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The Prototype of Animal Intrusion Detection and Monitoring System using IoT

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Abstract: The encroachment of wild animals poses a major problem, resulting in the loss of valuable resources such as crops. This work presents a new approach that utilizes the Internet of Things (IoT) to detect and address the intruder in a specific area. For example, the invasion of wild animals in agriculture such as wild pigs and monkeys. This method combines the use of Passive Infrared (PIR) sensors, a camera, a buzzer, and the Blynk app. The PIR sensor works as an early warning system, detecting intrusion by wild animals. The buzzer is activated to deter and repel intruders. The camera is used for farm monitoring, while the Blynk app delivers real-time alerts to farm owners, ensuring immediate notification and intervention. By using this innovative model, farmers can effectively detect and prevent trespassing around the farm by activating the buzzer, thereby enhancing overall security and minimizing losses. It empowers farmer with a reliable and efficient system for early detection and intervention, allowing them to protect their crops, and property from potential threats posed by wild animals.

Keywords: Agriculture, Animal Detection, Monitoring, IoT, PIR Sensor

1. Introduction

Agriculture serves as the foundation of human existence since it serves as the primary source of sustenance and essential raw materials [1]. As a result, it plays a crucial role in the economic progress of a nation [2]. Regrettably, many farmers endure significant losses on their farms due to the negligence of wild animals such as pigs and monkeys. Wild animals pose a distinctive challenge for farmers worldwide, inflicting substantial harm on crops. Particularly in our country, wild pigs and monkeys are prevalent and pervasive, causing extensive damage to crops in various habitats including forests, grasslands, and farmlands [3].

Wild pigs, being omnivores, employ their snouts to locate food sources, which can include roots, bulbs, and small creatures like insects or earthworms that are underground. These intelligent and crafty creatures also pose a threat to various plant species such as durian trees, bananas, tapioca, and more.

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Consequently, it has become customary for wild pigs to roam freely and encroach upon people's farms, particularly in rural areas [4].

To address this issue, an Animal Intrusion Detection and Monitoring System using IoT has been proposed. This system aims to solve the problem without causing harm to the animals while safeguarding crops by generating an alarm sound when an intrusion occurs. Additionally, this system proves beneficial for farm owners as it allows them to monitor animal intrusions by capturing images and relaying that information to the owner [5].

2. Methodology

2.1 Overview of the system

Figure 1 shows the block diagram of the development system. It is the initiative that aims to help the farm owner keep an eye on their farms from being invaded by wild animals. The sensors that have been used aim to detect and repel wild animals. In addition, the camera is also used to monitor and capture footage video of wild animals. The development system is divided into two parts. The first part involves controlled sensors, and the second part requires image monitoring. As for the sensor part, this system aims to ensure the presence of invasive animals. The monitoring system aims to inform the farm owner about the current situation of the farm.

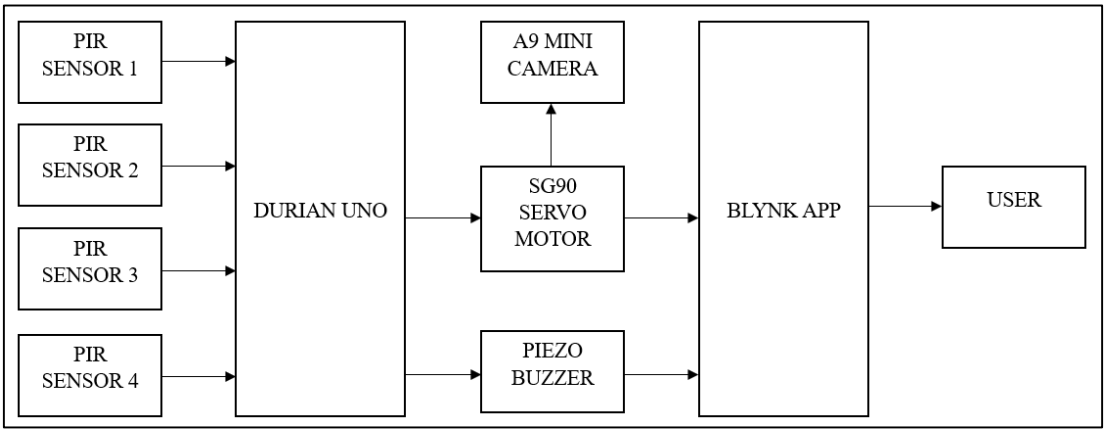

Figure 1: Block diagram of development system

2.2 Motion Detection System Implementation

Four PIR sensors have been used in this sensor system. The parameters for this sensor have been shown in Table 1 [6].

