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AUTOMATIC RAIN PROTECTION FOR FIELD CROPS USING IOT

[1]NVN. SOWJANYA, [2]R KAVYA, [3]P. SANDEEP KUMAR, [4]R. VINAY KUMAR

[1] Assistant Professor in Department of CSE Teegala Krishna Reddy Engineering College

[2 3 4] UG. Scholar Department of CSE Teegala Krishna Reddy Engineering College

Abstract

The proposes an innovative IoT-based system designed to automatically protect field crops from environmental hazards, utilizing the Node MCU ESP8266 microcontroller. The system employs a rain sensor to detect precipitation, which in turn activates a servo motor to deploy a protective cover over the crops, mitigating potential damage caused by excessive rainfall. To enhance field security, an infrared (IR) sensor is incorporated to detect the presence of humans, animals, or objects. Upon detection, the system issues alerts via the Blynk IoT platform and can activate warning mechanisms such as buzzers or LED indicators, enabling prompt intervention against threats like stray animals or unauthorized access. A flame sensor is also integrated to identify fire hazards. In the event of a fire, the system triggers a buzzer and a red LED alert while notifying the farmer through the Blynk platform. A green LED serves as an indicator of normal operational status. Through real-time monitoring and remote control via the Blynk IoT application, this system not only enhances crop resilience against environmental threats but also minimizes manual intervention. It supports sustainable agricultural practices by enabling timely, automated responses to varying field conditions.

I INTRODUCTION

Agriculture is the backbone of India's economy, with nearly 70% of the population relying on it for their livelihood. Despite its significance, agriculture faces numerous challenges, including damage to crops caused by heavy rainfall, animal interference, and environmental uncertainties. This project aims to develop a smart, IoT-based agricultural system that offers automatic protection to field crops using modern embedded systems and wireless technologies. The primary objective of this system is to protect crops from heavy rain by automatically deploying a double-coated polythene sheet using a rain sensor and servo motor mechanism. Additionally, the system facilitates rainwater harvesting, allowing the collected water to be stored and utilized for various needs such as livestock feeding, washing, and irrigation. Another major challenge in farming is the increasing conflict between humans and wild animals. Encroachment, deforestation, and climate change have pushed animals to venture into human settlements and farms, especially during summers when water is scarce. Incidents involving elephants and wild boars, particularly in South Asia and Africa, often lead to significant crop damage and even human fatalities. Traditional farm protection methods can be harmful to animals, triggering abnormal behavior and worsening the situation.

To address these issues, we propose a comprehensive crop protection system that integrates a range of sensors and automation technologies. The system uses Arduino, Node MCU ESP8266, and multiple sensors including soil moisture, humidity, rain, flame, and IR sensors. It also includes a relay-controlled water pump, DC motors for mechanical operations, and alert systems linked with the Blynk IoT platform for remote monitoring and real-time notifications.

This integrated system not only enhances crop protection against environmental and wildlife threats but also promotes sustainable farming by optimizing resource usage and reducing manual labor. Through real-time sensing and automation, the proposed solution ensures better yield, crop safety, and improved agricultural efficiency.

II LITERATURE SURVEY

Agriculture continues to be one of the most vital sectors of the Indian economy, and the protection of crops from natural and animal-induced threats is of increasing importance. Various researchers have proposed intelligent and automated systems to address these challenges using embedded systems, image processing, and IoT technologies. In the paper titled *“Smart Intrusion Detection System for Crop Protection Using Arduino”* by Srushti Yadahalli, Aditi Parmar, and Amol Deshpande, presented at the 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA), an Arduino-based system is introduced to detect and report intrusions in the field. Traditional methods like scarecrows are limited in scope and reliability. This proposed system detects intruders and suspicious activities, then sends alerts to the farmer, enhancing the security of the farmland. It provides an adaptable and practical solution for real-time monitoring and protection of crops from trespassers. The work was published by IEEE.

Another significant contribution is from Karthikeyan P., Paul Nishanth R., and Valarmathi R., in their paper *“Crop Field Protection from Animals Using Convolutional Neural Networks.”* This research focuses on protecting crops from animals such as buffaloes, cows, birds, and goats using a CNN-based automated system. The model is trained using large datasets to recognize animals from field images. Once an animal is detected, the system generates an alarm sound to drive it away. This method reduces the need for human presence and provides efficient, automated crop protection. The study was also published by IEEE.

