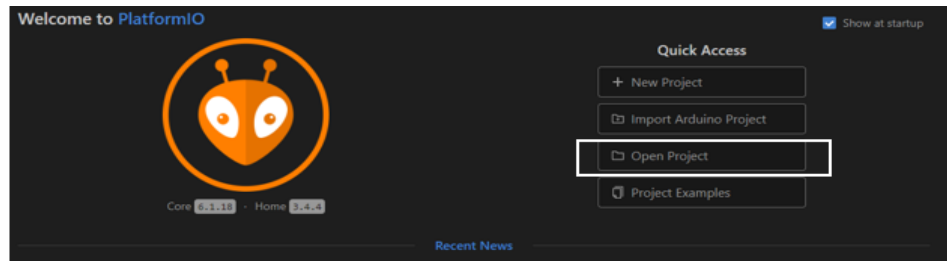
2. Open VsCode.



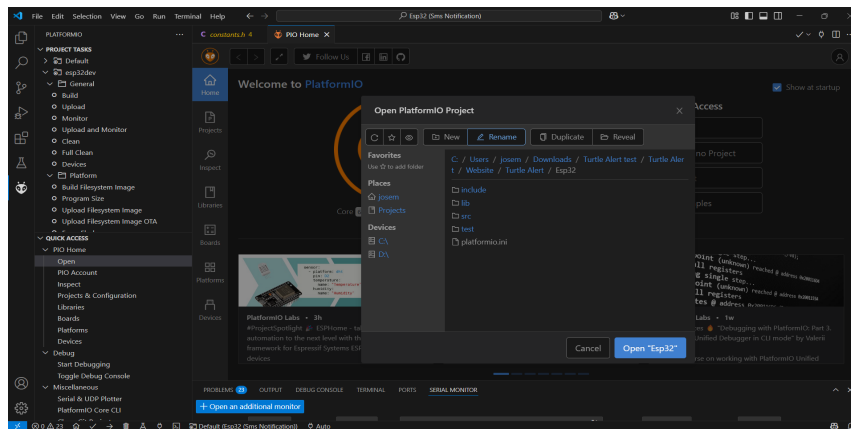
3. Click the **PlatformIO** icon, then click **Open**.



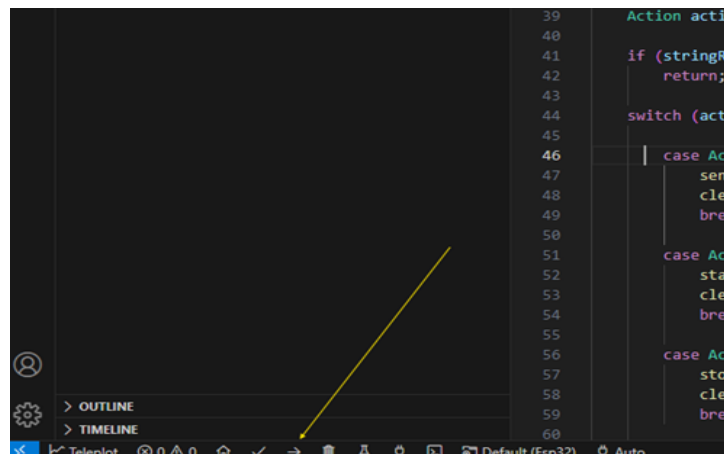
- Click **Open Project**, then find the downloaded folder **"Turtle Alert"**.



- Once you found the folder named **"Turtle Alert"**, Go to Turtle Alert > Website > Turtle Alert, then click **Open "ESP32"**.



- Click the arrow "→" icon bottom left to upload the code.



--If an error occurs, hold **"BOOT"** while uploading the file--

- Set up the device on the nest.



APPENDIX J

Website User Manual

Default users:

role	username	password
admin	wal	123
user	nutz	123

1. After running the server. **Do not close** the application. See “**User Manual for Setting up IP Address**”.

```

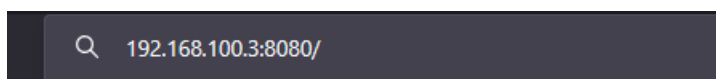
C:\Users\josem\Downloads\TurtleAlert\TurtleAlert.exe
TurtleAlert

LOCAL HOST SETTINGS
IP ADDRESS : 192.168.1.21
PORT NUMBER : 8080

ESP32 WIFI SETTINGS
SSID : PLDTHOMEFIBRa7288
PASSWORD : PLDTWIFic6gu7

1. SET LOCAL HOST
2. SET ESP WIFI
3. RESET
4. RUN
5. EXIT
-> 4
Server running on http://192.168.1.21:8080
Database Path: C:\Users\josem\Downloads\TurtleAlert test\TurtleAlert\Website\TurtleAlert\data\TurtleAlert.db
Server running on http://192.168.116.1:8080
Connected to the SQLite database.
File updated successfully.
Port 3 updated
File updated successfully.
  
```

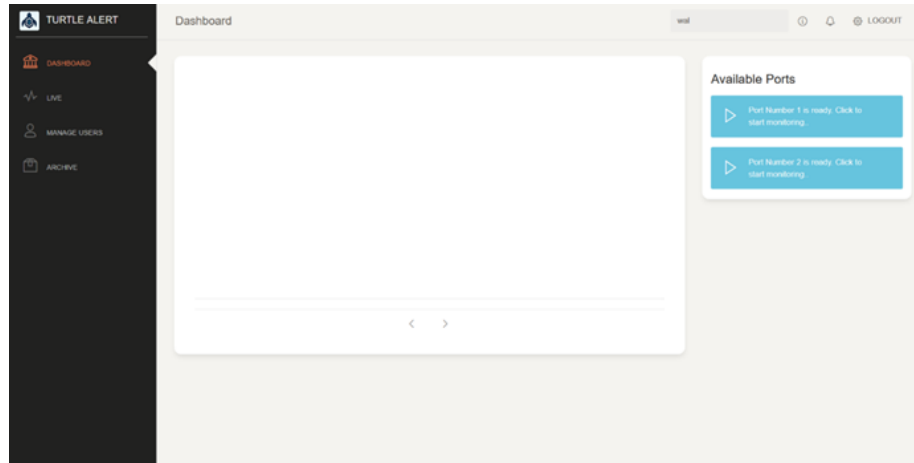
2. Open your web browser and enter the IP address you have set in the address bar: **ex. http://192.168.116.1:8080**



3. After entering the URL, you will be redirected to the Turtle Alert login page. You can log in using the website's default user credentials.



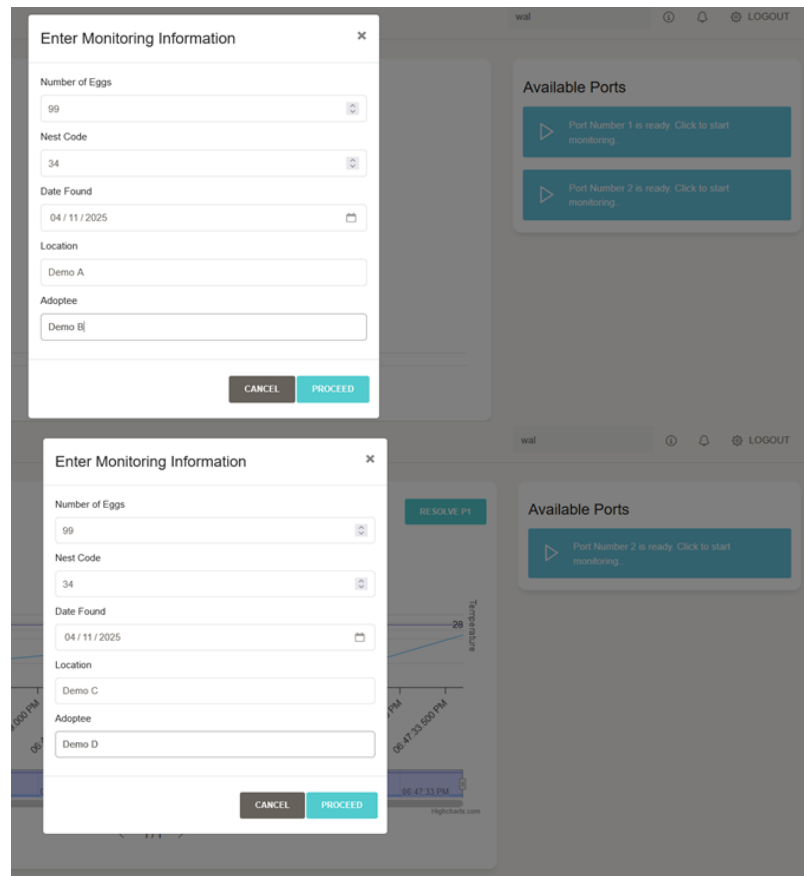
- Once logged in, you will be directed to the Dashboard page. From here, you can start monitoring if a smart sensor is available.



