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Smart IoT-Based Wildlife Detection & Crop Protection System

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ABSTRACT: Agricultural productivity is significantly impacted by wildlife intrusion and unfavourable environmental conditions, necessitating the integration of modern technology to enhance crop protection and growth monitoring. This project presents an intelligent IoT and sensor-based automation system designed to safeguard crops while ensuring optimal growth conditions. The system incorporates multiple sensors to monitor environmental parameters and detect potential threats in real time. A soil moisture sensor continuously assesses soil moisture levels, and when low moisture is detected, it automatically activates a water motor to initiate irrigation, preventing water stress in crops. Additionally, a DHT sensor monitors temperature and humidity, providing farmers with real-time data updates through a mobile IoT platform, enabling proactive decision-making for maintaining ideal growing conditions. To mitigate the risks posed by wildlife intrusion, a Passive Infrared (PIR) sensor is deployed to detect motion in the field. Upon detecting movement, the system triggers an alarm buzzer to deter animals and simultaneously updates the IoT platform, alerting farmers about potential threats. Furthermore, the security aspect is enhanced using image processing techniques based on MATLAB and Convolutional Neural Networks (CNN). The system captures and processes images of intruding wildlife, accurately identifying animal species and automatically triggering an alert system for immediate intervention. By integrating IoT with machine learning-based image recognition, the system offers a dual-layered security mechanism, ensuring a proactive response to wildlife threats.

I. INTRODUCTION

Agriculture plays a crucial role in ensuring food security and economic stability, but challenges such as wildlife intrusion and unpredictable environmental conditions continue to threaten crop productivity. Traditional farming methods often rely on manual intervention, which can be inefficient and time-consuming. To address these challenges, this project proposes an advanced IoT and sensor-based automation system that integrates modern technology to enhance crop protection and growth monitoring. The system utilizes a soil moisture sensor to detect moisture levels and automatically activates a water motor for irrigation when necessary, ensuring optimal soil conditions for plant growth. Additionally, a DHT sensor continuously monitors temperature and humidity, providing real-time updates through a mobile IoT platform, enabling farmers to make informed decisions. To protect crops from wildlife intrusion, a Passive Infrared (PIR) sensor detects movement in the field and triggers an alarm buzzer to deter animals while simultaneously updating the IoT system with an alert notification. For enhanced security, image processing techniques using MATLAB and Convolutional Neural Networks (CNN) are employed to analyze input images and accurately identify intruding animals, allowing for a more precise and automated response. By combining IoT with AI-driven image recognition, the system ensures a proactive and multi-layered approach to crop protection.

This smart agriculture framework not only helps in safeguarding crops but also improves resource management through automated irrigation and real-time monitoring. The integration of IoT and machine learning minimizes manual labour, optimizes water usage, and enhances overall farm efficiency. By leveraging automation and data-driven insights, the proposed system provides farmers with a more reliable, sustainable, and technology-driven solution to modern agricultural challenges.

migrant labour management, job security monitoring, and welfare services. The authors propose a system where workers' job statuses, shelter arrangements, and access to healthcare services are recorded and updated in real time on the cloud. The system also provides a platform for administrators to manage the workforce efficiently and ensure the workers' job security and well-being throughout their employment period.

II. OBJECTIVES

- └ **Enhance Crop Protection:** Implement an intelligent system to detect and prevent wildlife intrusion using PIR sensors and AI-based image processing.
- └ **Automate Irrigation:** Utilize soil moisture sensors to monitor soil conditions and activate water motors for efficient irrigation.
- └ **Real-Time Environmental Monitoring:** Integrate DHT sensors to continuously track temperature and humidity levels, providing real-time updates to farmers via an IoT platform.
- └ **Wildlife Intrusion Detection:** Deploy PIR sensors to detect motion in the field, triggering an alarm buzzer and notifying farmers through the IoT system.
- └ **AI-Based Image Processing for Animal Identification:** Use MATLAB and CNN-based image recognition to analyze and identify intruding animals, enhancing security measures.

III. SYSTEM IMPLEMENTATION

3.1 EXISTING SYSTEM

- The Wildlife Detection & Crop Protection system integrates IoT and sensor-based automation to enhance agricultural security and resource management.
- A soil moisture sensor monitors soil conditions and automatically activates a water motor when moisture levels drop, ensuring efficient irrigation.
- A DHT sensor continuously tracks temperature and humidity, providing real-time updates via a mobile IoT platform for remote monitoring.
- To detect wildlife intrusion, a PIR sensor identifies motion near the crops, triggering a buzzer alert and sending instant notifications to farmers via IoT. Additionally, MATLAB-based CNN image processing enables animal detection from input images, further enhancing security through an automated alert system.
- This smart system ensures effective crop protection, optimized irrigation, and real-time environmental monitoring with minimal manual intervention.