Table 1: The parameter of the PIR sensor

Parameter	Value
Wide working voltage range	DC 4.5V-20V
Current drain	<60uA
Detection angle	<110°
Detection distance	3m to 7m (can be adjusted)

Figure 2 shows the sensor system of this work. The sensor part of the system begins by detecting motion using a PIR (Passive Infrared) sensor. When motion is detected, the system proceeds to send a notification to the Blynk application. This notification serves as an alert to inform the farm owner about the intrusion. Once the farm owner receives the notification on the Blynk application, they can take action accordingly. The flowchart in Figure 2 shows two possible actions: activating or deactivating the buzzer. If the farm owner options to activate the buzzer, the system triggers the buzzer functionality,

which can effectively discourage or startle trespassing animals. Conversely, should the farm owner decide to deactivate the buzzer, the system promptly terminates the buzzing sound. After executing the chosen action, the sensor part of the system comes to an end. This flowchart outlines the sequence of events in the sensor part, starting from motion detection, notifying the farmer, and allowing the farmer to control the buzzer based on the intrusion alert.

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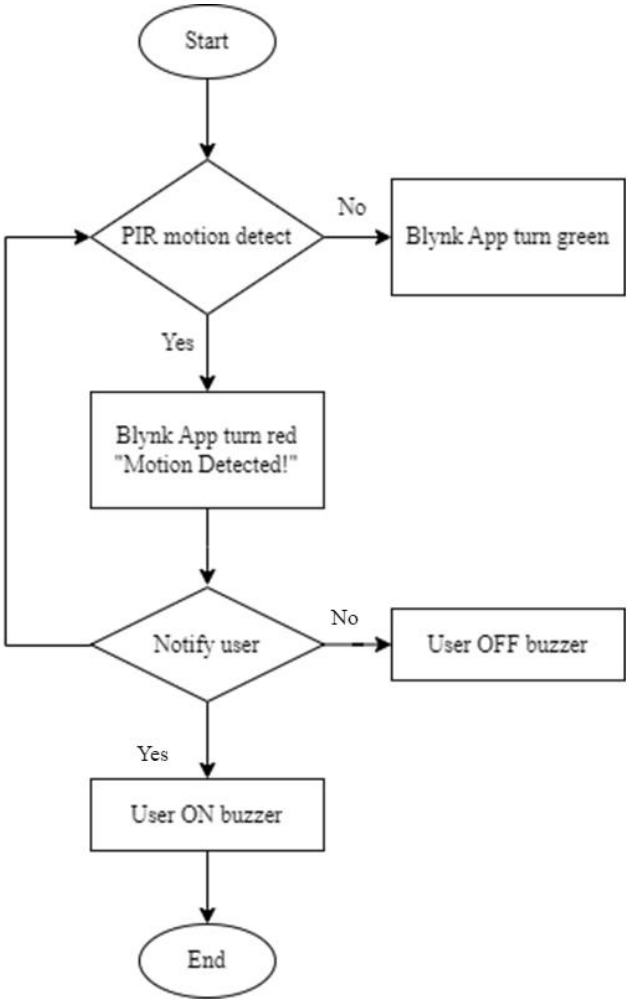


Figure 2: Sensor system flow chart

2.3 Monitoring System Implementation

Referring to Figure 3, the monitoring system follows a well-defined sequence of actions as illustrated in the provided flowchart. Upon detecting such movement, the PIR sensors trigger an alert,

promptly notifying the user through the Blynk application. This instantaneous alert ensures that the user is promptly informed about potential intrusions. Subsequently, the system provides the user with the choice to control the camera's orientation, granting options for both automatic and manual adjustments. This functionality is enabled through a servo motor that enables dynamic positioning of the camera. The monitoring process concludes, offering a comprehensive solution for the detection and response to intrusions in the monitored area.

