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AGRO SOLAR FENCE SECURITY SYSTEM FOR INDOOR FARMING USING IOT

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Abstract: In this innovative embedded system for agricultural applications, we address the major issue of crop damage caused by local and wild animals such as buffaloes, cows, goats, birds and elephants. Recognizing the challenges faced by farmers, we propose a thorough solution employing advanced technologies. Our system integrates PIR and fencing sensors to create an intelligent animal and human detection alerting system, providing an initiative defence against animal and humans into farmlands. This automated approach reduces the need for farmers to physically protect their fields thereby minimizing losses and ensuring crop protection. Beyond alerts, our system offers a versatile approach to agricultural enhancement. It provides live soil moisture information using IoT technology, enabling farmers to make data-driven decisions regarding irrigation. This not only optimizes water usage but also helps to increased crop yield. The integration of moisture levels in the soil and detection of human or animal presence further strengthens the system capabilities. The inclusion of notification alerts ensures that farmers are quickly informed of unusual conditions, allowing for fast responses. This integrated agricultural solution not only secures crops but also enables farmers with real-time information, automation and strengthens overall crop productivity. Additionally introducing a MQ2 sensor for fire detection and preventing the fire by pumping the water into the field automatically using the relay and motor. Introducing artificial light for photosynthesis to ensure plants receive the required light 24 hours a day, promoting continuous yield.

Keywords: live soil moisture, human detection alerting system, fire detection, artificial light for photosynthesis , agricultural.

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1. INTRODUCTION

Irrigation system in India has given a high priority in economic development. Crops are vulnerable to wild animals. Therefore, it is very important to monitor the presence of wild animals near the field. We proposed a unique method to protect farms from wild animals. The proposed method helps to provide an early warning about possible intrusion detection and damage by humans and animals. This project includes various features like animal and human detection and diversion, alerting system, soil humidity monitoring, automatic irrigation system, fire detection and prevention, artificial light for photosynthesis for indoor farming.

1.1 Solar Fence Security

Fencing sensor and PIR sensor are mainly used for the detection. The proposed monitoring scheme is to provide warning about possible animal and human detection caused by animals. It is applicable in remote areas which provide an economical and practical solution to achieve maximum protection of field or particular areas.

1.2 Automatic Irrigation System

Farmers are facing many challenges in watering their plants to keep their crops green. Sometimes they may forget to supply water to their crops, this leads to poor quality crops in this regard it is essential to monitor the soil condition continuously whether it is dry or wet. In this scientific world we can able to automate each and every process in order to reduce the manual workload and also the time consumption so, it will be more helpful if we introduce automation in this agricultural field. In this method the agriculture land will receive sufficient amount of water when required based on the soil condition. The main advantage of this approach is that the farmer need not visit the farm frequently; the system itself will take care of the farm. The farmer will get notified about the soil condition and he can monitor the water level in the soil by using Blynk IoT app.

1.3 Fire Detection and Prevention

Fire attacks in agricultural land present a threat to crops and environment resulting in losses. Fires can be caused by various factors like human activities, or accidents involving machinery or

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electrical systems. Integrating advanced technologies in agricultural practices is essential for improving efficiency and sustainability. One such innovation is the use of sensors for fire detection and prevention in the agriculture fields. MQ2 sensor is used for fire detection when any abnormal condition is triggered. If the MQ2 sensor values are deviating from the already set threshold values, then the relay goes to ON condition and the relay switches ON the motor pump which will pump the water into the field until the sensors reaches the required values. The main advantage of this work highlights the fact that the loss of food crop yield from the farmland could be minimized.

1.4 Artificial Light for Photosynthesis Generally plants relay on natural sunlight for photosynthesis. In environments when the natural light is insufficient or unavailable, such as indoor spaces or areas with little amount of sunlight exposure, plants face challenges in carrying out photosynthesis effectively. This can lead to poor crop yields and limited plant productivity. Artificial light for photosynthesis is a method used to supplement or replace natural sunlight where plants may not receive adequate light. By providing specific light wavelengths and intensities, artificial light can replicate natural sunlight, promoting continuous photosynthesis and plant growth even in indoor or low-light environments. The concept of this method is rooted in the understanding that plants require light within specific wavelengths (blue and red) mainly to carry out photosynthesis efficiently. LED lights can be tailored to emit light in these wavelengths, providing plants with the energy they needed for the strong growth and development.