The paper *"Image Processing-Based Protection of Crops from Wild Animals Using Intelligent Surveillance"* by A. Sathesh, K. Vishnu, A. Yuvaneshwar, V. Vellaisamy, and K. Gowthami proposes a surveillance-based solution that uses YOLO (You Only Look Once) object detection for identifying animal intrusions. Cameras are strategically placed across the field to capture real-time images, which are compared with predefined animal image datasets. Upon detection, the system sounds an alarm and sends an SMS alert to the farmer. This approach provides a smart, camera-based monitoring system for increasing farm security and reducing crop losses due to animal attacks. This work is also published by IEEE. Lastly, in the paper *"Intelligent Secure Smart Crop Protection from Wild Animals,"* the authors present an IoT-based solution tailored for farms located near forest areas that frequently encounter wild animal threats. The system is implemented in three stages: initial detection using a PIR sensor, verification through a Pi camera, and alert generation by transmitting the video to the farmer. This multi-layered approach allows for effective and informed decision-making, enabling farmers to take timely action to prevent crop damage. The solution is designed to be low-cost, environment-friendly, and farmer-friendly.

III EXISTING SYSTEM

Traditional farming practices predominantly depend on manual methods to protect crops from environmental factors such as rainfall. These approaches are often slow to respond, especially during sudden or unexpected weather changes, leading to potential crop damage. In most agricultural setups, there is a noticeable lack of automated systems for monitoring and security. Farms are generally not equipped with sensors or smart technologies to detect the presence of intruders, such as stray animals or unauthorized persons, which further increases the risk of damage to crops. Additionally, there is limited provision for real-time detection of fire hazards or other environmental threats. This absence of continuous monitoring makes crops highly vulnerable to natural disasters, ultimately affecting agricultural productivity and farmer income.

IV PROPOSED SYSTEM

The proposed system introduces an automated rain protection mechanism for field crops, offering significant innovation and efficiency in agricultural practices. It integrates advanced sensor technologies capable of detecting environmental parameters such as rainfall, temperature, humidity, and wind speed. Based on real-time data, the system can activate protective measures—such as deploying a polythene cover—to shield crops from excessive rainfall. Furthermore, the use of AI-powered predictive analytics enhances the system by forecasting rain patterns and enabling proactive responses. This not only reduces manual labor but also ensures timely and accurate protection of crops, contributing to improved yield and sustainable farming practices.

V METHODOLOGY

The proposed system aims to provide an automated solution for protecting field crops from environmental hazards such as heavy rainfall, fire, and intrusion by animals or unauthorized individuals. The system architecture integrates multiple sensors with a Node MCU ESP8266 microcontroller, which acts as the control unit. Sensors such as the rain sensor, IR sensor, and flame sensor continuously monitor the field's environmental conditions. These inputs help in taking immediate action to safeguard the crops.

When the rain sensor detects precipitation, it sends a signal to the Node MCU, which then activates a servo motor to automatically deploy a polythene sheet over the crops. This protects them from excessive water damage and also allows for the collection of rainwater, which can be reused for various agricultural needs. The IR sensor, on the other hand, is used to detect the movement of humans or animals in the farmland. When motion is detected, an alert is sent via the Blynk IoT platform, and an audible alarm is triggered using a buzzer along with visual cues through a red LED.

Fire detection is managed by a flame sensor, which identifies unusual heat signatures or flames in the field. On detecting fire, the system immediately alerts the farmer through the Blynk app, and the buzzer and red LED are activated to indicate a high-priority emergency. The system also uses a green LED to indicate normal conditions and standby readiness. All these components are managed in real-time, and the system ensures that alerts and responses are quick and automated.

Additionally, the integration of the Blynk IoT platform allows farmers to monitor sensor readings remotely using their smartphones. Notifications for rainfall, motion, or fire are sent instantly via email and the Blynk app, allowing for timely intervention. This methodology significantly reduces manual labor, increases the efficiency of field monitoring, and promotes sustainable agricultural practices through automation and real-time communication.

VI IMPLEMENTATION

The implementation of the system includes both hardware setup and software development. Hardware components such as the Node MCU ESP8266, IR sensor, rain sensor, flame sensor, servo motor, LEDs, and buzzer are assembled on a supporting framework. The Node MCU acts as the central controller, processing sensor data and executing commands based on predefined conditions in the code.

