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IoT Based Birds Repelling System

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Abstract:
Agriculture contributes one-third of India's Gross Domestic Product, and a large portion of the population depends on agriculture for subsistence. Farmers' annual income is heavily based on the yield of the crops they produce, which has been steadily declining owing to a variety of issues, one of which we are focused on is bird intrusion in crop fields. The Farmers face massive difficulty in protecting their crops from invading swarms of birds.
The most notable birds in this regard are peacocks and parrots, which destroy the harvest in agricultural farm fields such as Corn, Ground nut, etc., Considering a statistical survey of farmers on the proportion of crop damage caused by birds, we would like to present a Internet of Things (IoT) based automated bird detection and repeller system. This work aims to chase peacocks and parrots from the crop fields. The proposed approach has two modules: birds' intrusion detection using a Passive Infrared (PIR) sensor and a Repeller Unit, which consists of an audio amplifier and megaphone to make predator noises that will drive the birds away from the field.

Keywords— *Smart Agriculture, Internet of Things (IoT), Bird Intrusion Detection, Passive Infrared (PIR) Sensor, Crop Protection, Bird Repeller System, Precision Agriculture, Embedded Systems, Automated Monitoring, Sustainable Farming.*

Introduction:

Agriculture remains one of the primary contributors to food security and economic development across the world. In developing countries such as India, the agricultural sector supports the livelihood of a significant proportion of the population and contributes substantially to the national economy. However, agricultural productivity is continuously influenced by several environmental and biological factors that reduce crop yield and quality. Among these challenges, bird intrusion has emerged as a major concern for farmers cultivating cereal crops, oilseeds, fruits, and vegetables. Birds such as parrots, peacocks, pigeons, and sparrows feed on ripened crops during the harvesting season, resulting in considerable economic losses. The increasing demand for sustainable agricultural production has encouraged researchers to develop intelligent crop protection systems capable of minimizing such losses while reducing dependence on manual labour. Recent advances in the Internet of Things (IoT) have significantly contributed to the modernization of agricultural practices by enabling real-time monitoring, automated decision-making, and remote management of agricultural resources **[1]**.

The concept of precision agriculture has transformed conventional farming by integrating sensing technologies, embedded controllers, wireless communication, and cloud-based data management into agricultural operations. These technologies enable continuous monitoring of field conditions, allowing farmers to respond quickly to environmental changes and biological threats. IoT-based monitoring systems have been successfully employed for irrigation scheduling, soil nutrient assessment, greenhouse management, pest monitoring, and crop health analysis.

Nevertheless, automated protection against bird intrusion has received comparatively less attention despite its considerable impact on crop productivity. Existing bird deterrent methods are largely dependent on manual operation and therefore fail to provide continuous protection throughout the growing season **[2], [3]**.

Conventional bird repelling techniques include scarecrows, reflective ribbons, coloured flags, rotating objects, chemical repellents, and manual guarding. Although these approaches are inexpensive and easy to implement, their effectiveness gradually decreases because birds quickly adapt to repetitive visual and acoustic stimuli. Manual monitoring further increases labour costs and becomes impractical for large agricultural fields. Similarly, some electronic bird deterrent systems operate continuously regardless of bird presence, leading to unnecessary power consumption and reduced operational efficiency. These limitations highlight the necessity of developing an intelligent bird repelling mechanism capable of detecting bird intrusion before activating the repelling unit, thereby improving both energy efficiency and crop protection **[4], [5]**.

Recent developments in embedded systems have enabled the implementation of compact, low-cost, and energy-efficient monitoring platforms suitable for agricultural environments. Embedded microcontrollers integrated with motion sensors provide continuous surveillance while consuming very little electrical power. Among the available sensing devices, Passive Infrared (PIR) sensors have become attractive because they detect the movement of warm-bodied objects through variations in infrared radiation without requiring complex image processing hardware. Their low power requirement, simple interfacing, rapid response, and reliable operation make them suitable for continuous deployment in outdoor agricultural environments. When combined with embedded controllers, PIR sensors provide an economical solution for detecting bird intrusion before initiating appropriate deterrent actions **[6], [7]**.

