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Integrated Approaches for Smart Agriculture through Innovation

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Abstract: *Food deficit and population growth are the most challenges facing sustainable development all over the world. With a growing population, there's a need to increase agrarian products. During heavy rainfalls and showers, the growers face lots of problems as their cultivated crops get washed off or destroyed due to the water recession in the fields. The growers grow crops that are completely dependent on rainfall and natural conditions. Therefore, the focus of this paper is to execute a system that would help the farmers of our country to maximize their yields along with maximized gains. The Smart Agriculture system included those sensors for observing temperature, humidity, water level in the soil, rains and even there is any movement around the fence. This project aims to develop and implement a smart agricultural system integrating laser-based perimeter security and an automated rain-responsive roofing system. This integrated approach addresses critical challenges faced by modern agriculture: crop protection from environmental hazards and security threats, while optimizing resource utilization. The system will leverage sensor technology, IoT connectivity, and data analytics to enhance farm efficiency, security, and sustainability.*

Keywords: Crop Protection, Rain Roofing, Water Harvesting, IOT, SMS alert, Smart Agriculture

I. INTRODUCTION

The Food is the most important requirement for living beings. The main product of our food come directly or indirectly from agriculture. Now a days security of agriculture field is very important Crops in farms are many times damaged by birds and animals these causes' major losses to farmers. In every day farmers facing a different kind of problem. The birds are the major problem in agriculture birds are falling on crop and eating it. farmers cannot stay on the field for 24 hours and protect it to overcome the this problem an birds and animal detection system has been designed to detect the presence of birds and animals and it offers a warning and divert the animal without any harm the designed system will continuously check for any bird and animal to entire field. Birds and animal is having a specific range of hearing frequency. There irritating frequency is estimated by a specific logic at early morning and evening time birds falling on the crops and eating rice seeds, ragi crops corns and wheat…etc. So we can create irritating sound for birds and the flay outside of the field by using this idea, we can reduce most affected problem in agriculture. This circuit uses the motion detector is an electrical device that utilizes a sensor to detect nearby motion. Such a device is often integrated as a component of a system that automatically performs a task or alerts a user motion in an area.

In this system an automatic roof is inculcated which works by taking the signals from the rain and soil moisture sensors and covers the whole field to protect it from heavy rains. Whenever there is rainfall the rain sensor gets activated. The water level in the soil is sensed by the soil moisture sensor. Whenever there is rain, the rain sensor is „ON" and when the water level in the soil is beyond the normal level then soil moisture sensor is „ON". If both the sensors are "ON" then this information is send to the controller. Then the controller indicates the DC motor to run which opens the roof automatically to close the field.

IoT can be used in every sector of the Indian economy in which the farming sector can get an efficient contribution through the application. New smart agricultural techniques can enhance the productivity of the crops as well as it can reduce the number of waste crops. Our smart agricultural device will enable the farmers to reduce waste, protect the crops, and comparatively reduce the need for manpower for the productivity of the field. We have designed an

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automated Smart Agricultural system and rain protection management that reduces the time and resources that are required while performing it manually the purpose of the smart agriculture system is to help the farmers in producing crops more efficiently as they can monitor the field, and check the soil moisture content as well. Our proposed system also helps in security purposes by preventing the crops from excess rain through a rain shield and also letting the farmers know if any wild animal trespass to the field through the alarm. This device will help in reducing the need for manpower in cultivation so that it can be used in other fields for other work making both agriculture and time management easy for farm workers.

Objective:

- Design and implement a functional smart rain roofing system.
- Develop and deploy a reliable laser security system.
- Integrate sensor data and control systems using an IoT platform.
- Improve crop protection from environmental hazards and security threats.
- Optimize water resource utilization through rainwater harvesting.
- Enhance farm security and reduce losses due to intrusions.
- Provide real-time data and remote control capabilities to farmers.
- To create a system that is robust and reliable in the local climate.