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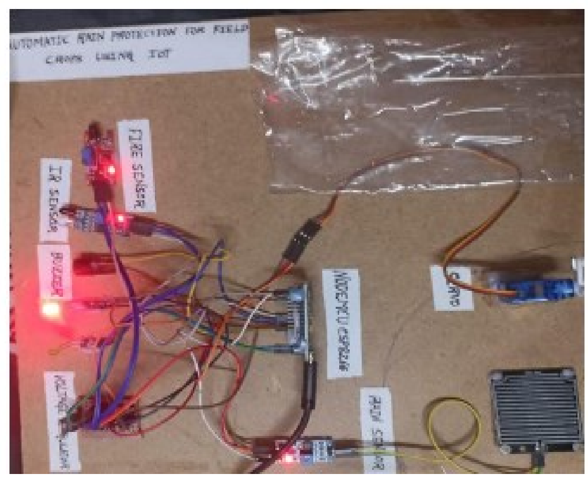
The rain sensor module is responsible for detecting rainfall through changes in resistance across its surface. When rain is detected, the Node MCU receives this signal and triggers the servo motor to deploy a protective polythene cover over the crops. Once the rainfall stops, the motor retracts the cover automatically. Similarly, when the IR sensor detects movement within the farm boundaries, the system identifies it as a potential threat and sends alerts via the Blynk IoT application, along with activating a red LED and buzzer.

The flame sensor monitors the field for fire or abnormal heat conditions. It can detect flames within a specific range and angle. If a flame is detected, the sensor sends input to the microcontroller, which then alerts the farmer using email and the Blynk platform while activating audible and visual alarms. The green LED indicates that no threat is present and the system is functioning normally.

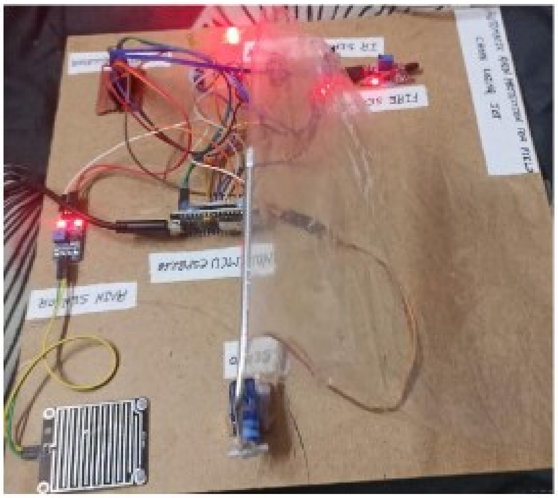
On the software side, the Arduino IDE is used for programming the Node MCU. The firmware includes logic for sensor input reading, condition checking, and actuator control. The Blynk library is used for real-time communication with the mobile app. The Blynk server handles all alerts and logs system events, such as rainfall detection or fire alerts, enabling farmers to take action even when they are not physically present on the farm.

The complete code includes initialization of components, continuous monitoring through a timer function, and handling of events such as sensor triggers. Alerts are sent using Blynk virtual pins and email functions. The servo motor is controlled through PWM signals to rotate it to specified angles for opening and closing the crop cover. This implementation ensures that the system operates efficiently, reduces manual dependency, and responds promptly to potential threats in the agricultural environment.

VII RESULTS



The fire sensor detects the presence of fire in the field and immediately triggers a buzzer alert through the Node MCU. It helps in early fire detection to protect crops from potential damage



The rain sensor detects rainfall and sends a signal to the Node MCU to activate the servo motor for crop protection. It ensures automatic shielding of crops during rain to prevent water damage

VIII CONCLUSION

The crop protection system developed in this project demonstrates a practical and innovative approach to safeguarding agricultural fields from environmental threats such as heavy rainfall, wild animal intrusion, and fire hazards. The system's design is adaptable and can be implemented in various environmental conditions with high accuracy. Additionally, it can be powered using solar energy, thereby reducing operational costs and making it more sustainable and accessible, especially for farmers in rural areas.The integration of IoT technology significantly enhances the system's effectiveness by enabling remote monitoring and control. Farmers can now receive real-time alerts and status updates through a mobile application, making the process more efficient and less labor-intensive. This smart crop protection approach represents a step forward in transforming traditional farming practices in India into more intelligent and responsive systems.Furthermore, the system also supports rainwater harvesting, making efficient use of one of the purest natural resources. By detecting rainfall and collecting water through the deployed protective cover, the system ensures that rainwater can be stored and reused for irrigation, livestock feeding, and other household or agricultural purposes. This reduces wastage and promotes water conservation, which is vital in areas with limited water availability.

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