Wireless communication technologies have further improved the capabilities of embedded agricultural systems by enabling real-time monitoring and remote supervision. Modern IoT platforms allow field data to be transmitted to smartphones or cloud servers, enabling farmers to receive instant notifications regarding abnormal events without physically visiting agricultural fields. Such connectivity not only improves operational efficiency but also reduces maintenance requirements and supports data-driven agricultural management. Furthermore, optimized embedded architectures significantly reduce system energy consumption, making IoT-based crop protection systems suitable for deployment in remote agricultural locations powered by batteries or renewable energy sources **[8]**.

Although several IoT-based agricultural monitoring systems have been reported in recent years, many existing solutions primarily focus on irrigation control, environmental monitoring, or pest detection, whereas comparatively limited attention has been given to intelligent bird repelling systems. Existing bird deterrent devices either rely on continuous sound generation, which causes unnecessary energy consumption, or employ vision-based techniques requiring expensive hardware and high computational resources. Moreover, adaptive activation of acoustic deterrent mechanisms based on real-time bird detection has not been sufficiently explored for low-cost agricultural applications. Therefore, there remains a need for an intelligent, energy-efficient, and economically viable system capable of detecting bird intrusion automatically while minimizing power consumption and reducing human intervention **[9]**.

To address these limitations, this research proposes an IoT-Based Birds Repelling System that integrates a Passive Infrared (PIR) sensor, embedded microcontroller, wireless communication module, audio amplifier, and megaphone into a unified crop protection platform. The proposed system continuously monitors agricultural fields for bird movement and activates an acoustic repelling mechanism only when intrusion is detected. This event-driven operation minimizes unnecessary power consumption while ensuring effective crop protection. In addition, IoT connectivity enables remote monitoring of system status, thereby improving operational reliability and reducing farmer effort. The proposed architecture is designed to provide a low-cost, scalable, and energy-efficient solution that supports precision agriculture and contributes to sustainable crop production.

Existing System

Conventional bird repelling methods, such as scarecrows, reflective tapes, or soundbased devices, are often static and lose effectiveness over time as birds adapt. These systems are not automated, lack real-time control, and cannot be monitored or adjusted remotely, leading to reduced efficiency in protecting crops, buildings, or sensitive equipment.

Proposed System

The proposed IoT-based bird repelling system uses sensors to detect bird presence and activates repelling mechanisms such as sound emitters, lights, or water sprays. Integrated with IoT technology, the system can be monitored and controlled remotely through web application. It allows for real-time alerts, scheduling, and adaptive responses, making it a smarter and more effective solution for keeping birds away while minimizing manual effort.

Literature Review

Ahmed et al. investigated the application of the Internet of Things (IoT) in precision agriculture with the objective of improving agricultural productivity through continuous monitoring and intelligent automation. Their study highlighted that IoT devices integrated with environmental sensors enable real-time collection of agricultural data, allowing farmers to monitor field conditions remotely and make informed decisions. The authors reported that sensor-based automation significantly reduces manual labour while improving resource utilization and crop management. They also emphasized that IoT-based monitoring systems provide a scalable platform for integrating multiple agricultural applications, including crop protection, irrigation management, and environmental monitoring. Their work demonstrated that IoT technologies are becoming an important component of modern precision agriculture due to their reliability, flexibility, and low operational cost. **[1]**

Ayaz et al. presented a comprehensive review of IoT-enabled smart agriculture technologies and discussed the role of intelligent sensing, wireless communication, cloud computing, and embedded systems in agricultural automation. According to the authors, the integration of interconnected sensing devices enables continuous monitoring of crop health, environmental conditions, and agricultural activities. They explained that automated monitoring reduces human intervention while improving the accuracy and efficiency of agricultural operations. Their review further indicated that IoT platforms facilitate remote supervision, timely decision-making, and efficient resource management, making them highly suitable for sustainable agricultural practices. The study established IoT as a key enabling technology for the future development of intelligent farming systems. **[2]**