2. LITERATURE SURVEY

By referring the above research articles, the issues with each paper have been identified. Incorrect fencing causes disturbance and abnormal conditions in farms and agricultural fields. Animals invading the fields in search of food are a major problem as it destroys the crops which results in huge loss for farmers. Dangerous accidents and deaths are the outcomes of negligent fencing methods. Protection of property or land can be improvised as the older fencing methods haven't proven to be much effective. When any human/animal has entered in into farm they just receive a short amount of shock. Most of the previous models

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don't have PIR sensor for detection and the farmer is not notified about the fencing details. In agriculture field, farmers are facing many problems in watering their plants to keep their crops green. Sometimes they may forget to supply water to their crops, this leads to poor quality crops, in this regard it is essential to monitor the soil condition continuously weather it is dry or wet. Farms are at risk due to fire attacks. During summer there is a huge risk of fire accidents either manmade or natural. There is no automated system to detect gas and pump water into field to prevent fire damage. Plants rely on natural sunlight for photosynthesis, which limits the ability to grow and produce food efficiently. Insufficient light can lead to lower productivity, especially in regions with limited sunlight or during certain seasons.

Suraj Dilip Chincholeet al. This paper discusses the design and implementation of a solar-based electronic fence for livestock control. The methodology includes introducing fundamental concepts of electric fence technology, presenting a new design method for a livestock electric fence energizer circuit and impulse transformer, and analysing the circuit using transmission line theory and propagation waves. The paper also discusses safety standards and data performance, and presents a circuit model based on the measured results of a real fence.

Mr. Chandolu Sai Deepaket al. proposed system utilizes operational amplifier circuits for detecting animal intrusion and provides early warning about possible damage. The solar electric fence system is an effective alternative to conventional fencing methods. The methodology involves storing solar energy, creating a shocking circuit, and implementing ON/OFF control for the fence based on the PIR sensor.

Prof. S Firdosh Parveenet al. The system is based on a microcontroller circuit and includes components such as a solar panel, IC ULN 2003, controller circuit, driver circuit, and buzzer. The electric fence delivers a short, safe electric shock to animals or humans that come in contact with it, acting as an effective barrier. The methodology involves using a 12v rechargeable battery connected to a solar panel for charging, a controller circuit to regulate voltage, a driver circuit to control the flow of current

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through the fence, and an alarm system to detect interruptions.

The implementation of a solar power fencing system for agriculture using GSM technology. When motion is detected, the microcontroller sends a message to an authorized person through the GSM modem and activates the buzzer. The system is powered by solar energy with a backup facility for uninterrupted operation during the night and cloudy days. Motor can be controlled by GSM. Advantage of our proposed system are Solar energy is used, Easy to control and maintain the fence, Less time consuming.

The methodology used in the implementation of solar-powered virtual fences in rural agriculture involves transforming solar energy into electrical energy and using electric shocks to deter animals and theft. The solar energy is converted into unregulated DC voltage, which is then transformed into regulated DC voltage and finally into AC voltage using an inverter. The types of sensors used are infrared (IR) sensor which include PIR sensor and so on.

3. PROPOSED SYSTEM

The proposed integrated security and automation system, the utilization of PIR sensors emerges as a fundamental technology for detecting both human and animal presence. The fencing sensor component plays a crucial role in providing security, strategically placed along the fence to understand any form of touching or movement. Upon sensing such type of activity, the system quickly activates an alerting mechanism on the IoT platform, ensuring that authorized users receive instantaneous notifications. The integration of a voice announcement system serves as an additional layer of alerting, providing audible signals that complement the visual alerts. Simultaneously, the proposed system addresses environmental sustainability through a smart irrigation solution. Soil moisture sensors embedded in the soil continuously monitor moisture levels, enabling the system to make intelligent decisions regarding irrigation. When dryness is detected, the system autonomously triggers the water pump, initiating an efficient irrigation process. The pump remains active until an optimum moisture level is achieved, at which point it is automatically turned off. This not only assures the proper use of water resources but also allows users to externally manage and customize irrigation schedules through the IoT

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platform. The proposed project aims to protect the field from fire accidents. A MQ2 sensor is used to detection when the sensor triggers any smoke or gas the relay will turn ON the motor and it will pump the water into the field to prevent fire. Another feature is artificial light for photosynthesis. By implementing this method, the plants will receive the light 24/7 which is crucial for photosynthesis.

