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Swiftlet Sanctuary Surveillance: Integrating Temperature, Humidity, and Light Sensors for Enhanced Monitoring

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Abstract

The surging demand for saliva-based nests in East Asia has led to increased swiftlet farming, despite challenges in manually monitoring swiftlet house conditions. This study introduces an automated monitoring system utilizing DHT11, LDR, and ESP32 microcontrollers. Real-time monitoring of temperature, humidity, and light levels aims to ensure an ideal swiftlet habitat. Integration with Blynk enables remote data access and timely notifications based on set thresholds. Project goals include creating a notification system for environmental changes, implementing an effective monitoring system, and displaying real-time data on an IoT platform. The project focuses on regular monitoring, web-based accessibility, and notification delivery. The use of DHT11, LDR, and ESP32 is expected to yield desired results, with data presented on a Blynk mobile app [2]. The system alerts extreme values with a siren and LEDs. This project contributes to knowledge on swiftlet monitoring, aiding farmers in providing conducive environments, enhancing nest quality, and promoting ethical farming. The monitoring system, through remote access and notifications, safeguards nests, swiftlets, and encourages sustainable farming practices, potentially boosting profits in the Southeast Asian swiftlet farming sector.

1. Introduction

Swiftlet houses are special structures designed for breeding swiftlets, known for their prized saliva-based nests used in the food and pharmaceutical industries, particularly in East Asia. The key is to create a comfortable environment for the birds to thrive and build nests.

Maintaining an ideal habitat within a swiftlet house is crucial to attract and retain swiftlet populations. Factors like temperature, humidity, and light levels play a significant role. To ensure the well-being of the birds and successful nesting, it's essential to monitor and control these environmental conditions.

Recent advancements in wireless communication and microcontroller technology have enabled the development of intelligent monitoring systems for swiftlet homes [1]. Microcontrollers like the ESP32, along with sensors such as DHT11 (humidity and temperature) and LDR (light), can be used to gather real-time environmental data. This technology allows precise monitoring and control.

Connecting the monitoring system to a mobile app like Blynk enhances accessibility. Users can remotely access and review the collected data. The program can also send timely warnings and messages based on predefined thresholds. This feature enables swiftlet home owners or caretakers to respond quickly to any adverse changes in the environment and maintain ideal conditions.

In conclusion, integrating microcontroller technology, sensors, and mobile applications in a swiftlet home monitoring system can significantly enhance swiftlet population management and maintenance. This benefits both the birds and the industries associated with their nests.

1.1 Problem Statement

Swiftlet houses are traditionally monitored manually, which takes time. Environmental conditions assessment is necessary on a regular basis and can be difficult, particularly for large-scale swiftlet farms. Additionally, when environmental conditions differ from the ideal range, the manual monitoring strategy might not promptly warn users, which could have a negative impact on swiftlet numbers.

An automated monitoring system for swiftlet homes utilising the ESP32 microcontroller, DHT11 humidity and temperature sensors, and LDR light sensors is suggested in order to overcome these difficulties. The technology intends to gather information about the swiftlet house's temperature, humidity, and light levels in real-time and send notifications via a digital platform.

1.2 Objective

a) To design and implement an efficient monitoring system enabling farmers to oversee the conditions within the swiftlet house.
b) To establish a notification mechanism that promptly alerts users to environmental changes within the swiftlet house.
c) To integrate and display real-time data on an IoT platform, providing users with instant access to crucial information for informed decision-making

1.3 Scopes

(a) Farmers will be able to access the monitoring system from any device with an internet connection because it will be a web-based application.

(b) The swiftlet house's interior temperature, humidity, and light levels will all be regularly monitored by the system.
(c) An notification will be delivered to the farmer's mobile device when the temperature, humidity, or light levels surpass a predetermined threshold..

2. Materials and Methods

Part name	Qty	Function
ESP 32	1	Used as microcontroller board to read and send data to Blynk
DHT 11	1	To measure Humidity and Temperature
LDR	1	Used to indicate the presence or absence of light
Breadboard	1	Used for building circuits
Jumper Wires		Connects components on a circuit board
Resistor	3	Regulates current flow in the circuit
9V Battery	1	Power source for the circuit
Battery Shield	1	Holds and provides connection for the battery

2.1 System Block Diagram

The Swiftlet home monitoring system integrates temperature, humidity, and light sensors to assess the environmental conditions within a Swiftlet enclosure. The DTH11 temperature and humidity sensors, connected to the ESP32 microcontroller, enable real-time data collection and analysis. If values deviate from the acceptable ranges, the Blynk application initiates warnings, activating a red LED via an ESP32 output pin if the sensor reading is not in range while green LED will turn ON if the reading is in range . The LDR measures light intensity, communicating with the ESP32 to gauge illumination conditions. The entire system is powered by a portable 9V battery for flexibility. The ESP32 acts as the central control unit, processing sensor data, managing output devices, and facilitating communication with the Blynk app for remote monitoring. Overall, the ESP32 microcontroller ensures optimal conditions in the Swiftlet housing by monitoring and controlling sensor data.