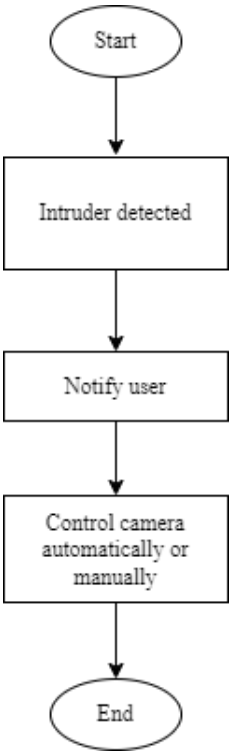


Figure 3: Monitoring system flow chart

2.4 Hardware Design

A PIR sensor, an A9 small camera, a servo motor, and a Blynk application were all integrated into the experimental setup. Figure 4 shows the hardware connection used in this work, while the final prototype is shown in Figure 5 and Figure 6. Figure 5 shows the system controller of this work. The control of the system is divided into two parts: the first involves the control's system location, which manages the sensor system, and the second focuses on the voltage input for this system. The subsequent section discusses the placement of sensors for data collection, where four PIR sensors are employed in this work. Figure 6 shows the camera system and buzzer system. The camera system enables users to view live video of the farm condition and also captures images of the animal intruders when motion is detected, with notifications sent via the Blynk application. On the other hand, the buzzer system is designed to repel the animal intruders. The user can control the activation and deactivation of the buzzer through the Blynk application.

