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Agricultural Field Soil Monitoring System & Smart Protection of Crops using Agricultural IOT

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Abstract:

Globally, the economy of many countries is dependent upon agriculture. Despite economic development agriculture is the backbone of the economy. Agriculture is the main stay of economy. It contributes to the gross domestic product. But because of animal interference and lack of soil monitoring factors (Humidity, Moisture, Temperature, Methane), there is huge loss of crops. Crops are totally getting destroyed. To avoid these financial losses, it is very important to protect agricultural field or farms from animal and unwanted changes in the soil. To overcome this problem, we are going to make use of evolving technology called "Internet of Things". In our proposed system, we shall design a system which will serve two most important use cases. First, to prevent the entry of animals into the farm so that the crops can be protected. Second, the system will monitor each factor that is responsible for maintaining the fertility of the soil like temperature, humidity, gases, and moisture. To show the reading of different sensors to the user, we will make use of ThingSpeak. The system will be integrated with ThingSpeak framework via different APIs for writing and reading data to and from ThingSpeak respectively.

Keywords:

Agriculture, Arduino, ThingSpeak, IoT, Crop Protection, Sensors.

1. INTRODUCTION

In the world, the economy of many nations depends upon agriculture. Despite financial improvement agriculture is the spine of the financial system. Agriculture is the principle live of financial system. It contributes to the gross home product. Agriculture meets meals necessities of the humans and produces numerous uncooked substances for industries. But due to animal interference and absence of soil tracking elements (Humidity, Moisture, Temperature, Methane), there may be large lack of plants. Crop may be absolutely getting destroyed. There may be big quantity of lack of farmer. To keep away from those monetary losses, it's miles very essential to shield agricultural subject or farms from animal and undesirable adjustments withinside the soil. To conquer this problem, in our proposed paintings we will layout a machine to save you the access of animals into the farm. Our predominant cause of venture is to broaden intruder alert to the farm, to keep away from losses because of animals' undesirable adjustments withinside the soil. These intruder

alert shield the crop from detrimental that circuitously growth yield of the crop. The broaden machine will now no longer dangerous and injurious to animal in addition to human beings. Theme of venture is to layout a sensible protection machine for farm safety with the aid of using the usage of Embedded machine and an tracking machine so as to screen the elements of farming soil like humidity, temperature, moisture and methane gas. The entire records may be additionally regarded the usage of an android application. Animal assaults in India are a common tale nowadays. Due to the unavailability of any detection machine those assaults kill villagers and additionally spoil their plants. Due to loss of right protection measures, those villagers are left helpless to their fate. Therefore, a right detection machine may want to assist store their lives and to the upkeep of plants. Also, the plants of villagers are destroyed because of common interference of animals. The plants and paddy fields cannot be continually fenced. So, the opportunity of plants being eaten away with the aid of using cows and goats are very a lot present. This may want to bring about large wastage of plants produced with the aid of using the farmers.

The present generation of Smart Computing is primarily based totally at the Internet of Things (IoT). The Internet of Things (IoT), in recent times is gambling an important position in transforming "Traditional Technology" from houses to workplaces to "Next Generation Everywhere Computing". One of the primary regions wherein IoT primarily based totally studies goes on and new merchandise are launching on a normal foundation to make the sports smarter and green toward higher manufacturing is withinside the discipline of "Agriculture". Agriculture zone is regarded because the maximum important zone globally for making sure food security. Speaking of India farmers, they may be proper now in large trouble, a disadvantageous role in farm size, technology, trade, authorities' policies, weather conditions etc. Agricultural production requires masses of activities like soil and plant tracking, environmental tracking like moisture and temperature, transportation, supply chain management, infrastructure control, control systems control, animal monitoring, pest control etc. Monitoring the environmental elements isn't the complete approach to boom the yield of crops. There are several different elements that lower productiveness to a greater extent.

2. PROPOSED SYSTEM

In this paper we are going to propose a system which will monitor the soil and will also act as a security controller from animals. We have combined the various components into a single unit, so that we develop a system beneficial for agricultural purposes. Following figures (Fig i and Fig ii) illustrates the various components of our system.

In the proposed system we have combined the two fields i.e., Sensor part for the monitoring of soil and security part for the protection of crops. As shown below in the diagram, we will be using Arduino Uno as main controller of the system.