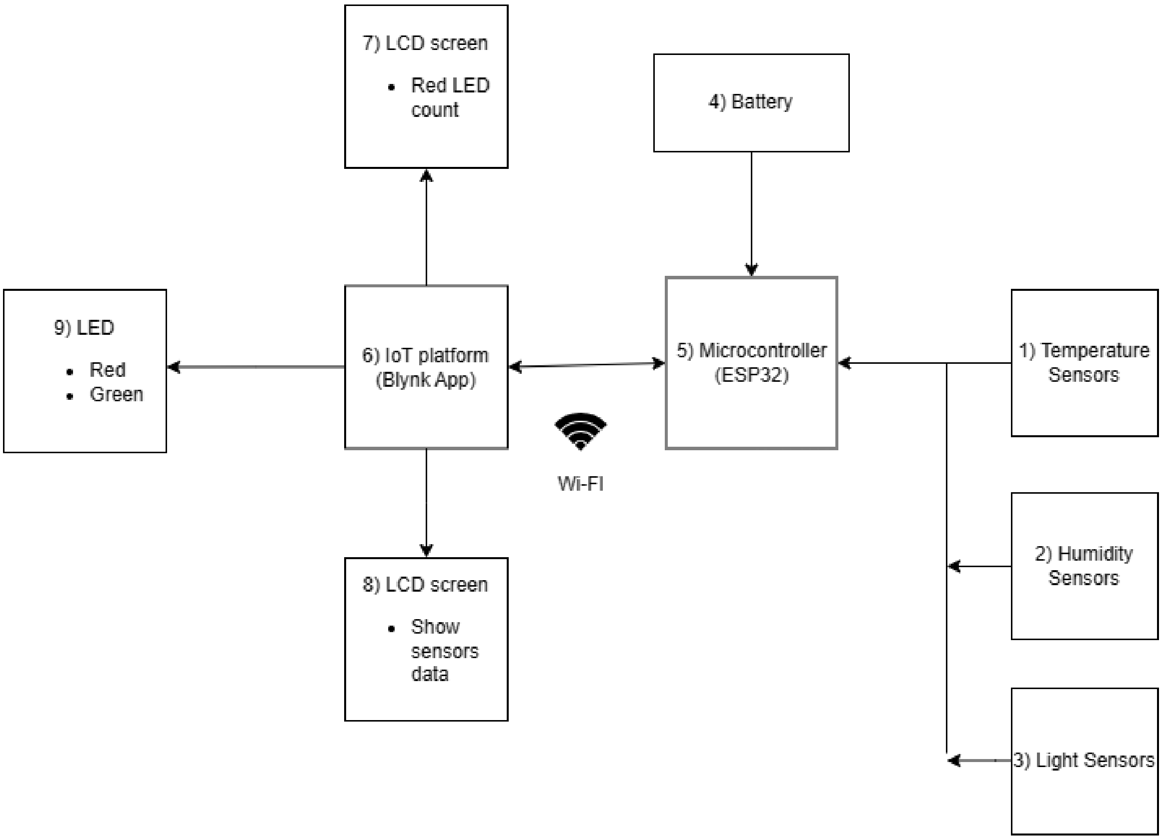


Fig. 2.1 *Block diagram of the project*

2.2 System Flowchart

The Swiftlet House monitoring system, driven by the ESP32 microcontroller and DHT11 temperature/humidity sensors, as well as LDR light sensors, aims to automate climate control. After system initialization and Wi-Fi connection establishment, the flowchart progresses to sensor readings, starting with the DHT11 for humidity and temperature, followed by the LDR for light intensity. Decision points assess whether the values are within preferred ranges; if so, the green LED on the app indicates optimal conditions. If values deviate, the red LED signals undesirable conditions, triggering alerts. The flowchart then loops back to sensor readings for continuous monitoring, ensuring real-time feedback on the phone app for maintaining an ideal environment in the Swiftlet House.