BLOCK DIAGRAM

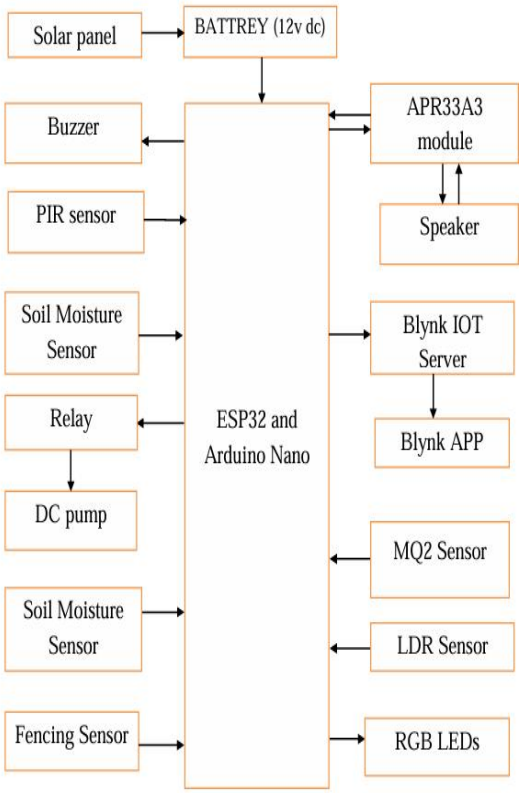

Fig.1 Block Diagram of Agro solar fence security system for indoor farming

4. MODULES

Solar Fence Security

It is not possible for farmers to keep barrier for entire field or to stay on the field 24 hours and guard it. To overcome this problem, in our proposed work we are designing a system to detect the entry of animals into the farm by using PIR and fencing Sensor and divert them with voice announcements by speakers.

Solar Panels

A solar panel is a device which converts sunlight into electricity by using photovoltaic (PV) cells. PV cells are made of materials that create excited electrons when exposed to light. These electrons flow through a circuit and form direct current (DC) electricity, which can be later used to power various devices or store it in batteries. Solar panels are also termed as solar cell panels, solar electric panels, or PV modules.

Fig.2 Solar panel

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Features of Solar Panels:

- Efficiency
- Durability
- Modularity
- Inverter compatibility
- Sustainability

Bypass Diode

The use of a diode in the connection between a solar panel and a battery is a common practice in solar power systems.

- Preventing Reverse Current Flow
- Blocking Discharge to Ensure Battery Health
- Protection Against Shadowing
- Minimizing Power Loss

Fig.3 Bypass Diode

Rechargable Battery

Lead-acid batteries are commonly used with the solar panels to preserve excess electricity generated during sunny periods. These batteries employ a reversible electrochemical reaction including lead dioxide, sponge lead, and sulfuric acid. During charging, surplus solar energy is used to convert lead sulfate back into lead dioxide and sponge lead. When electricity is needed such as during low sunlight or at night time the stored chemical energy is converted back into electrical energy.

Fig.4 Rechargable Battery

Fencing Sensor

Fencing sensors, commonly used in security systems, are devices designed to detect and respond to physical animal and human detection or disturbances along a defined perimeter, such as a fence or boundary. When an animal or person is detected, the sensor triggers an alarm or activates security measures, alerting sound or initiating further surveillance. Fence sensors play a crucial role in perimeter security,

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providing an early warning system against illegal access.