Navulur et al. reviewed the application of wireless sensor networks and Internet of Things technologies in agricultural management. Their study explained that distributed sensor nodes installed throughout agricultural fields continuously monitor environmental parameters such as temperature, humidity, soil moisture, and field activity. The collected information is transmitted to a central controller where appropriate decisions are made automatically. The authors concluded that sensor-based agricultural monitoring improves crop productivity by providing timely information regarding changing field conditions. Their findings also suggested that integrating embedded systems with wireless communication technologies significantly enhances the efficiency of agricultural management while reducing operational costs. **[3]**

Kumar and Singh developed an IoT-based smart farming framework for real-time crop monitoring and protection. Their proposed system employed multiple sensors to collect environmental information and transmitted the acquired data to cloud servers for remote analysis. The authors demonstrated that continuous monitoring enables early identification of abnormal agricultural conditions and allows farmers to implement preventive measures before crop damage becomes severe. Experimental observations showed improvements in monitoring accuracy, communication reliability, and resource utilization. The study concluded that IoT-based monitoring systems provide an effective approach for enhancing agricultural productivity through intelligent automation and remote accessibility. **[4]**

Braga et al. examined the use of embedded systems and Internet of Things technologies for smart agriculture applications. Their review focused on low-power embedded hardware, intelligent sensing devices, wireless communication modules, and automated control mechanisms designed for agricultural environments. The authors reported that embedded systems improve operational efficiency by processing sensor information locally while consuming minimal electrical power. They further highlighted that modular embedded architectures simplify system expansion and maintenance, allowing additional sensors and control units to be incorporated easily. Their findings demonstrated that embedded technologies provide a reliable foundation for implementing intelligent crop monitoring and protection systems in modern agriculture. **[5]**

Sharma and Gupta proposed an IoT-based automated bird repeller system intended to reduce crop losses caused by bird intrusion. Their work utilized motion detection sensors together with embedded controllers to activate acoustic deterrent devices whenever birds entered the protected agricultural area. The proposed system operated automatically without requiring continuous human supervision, thereby reducing labour requirements and improving crop protection efficiency. The authors reported that event-driven activation of acoustic devices minimized unnecessary power consumption while maintaining effective bird deterrence. Their research demonstrated that intelligent sensing combined with embedded control offers an economical solution for protecting crops against bird attacks in precision agriculture. **[6]**

Mishra, Patel, and Verma developed an embedded system for intelligent crop monitoring with a focus on bird intrusion detection using Passive Infrared (PIR) sensors. Their proposed system continuously monitored the protected area and identified movement by detecting changes in infrared radiation emitted by living organisms. Once bird activity was detected, the embedded controller immediately activated the warning mechanism to prevent crop damage. The authors observed that PIR sensors provide a practical solution because of their low power consumption, fast response time, simple interfacing, and reliable performance under outdoor conditions. The study concluded that PIR-based detection systems can effectively reduce unnecessary power consumption by activating the repelling mechanism only during bird intrusion events, thereby improving overall system efficiency. **[7]**

Islam, Hasan, and Hossain proposed a low-power Internet of Things architecture for precision agriculture applications with emphasis on energy-efficient sensor networks and embedded controllers. Their research demonstrated that optimized sensing intervals, intelligent power management, and efficient wireless communication protocols significantly reduce energy consumption without affecting monitoring performance. The proposed architecture was capable of continuously collecting agricultural data while extending battery life and minimizing maintenance requirements. The authors highlighted that low-power IoT platforms are particularly beneficial for agricultural fields located in remote areas where continuous power supply is limited. Their work provides valuable design guidelines for developing sustainable agricultural monitoring systems. **[8]**