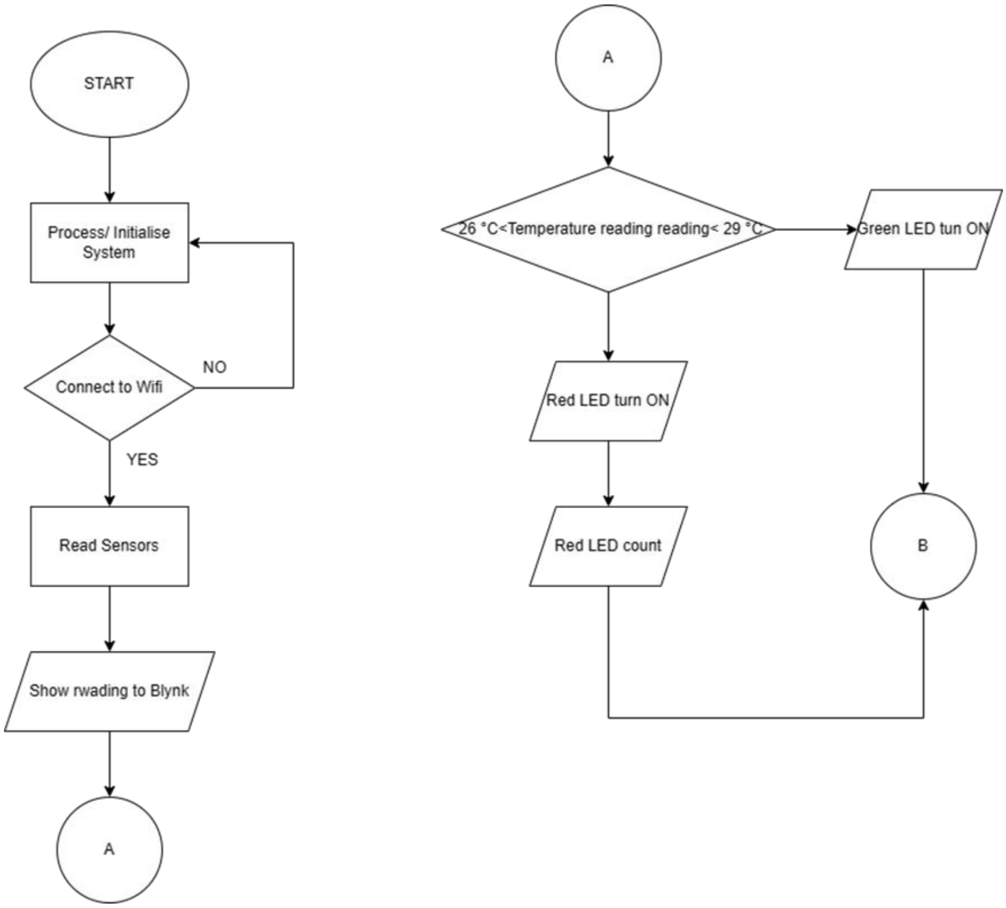


Fig. 2.2 *Flowchart of the system*

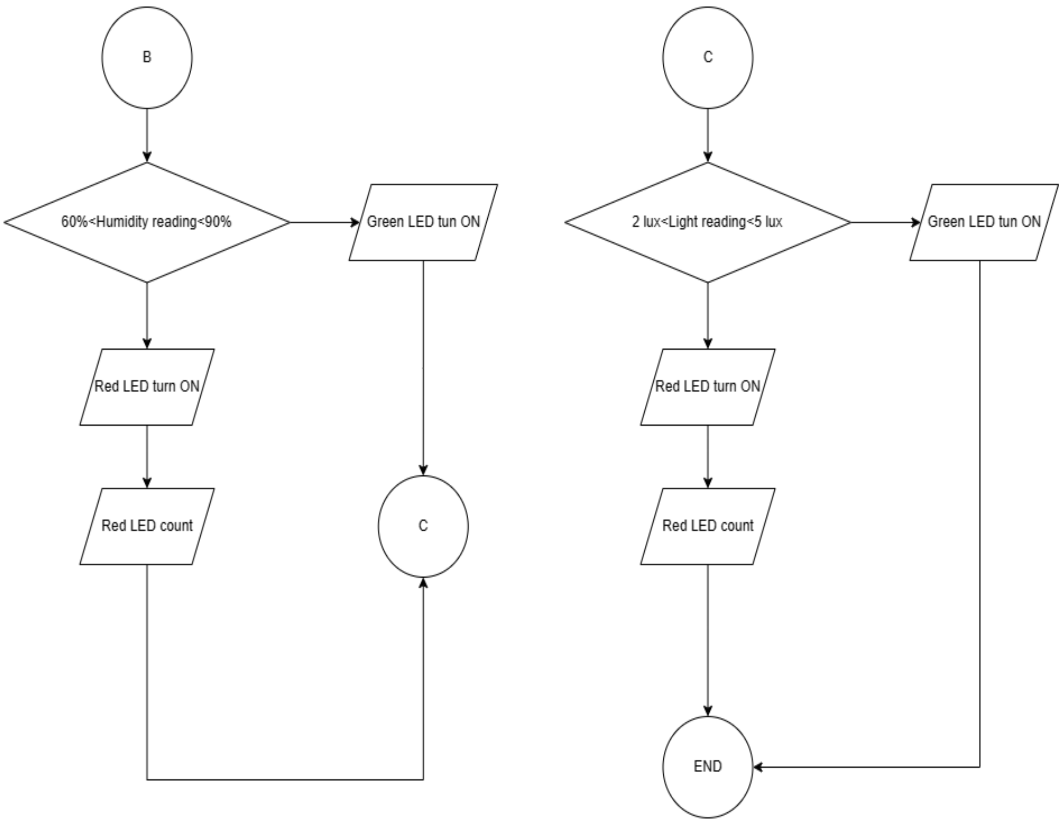
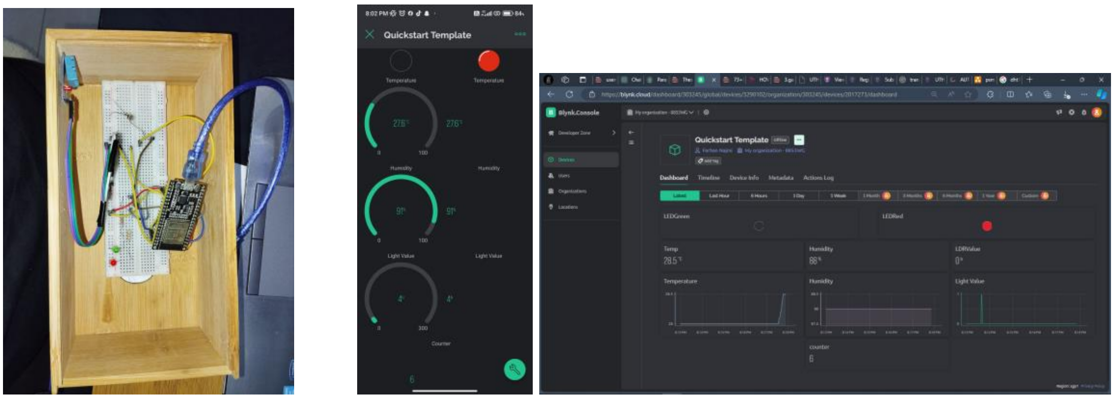


Fig. 2.2 *Flowchart of the system (Continue)*

3. Results and Discussion

3.1 Results

This chapter examines the results of experiments supporting the project's goals of creating a comprehensive monitoring system for swiftlet housing. The main aim was to provide real-time environmental data using advanced technologies like the ESP32 microcontroller, Farmers now have timely data for informed decisions and preventive actions to maintain optimal conditions. The functional overall system prototype is shown in Figure 5.



(a) (b)

Fig. 3.1 *Device testing a) Overall System Test b) Blynk Interface*

DHT11 sensors for humidity and temperature, and LDR sensors for light. Blynk interface show the reading of the sensors, LED indicator and red LED couner to count how many red LED. The primary focus was on optimizing swiftlet housing conditions to ensure their well-being and create ideal nesting environments. Monitoring variables such as temperature, humidity, and light levels is crucial for swiftlet health and successful nesting. The initiative also sought to use intelligent monitoring technologies to improve swiftlet population control.

4.3 Real-time Data Collection

4.3.1 Temperature Data

The temperature data in the swiftlet housing was analyzed using graphs and charts to understand the thermal dynamics during the monitoring period. These visuals show daily temperature fluctuations, helping us comprehend how the environment affects swiftlet well-being and nesting behavior. range.