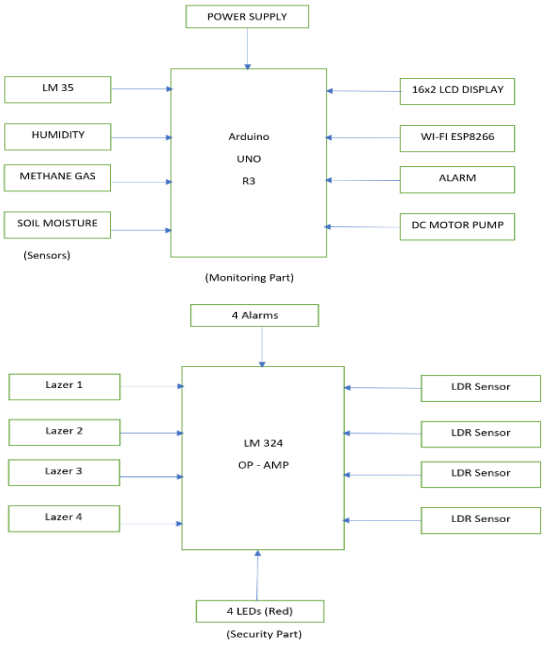

Fig (2): Block Diagram-II

We will be using four different sensors for the monitoring of temperature, humidity, moisture, and methane gas and all of them will be connected to Arduino through A0, A1, A2 and A3 pins respectively. For the connectivity of the system, we will be having Wi-Fi ESP8 266. To show the result, we will be having LCD Display. If the moisture is not detected, a dc motor will be switched on which is also connected to the Arduino controller. If the temperature, humidity, and methane gas is deviated from their threshold conditions, there will be a signal in the form of alarm.

For the security system, we will be using four Lasers and four LDR sensors for the detection of intrusion in the form of wild and domestic animals. These will be placed around the farming plot land. Once the intrusion has been detected, there will be an alarm and create hindrance to animals and they will move out from the land. The whole system will be monitored by using an android application. In the upcoming sections we will discuss how we can detect and monitor different factors and how we can save the crops from damage.

3. COMPONENTS OF SYSTEM

a. Methane Gas Sensor

Methane Gas or CH_4 is a carbon compound which is being emitted during the production and transportation of natural gas, coal, and oil. The emission of methane also results from livestock and other agricultural activities, and by the decay organic wastes in soil. When animal manure is stored in the fields to enhance the fertility of the soil, methane gas produced. The agriculture is the second largest source of producer of methane gas.

To maintain the integrity into our atmosphere, we must ensure the less emission of Methane gas into atmosphere. Thus, it is very important to monitor the methane gas emission.

For monitoring the production of Methane gas, we have used a sensor called “MQ2 Methane Sensor”. Its is mainly used for gas leakage detection for industrial and domestic purposes. The response of this sensor is very fast and hence the necessary actions are taken in no time.

b. Temperature and Humidity Sensor

LM35 Temperature Sensor is used to sense the temperature in the field and its output voltage is proportional to the centigrade. The LM35 sensors have low output impedance, linear output and precise inherent calibration makes interfacing to the control circuitry easy. We can also make use of DHT11 Humidity sensor which is bases on the resistive sensing technology. This sensor can be used to monitor both the temperature and the relative humidity.

Fig (4): LM35 Temperature Sensor

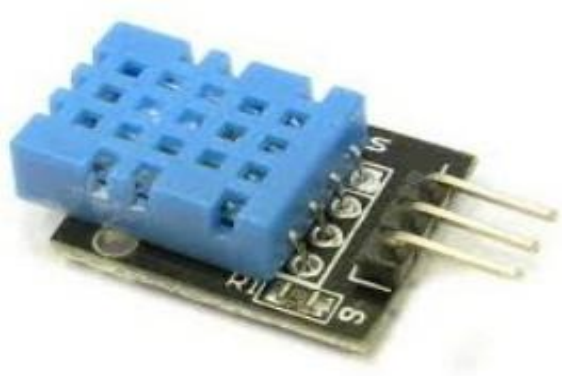

Fig (iv): DHT11 Sensor

c. Soil Moisture Sensor

The soil moisture senses the moisture content in the soil and based on the quantity that is sensed by the sensor, according to the control circuit motor will be start ant it will pump the water with the help of a pump and the pumping actions will continue till it fulfills the conditions. With the help of this sensor which is shown below we can find whether the soil is dry or wet and accordingly monitor the system. A local circuit connection is shown below.