II. LITERATURE SURVEY

One of the major economic issues faced by the country is agriculture as this is the sector which is source of livelihood for about 54% of Indians till date. Still today this sector is not well developed and faces lots of problems resulting into low productivity of crops. As 43% of land in India, is used for farming but contributes only 18% of the nation's GDP. The poor condition of agriculture in the country is the point of concern for Indians. The rural farmers in India suffer from poverty and most of them are illiterate so there is lack of good extension services. The problem of wild life attack on crops i.e., crop Vandalization is becoming very common in the states of Tamil Nadu, Himachal Pradesh, Punjab, Haryana, Kerala and many other states. Wild animals like monkeys, elephants, wild pigs, deer, wild dogs, bison, nilgais, estray animals like cows and buffaloes and even birds like parakeets cause a lot of damage to crops by running over them, eating and completely vandalizing them. Thislead to poor yield of crops and significant financial loss to the owners of the farmland. This problem is so pronounced that sometimes the farmer decide to leave the areas barren due to such frequent animal attacks.

According to Dr.N.Suma [1] et.al, IOT based smart agriculture monitoring system the newer scenario of decreasing water tables, drying up of rivers and tanks, unpredictable environment present an urgent need of proper utilization of water. To cope up with this use of temperature and moisture sensor at appropriate locations for observation of crops is implemented in. An algorithm elevated with threshold values of temperature and soil moisture can be programmed into a microcontroller-based gateway to manage water quantity. The system can be powered by solar panels and can have a semidetached communication link based on a cellular Internet interface that allows data inspection and irrigation scheduling to be programmed through a web page. According to Ravi Kishore Kodali [2] et.al, Iot Based Smart Greenhouse India receives ample amount of precipitation and have many large river systems but still only one third of the total agricultural land is connected via canal irrigation system. Remaining majority of the portion is dependent on monsoon or tube wells. Places with excess water faces problem of land stability due to over irrigation and water logging. Water collected on the surface also blocks pores in the soil and kills beneficial microorganisms.

Mukesh Mahajan et al., [3] worked on protecting the crop in the farm field from animals such as buffaloes, cows, goats, and birds using a PIC microcontroller. The developed model uses the motion sensor to detect the animals that are near to farm field and the sensor signals the microcontroller to take appropriate action by farmers. The PIR-based motion sensor is used to detect the animals and the buzzer is used to notify the farmers based on the microcontroller instruction. Here authors claim that this model avoids the farmers staying for 24 hours in the farm field and barricade their crops.

Iniyaa K K et al., [4] worked on protecting crops by animals using deep machine learning and Convolutional neural network algorithm. The author aims to protect the crops from animals and not harm both animals as well as humans in

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the conflict. Due to this, the authors developed a model to divert the animals nearer to the crop fields. The machine-learning algorithm-based model is developed to detect the animals coming nearer to the farm field using the neural network concept through the computer vision technique. In this model, the farm field is monitored using a camera placed at the farm field at a regular interval of time.

Kalra et al., [5] worked and developed a model to protect the crop from insects and small animals through the sensor and also for control irrigation using the IoT technologies. The Arduino UNO microcontroller works like a heart for the proposed model in managing proper irrigation and crop protection. The irrigation is managed automatically on/off water siphons depending on the dampness parameters of the farm field. The crops are protected by insects, animals, etc through the use of deliberate sensors connected in the farm field; sensors estimate the motion of insects and animals nearer to the crop and sent the signal to the Arduino Uno microcontroller for calculation of distance and all.

Raksha R and Surekha P, [6] worked and developed a prototype to monitor the crops and warning the wild animals based on two emerging technologies such as IoT and Machine learning. The IoT components used are like PTZ (Pan-Tilt-Zoom) camera, GSM module, Sensors, and Arduino UNO microcontroller and Machine learning algorithm for classification of the animals are done using KNN (K-Nearest Neighbor) Algorithm, Logistic Regression, and SVM (Support Vector Machine) Algorithm. Datasets of elephants, horses, Zebra, etc are taken in total in some 605 images. SVM provides an accuracy of 89.6% compared to the KNN and Logistic Regression model for the iterated regularization parameter of C=100