- For Email Notification, the logged in Admin must create a new user with their Email on the **"Manage User"** Section. Delete unnecessary accounts if needed.

A screenshot of a web form titled "Add New User". The form contains the following fields: "First Name" (Adrian Dave), "Middle Name" (C), "Last Name" (Forte), "Gmail" (adriandave.forte@lorma.edu), "Username" (adrianDave), "Password" (123), and "Role" (Admin). At the bottom of the form are two buttons: "CLEAR" and "SUBMIT".

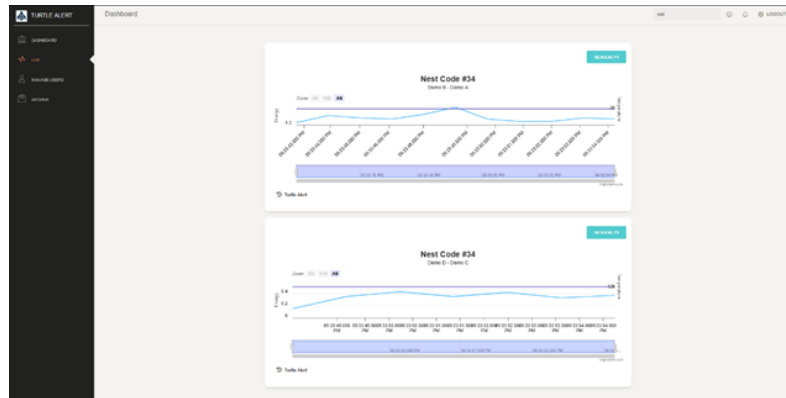
- To begin monitoring Port 1 and Port 2, go to the Available Ports tab and click the Play button next to each port.



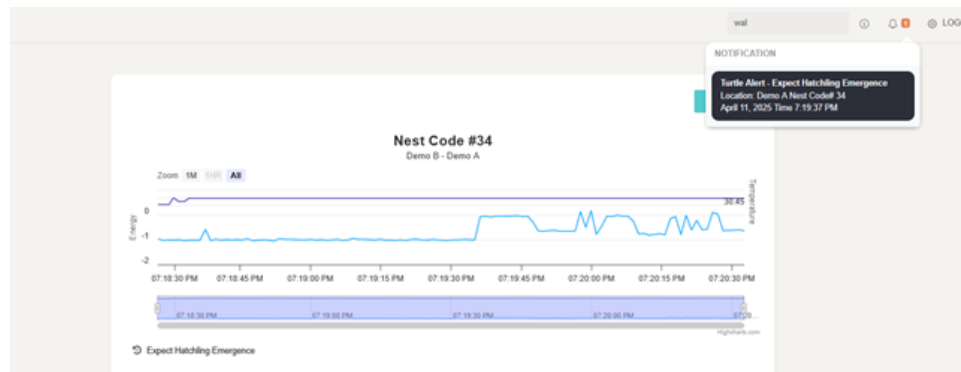
- If there are no available ports and all ports are already monitoring, the Dashboard will display all active monitoring sessions, as shown below.



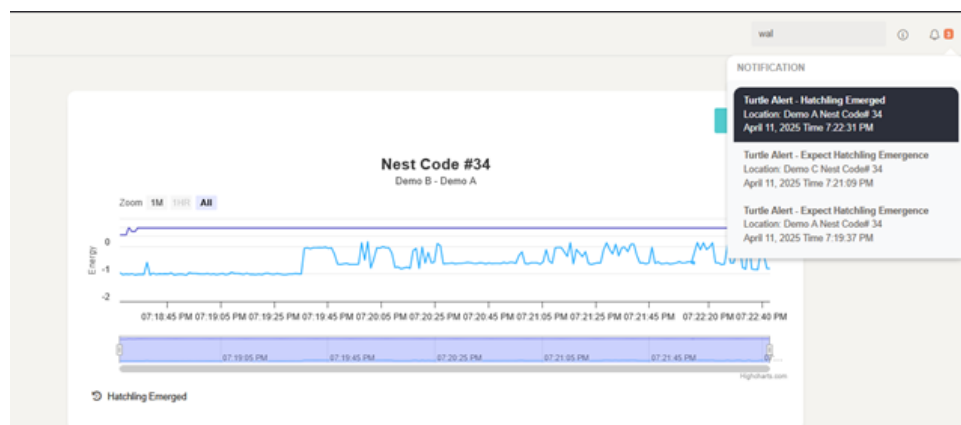
8. Navigate to the Live tab to view real-time data from both ports. The graphs update every second, allowing you to monitor sensor activity as it happens.



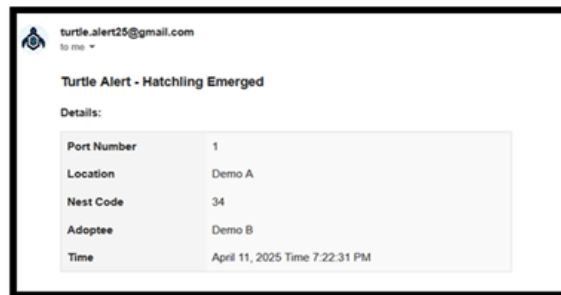
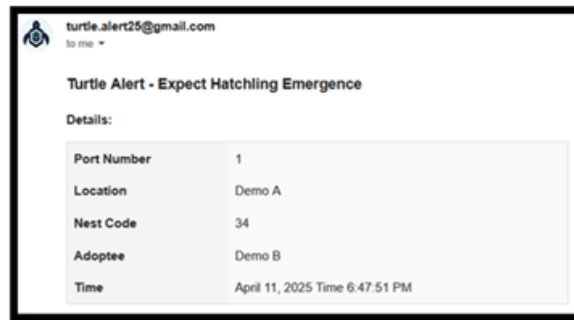
--Let's simulate an aggressive movement at Port 1 to mimic the detection of hatchling emergence. This will trigger the system to recognize and log the activity accordingly.--