Table 4.1 *Results of the Tests*

Time	Temperature (°C)
9:00 AM	26.5
9:10 AM	26.7
9:20 AM	26.9
9:30 AM	27.1
9:40 AM	27.3
9:50 AM	27.5
10:00 AM	27.7
10:10 AM	27.9
10:20 AM	28.1
10:30 AM	28.3
10:40 AM	28.5
10:50 AM	28.7

11:00 AM	28.9
11:10 AM	29.1
11:20 AM	29.3
11:30 AM	29.5
11:40 AM	29.7
11:50 AM	29.9
12:00 PM	30.1

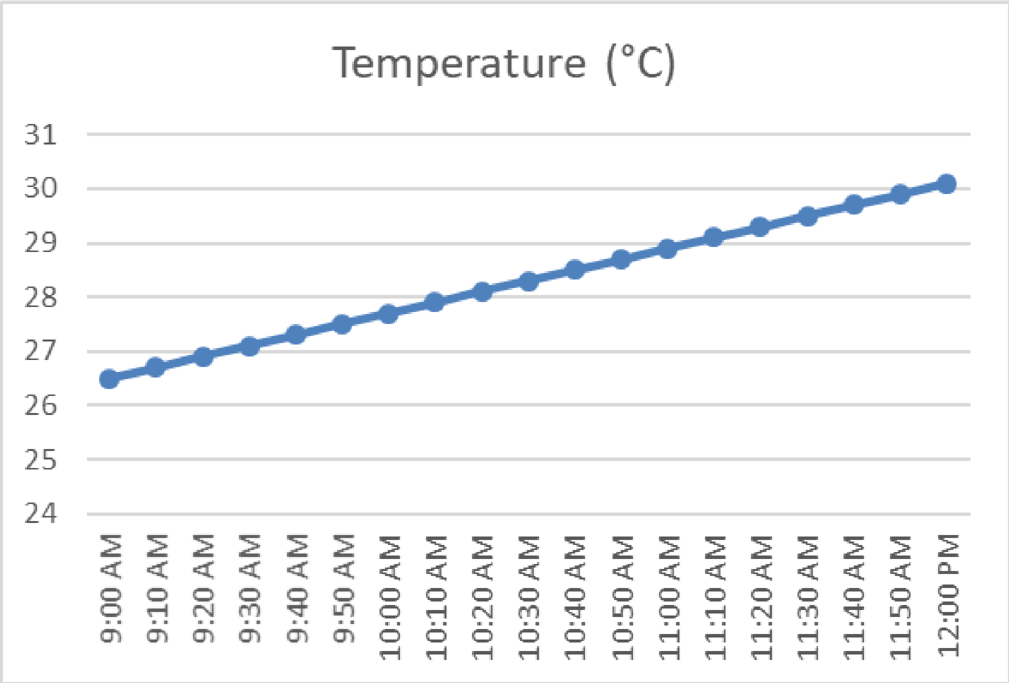


Fig. 4.1 *Graph Temperature Over Time*

For example, the temperature increased from 26.5°C at 9:00 AM to 30.1°C at 12:00 PM, illustrating the complex dynamics influencing the birds. We also considered how these temperature variations correlate with external factors like weather or seasons. By monitoring these changes, we can ensure the swiftlet house maintains an ideal temperature for successful nesting and reproduction. The temperature graph depicts a gradual upward trend from 9:00 AM to 12:00 PM, indicating a slow temperature increase. Peaks and troughs in the graph highlight daily temperature changes, offering a quick visual indicator. This visual representation enhances our understanding of the interactions between environmental elements and swiftlet well-being. For instance, tracking temperature changes helps identify times when the swiftlets may be uncomfortable or at ease.

4.3.2 Humidity Data

Humidity data was examined through graphs, showing how moisture levels in the swiftlet housing change over time in response to various factors. Humidity strongly affects swiftlet health and nesting habits, and understanding these variations helps create the best habitat for them. The graphical data reveals patterns and interactions between environmental conditions, humidity, and swiftlet well-being.

Table 4.2 *Results of the Tests*

Time	Humidity (%)
9:00 AM	82
9:10 AM	82.3
9:20 AM	82.6
9:30 AM	82.9
9:40 AM	83.2
9:50 AM	83.5
10:00 AM	83.8

10:10 AM	84.1
10:20 AM	84.4
10:30 AM	84.7
10:40 AM	85
10:50 AM	85.3
11:00 AM	85.6
11:10 AM	85.9
11:20 AM	86.2
11:30 AM	86.5
11:40 AM	86.8
11:50 AM	87.1
12:00 PM	87.4

