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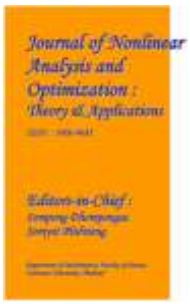

SMART IRRIGATION AND CROP PROTECTION FROM WILD ANIMALS USING IOT

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1. ABSTRACT

In recent years, agriculture has grappled with significant challenges arising from damage caused by wild animals. Traditional crop protection methods, such as fencing and manual surveillance, are often inefficient, labor-intensive, and costly. This paper presents a Smart Crop Protection System powered by the Internet of Things (IoT) to address this issue and safeguard agricultural fields against wild animal intrusions. The proposed system integrates IoT-enabled sensors, including motion detectors and environmental sensors, to monitor fields continuously and detect animal presence in real-time. The collected data is analyzed using an intelligent algorithm that identifies potential threats and triggers immediate countermeasures, such as activating deterrent devices like sound alarms or flashing lights to ward off animals. Furthermore, the system includes a mobile application for remote monitoring, enabling farmers to receive real-time alerts and control deterrent mechanisms from anywhere. By reducing dependency on manual labor and enhancing the efficiency of animal deterrents, this smart solution aims to minimize crop losses, boost agricultural productivity, and support sustainable farming practices. Designed to be cost-effective, scalable, and adaptable to diverse agricultural landscapes, the proposed system offers a modern and practical approach to addressing a long-standing agricultural challenge.

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2. INTRODUCTION

Agriculture plays a vital role in the economies of most countries, serving as the backbone of development through farming, food production, and the processing of raw materials. The establishment of agricultural enterprises forms the foundation of regional economies. Effective irrigation systems, such as the Genius Water System, contribute to maintaining well-balanced and aesthetically pleasing landscapes while minimizing wastewater accumulation. However, overpopulation and deforestation have led to shortages of food, water, and shelter in forests, driving wild animals into human settlements. This increasing encroachment disrupts human life, damages land, and escalates conflicts between humans and wildlife. Despite these conflicts, every species plays a crucial role in the ecosystem, as dictated by nature's balance. Horticulture remains a cornerstone of the economy, but significant crop losses occur due to wildlife interference in rural areas. Animals such as elephants often invade human spaces, destroying crops, food storage facilities, water resources, and even homes. Such destruction negatively impacts communities and intensifies human-wildlife conflicts, posing a threat to both agricultural productivity and human safety. Traditional methods used by farmers to mitigate these issues, such as manual monitoring or deploying guards, are neither cost-effective nor sustainable.Given that the well-being of both humans and animals is essential, developing systems to monitor and manage wildlife activity in agricultural areas is critical for ensuring harmony, protecting livelihoods, and maintaining ecological balance.

3. LITERATURE SURVEY

Bindu D and Dilip Kumar M D et al. highlight the challenge of protecting crop fields from animal intrusion, particularly from animals within protected areas (PAs) that frequently invade agricultural lands. This ongoing issue has made crop protection a significant concern. Current methods have proven ineffective, leading the authors to propose a more practical solution: a device that analyzes animal behavior, detects their presence, and emits specific sounds that irritate the animals, thus scaring them away. Additionally, the system sends a message to the designated person to alert them of the intrusion. The system also features multi-class classification, ensuring zero false alarms and precise species identification. Krishnamurthy B, Divya M et al. emphasize the importance of agriculture in meeting global food demands and

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providing raw materials for various industries. However, wild animal intrusion poses a serious threat to crops, leading to significant losses. They propose a system designed to shield agricultural lands from wild animals, utilizing operational amplifier circuits to detect animal presence near farms. The proposed solution offers early warnings of potential intrusions, allowing farmers to take timely action. They suggest the use of a Solar Electric Fence as a modern, efficient alternative to traditional fencing methods, significantly reducing crop damage caused by animals.

4. EXISTING SYSTEM

The primary investigation involves several key stages, including analyzing existing approaches, identifying system requirements, and developing a conceptual framework for the solution. The system integrates soil moisture sensors, temperature sensors, and humidity sensors placed at the roots of plants to monitor environmental conditions. The collected soil moisture data is processed by a microcontroller, which regulates the water supply accordingly. Additionally, temperature, humidity, and soil moisture levels are displayed on a mobile application accessible to users. The proposed Smart Irrigation System utilizes soil moisture sensing to automate the irrigation process. It activates or deactivates the water pump based on the detected soil moisture percentage, ensuring efficient water usage. Designed for agricultural use in remote locations, the system provides water to plants only when the soil moisture falls below a predefined threshold. This wireless, IoT-enabled solution incorporates drip irrigation automation supported by real-time soil moisture values, while also displaying temperature and humidity readings via the user's device. By automating irrigation and providing real-time environmental data, this smart system enhances water efficiency, reduces manual intervention, and supports sustainable agricultural practices.