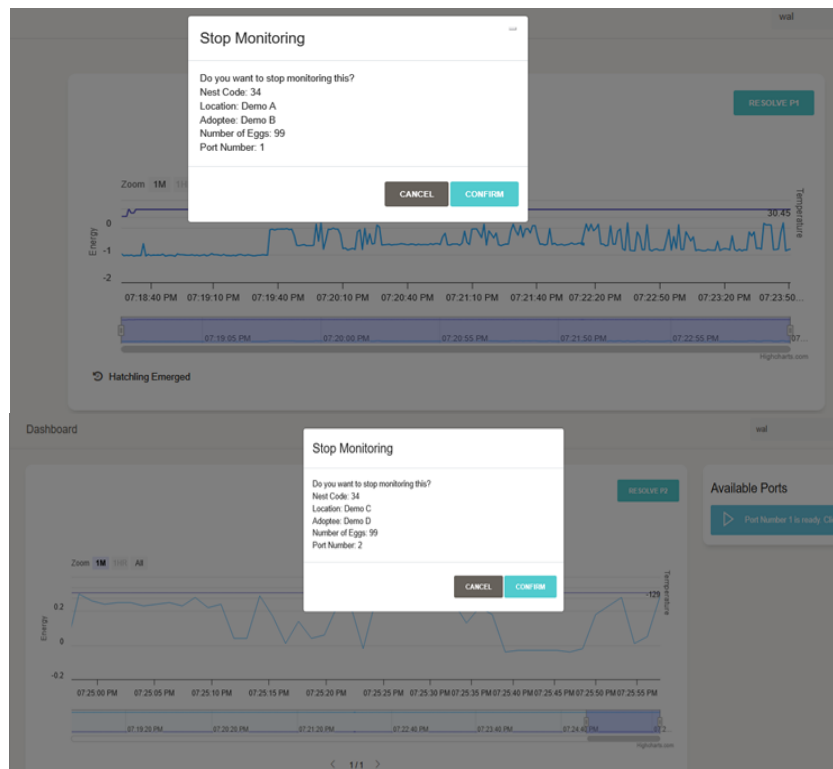
--Once the activity is detected, the backend of the website will automatically send a notification email to all registered users via Gmail.--



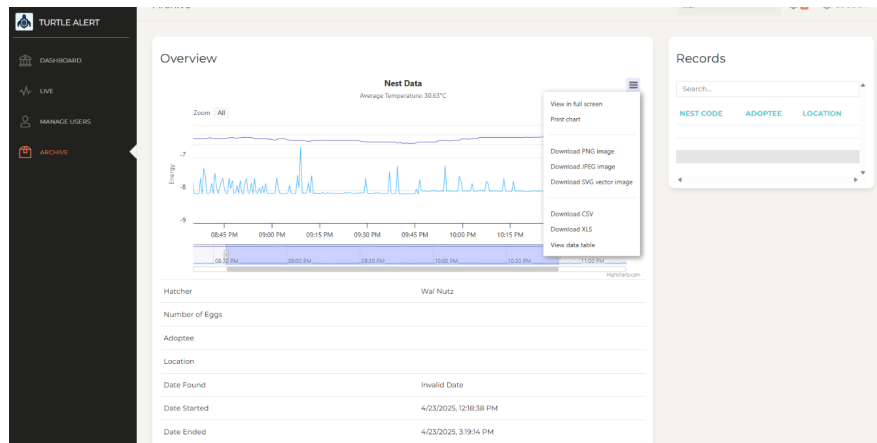
example of the notification sent by the backend to registered users:



- After completing the monitoring, you can save the data. It will be stored on the Archive page for future reference.



10. The Archive page stores all resolved nest monitoring data, including details such as temperature and movement.



On the Archive page, you can view the graph showing when the aggressive movement started and the hatchling emergence event. You can also see the details of who monitored and resolved the monitoring for each port. Additionally, the page displays the start and end times of the monitoring, along with the complete date and duration. You'll also find the average temperature of the nest throughout the monitoring process. You can export the graph as PNG, PDF, JPEG, or SVG vector. Lastly, download the nest data as Json, Xls or Csv file.

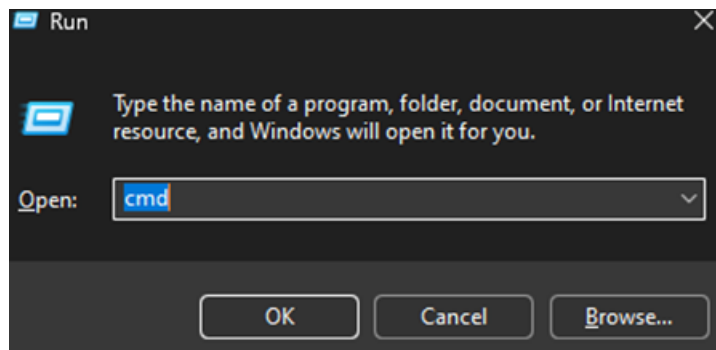
11. On the Manage Users page, if you have admin privileges, you can add, edit, or delete users.

The screenshot shows the 'TURTLE ALERT' User Management interface. The left sidebar is the same as in the previous image. The main area is titled 'User Management' and contains two sections. On the left is a 'Add New User' form with fields for First Name, Middle Name, Last Name, Email, Username, Password, and Role (set to 'Admin'). On the right is a 'Users' table listing existing users.

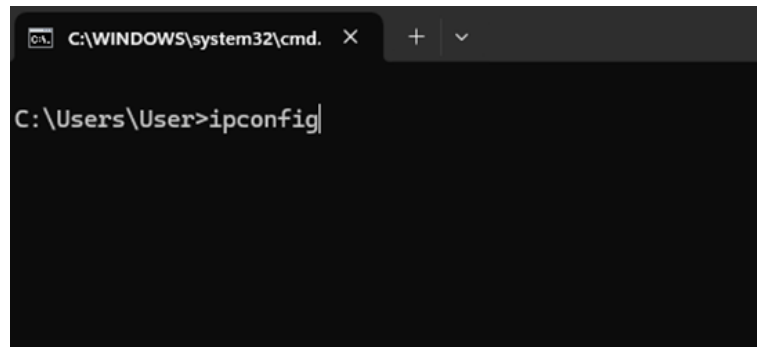
FULLNAME	EMAIL	USERNAME	PASSWORD	ROLE	
Wal Nutz	admin@gmail.com	wal	123	admin	<button>EDIT</button>
Francis Jay C. Desierto	user@gmail.com	nutz	123	user	<button>EDIT</button> <button>DELETE</button>

How to find your IP Address

1. Open the command prompt:
 - On Windows, press Win + R, type cmd, and press Enter to open the Command prompt.



- Run the ipconfig Command



- Find The Ipv4 Address

```
Connection-specific DNS Suffix . :  
Link-local IPv6 Address . . . . . :  
IPv4 Address. . . . . : 192.168.100.3  
Subnet Mask . . . . . : 255.255.255.0  
Default Gateway . . . . . : 192.168.100.1
```

Make sure that the Default Gateway is listed under the same section. This is the network gateway, and it's usually the router's IP address.



APPENDIX K

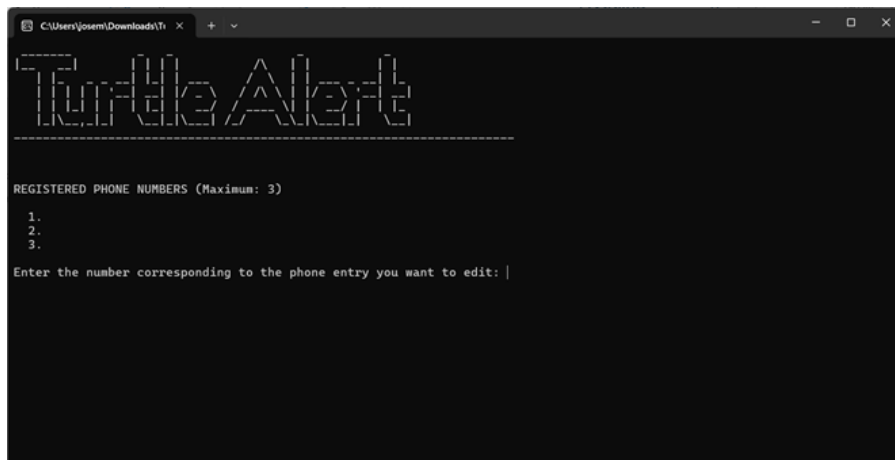
User Manual for Setting up Phone Number for SMS Notification

1. Go to Turtle Alert Folder > Sms > SMS (Sms Notification).
2. Open the application named "**TurtleAlert PhoneNumber Setup**".