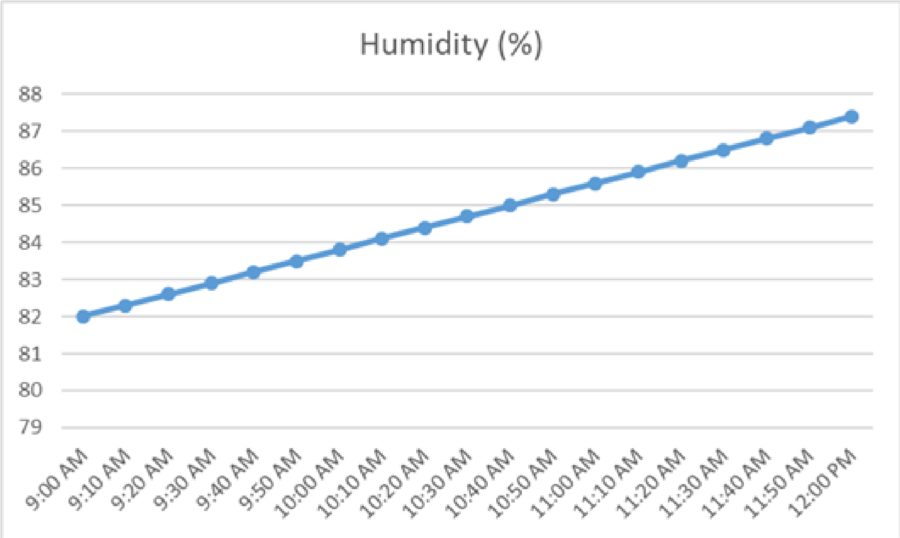


Fig. 4.2 *Graph Humidity Over Time*

The Humidity Data, presented in Table 4.2 and graphically illustrated, is a crucial part of our effort to optimize the swiftlet housing environment. The graph visually depicts the dynamic interactions between environmental factors and moisture content, vital for swiftlet health and nesting behaviors. The graph shows a steady rise in humidity from 82% at 9:00 AM to 87.4% at 12:00 PM, indicating fluctuations. Peaks and troughs in the graph visually represent numerical changes, helping us assess whether the swiftlets might be stressed or comfortable. This detailed understanding of humidity dynamics improves our ability to regulate the swiftlet housing environment, aligning with the project's goal of creating favorable conditions for swiftlet nesting and reproduction.

4.3.3 Light Data

Observing light levels in the swiftlet house is crucial for our comprehensive environmental monitoring. Light, beyond its brightness, significantly impacts swiftlet nesting behavior and overall health. Adjusting the swiftlet house environment based on these light fluctuations helps create ideal conditions for nesting and breeding, aligning with the birds' circadian rhythms. Additionally, a closer look at light data may unveil seasonal preferences, aiding farmers in anticipating and meeting the birds' needs at specific times. Essentially, tracking light data contributes to a comprehensive understanding, improving the sustainability and overall well-being of the swiftlet population by examining the complex interactions between light, swiftlet behavior, and environmental factors.

Table 4.3 *Results of the Tests*

Time	Lux Level (Lux)
9:00 AM	3.2
9:10 AM	3.4

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9:20 AM	3.6
9:30 AM	3.8
9:40 AM	4
9:50 AM	4.2
10:00 AM	4.4
10:10 AM	4.6
10:20 AM	4.8
10:30 AM	5
10:40 AM	5.2
10:50 AM	5.4
11:00 AM	5.6
11:10 AM	5.8
11:20 AM	6
11:30 AM	6.2
11:40 AM	6.4
11:50 AM	6.6
12:00 PM	6.8