3.2 DISADVANTAGES

- **High Initial Cost** – Implementing an IoT-based system with multiple sensors, image processing modules, and cloud integration requires significant initial investment, making it less accessible for small-scale farmers.
- **Dependency on Internet Connectivity** – The system relies on IoT for real-time monitoring and alerts, which may not function effectively in rural areas with poor internet connectivity.
- **Power Consumption Issues** – Continuous operation of sensors, image processing units, and IoT modules may lead to high power consumption, requiring a reliable power source or solar-based alternatives.
- **False Alarms** – The PIR sensor may detect non-threatening movements such as wind-driven objects or small animals, leading to unnecessary alerts and disruptions.
- **Limited Detection Range** – The efficiency of PIR sensors is limited by their range and sensitivity, making it challenging to detect animals at a distance or in large farmlands without multiple sensor installations.
- **Complexity in Maintenance** – The integration of multiple sensors, automated irrigation, and AI-based image processing requires regular maintenance and troubleshooting, which may be difficult for farmers without technical expertise.

3.3 PROPOSED METHODOLOGY

- The Wildlife Detection & Crop Protection system integrates IoT and sensor-based automation to enhance agricultural security and resource management.
- A soil moisture sensor monitors soil conditions and automatically activates a water motor when moisture levels drop, ensuring efficient irrigation.

- A DHT sensor continuously tracks temperature and humidity, providing real-time updates via a mobile IoT platform for remote monitoring.
- To detect wildlife intrusion, a PIR sensor identifies motion near the crops, triggering a buzzer alert and sending instant notifications to farmers via IoT. Additionally, MATLAB-based CNN image processing enables animal detection from input images, further enhancing security through an automated alert system.
- This smart system ensures effective crop protection, optimized irrigation, and real-time environmental monitoring with minimal manual intervention.

3.4 ADVANTAGES

- └ **Enhanced Crop Security** – The system provides real-time wildlife detection, reducing crop damage caused by animal intrusions.
- └ **Automated Irrigation** – The soil moisture sensor ensures that crops receive optimal water supply by automatically activating the water motor, preventing over-irrigation and under-irrigation.
- └ **Remote Monitoring and Control** – Farmers can monitor temperature, humidity, and soil conditions in real time via a mobile IoT platform, allowing them to manage their farms remotely.
- └ **Efficient Resource Management** – The system optimizes water and energy use by automating irrigation and security alerts, reducing waste and conserving valuable resources.
- └ **AI-Based Animal Detection** – MATLAB-based CNN image processing accurately identifies intruding animals from images, improving security and reducing false alarms.
- └ **Reduced Manual Labor** – Automation reduces the need for constant human supervision, minimizing labor costs and effort.
- └ **Increased Crop Yield** – By protecting crops from wildlife and ensuring proper irrigation, the system contributes to improved plant health and higher yields.
- └ **Scalability** – The system can be expanded to monitor larger farmland areas by adding more sensors and integrating additional IoT modules.
- └ **Customizable Alerts** – Farmers can set thresholds for moisture levels, temperature, and wildlife intrusion sensitivity to receive alerts tailored to their needs.
- └ **Weather Adaptability** – The DHT sensor helps track climate variations, allowing farmers to prepare for extreme weather conditions.