DISADVANTAGE

- ✓ Connectivity Issues: In remote areas with poor internet or network connectivity, the real-time monitoring and IoT functionality may face disruptions.
- ✓ Limited Compatibility: The system may not account for diverse crop-specific requirements, soil types, or irrigation methods without significant customization.
- ✓ Environmental Concerns: Improper disposal of electronic components and sensors after their lifecycle could contribute to electronic waste.

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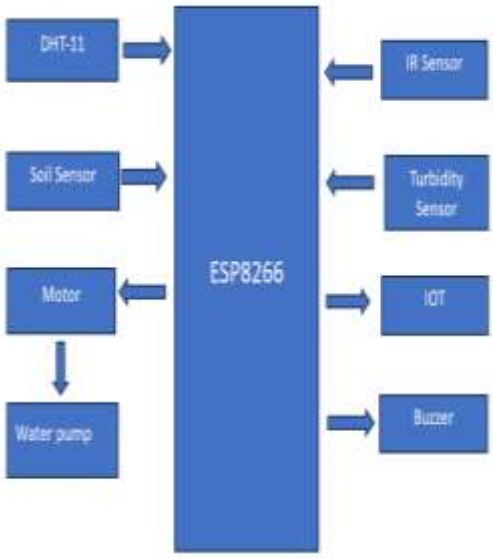
5. PROPOSED SYSTEM

All sensors, including the moisture sensor, humidity sensor, and temperature sensor, are connected to a microcontroller powered by a 5-volt supply. The microcontroller processes the moisture data and relays the information to a control system. If the soil moisture level drops below a predefined threshold, the microcontroller automatically activates the motor to initiate irrigation, and a notification is sent to the user's device. This smart irrigation system integrates three key sensors, which are connected to the controller. The sensor readings are continuously monitored and transmitted to a mobile application allowing users to track real-time data and manage irrigation remotely.

ADVANTAGE

- ✓ Real-Time Monitoring: Continuous, real-time updates on crop health and environmental conditions enable swift responses to emerging threats.
- ✓ Precision Agriculture: Automated systems for irrigation, fertilization, and pest control optimize resource usage, minimizing waste and lowering costs.
- ✓ Enhanced Crop Yields: By ensuring ideal growing conditions and mitigating the effects of pests and diseases, IoT technology helps boost crop production.
- ✓ Cost Efficiency: Targeted application of water, fertilizers, and pesticides cuts down on resource wastage and reduces labor expenses.

6. BLOCK DIAGRAM



7. HARDWARE REQUIREMENT

ESP8266

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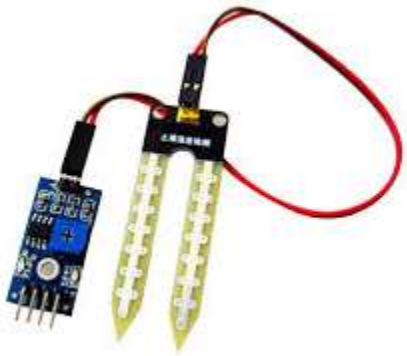
The ESP8266 is a low-cost, Wi-Fi-enabled microcontroller module widely used in IoT applications. It features an integrated TCP/IP stack, enabling seamless internet connectivity for devices. The module operates on a 2.4 GHz frequency and supports 802.11 b/g/n Wi-Fi standards. It includes GPIO pins, making it versatile for controlling sensors, actuators, and other peripherals. Programmable using Arduino IDE or other platforms, it supports custom firmware development. Popular for its compact size and affordability, it powers projects like smart home automation and remote monitoring systems.

DHT-11

The DHT-11 is a low-cost, digital sensor used to measure temperature and humidity with decent accuracy. It combines a capacitive humidity sensor and a thermistor to provide calibrated digital output. The sensor operates within a temperature range of 0°C to 50°C and a humidity range of 20% to 90% RH. It is easy to interface with microcontrollers, requiring just a single data pin for communication. Commonly used in IoT projects, it is ideal for applications like weather monitoring and climate control systems.

SOIL SENSOR



A soil sensor measures soil moisture levels, helping monitor water content for agricultural and gardening applications. It typically consists of two probes that detect electrical resistance or capacitance in the soil. Lower resistance indicates higher moisture, while higher resistance indicates drier conditions. Many soil sensors also measure other parameters, such as temperature, pH, or nutrient levels. They are commonly used in automated irrigation systems to optimize water usage. Easy to interface with microcontrollers, they provide analog or digital output for real-time monitoring. Soil sensors promote precision agriculture by ensuring plants receive the right amount of water, improving yields and reducing waste.

