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IoT Based Crop Rakshak

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Abstract: This project aims to develop a low-cost and effective solution to protect crops from stray animals using a Raspberry Pi and a camera. The system will be designed to detect and track animals that enter the crop area and alert the farmers in real time, allowing them to take appropriate actions. The Raspberry Pi will be programmed to use computer vision algorithms to identify and differentiate between different types of animals, such as birds, rodents, and larger mammals triggered an alarm and send alerts to the farmers' smartphones or computers. The system will also be able to capture and store images and videos of the animals for further analysis. The proposed solution can significantly reduce crop damage caused by stray animals and help farmers increase their yields and profits.

Index Terms - Raspberry-PI, Soil moisture sensor, Solar panel, Processor, ESP8266.

I. Introduction

The protection of crops from stray animals is a critical issue in agriculture, as it directly affects the yields and profits of farmers. Traditional methods of crop protection, such as fencing and scarecrows, can be expensive and ineffective, particularly in large crop areas. This has led to an increased demand for innovative and cost-effective solutions to address these challenges. In recent years, the use of technology has become increasingly prevalent in agriculture, including the use of computer vision and machine learning techniques. This project proposes a solution that utilizes a Raspberry Pi, camera, and alarm system to detect and deter stray animals from entering the crop area. The Raspberry Pi is a small, low-cost computer capable of running various computer vision algorithms. The camera will capture images and videos of the crop area, and the Raspberry Pi will process the data using computer vision algorithms to detect and differentiate between different types of animals. The alarm system will be triggered when an animal is detected, alerting farmers to take necessary actions to deter the animal from entering the crop area. The system will be designed to differentiate between different types of animals, such as birds, rodents, and larger mammals, and the alarm will be set to trigger different responses based on the type of animal detected. The system will also store images and videos of the animals for further analysis, helping farmers to better understand the types of animals that are causing crop damage. Overall, this project aims to provide a cost-effective and innovative solution to protect crops from stray animals, allowing farmers to reduce crop damage and increase their yields and profits.

Index Terms – Raspberry-PI, Soil moisture sensor, Solar panel, Processor, ESP8266.

II. EXISTING HARDWARE

There are several hardware components that are commonly used for crop protection, including

1. **Fencing**: Fencing is one of the oldest and most widely used methods for crop protection. It involves surrounding the agricultural field with a physical barrier to prevent animals from entering. Fencing can be made of different materials, including wood, wire, and plastic.

2. **Scarecrows:** Scarecrows are human-like figures made of straw or other materials that are designed to scare away birds and other small animals from agricultural fields.
3. **Chemical repellents:** Chemical repellents are substances that are sprayed or applied to crops to repel animals. These substances can be natural or synthetic and are usually non-toxic to humans.
4. **Motion-activated sprinklers**: Motion-activated sprinklers use a sensor to detect the presence of animals and then spray water to scare them away.
5. **Guard animals:** Guard animals such as dogs or llamas are trained to protect agricultural fields by chasing away animals that pose a threat.

While these methods can be effective, they also have several limitations. Fencing can be expensive to install and maintain, and it may not be effective against larger animals such as deer or wild boars. Scarecrows and chemical repellents may be ineffective against animals used to human presence. Motion-activated sprinklers and guard animals can be effective but expensive and require specialized training. The proposed IoT-based crop protection system using Raspberry Pi, camera, and alarm addresses many of these limitations by providing a cost-effective and efficient solution that can be deployed in any agricultural field. The system's ability to detect and prevent damage caused by stray animals in real time makes it an innovative and practical solution for crop protection.

III. WORKING METHODOLOGY

The project is divided into two parts-

- The proposed IoT-based crop protection system consists of a Raspberry Pi, camera, and alarm. The system is designed to monitor agricultural fields in real time and detect the presence of stray animals using a camera module. The captured images are then processed using machine learning algorithms to identify animals. Raspberry Pi acts as a central processing unit to control the entire system and trigger the alarm when the system detects any stray animal movement.