3.5 BLOCKDIAGRAM

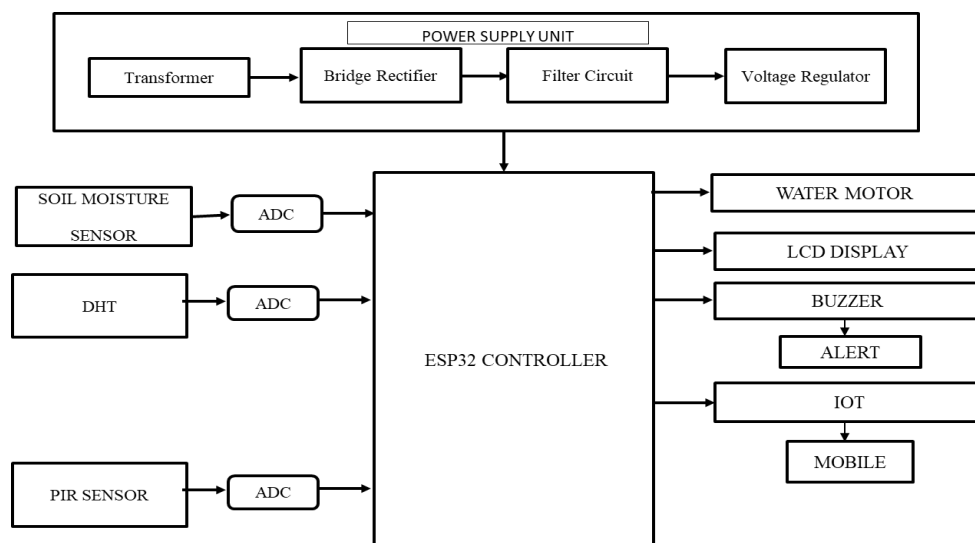


FIG-3.5.1 BLOCK DIAGRAM

IV.WORKING

When sufficient voltage is applied to the electrodes the liquid crystal molecules would be aligned in a specific direction. The light rays passing through the LCD would be rotated by the polarizer, which would result in activating/highlighting the desired characters. The power supply should be of +5v, with maximum allowable transients of 10mv. To achieve a better/suitable contrast for the display the voltage (VL) at pin 3 should be adjusted properly. A module should not be removed from a live circuit.

The ground terminal of the power supply must be isolated properly so that voltage is induced in it. The module should be isolated properly so that stray voltages are not induced, which could cause a flicking display. LCD is lightweight with only a few, millimeters thickness since the LCD consumes less power, they are compatible with low power electronic circuits, and can be powered for long durations. LCD does not generate light and so light is needed to read the display. By using backlighting, reading is possible in the dark. LCDs have long life and a wide operating temperature range. Before LCD is used for displaying proper initialization should be done.

LCDs with a small number of segments, such as those used in digital watches and pocket calculators, have individual electrical contacts for each segment. An external dedicated circuit supplies an electric charge to control each segment. This display structure is unwieldy for more than a few display elements. Small monochrome displays such as those found in personal organizers, or older laptop screens have a passive-matrix structure employing super-twisted nematic (STN) or double-layer STN (DSTN) technology—the latter of which addresses a color-shifting problem with the former—and color-STN (CSTN)— wherein color is added by using an internal filter. Each row or column of the display has a single electrical circuit.

The pixels are addressed one at a time by row and column addresses. This type of display is called passive-matrix addressed because the pixel must retain its state between refreshes without the benefit of a steady electrical charge. As the number of pixels (and, correspondingly, columns and rows) increases, this type of display becomes less feasible.

The row line is then deactivated and the next row line is activated. All of the row lines are activated in sequence during a refresh operation. Active-matrix addressed displays look "brighter" and "sharper" than passive-matrix addressed displays of the same size, and generally have quicker response times, producing much better images. A general purpose alphanumeric LCD, with two lines of 16 characters. So the type of LCD used in this project is 16 characters * 2 lines with 5*7 dots with cursor, built in controller, +5v power supply, 1/16 duty cycle.

4.7 WATER MOTOR



FIG 4.7.1 WATER MOTOR

Operating DC Voltage: 2.5-6V
Maximum Water lift height: 40-110cm / 15.75"-43.4"
Flow rate: 80-120L/H

Outer Diameter of Water Outlet: 7.5mm / 0.3"
Inside Diameter of Water Outlet: 5mm / 0.2"
Pump Diameter: Approx. 24mm / 0.95"
Pump Length: Approx. 45mm / 1.8"
Pump Height: Approx. 30mm / 1.2"
Wire Length: ~13mm cm

4.8 SOIL MOISTURE SENSOR

Soil moisture sensors measure the water content in soil. A soil moisture probe is made up of multiple soil moisture sensors.