III. METHOD OF DISEASE DETECTION

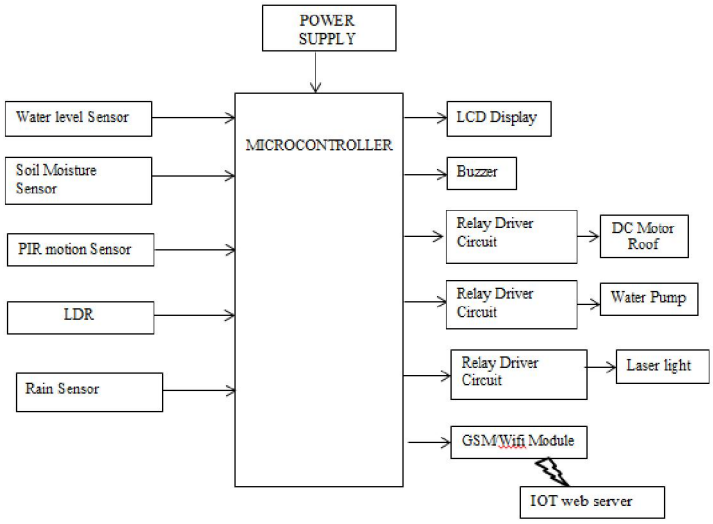

Fig. 1. Block Diagram

This is the block diagram for the smart crop protection system. Here we are using different types of sensors like IR Sensor, LDR Sensor and ultrasonic sensor. The ultrasonic sensor is used for obstacle detection in the field and a buzzer is used to make the person alert. The ultrasonic sensor that we are using is HC-SR04. This always measures the distance, and a buzzer that beeps when an obstacle is encountered. And IR Sensor senses whether there is an object near it or not. The LDR Sensor is used to detect the presence of light. GSM module helps them to give information to guardian where the person is located. The regulated power supply converts the 12v dc current into 5v dc current. The 3 inputs IR sensor, ultrasonic sensor, LDR Sensor is given to the controller then it process the output in the form of buzzer, LED and GSM. Input modules are LDRs sensor, Ultrasonic Sensor. Output modules are Buzzer, GSM, LED indicator, LCD indicator. In this proposed block diagram consist of several sensors (rain sensor, moisture sensor)is connected to our controller. The auto roof is mainly depends on the rain sensor, soil moisture sensor.

If moisture is > threshold value it displays the respective moisture content reading (Eg: If moisture content =540). It indicates that the land is moist and does not need water. 2. If moisture content < threshold value it displays the

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respective reading (Eg: If moisture content =120). It indicates that the land is dry and requires water. In the same way we track the conditions of other Sensors and the respective action will be taken.

Moisture Sensor measures the amount of moisture content in the soil. If the moisture level is normal then it indicates there is sufficient amount of water present in the soil. If the moisture level is above the normal value it indicates that the land is getting over water due to heavy rain, in that case the roof panels will be closed by sending signals to the Motors attached to the panel. If in case the moisture level is below the normal value it indicates that the land is dry, in that case the pump attached to the water storage is turned ON to water the field.

Sensor Selection: Identify and procure appropriate sensors (rain, light, temperature, humidity, motion, laser grid).

Roofing System Development: Design and construct a prototype rain-responsive roofing structure with automated control mechanisms.

Security System Development: Implement a laser grid perimeter, motion sensors, and camera integration.

IoT Platform Development: Develop a cloud-based platform for data collection, storage, and analysis.

System Integration: Integrate all components and develop control algorithms.

Testing and Validation: Conduct field tests to evaluate system performance and reliability.

Data Analysis and Optimization: Analyze collected data to optimize system parameters and improve efficiency.

A. PIC18f4520 Microcontroller

It is an 8-bit enhanced flash PIC microcontroller that comes with nano Watt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip.

- Data Memory up to 4k bytesn Data register map - with 12-bit address bus 000-FFF
- Divided into 256-byte banks
- Half of bank 0 and half ofbank 15 form a virtual (oraccess) bank that is accessibleno matter which bank isselected – this selection isdone via 8-bit
- Program memory is 16-bits wide accessed through a separate program data bus and address bus inside the PIC18.
- Program memory stores the program and also static data in the system.
- On-chip program memory is either PROM or EEPROM.