Chen, Wang, and Liu introduced a real-time wildlife and bird detection framework using edge computing and Internet of Things technologies. Their system processed sensor information locally to reduce communication delays and improve response time during intrusion events. The authors demonstrated that edge-based processing enables immediate activation of protection mechanisms without relying entirely on cloud computing infrastructure. Experimental evaluation showed improved detection accuracy together with lower communication overhead, making the proposed approach suitable for large agricultural environments. The study also emphasized that integrating intelligent detection algorithms with embedded platforms enhances the reliability of automated crop protection systems. **[9]**

Alsharif, Alqahtani, and Alghamdi designed an IoT-based smart crop protection system incorporating embedded sensing devices and wireless communication modules for continuous agricultural monitoring. Their proposed framework collected environmental information from multiple sensors and transmitted the data to remote users through an IoT communication platform. The authors reported that real-time monitoring improved decision-making and enabled rapid responses to abnormal agricultural conditions. They further observed that integrating sensing devices with automated control mechanisms reduced human intervention while increasing operational efficiency. Their findings confirmed that IoT-enabled embedded systems provide an effective platform for modern precision agriculture applications requiring continuous monitoring and automated crop protection. **[10]**

Singh, Sharma, and Yadav investigated the application of wireless sensor networks, embedded controllers, and Internet of Things technologies in precision agriculture. Their research highlighted the importance of integrating multiple sensing devices for monitoring environmental conditions and agricultural activities simultaneously. The proposed framework improved data collection efficiency, communication reliability, and resource utilization while reducing operational costs. The authors concluded that intelligent embedded systems equipped with wireless connectivity provide farmers with real-time information necessary for efficient crop management. They also suggested that future agricultural systems should focus on energy-efficient automation capable of supporting various crop protection applications, including animal and bird intrusion detection. **[11]**

Block Diagram:

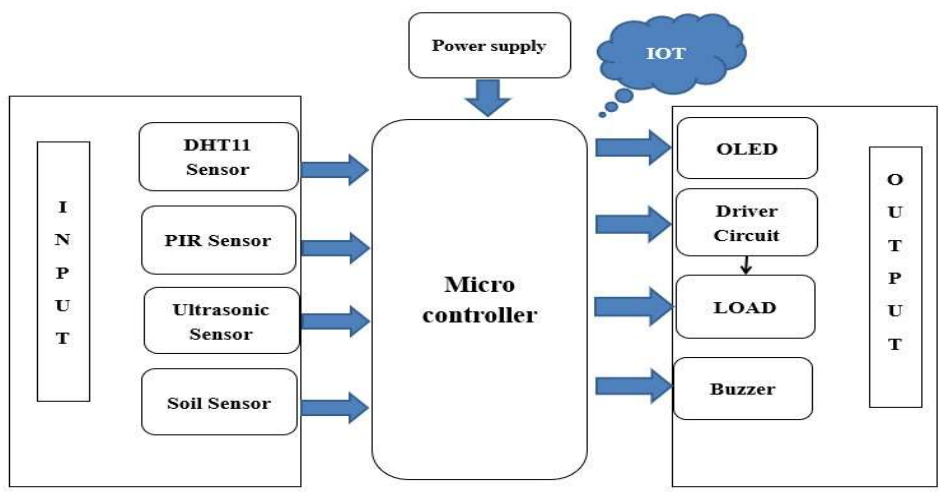

Figure 1 : Block Diagram

Block Diagram Description

Figure 1 illustrates the architecture of the proposed IoT-Based Birds Repelling System, which is designed to detect bird intrusion in agricultural fields and automatically activate a repelling mechanism to protect crops. The system consists of four major sections: the input sensing unit, the microcontroller-based processing unit, the IoT communication module**,** and the output control unit**.** The complete system is powered through a regulated power supply, ensuring stable operation of all electronic components.

The input section includes four sensing devices: a DHT11 sensor**,** a Passive Infrared (PIR) sensor**,** an ultrasonic sensor**,** and a soil moisture sensor. Each sensor performs a specific function to improve the overall monitoring capability of the system. The DHT11 sensor continuously measures the ambient temperature and relative humidity surrounding the crop field. These environmental parameters help monitor weather conditions that may influence crop growth and bird activity. The measured values are transmitted to the microcontroller for further processing and are also displayed to the user through the monitoring interface.