The system operates as follows:

1. **Image capture:** The camera module is used to capture images of the agricultural field continuously. The camera module is placed at a strategic location where it can capture the entire field's view.
2. **Image processing:** The captured images are processed using machine learning algorithms to identify animals. The system employs object detection techniques to identify animals and distinguish them from other objects in the image. Once an animal is detected, the system triggers the alarm to alert the farmers.
3. **Alarm triggering**: When the system detects any stray animal movement, the Raspberry Pi triggers the alarm to alert the farmers. The alarm can be in the form of a loudspeaker or a mobile notification. Farmers can take immediate action upon receiving the alarm to prevent potential crop damage caused by stray animals.

- The second part is the detection and monitoring system of the environment through various sensors in the field. There are different sensors are used like temperature sensor, soil moisture sensor, humidity sensor and soil mineral sensor which gives the current readings and processes the data in the processor and sends the data to the remote user. The proposed system has several advantages over traditional crop protection methods. It is highly efficient in detecting and preventing damage caused by stray animals, cost-effective, and easy to implement. The system can be deployed in any agricultural field, and farmers do not need any technical knowledge to operate it. Additionally, the system operates in real-time, allowing farmers to take immediate action to prevent crop damage.

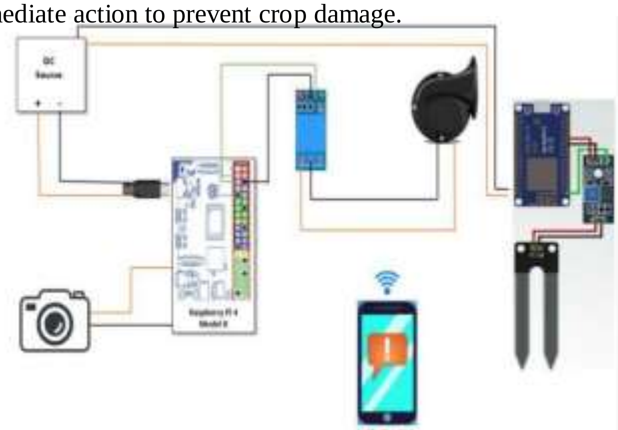

Figure 1.Circuit Diagram

IV. BLOCK DIAGRAM

[Part-1] Detection and monitoring system for straying animals (Fig- 1)

[Part-2] Detection and monitoring system of the environment through various sensors (Fig- 2)