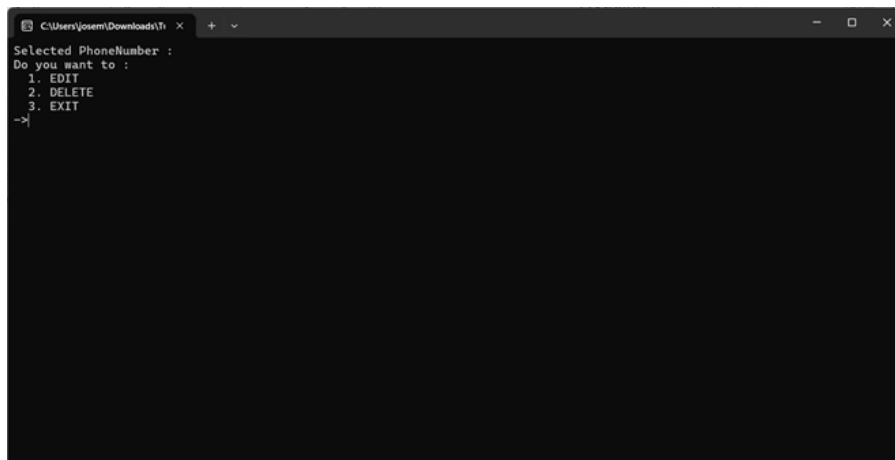


TurtleAlert PhoneNumber Setup

3. Enter the corresponding number you want to add or edit.



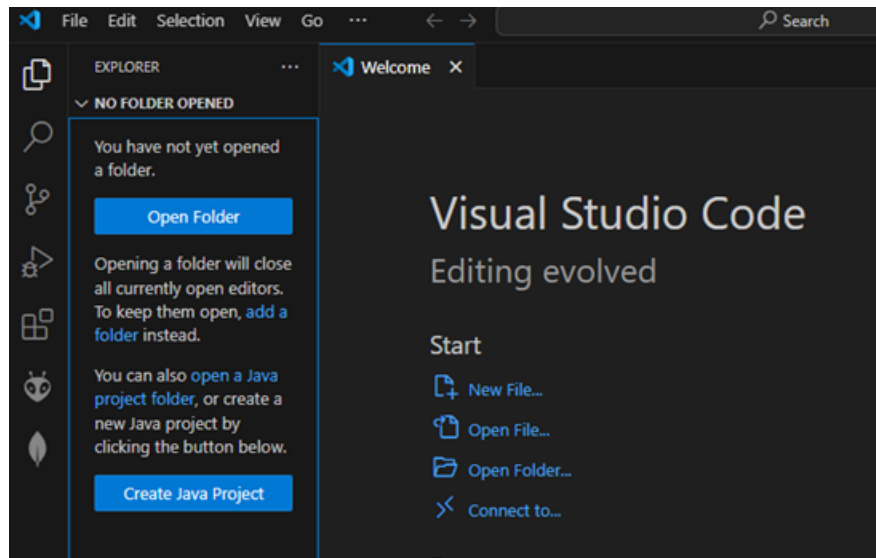
4. Select which function you want to do with the number.



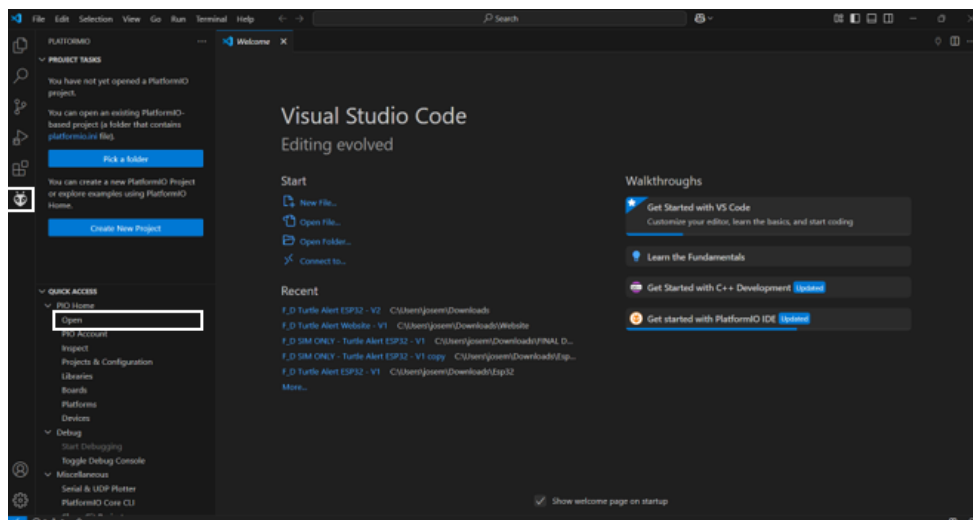
5. If done with the setup, Plug the ESP32 into a computer or laptop.



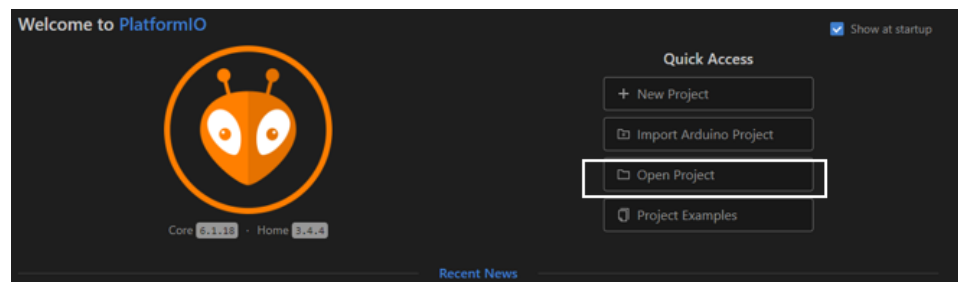
6. Open VsCode.



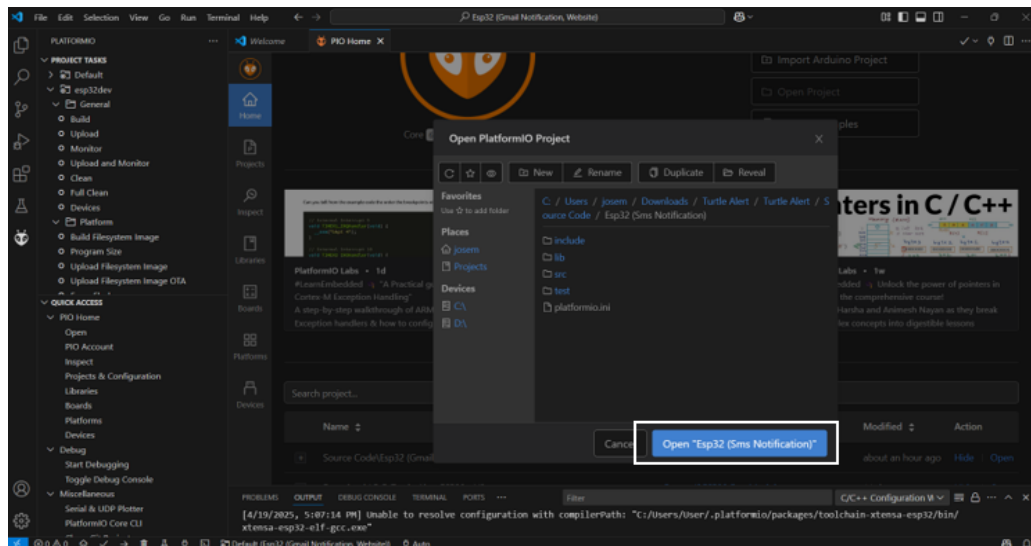
7. Click the **PlatformIO** icon, then click **Open**.