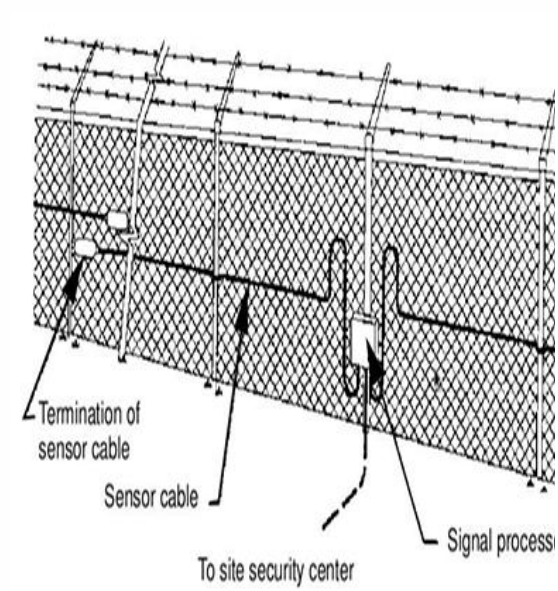

Fig.5 Fencing Sensor

Working:

We are preparing this fencing sensor it contains two layers namely the outer layer is a fence which is connected to regulator which works on a voltage of 5V and the inner layer by default it has 0V. When an intruder touches the outer fence, it touches the inner fence which disrupts the voltage flow then from 0V to 5V thus this change is registered as a touch event it then sends this information to the microcontroller and then the microcontroller initiates a sound by using a buzzer. The buzzer is set for three seconds once the buzzer stops then the audio is played by using a speaker.

PIR Sensor

A Passive Infrared (PIR) sensor is mainly used for human and animal detection. It is a type of electronic sensor that detects infrared radiation emitted by objects in its field of view. PIR sensors are commonly used for motion detection, and they find applications in many devices and systems, including security systems, lighting control, and automation.

Fig.6 PIR Sensor

Working:

The sensor is partitioned into zones, with each zone corresponding to a specific area in its field of view. In the absence of motion, the sensor establishes a baseline voltage. When an object enters the field, emitting infrared radiation and causing changes

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in temperature, the pyroelectric material generates voltage signals in the affected zones. These signals undergo differential amplification, enhancing sensitivity. Signal processing and thresholding follow, granting the sensor to distinguish significant changes from noise. Upon surpassing the threshold, the PIR sensor produces an output signal, indicating detected motion. Optional features such as time delay and sensitivity adjustment boost functionality, and the sensor often enters a standby mode for power conservation during periods of inactivity.

SYSTEM ARCHITECTURE

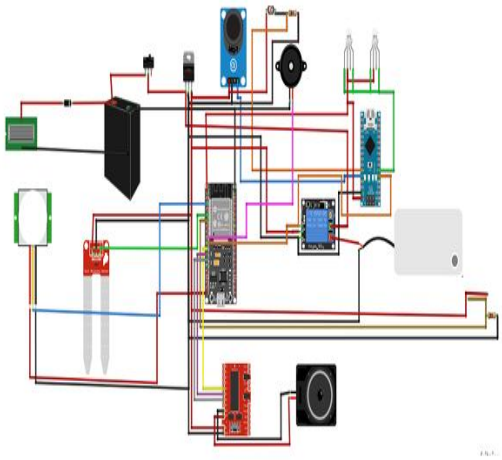

Fig.7 System Architecture of Agro solar fence security system for indoor farming

The solar panel harnesses renewable energy to charge the battery, providing sustainable power. Soil moisture and motion detection are continuously monitored by sensors, with the ESP32 microcontroller coordinating responses. Low soil moisture activates the submersible pump for automated irrigation, optimizing crop growth. The PIR sensor acts as an intruder alert, triggering a sound alert through the APR33A3 module and buzzer. The ESP32 microcontroller ensures real-time communication with an IoT platform, offering valuable data to farmers. This innovative approach not only protects crops from potential threats but also improves yield through automated irrigation and timely alerts, implementing an efficient and responsive agricultural environment. The MQ2 sensor is used for fire detection, LDR sensor, LED are used for artificial light for photosynthesis. The MQ2, LDR, LED connected to the Arduino Nano microcontroller. We are using two microcontrollers for better results.