The **PIR sensor** serves as the primary bird intrusion detector. It identifies the movement of warm-bodied objects by sensing changes in infrared radiation within its detection range. Whenever a bird enters the protected area, the PIR sensor generates a signal that is immediately sent to the microcontroller. This event-driven operation ensures that the repelling mechanism is activated only when bird movement is detected, thereby reducing unnecessary power consumption and improving the efficiency of the system.

The **ultrasonic sensor** complements the PIR sensor by measuring the distance between the sensor and nearby objects. It helps verify the presence of birds or other moving objects within a predefined range, reducing false detections caused by environmental disturbances such as moving leaves or small animals. By combining motion detection with distance measurement, the proposed system improves the reliability of bird intrusion detection.

The **soil moisture sensor** continuously monitors the moisture content of the agricultural field. Although its primary purpose is not bird detection, it provides valuable information regarding soil conditions, enabling farmers to observe the health of the crop along with the security status of the field. The inclusion of this sensor makes the system suitable for broader smart agriculture applications by supporting both crop protection and environmental monitoring.

The **microcontroller** acts as the central processing unit of the proposed system. It receives input signals from all sensing devices, processes the collected information, and executes the control algorithm developed for bird detection and crop protection. The controller continuously analyzes sensor readings and determines whether bird intrusion has occurred. If the PIR sensor detects movement and the ultrasonic sensor confirms the presence of an object within the specified distance, the microcontroller activates the repelling unit through the driver circuit. At the same time, environmental data collected from the DHT11 and soil moisture sensors are processed and prepared for local display and IoT-based monitoring.

The system incorporates an **IoT communication module**, which enables remote monitoring of the agricultural field. Sensor readings and system status are transmitted to an Internet-based monitoring platform, allowing farmers to observe field conditions from a smartphone, tablet, or computer. The IoT functionality provides real-time updates regarding temperature, humidity, soil moisture, bird detection events, and system operation. This remote accessibility minimizes the need for continuous field visits and enables timely decision-making, particularly for farms located in remote areas.

The output section consists of an OLED display**,** a driver circuit**,** an external load, and a buzzer. The OLED display provides real-time information such as temperature, humidity, soil moisture level, intrusion status, and system operation, allowing users to monitor the system locally. The driver circuit functions as an interface between the microcontroller and the output devices by supplying sufficient current to operate external components safely. Depending on the system configuration, the connected load may include an audio amplifier, megaphone, predator sound generator, or any other bird-repelling device. Once bird intrusion is confirmed, the driver circuit activates the load to generate acoustic signals that scare birds away from the crop field. Simultaneously, the buzzer produces an audible alarm to indicate bird detection and notify nearby farmers of the intrusion.

The regulated **power supply** provides the required operating voltage to the microcontroller, sensors, communication module, and output devices. A stable power source ensures reliable data acquisition, continuous monitoring, and uninterrupted system performance during field operation.

Overall, the proposed architecture integrates environmental sensing, bird intrusion detection, embedded processing, IoT communication, and automated repelling into a single intelligent platform. By combining