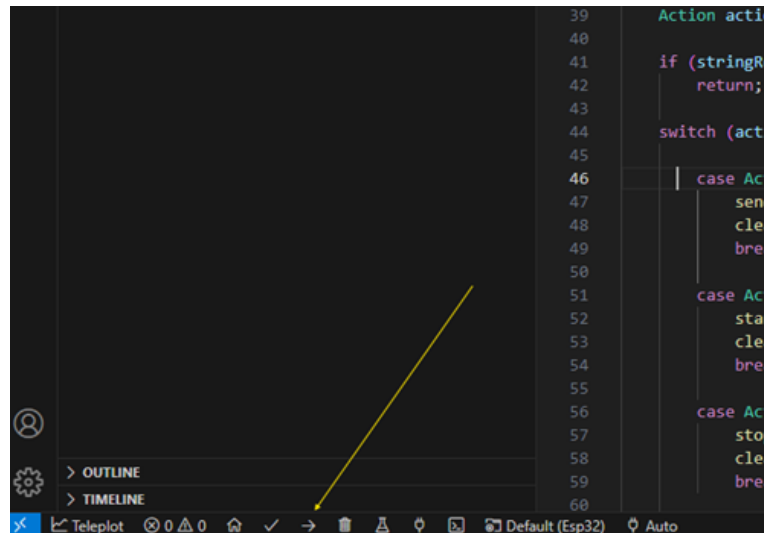
8. Click **Open Project**, then find the downloaded folder "**Turtle Alert**".



9. Once you found the folder named **"Turtle Alert"**, Go to Turtle Alert > Sms, then click **Open "ESP32 (Sms Notification)"**.



10. Click the arrow "→" icon bottom left to upload the code.



--If an error occurs, hold **"BOOT"** while uploading the file--

11. Set up the device on the nest.

NOTE: For SMS Notification, make sure the SIM Card has sufficient load/credit for sending SMS messages.

SIM card number: 09956649939



APPENDIX L

User Manual for Main Hub and Smart Sensors Nest Setup

1. The user should connect the 5V 4A Power Adapter's Barrel plug to the DC Barrel Jack in the Main Hub's back labeled "Power". The device must be powered first before plugging in Smart Sensors.



2. Plug the stand of the Main Hub.
3. Plug the stand on the side of the Smart Sensor.
4. Bury the Smart Sensor's accelerometer (MPU6050) one foot above the nest



5. Bury the temperature sensor (DS18B20) at the center of the nest.



6. Remove the ports cover.



7. Plug the Smart Sensor into the Main Hub to start monitoring.



Sample TurtleAlert Setup:



PHOTO DOCUMENTATION



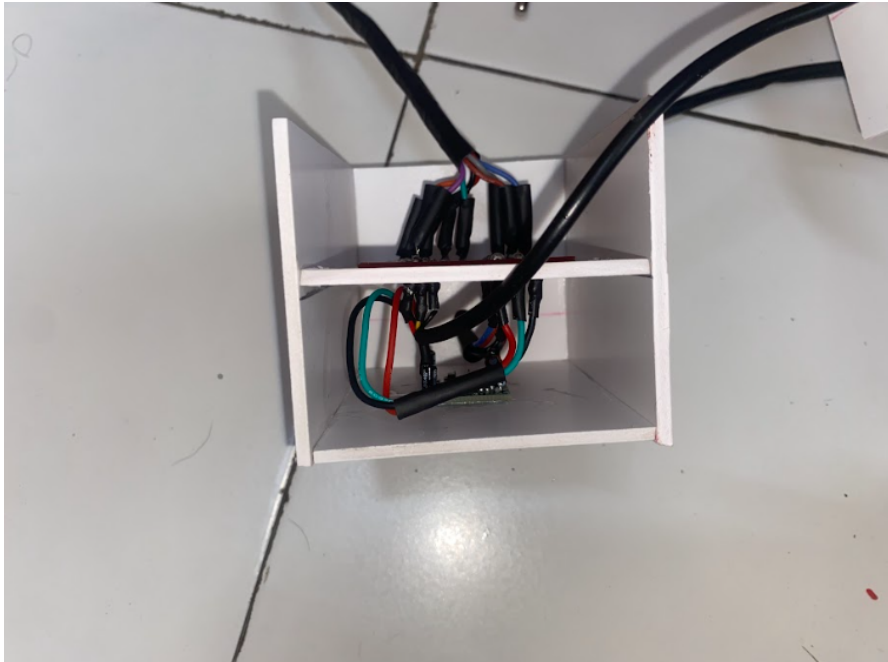
Distribution of Assessment Form



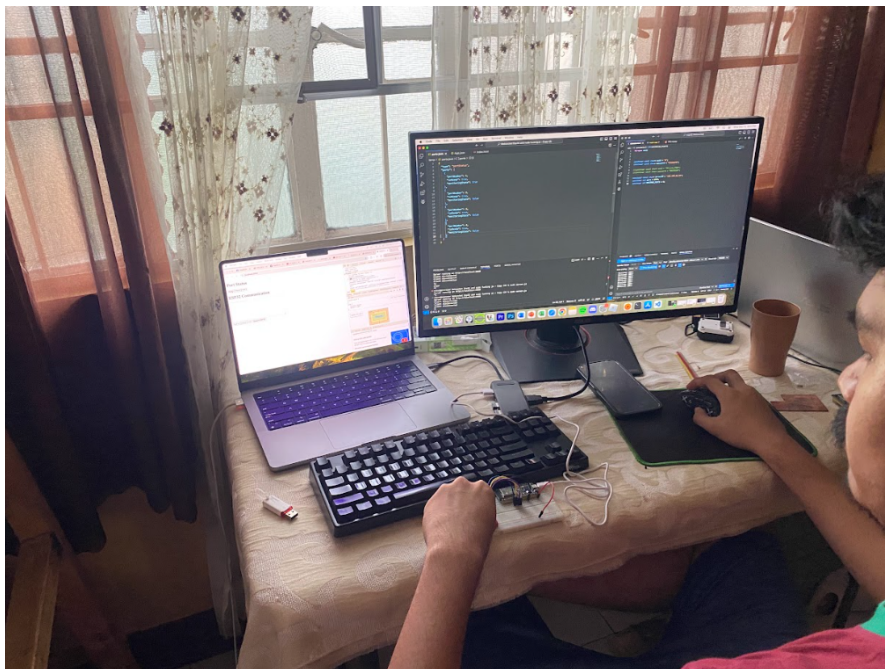
Assessment Form Content Validation



TURTLEALERT'S DEVELOPMENT PHASE

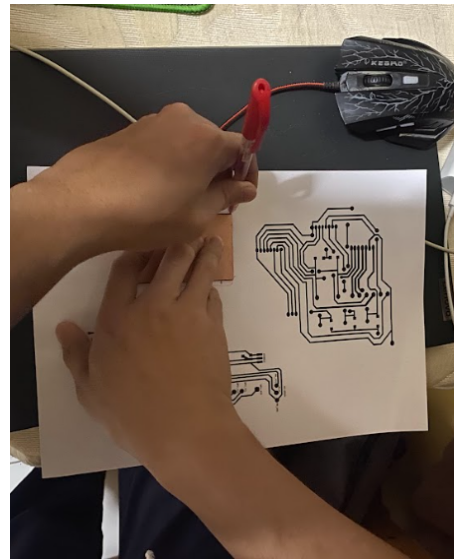


Smart Sensor Casing in Making

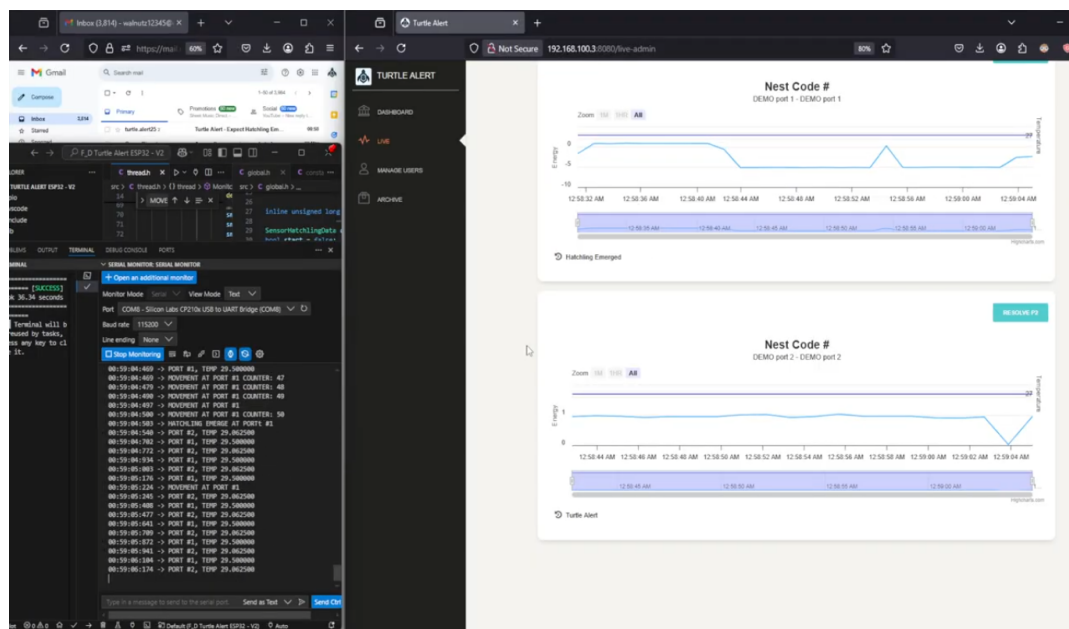


Initial Testing of Pin Activator using a Switch for Multiple Nest Monitoring





TurtleAlert's First Main and Smart Sensor PCB in Making



Real-Time Graph Display of TurtleAlert

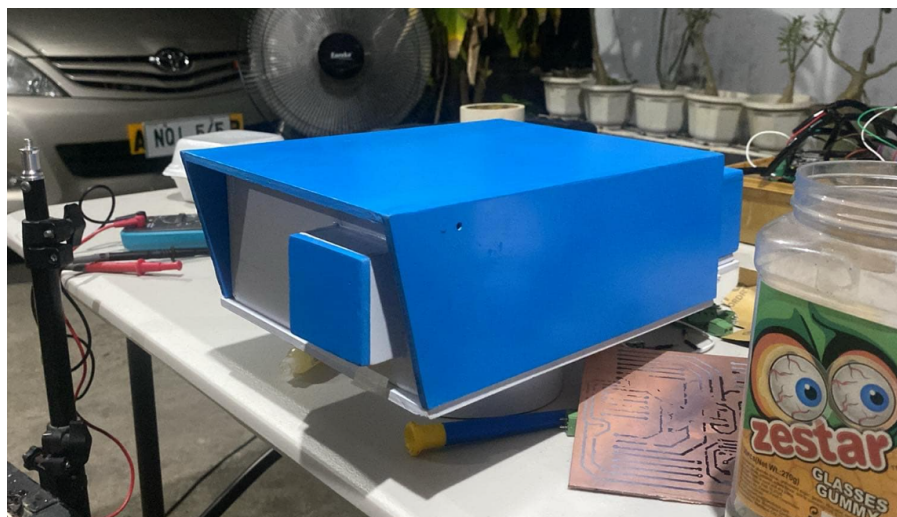




Accelerometer Movement Detection 1ft Below Sand Testing



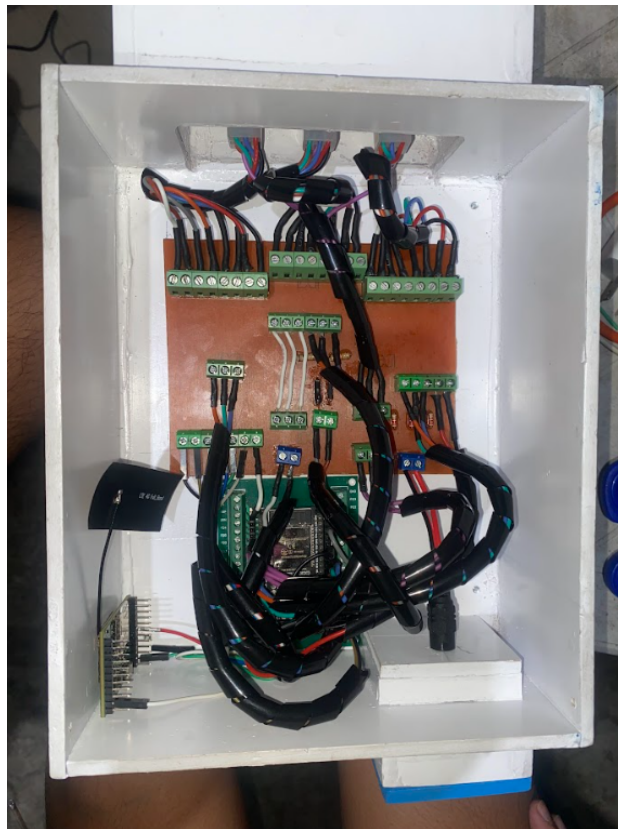
TurtleAlert Second Version in Making



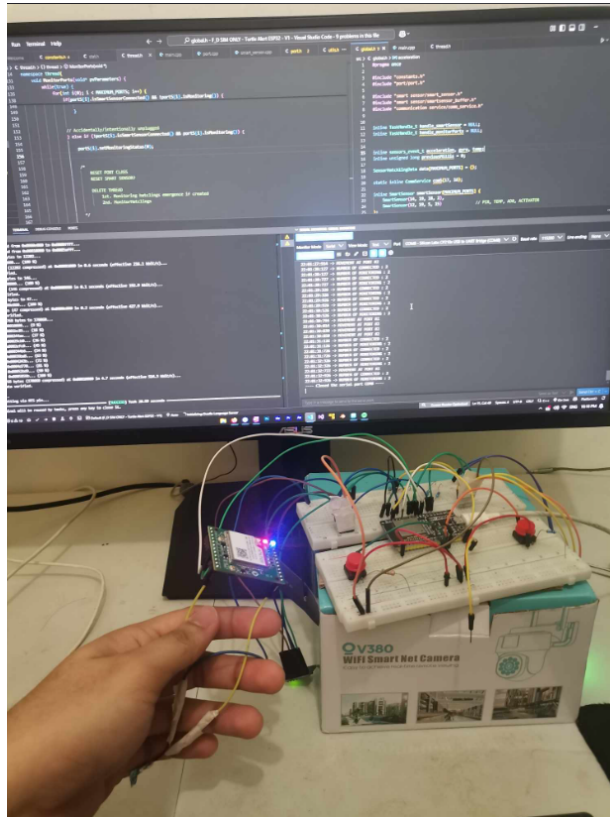
Second Version of TurtleAlert's Main Hub