WATER PUMP

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A water pump is a mechanical device used to move water from one location to another, commonly used in agriculture, households, and industries. It operates by creating pressure to lift or transfer water, powered by electricity, diesel, or solar energy. Common types include centrifugal pumps, submersible pumps, and diaphragm pumps, each suited for specific applications. In agriculture, water pumps are crucial for irrigation, ensuring a steady and reliable water supply to crops. Modern pumps can be integrated with automated systems to regulate water flow based on soil moisture levels. Efficient water pumps help conserve resources, reduce manual labor, and improve water management practices.

IR SENSOR

An IR (Infrared) sensor detects infrared radiation emitted by objects to sense their presence, motion, or heat. It works by emitting IR light and analyzing the reflection or absorption to determine object distance or surface characteristics. IR sensors are widely used in applications like obstacle detection, motion tracking, and remote controls. They are categorized into active (emitting IR light) and passive (detecting ambient IR radiation) types. Compact and energy-efficient, IR sensors are easy to integrate with microcontrollers for automation projects. Commonly found in devices like automatic doors, security systems, and robotic navigation systems.

Turbidity Sensor

A turbidity sensor measures the cloudiness or haziness of a liquid by analyzing the amount of light scattered by suspended particles. It typically uses a light emitter and a photodetector to assess water clarity in real-time. Turbidity sensors are widely used in water quality monitoring, wastewater treatment, and environmental research. High turbidity levels can indicate pollution, sedimentation, or microbial activity in the water. These sensors are easy

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to interface with microcontrollers and IoT systems for automated monitoring applications. By providing accurate turbidity data, they help ensure safe water for drinking, aquaculture, and industrial processes.

BUZZER

A buzzer is an audio signaling device that produces sound, often used for alarms, notifications, and alerts. It operates by converting electrical signals into sound, typically using piezoelectric or electromagnetic mechanisms. Buzzers are compact, lightweight, and energy-efficient, making them suitable for a variety of electronic applications. They are commonly found in devices like timers, alarms, security systems, and electronic toys. Depending on the design, a buzzer can emit continuous tones, beeps, or custom sound patterns. Easy to integrate with microcontrollers, buzzers are widely used in IoT and embedded systems for audible feedback.

8. SOFTWARE REQUIREMENT

Arduino Software (IDE)

The Arduino IDE (Integrated Development Environment) is a user-friendly platform for programming Arduino boards. It supports the C and C++ programming languages, offering a simplified syntax tailored for microcontroller development. The IDE features a straightforward interface with tools to write, compile, and upload code to Arduino boards. It comes with an extensive library of built-in functions, simplifying tasks like reading sensors and controlling actuators. The serial monitor in the IDE enables real-time communication and debugging between the board and the computer. It supports multiple operating systems, including Windows, macOS, and Linux, ensuring wide accessibility. The IDE includes an extensive community-contributed library manager for adding additional functionalities. It is open-source, allowing

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developers to customize and extend its features based on project requirements. The platform is widely used for prototyping IoT projects, robotics, and embedded systems. Its simplicity and flexibility make it ideal for beginners while still being powerful enough for advanced users.

9. APPLICATION

- ✓ Precision Agriculture: Automates irrigation based on real-time soil moisture data, optimizing water usage and improving crop yield.
- ✓ Wildlife Intrusion Detection: Detects and deters wild animals near crop fields using motion sensors, alarms, and lights to protect crops.
- ✓ Remote Monitoring: Enables farmers to monitor environmental parameters like soil moisture, temperature, and humidity via mobile apps.
- ✓ Weather-Based Irrigation: Integrates weather data to adjust irrigation schedules, preventing overwatering or underwatering.
- ✓ Eco-Friendly Farming: Reduces water wastage and minimizes manual intervention, promoting sustainable agricultural practices.

10.CONCLUSION

The "Internet of Things" (IoT) is extensively used to connect devices and gather data, offering a reliable and efficient solution for agricultural monitoring and corrective actions. Wireless field monitoring reduces the need for manual labor while allowing users to precisely track changes in agricultural productivity. This approach is cost-effective and energy-efficient. A smart agriculture system has been developed and implemented, providing farmers with a more efficient and beneficial method for managing crops. It monitors air temperature and humidity in agricultural fields, alerting users when these parameters deviate from their optimal ranges. The technology is particularly useful for greenhouses and plants requiring specific environmental conditions. Implementing such systems in agriculture can significantly contribute to advancements in farming practices.

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