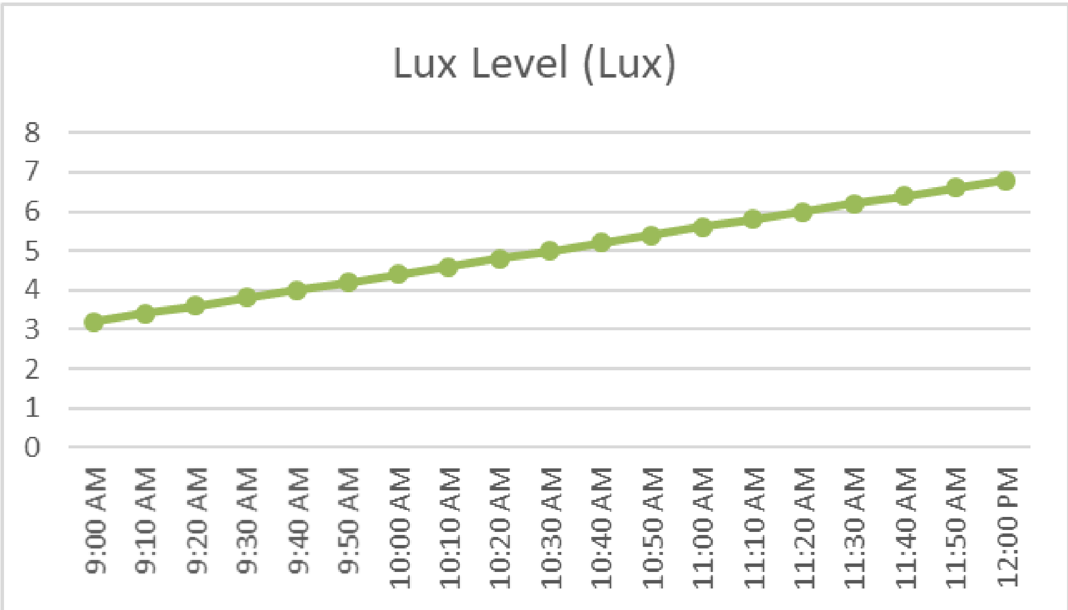

Fig. 4.3 *Graph Lux Over Time*

The Light Data in Table 4.3 is crucial for keeping an eye on the swiftlet environment. It shows daily changes in lux levels, like from 3.2 Lux at 9:00 AM to 6.8 Lux at 12:00 PM. This helps farmers recreate similar lighting in the swiftlet house, matching the birds' natural rhythms. The graph also guides in optimizing the swiftlet housing environment. In simple terms, watching light data helps us grasp how light, swiftlet behavior, and the environment connect, making sure the birds stay healthy.

4.4 Real-time Data Presentation on Blynk

Our monitoring system smoothly connects with Blynk, offering real-time environmental data on an easy-to-use mobile app. Users can remotely monitor the swiftlet housing environment, aided by detailed graphs in Figure 4.10 that show temperature, humidity, and light data. This visual representation allows quick decision-making by spotting deviations from the ideal range. Blynk's intelligence generates alerts promptly when conditions exceed set thresholds, enhancing accessibility and responsiveness

Table 4.4 *Real Time Blynk Data*

Time	Temperature (°C)	Humidity (%)	Lux Level (Lux)	Status
9:00 AM	26.5	82	3.2	GREEN
9:10 AM	26.7	82.3	3.4	GREEN
9:20 AM	26.9	82.6	3.6	GREEN
9:30 AM	27.1	82.9	3.8	GREEN
9:40 AM	27.3	83.2	4	GREEN
9:50 AM	27.5	83.5	4.2	GREEN
10:00 AM	27.7	83.8	4.4	GREEN
10:10 AM	27.9	84.1	4.6	GREEN
10:20 AM	28.1	84.4	4.8	GREEN
10:30 AM	28.3	84.7	5	RED
10:40 AM	28.5	85	5.2	RED
10:50 AM	28.7	85.3	5.4	RED
11:00 AM	28.9	85.6	5.6	RED
11:10 AM	29.1	85.9	5.8	RED
11:20 AM	29.3	86.2	6	RED
11:30 AM	29.5	86.5	6.2	RED
11:40 AM	29.7	86.8	6.4	RED
11:50 AM	29.9	87.1	6.6	RED
12:00 PM	30.1	87.4	6.8	RED

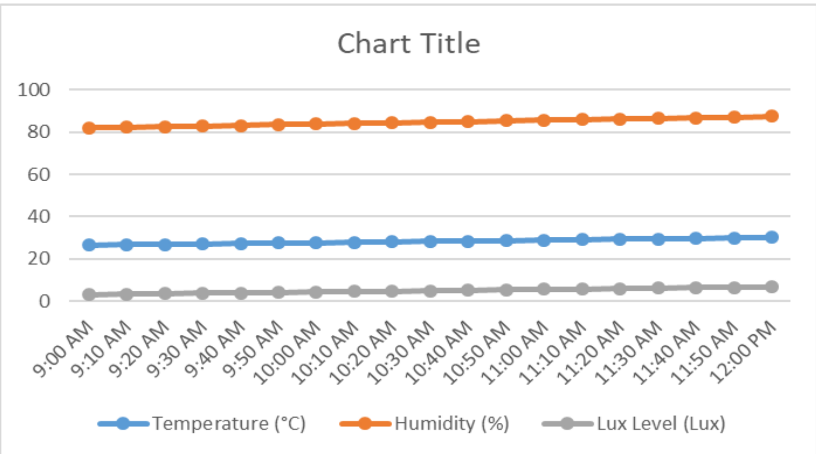

Fig. 4.4 *Graph Blynk Interface Data Over Time*

This improves the overall effectiveness of the monitoring system, enabling swift action to preserve an ideal habitat for swiftlets. The Blynk system aids in quickly identifying issues and maintaining optimal conditions, ultimately benefiting the birds' health and the quality of their nests.