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5. RESULTS

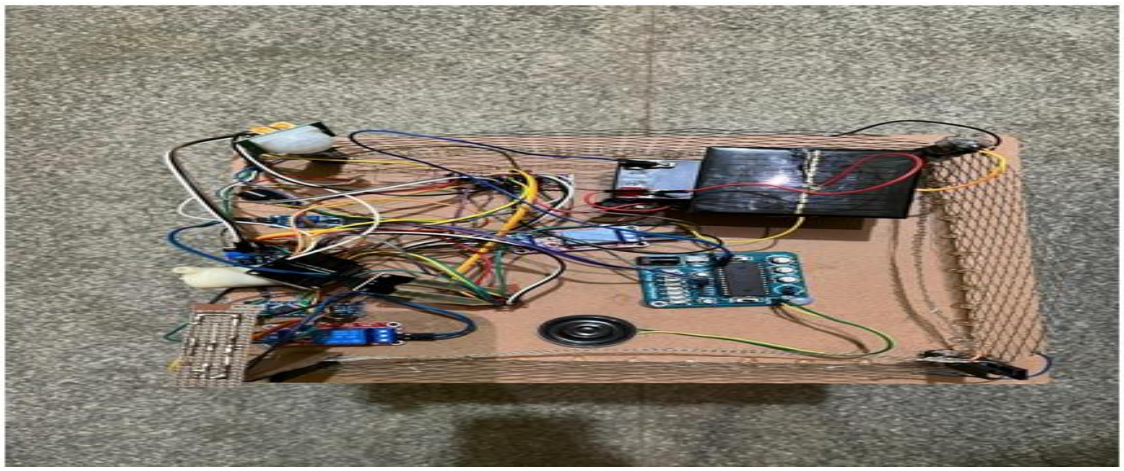

Fig.8 Output Device of Agro Solar Fence Security System for Indoor Farming

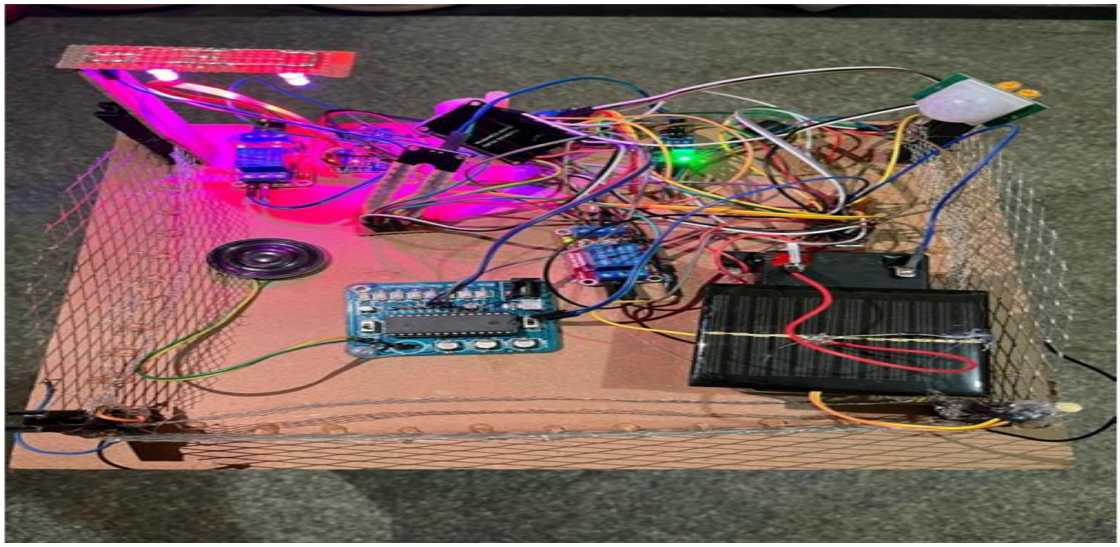

Fig.9 Working Output Device of Agro Solar Fence Security System for Indoor Farming

6. CONCLUSION

This innovative solution implemented in agricultural land will help the farmers from humans and wild animals. By integrating advanced technology, the system acts as a watchful protector, tirelessly monitoring agricultural areas to block animals and humans. Its low-cost nature not only makes it available to a wide range of farmers but also addressing the major issue of financial constraints within the agricultural sector. Furthermore, the main goal of this protective system extends beyond

security, encompassing essential features such as soil moisture monitoring, fire detection and prevention mechanisms, artificial light for photosynthesis and motor pump automation. The integration of soil moisture monitoring allows farmers to make informed decisions, optimizing their agricultural practices based on real-time weather conditions. By implementing the automatic irrigation system, we are reducing the manual work and increasing the crop yield. Our project is working properly and effectively and correctly. By integrating gas detection, water pumping, and artificial light for photosynthesis we have created a sustainable solution that ensures plant growth and yield while protecting crops from fire accidents

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