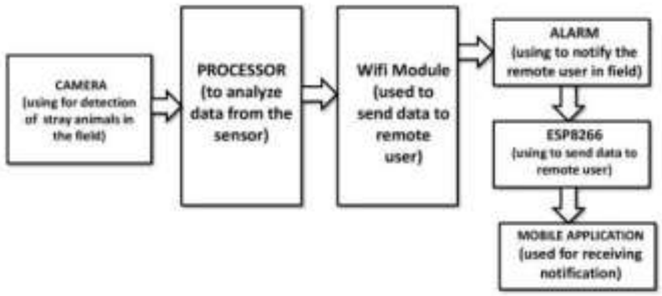

FIG.1 DETECTION AND MONITORING SYSTEM FOR STRAY ANIMALS

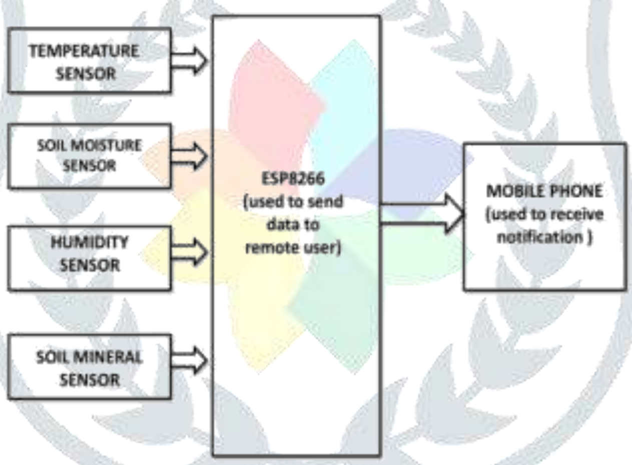

FIG-2 DETECTION AND MONITORING SYSTEM FROM VARIOUS SENSOR

V. HARDWARE DETAILS

1- Raspberry Pi

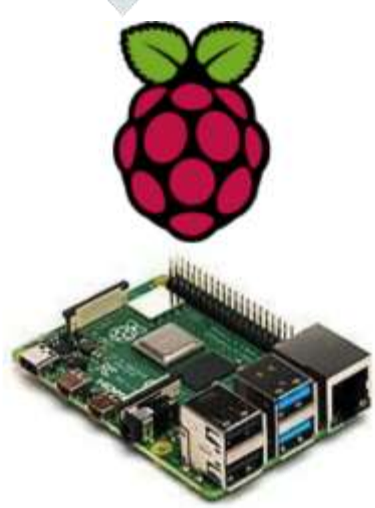

Figure 3: Raspberry-pi

Raspberry Pi is a small, single-board computer that can be used for a variety of applications, including IoT-based systems. It is an affordable and versatile computer that can run various operating systems, including Linux, and can be programmed using various programming languages. The Raspberry Pi board includes several components, including a processor, memory, input/output pins, and USB ports. These components allow the Raspberry Pi to connect to various sensors and peripherals, making it an ideal platform for IoT-based systems. In the proposed IoT-based crop protection system, Raspberry Pi acts as a central processing unit to control the entire system. It receives images captured by the camera module and processes them using machine learning algorithms to identify animals.

When the system detects any stray animal movement, the Raspberry Pi triggers the alarm to alert the farmers. Raspberry Pi's affordability and versatility make it an ideal platform for developing IoT-based systems, particularly in the agricultural sector. Its low power consumption and ability to run on battery power also make it suitable for use in remote locations where power may be limited.

2- Soil Moisture Sensor

Figure 4: Soil Moisture Sensor

A soil moisture sensor is a device that measures the amount of moisture in the soil. It is an essential component of precision agriculture as it allows farmers to optimize irrigation, conserve water, and maximize crop yields. Soil moisture sensors work by measuring the electrical conductivity of the soil. The more moisture in the soil, the higher the electrical conductivity. There are two types of soil moisture sensors: contact and non-contact sensors. Contact sensors are inserted into the soil and measure the moisture content in the immediate vicinity. These sensors are usually composed of two metal probes that are inserted into the soil. The probes are connected to a device that measures the electrical resistance between them. The higher the resistance, the lower the soil moisture content. Non-contact sensors, on the other hand, use electromagnetic waves to measure the moisture content of the soil. These sensors emit a low-frequency electromagnetic wave that travels through the soil. The wave is reflected back to the sensor, and the time it takes for the wave to travel back is measured. The moisture content of the soil can be calculated based on the time it takes for the wave to travel through the soil. Soil moisture sensors can be connected to an IoT-based system to provide real-time data on soil moisture levels. This data can be used to optimize irrigation schedules and prevent overwatering, which can lead to water waste and crop damage. The proposed IoT-based crop protection system using Raspberry Pi, camera, and alarm can be enhanced by adding a soil moisture sensor to provide real-time data on soil moisture levels, allowing farmers to optimize irrigation schedules and maximize crop yields.

3- Solar Panel

Figure 5: Solar Panel

A solar panel is a device that converts sunlight into electrical energy. It is composed of photovoltaic cells that absorb photons of light and release electrons, creating a flow of electricity. Solar panels are commonly used to power homes, buildings, and electronic devices, and they are also an ideal power source for IoT-based systems. Solar panels can be used to power the proposed IoT-based crop protection system using Raspberry Pi, a camera, and an alarm. The system can be powered by a solar panel and a battery, making it ideal for use in remote agricultural areas where access to electricity may be limited. The solar panel can be connected to a charge controller, which regulates the amount of energy that flows into the battery, preventing overcharging and extending the battery's lifespan. The battery can then be used to power the Raspberry Pi, camera, and alarm, providing a reliable power source for the system.