Fig (5): Soil Moisture Sensor

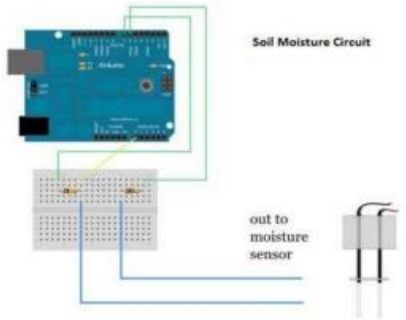

Fig (6): Soil Moisture Circuit

d. DC Motor and Its Circuit

The DC motor works to felicitate the working of pump to pump the water into the soil field when the moisture level is below optimum level which has been set in the microcontroller program.

Fig (7): DC Motor

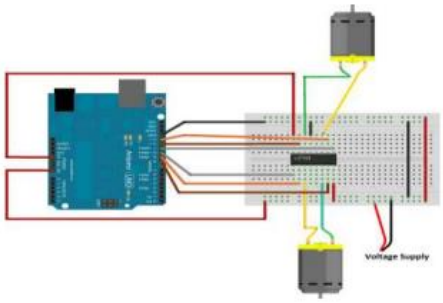

Fig (8): DC Motor Drive Circuit

e. Arduino Uno

Arduino uno is a microcontroller which is shown below. This microcontroller has 14 digital input and output pins, 6 analog inputs and 16MHz ceramic resonator. We can connect this to a computer system with the help of USB cable and powers it with ac to dc adaptor or we can also a battery for power supply.

Fig (9): Arduino Microcontroller

f. ESP8266 Wi-Fi Module

This module enables the microcontroller to connect to 2.4GHz Wi-Fi. It is a self-contained SOC which has been integrated with TCP/IP protocol stack that given microcontroller access to your local Wi-Fi.

Fig(10): ESP8266 Wi-Fi Module

g. 16 x 2 LCD Display

This is 16 pin device and has 2 rows and each row can accommodate 16 characters. We can use it in a 4-Bit Mode and in 8-Bit Mode and is mainly used to generate the custom characters. It possesses the 8 data lines and 3 control lines that are used for control purposes.

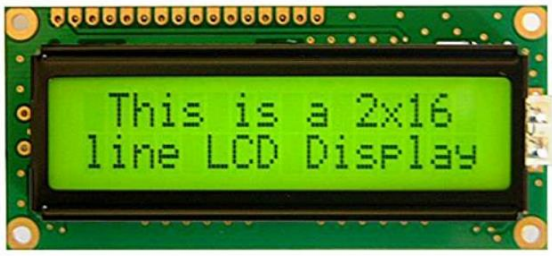

Fig (11): 16x2 LCD Display

h. Arduino Alarm System

Arduino Uno alarm that detects movement, alerts when triggered, can be armed, and disarmed via keypad and displays status on an LCD. display. This system is used to scare an intruder away from your premises or alert you of a threatening situation such as a fire or the presence of carbon monoxide, less temperature and humidity, intrusion of animals etc.

Fig (12): Arduino Alarm

i. LDR

An LDR (Light Dependent Resistor) is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. Light Dependent Resistors (LDR) are also called photoresistors.

Fig (13): LDR Sensor

j. Lazers

Lazer module emits a small intense high focused beam of visible red light. We can use this module with an Arduino and photo resistor module to perform basic remote signaling. This is used to monitor the entrance of animals in our system.

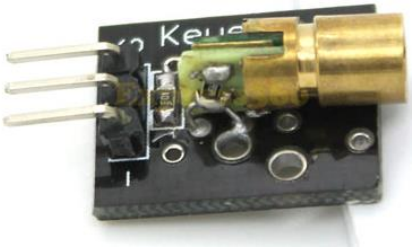

Fig (14): Lazer

k. LM 324 Operational Amplifier

LM 324 is an operational amplifier. It has four channels. It is most widely used amplifier because it is cost efficient. It can operate from single power supply to wide range of voltages ranging from 3 to 32V.