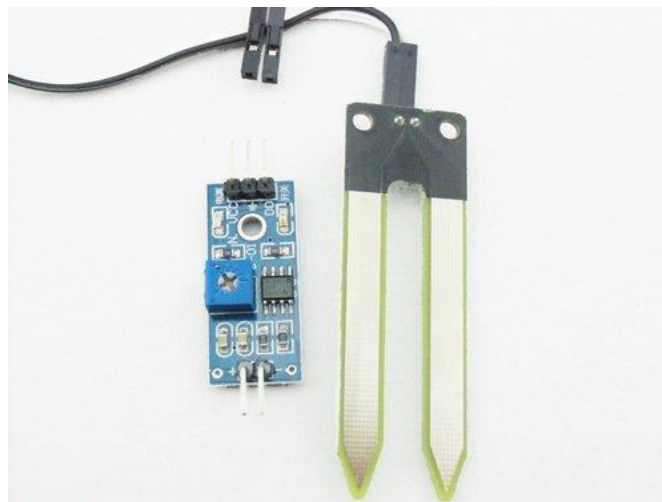
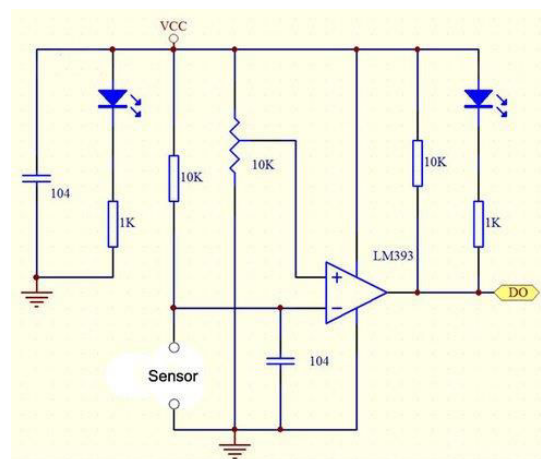
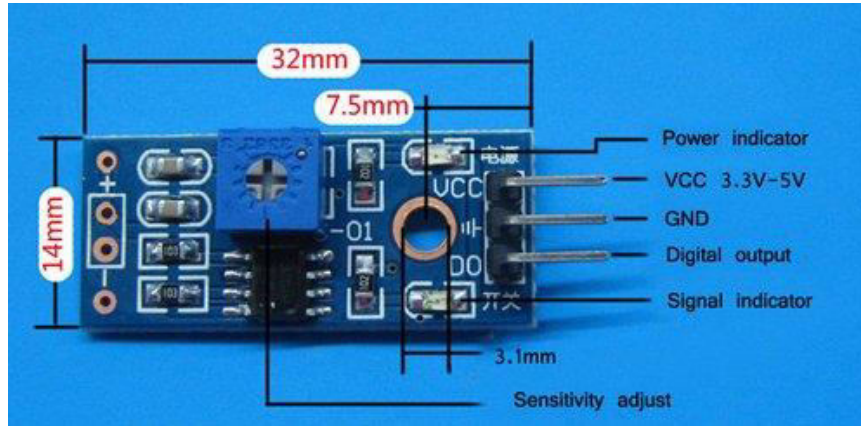


FIG 4.8.1 SOIL MOISTURE SENSOR

This Soil Moisture Sensor can be used to detect the moisture of soil or judge if there is water around the sensor, let the plants in your garden reach out for human help. Insert this module into the soil and then adjust the on-board potentiometer to adjust the sensitivity. The sensor would outputs logic HIGH/LOW when the moisture is higher/lower than the threshold set by the potentiometer. With help of this sensor, it will be realizable to make the plant remind you : Hey, I am thirsty now, please give me some water.

FEATURES

- Digital output, easy to adjust
- Nickel plating to avoid corrosion
- Working voltage: 3.3V-5V
- On-board LM393 chip
- Dimension of the board: 3.2cm * 1.4cm



V. CONCLUSION

The **Wildlife Detection & Crop Protection system** offers an automated and efficient approach to safeguarding crops while optimizing irrigation using **IoT and sensor-based technology**. By integrating multiple sensors such as **soil moisture, DHT, and PIR sensors**, the system ensures real-time monitoring of environmental conditions, automated irrigation management, and instant alerts in case of wildlife intrusion. The soil moisture sensor maintains optimal irrigation by activating a **water motor when moisture levels drop**, ensuring efficient water usage. The **DHT sensor continuously tracks temperature and humidity**, providing valuable environmental data for better decision-making. To enhance **farm security**, a PIR sensor detects motion near crops and triggers an **instant buzzer alert and IoT notification**, allowing farmers to respond quickly to potential threats. Additionally, **MATLAB-based image processing** utilizing **Convolutional Neural Networks (CNNs)** further strengthens security by accurately identifying animals and activating necessary countermeasures. This **AI-driven detection system** reduces false alarms and improves the accuracy of wildlife identification, helping farmers take appropriate action.

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