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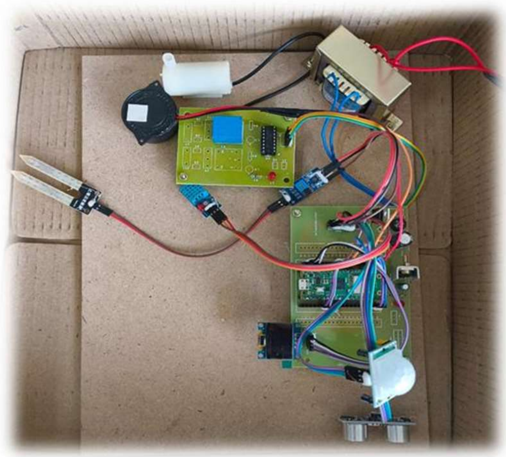
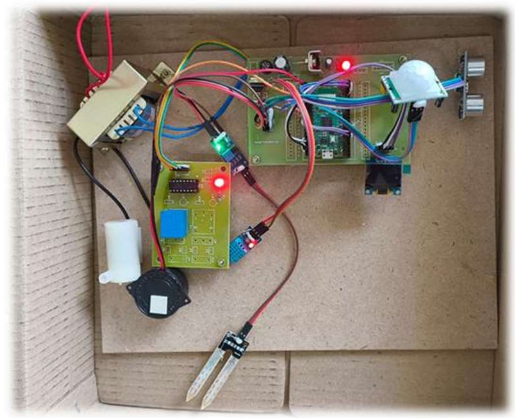
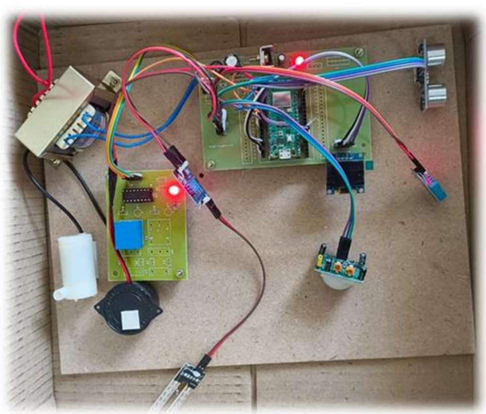
multiple sensors with event-based control and remote monitoring capabilities, the system provides an efficient, low-cost, and energy-conscious solution for protecting agricultural crops from bird damage. The modular design also allows additional sensors and communication technologies to be incorporated in future enhancements, making the system suitable for precision agriculture and sustainable farming applications.



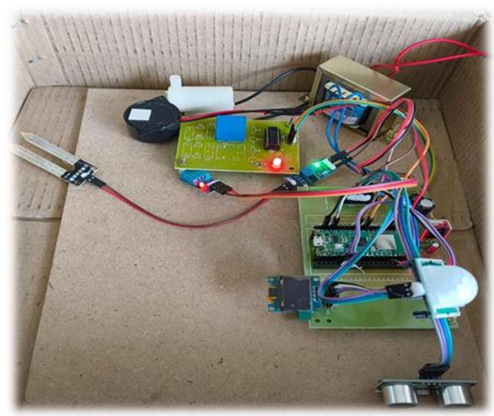
Hardware Kit



Hardware Kit On



Detecting Motion of Bird



Buzzer Sound that Birds Drive away

Conclusion:

This proposed model is a cost-effective, reliable, and simply understandable solution. This approach of using IoT devices believes that problems like protection of college areas or buildings from birds and many such related problems can be solved under this area of interest, hence broadening the horizon of researchers to bring on effective implementable ideas or solutions for different problems similar to this. an IoT-based bird repelling system highlights its efficiency as a sustainable, humane, and highly effective alternative to traditional methods. By integrating real-time sensors (like PIR or cameras) with intelligent deterrents (such as ultrasonic waves, lasers, or predator mimics), these systems successfully reduce crop damage and safety hazards while eliminating the need for harmful chemicals or manual labor. The inclusion of IoT connectivity allows for remote monitoring and datadriven insights, enabling farmers and facility managers to respond to bird activity instantly through mobile applications. Ultimately, these systems offer a scorable and autonomous solution that not only protects agricultural yields and urban infrastructure but also preserves ecological balance by repelling birds without causing them physical harm. This predictive capability ensures that resources are used only when necessary, extending the lifespan of the hardware and reducing energy consumption.

From a broader perspective, the shift toward IoT-based repelling marks a significant move toward Precision Agriculture and smart city management. As the technology becomes more affordable and accessible, it bridges the gap between high-tech surveillance and traditional pest control. The success of such a system underscores the potential of the Internet of Things to solve age-old conflicts between human activity and wildlife in a way that is both technologically advanced and ethically sound.

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