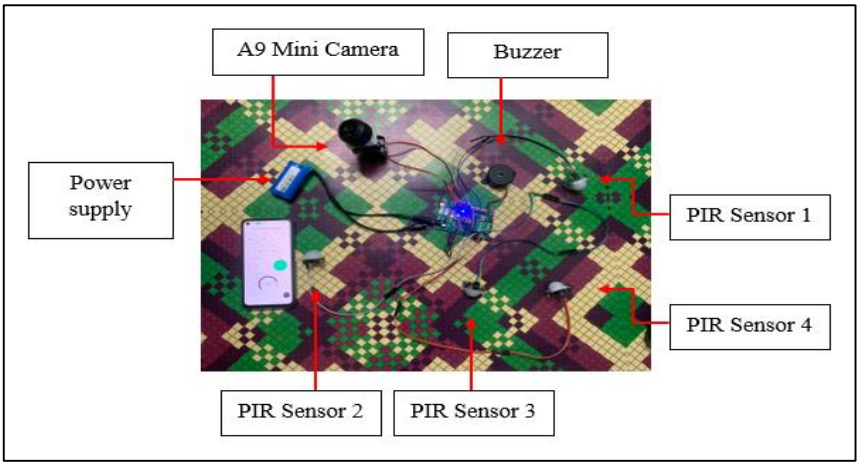


Figure 4: Hardware connection

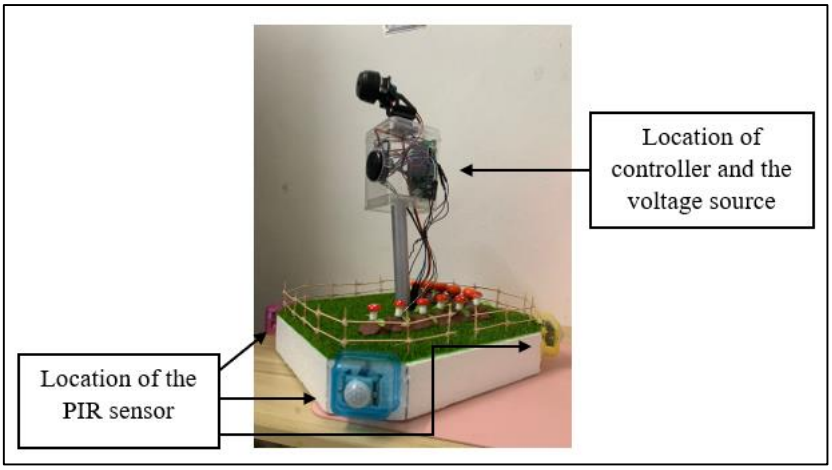


Figure 5: System controller

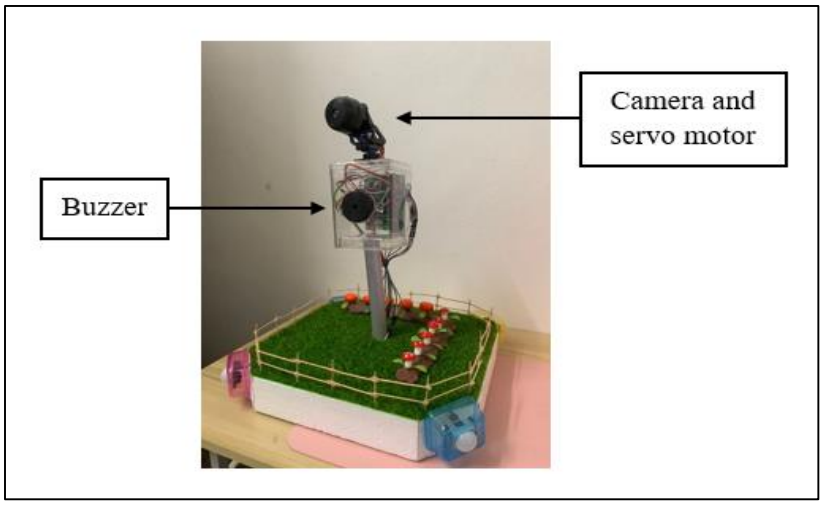


Figure 6: Monitoring system

3. Results and Discussion

This section presents the results obtained from the implementation and evaluation of the Prototype Animal Intrusion Detection and Monitoring System using IoT. The system's effectiveness in spotting and keeping track of animal invasions in farm areas is highlighted in a detailed discussion and analysis of the results that have been gathered appropriately.

3.1 Final Prototype

The IoT-based wildlife intrusion detection and prevention system for agriculture utilizes a combination of Passive Infrared (PIR) sensors, an A9 mini camera, a piezo buzzer, and the Blynk app to detect and address the encroachment of wild animals. PIR sensors act as an early warning system by detecting the presence of warm-bodied objects. When an intrusion is detected, the central control unit triggers the activation of a piezo buzzer to deter and repel intruders. The camera placed strategically across the farm provides real-time monitoring and visual evidence. The Blynk app delivers real-time alerts to the farm owner, allowing immediate notification and intervention. By integrating these technologies, farmers can effectively detect and prevent trespassing, enhancing overall security and minimizing losses caused by wild animals. Figure 7 shows the final prototype of this system.

Figure 7: Final prototype of Animal Intrusion Detection and Monitoring System using IoT

3.2 Blynk Notification

Figure 8 shows the user's mobile phone screen displaying a notification from Blynk and shows the split screen view of the 365Cam app and the Blynk app. The notification informs the user about the detected movement and also alerts them regarding the low battery status of the system. Through the 365Cam app, the user can observe the condition of the farm and identify the type of intruder passing by. This enables the user to monitor and control the farm’s status simultaneously through both applications.

Figure 9 shows the testing of the prototype of an animal intrusion detection and monitoring system using IoT. The prototype is positioned close to the farm area. Figure 10 shows the screen display of an intrusion captured by the A9 small camera and detected by the PIR sensor. Figure 10(a), depicts the detection of a cat roaming around the farm area, while Figure 10(b) shows the subsequent discovery of two chickens a few minutes later.