Second Version of TurtleAlert's Smart Sensor



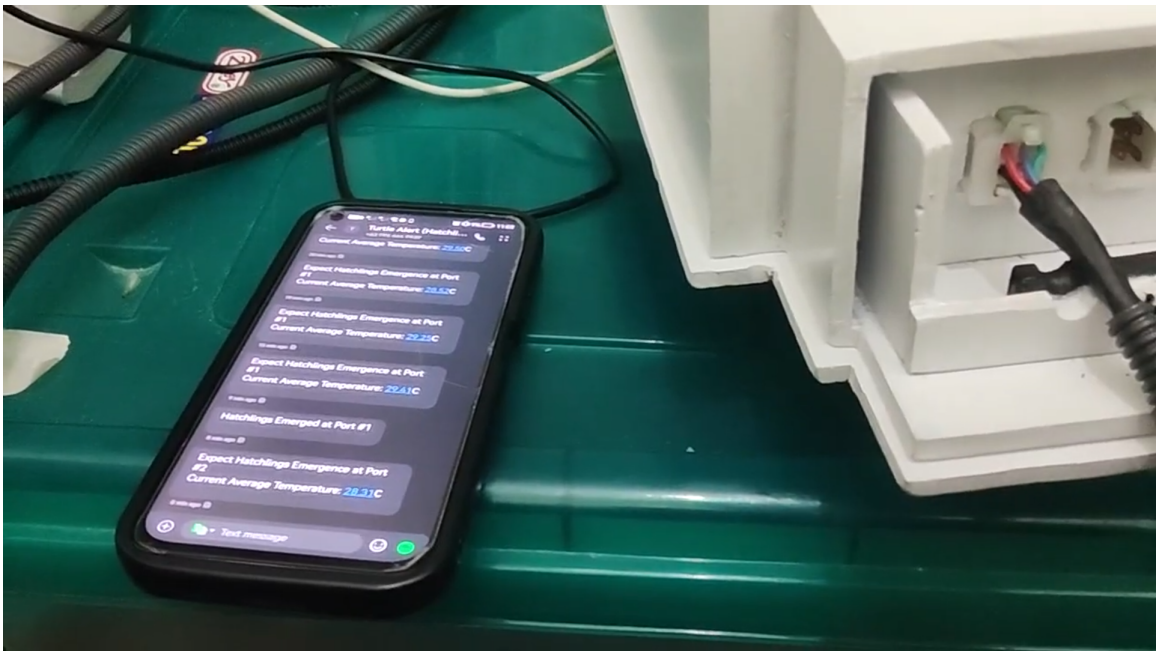
Main PCB of TurtleAlert



Testing of SIM A7672s



Optimized Real-Time Display of Graph



Testing A7672s for SMS notification



Testing TurtleAlert's Functionality



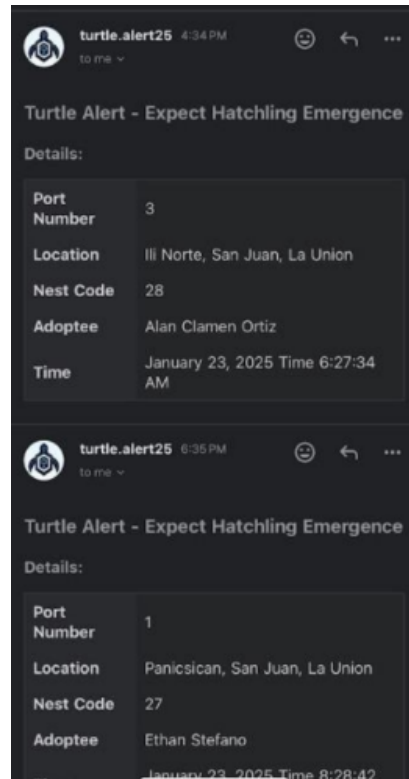
DEPLOYMENT OF TURTLEALERT



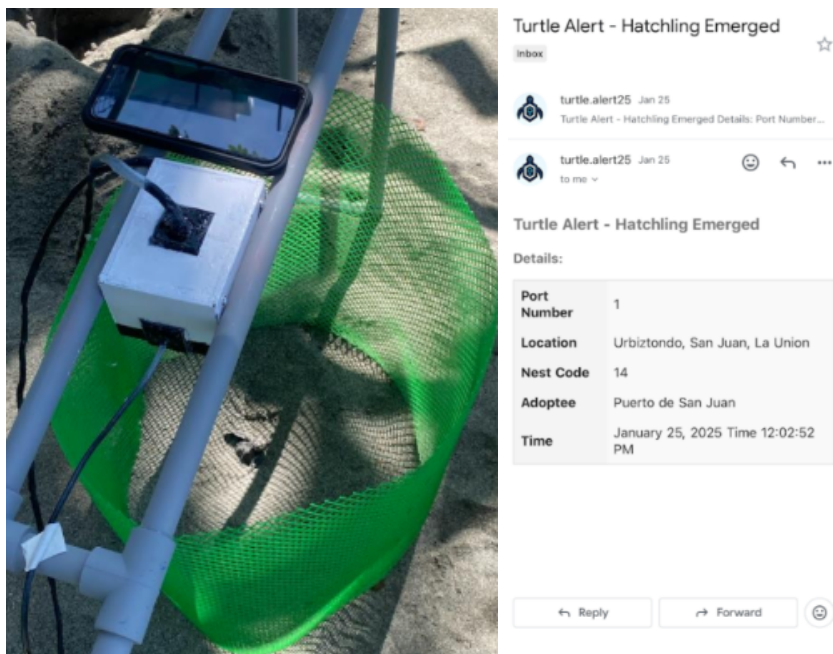
Final Device Testing Before First Deployment



First Deployment of TurtleAlert



First Hatchling Emergence Prediction Notification



First Hatchling Emergence Detected



Second Deployment of TurtleAlert



Second Hatchling Prediction and Emergence Detected





TurtleAlert V2 Deployment

PRE-FINAL DEFENSE



Pre-Final Defense at Project CURMA, San Juan



FINAL DEFENSE



Final Defense at Project CURMA



Final Defense at LORMA Colleges, CLI



CURRICULUM VITAE



Adrian Dave C. Forte

I. PERSONAL INFORMATION

Address : Las-ud, Caba, La Union
Contact Number : 09215182145
Email address : adriandave.forte@lorma.edu
Date of Birth : April 15, 2023
Place of Birth : Las-ud, Caba, La Union

II. EDUCATIONAL BACKGROUND

Tertiary LORMA Colleges, Inc.
Secondary Caba National High School (Grade 12 Senior High School & Junior High School)
AMA Computer College (Grade 11 Senior High School)
Primary Caba Elementary School

III. AWARDS/CITATIONS/RECOGNITIONS RECEIVED

Award/Citations/Recognitions Received	Institution	Year
Academic Half Scholar – 2nd Semester 2023-2024	LORMA Colleges	2023-2024
Academic Half Scholar – 1st Semester 2023-2024	LORMA Colleges	2023-2024
Academic Full Scholar – 2nd Semester 2022-2023	LORMA Colleges	2022-2023
Academic Half Scholar – 1st Semester 2022-2023	LORMA Colleges	2022-2023



Academic Half Scholar – 2nd Semester 2021-2022	LORMA Colleges	2021-2022
Academic Half Scholar – 1st Semester 2021-2022	LORMA Colleges	2021-2022
Grade 12 – With Honors	Caba National High School	2020-2021
Grade 11 – With Honors	AMA Computer College	2019-2020
Grade 10 – With Honors	Caba National High School	2018-2019
Grade 9 – With Honors	Caba National High School	2017-2018
Grade 8 – With Honors	Caba National High School	2016-2017
Grade 1 – With Honors	Caba Elementary School	2009-2010

IV. WORK EXPERIENCE

On-The-Job Training (OJT) - New Product Introduction (NPI)
Department of CREOTEC Philippines Inc., Laguna Technopark, Biñan,
Laguna

V. ELIGIBILITY

None.