4. Analysis of Red LED Activations

Understanding Red LED activations is crucial for identifying when the swiftlet housing environment deviates from the ideal. This detailed investigation categorizes the number of times the red LED lights up in 30-minute intervals, creating a comprehensive log. This log helps swiftlet farmers pinpoint exact times when environmental factors go beyond the optimal range, allowing for quick and informed decision-making. The organized format of this analysis enables users to act promptly, ensuring the well-being of the swiftlets and the quality of their nests.

Table 4.5 *Red LED Activation Count*

Time Interval	Number of RED LEDs
9:00 AM - 9:30 AM	0
9:30 AM - 10:00 AM	0
10:00 AM - 10:30 AM	3
10:30 AM - 11:00 AM	5
11:00 AM - 11:30 AM	5
11:30 AM - 12:00 PM	5

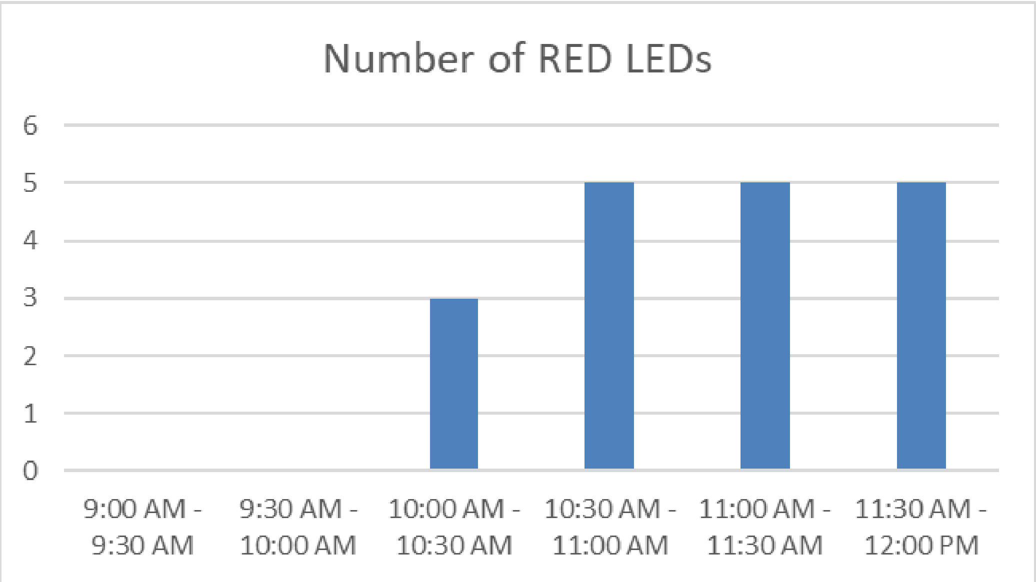

Fig. 4.5 *Red LED Over Time*

Examining Red LED activations reveals key moments when the swiftlet housing environment isn't ideal. Notably, three red LED flashes between 10:00 AM and 10:30 AM indicate the outside temperature exceeding the optimal range. This trend continues with five activations in the next two intervals. For swiftlet farmers, this information is invaluable, guiding interventions to maintain favorable conditions for the birds. The explanation clarifies the accompanying graph (Figure 4.10), offering a detailed view of temporal dynamics and variations from ideal conditions. This dual approach supports timely, well-informed decisions aligned with the main goals of ensuring swiftlet welfare and preserving nest quality.

Conclusion

Finally, by using a wide range of sensors and real-time data visualisation via the Blynk platform, our study has shed important light on the swiftlet house monitoring system. The results of data analysis on temperature, humidity, and light have shed light on the complex environmental dynamics affecting swiftlet welfare and nesting practices. The temperature data showed significant daily variations, demonstrating the system's ability to detect subtle thermal variations. The examination of humidity data made clear how important it is to keep an eye on moisture levels, which are essential for establishing the ideal environment for swiftlets. The analysis of light data demonstrated how important lighting is in affecting circadian cycles and nesting behaviour. The incorporation of real-time data presentation on Blynk showed improved responsiveness and accessibility, enabling users to take rapid, well-informed decisions.

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This guide contains examples of common types of APA Style references. Section numbers indicate where to find the examples in the Publication Manual of the American Psychological Association (7th ed.).

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