Fig. 2. PIC 18f4520 Microcontroller

B. Rain Sensor

The Raindrops Detection sensor module is used for rain detection. This raindrop sensor is also used for measuring rainfall intensity. The rain sensor can be used for all kinds of weather monitoring and translated into output signals and AO. The rain sensor can be used to monitor a variety of weather conditions and turned into several fixed output signals and Analog outputs.

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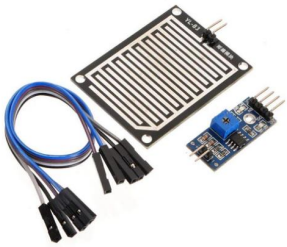

Fig.3. Raindrop Sensor

C. Soil Moisture

The Soil Hygrometer module is convenient to sense the moisture level of the soil and determine whether the plants have been overwatered or under watered. It has 2 probes which act as variable resistors. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value

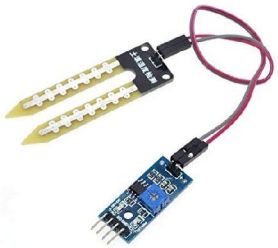

Fig. 4.Soil Moisture Sensor

D. DC Gear Motor

This is 60RPM 12V Low Noise Dc Motor With Metal Gears – Grade A

The metal gears have better wear and tear properties. The gearbox is sealed and lubricated with lithium grease and requires no maintenance. Although motor gives 60 RPM at 12V, the motor runs smoothly from 4V to 12V and gives a wide range of RPM, and torque. The shaft has a hole for better coupling.

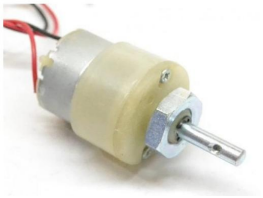

Fig -5: DC Gear Motor

E. PIR Motion Sensor

It is used The PIR Motion Sensor Detector Module HC SR501 allows you to sense motion. It is almost always used to detect the motion of a human body within the sensor's range. If you want to build a device that is used to detect sense motion and almost always used to detect whether a human has moved in or out of the sensors range.

Fig. 6.PIR Motion Sensor

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F. LCD Display

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD.

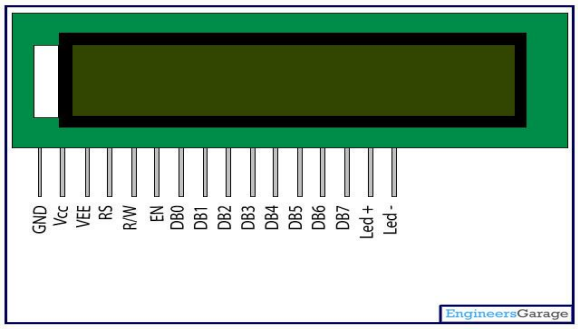

Fig. 7.LCD Display

IV. CONCLUSION

It can be concluded that the use of electronic and mechanical System will be very advantageous for better agricultural output. In this project we have designed a model to help the farmers by sending alert messages and controlling agricultural activities in the land in the presence or absence of the farmer using wireless Sensor network technology by simply sending a message.The proposed System is capable of controlling the essential parameters necessary for growth of the plants which includes, watering the crops depending on temperature, humidity, soil moisture and light intensity as per variety of the crop.This project will help farmers in protecting their orchards and fields and save them from significant financial losses and will save them from the unproductive efforts that they endure for the protection their fields. This will also help them in achieving better crop yields thus leading to their economic wellbeing. The experimental results are obtained for particular animals and animals. Our proposed system also helps in security purposes by preventing the crops from excess rain through a rain shield and also letting the farmers know if any wild animal trespass to the field through the alarm. This device will help in reducing the need for manpower in cultivation so that it can be used in other fields for other work making both agriculture and time management easy for farm workers.

Advantages

- Less maintenance
- Smart crop protection system reduces the time of farmer
- It is not possible for farmers to barricade entire fields or stay on field 24hours and guard
- Smart crop protection system diverts the animal without any harm.
- This Reduce to huge losses for the farmers.
- Improved the utilization of local resources for crop production.
- Minimum human effort diagnostics.

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