VI. SEMINARS ATTENDED

4th National Conference on Computing, Education and Business
2024
Y4IT (Youth for Information Technology) Research Summit
2024

VII. INVOLVEMENT IN RESEARCH/RESEARCHES CONDUCTED

None.





Francis Jay C. Desierto

I. PERSONAL INFORMATION

Address : Sitio Padayao, Brgy. Dirdirig, Burgos,
Ilocos Sur
Contact Number : 09982902749
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Date of Birth : May 27, 2003
Place of Birth : Sta. Maria, Ilocos Sur

II. EDUCATIONAL BACKGROUND

Tertiary LORMA Colleges, San Juan Campus
Secondary Saint Louis College (Senior High School)
Saint Louis College (Junior High School)
Primary Padayao Elementary School
Carot Elementary School

III. AWARDS/CITATIONS/RECOGNITIONS RECEIVED

Award/Citations/Recognitions Received	Institution	Year
Academic Dean's Lister - 1st Semester 2021-2022	LORMA Colleges	2021-2022

IV. WORK EXPERIENCE

On-The-Job Training (OJT) – Lorma Colleges Center of Learning
and Innovation.

V. ELIGIBILITY

None.

VI. SEMINARS ATTENDED

None.

VII. INVOLVEMENT IN RESEARCH/RESEARCHES CONDUCTED

None.





Jose Marie A. Abuda

I. PERSONAL INFORMATION

Address : Purok 7 Barrientos, Luna, La Union
Contact Number : 09637719660
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Date of Birth : December 31, 2002
Place of Birth : City of San Fernando, La Union

II. EDUCATIONAL BACKGROUND

Tertiary Lorma Colleges, College of Computer Studies and Engineering
Urbiztondo, San Juan, La Union
2021 – Present

Secondary Saint Louis College, Senior High School
2019 – 2021
San Nicolas Academy, Junior High School
Dr. Camilo Osias, Balaoan, La Union
2015 – 2019

Primary San Nicolas Academy
Dr. Camilo Osias, Balaoan, La Union
2009 – 2015

III. AWARDS/CITATIONS/RECOGNITIONS RECEIVED

Award/Citations/Recognitions Received	Institution	Year
Academic Full Scholar, Second Semester	LORMA Colleges	2023-2024
Academic Half Scholar, First Semester	LORMA Colleges	2023-2024
Academic Full Scholar, Second Semester	LORMA Colleges	2022-2023



Academic Half Scholar, First Semester	LORMA Colleges	2022-2023
Academic Half Scholar, Second Semester	LORMA Colleges	2021-2022
Academic Half Scholar, First Semester	LORMA Colleges	2021-2022
Grade 12, With Honors	Saint Louis College	2020 – 2021
Grade 10, With High Honors	San Nicolas Academy	2018 – 2019
Grade 9, With Honors	San Nicolas Academy	2017 – 2018
Grade 8, With Honors	San Nicolas Academy	2016 – 2017
Grade 7, First Honors	San Nicolas Academy	2015 – 2016
Grade 6, First Honorable Mention	San Nicolas Academy	2014 – 2015
Grade 5, With Honors	San Nicolas Academy	2013 – 2014
Grade 4, Fourth Honors	San Nicolas Academy	2012 – 2013
Grade 3, With Honors	San Nicolas Academy	2011 – 2012
Grade 2, With Honors	San Nicolas Academy	2010 – 2011
Grade 1, With Honors	San Nicolas Academy	2009 – 2010
Kindergarten, With Honors	San Nicolas Academy Kindergarten	2008 – 2009

IV. WORK EXPERIENCE

On-The-Job Training (OJT) - New Product Introduction (NPI)
Department of CREOTEC Philippines Inc., Laguna Technopark, Biñan,
Laguna



V. ELIGIBILITY

None.

VI. SEMINARS ATTENDED

4th National Conference on Computing, Education and Business

2024

Y4IT (Youth for Information Technology) Research Summit

2024

VII. INVOLVEMENT IN RESEARCH/RESEARCHES CONDUCTED

None.





Ryne Joshua O. Boado

I. PERSONAL INFORMATION

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Date of Birth : January 12, 2003
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II. EDUCATIONAL BACKGROUND

Tertiary LORMA Colleges, Inc.
Secondary Saint Louis College (Senior High School)
Castor Z. Concepcion Memorial National High School
(Junior High School)
Primary Balaoan Central School

III. AWARDS/CITATIONS/RECOGNITIONS RECEIVED

Award/Citations/Recognitions Received	Institution	Year
Academic Full Scholar - 2nd Semester 2023-2024	LORMA Colleges	2023-2024
Academic Full Scholar - 1st Semester 2023-2024	LORMA Colleges	2023-2024
Academic Full Scholar - 2nd Semester 2022-2023	LORMA Colleges	2022-2023
Academic Full Scholar - 1st Semester 2022-2023	LORMA Colleges	2022-2023
Academic Half Scholar - 2nd Semester 2021-2022	LORMA Colleges	2021-2022



Academic Half Scholar - 1st Semester 2021-2022	LORMA Colleges	2021-2022
Grade 12, With Honors	Saint Louis College	2020 – 2021
Grade 10, With High Honors	Castor Z. Concepcion Memorial National High School	2018 – 2019
Grade 9, With Honors	Castor Z. Concepcion Memorial National High School	2017 – 2018
Grade 6, First Honorable Mention	Balaoan Central School	2014 – 2015
Grade 5, With Honors	Balaoan Central School	2013 – 2014
Grade 4, Fourth Honors	Balaoan Central School	2012 – 2013
Grade 3, With Honors	Balaoan Central School	2011 – 2012

IV. WORK EXPERIENCE

On-The-Job Training (OJT) - New Product Introduction (NPI)
Department of CREOTEC Philippines Inc., Laguna Technopark, Biñan,
Laguna

V. ELIGIBILITY

Civil Service Commission Sub-Professional Passer - March 2023

VI. SEMINARS ATTENDED

4th National Conference on Computing, Education and Business
2024
Y4IT (Youth for Information Technology) Research Summit 2024

VII. INVOLVEMENT IN RESEARCH/RESEARCHES CONDUCTED

None.





BRIANNE MARK T. AQUINO

I. PERSONAL INFORMATION

Address : #23 Brgy. Panicsican, San Juan, La Union
Contact Number : +639108042422
Email address : brianneaquino@gmail.com
Date of Birth : July 12, 1993
Place of Birth : Brgy. Panicsican, San Juan, La Union

II. EDUCATIONAL BACKGROUND

Tertiary BS IN COMPUTER ENGINEERING
Lorma Colleges
2010-2016
Secondary High School
Lorma Special Science HS
2007-2010
Primary Grade School
Felkris Academy Inc.
2000-2006

III. WORK EXPERIENCE

Teacher, 2019-Present
Lorma Colleges, CCSE Department

I am responsible for instructing students in various subjects, creating lesson plans, evaluating student performance, and fostering a positive learning environment. Our job play a vital role in shaping the education and development of students.

Barangay Secretary, 2017-2019
LGU Panicsican, Panicsican, San Juan, La Union

I perform administrative duties in local government units,



maintaining records, organizing meetings, and assisting with official documents. My job play a crucial role in supporting the operations and governance of the barangay.

IV. REFERENCES

Alejandrino A. Morla
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Ardee Joy T. Ocampo, DIT
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