4- ESP8266

Figure 6: ESP8266

ESP8266 is a low-cost, Wi-Fi-enabled microcontroller that is widely used in IoT-based applications. It can be programmed using the Arduino Integrated Development Environment (IDE) and supports multiple programming languages, including C and C++. The ESP8266 microcontroller includes a Wi-Fi module, a processor, and input/output pins, making it ideal for connecting IoT-based systems to the internet. The Wi-Fi module allows the ESP8266 to connect to a wireless network and communicate with other devices, making it an ideal platform for IoT-based systems that require internet connectivity. In the proposed IoT-based crop protection system, ESP8266 can be used as an alternative to Raspberry Pi to control the system. ESP8266 can receive images from the camera module and process them using machine learning algorithms to identify animals. When the system detects any stray animal movement, ESP8266 can trigger the alarm to alert the farmers. ESP8266's low cost and compact size make it ideal for IoT-based applications, particularly in the agricultural sector, where cost and space are critical factors. Its ability to connect to Wi-Fi networks and communicate with other devices also makes it an ideal platform for developing IoT-based systems that require internet connectivity

5- LCD (Liquid Crystal Display)

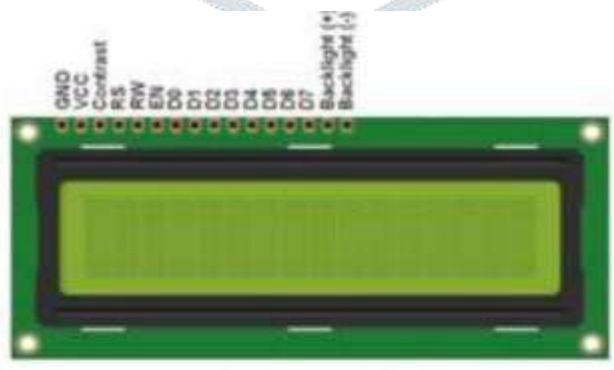

Figure 7: LCD (16 X 2)

A liquid crystal display (LCD) is a type of flat panel display that uses the light-modulating properties of liquid crystals to produce images or text. The 16x2 LCD display is a common type of LCD module that displays two lines of 16 characters each. In the proposed IoT-based crop protection system, a 16x2 LCD display can be used to provide real-time feedback on the status of the system. The display can be connected to the Raspberry Pi or ESP8266 to show the system's current state, such as the status of the camera, the detection of any stray animal movement, or the battery level. The LCD display can also be used to provide error messages, such as when there is a problem with the system's connectivity or when the battery level is critically low. This information can be used by farmers to quickly identify and resolve any issues with the system, ensuring its reliable operation. The 16x2 LCD display is compact and easy to use, making it an ideal choice for IoT-based systems that require a small form factor. It is also low power, which is crucial for IoT-based systems that rely on battery power. With its ability to provide real-time feedback and error messages, the LCD display can enhance the functionality and reliability of the proposed IoT-based crop protection system.

VI. HARDWARE RESULT

Figure 8: Hardware Setup in Field

Figure 9: Final Hardware Design

Figure 10: Notification in Mobile Phone

VII. CONCLUSION

The proposed IoT-based crop protection system using Raspberry Pi, ESP8266, camera, and alarm can help farmers to protect their crops from stray animal damage. The system uses a camera to capture images of the field, which are processed using machine learning algorithms to detect any stray animal movement. When the system detects any such movement, an alarm is triggered to alert the farmers. The system can be powered using a solar panel and a battery, making it sustainable and suitable for use in remote agricultural areas. The 16x2 LCD display can provide real-time feedback and error messages to ensure the system's reliable operation. By using IoT-based technology, this system can significantly reduce crop losses caused by stray animal damage, thus improving agricultural productivity and reducing the financial burden on farmers. The system can also be adapted for use in other areas, such as wildlife monitoring or security applications. Overall, the proposed IoT-based crop protection system is an innovative and practical solution for addressing the issue of stray animal damage in agriculture.

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