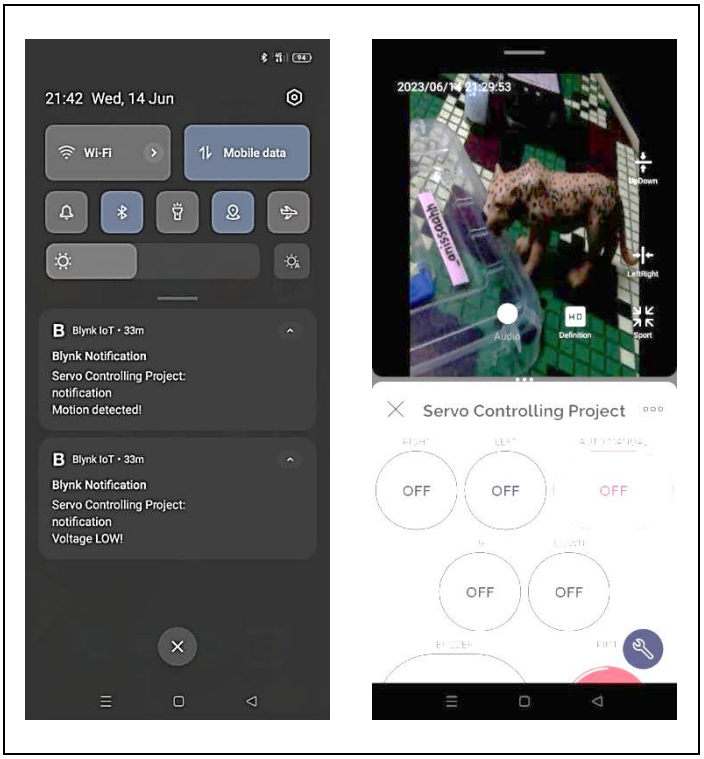
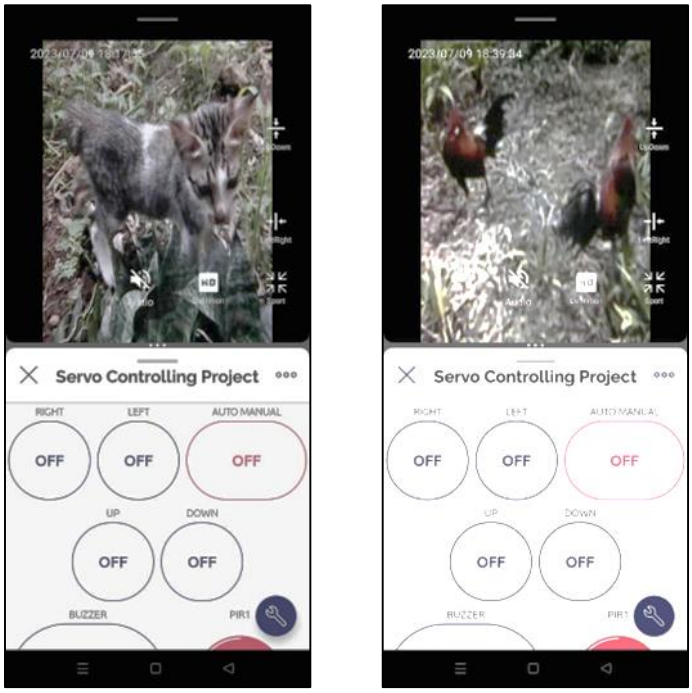


Figure 8: Blynk notification and split screen of 365Cam app and Blynk app

Figure 9: The placement of the prototype in the farm area



(a) (b)

Figure 10: (a) The detection of a cat roaming around the farm area and (b) the subsequent discovery of two chickens

4. Conclusion

In conclusion, the successful integration of the Durian Uno board, PIR sensor, and Blynk application in this work has resulted in an efficient animal intrusion detection system. The system proves to be reliable in detecting animal intrusions and issuing timely alerts to users. By effectively distinguishing between motion and non-motion events, it enhances overall performance. However, its effectiveness relies on the accuracy and positioning of the sensor, and its wireless communication range is limited. Moreover, the system effectively deters intruders through the activation of the buzzer. Its user-friendliness, accessibility, and optimistic performance make it a valuable contribution to the field of animal intrusion detection, with promising applications in farm security and animal monitoring.

Acknowledgement

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