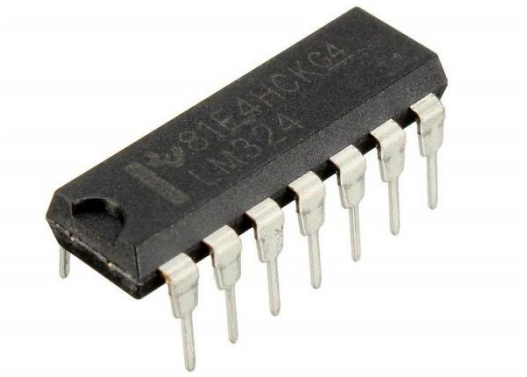

Fig (15): LM 324

4. WORKING OF SYSTEM

The "Agricultural Field Soil Monitoring System & Smart Protection of Crops using Agricultural IOT", is a system whose function can divided into two categories i.e., Monitoring/Sensing of soil parameters and Protection of Crops.

To monitor the soil parameters, we have used different sensors as discussed above. These sensors sense the soil and produce the output according against the pre-programmed values. If it is found that the values are above the mentioned level, then alarms are activated, and farmers also monitor the data through smart phone. Let us consider a scenario where we must monitor the soil and show the monitored reading in a display and sent to a mobile application. Suppose we have programmed the microcontroller for the following values. If temperature is above 33°C, then the alarms must be activated. In the same way, we have defined the threshold conditions for methane gas, humidity, and soil moisture. After providing the power supply, various sensors sense the soil and for example if it is found that the parameters are above then the mentioned threshold conditions, then the alarms are activated. In the same way, if the moisture is not detected, then motor will be turned ON and it will irrigate the fields. If the moisture has reached the threshold and level

and moisture sensor show the presence of moisture the motor will switched OFF.

For securing the crops from the wild and domestic animals, we have proposed a system where we will use four Lazers, four LDRs, four Alarms and four red colored LEDs. When any animal enters the crop field, the high intensity lazer light strikes with it and LDR sensor has no lazer light and it activates the alarms. After listening to alarms, the farmer can get information about the entrance of wild animals into the crop field and hence the crops can be secured.

5. THINGSPEAK INTEGRATION

ThingSpeak is an open-source platform which has been written in Ruby Programming language. ThingSpeak was originally launched by ioBridge in 2010 as a service in support of IoT applications. ThingSpeak is a IoT analytics platform service, which allows users to communicate with the internet enables devices. It provides user a facility to aggregate, visualize and analyze live data streams in the cloud. A user needs to the ThingSpeak official website and must create an account. After the account creation, ThingSpeak allow user to use its platform via set of APIs. ThingSpeak provides two of APIs: One for writing data into ThingSpeak Cloud and Second for reading the data from the ThingSpeak Cloud.

ThingSpeak in integrated with the MathWorks and MATLAB to support the numerical computing. The output ThingSpeak looks as follows:

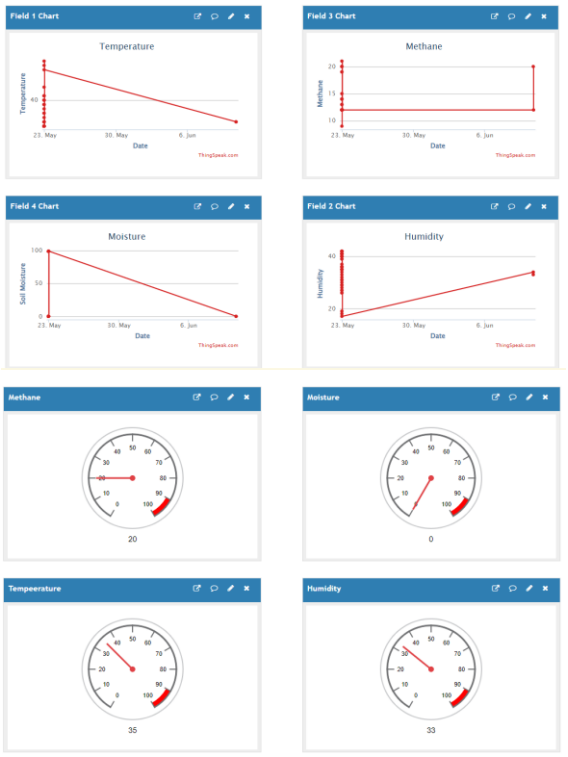

Fig (15): ThingSpeak Output

6. CONCLUSION

The problem of crop vandalization by wild and domestic animals has become a measure social problem. It needs heavy attention in order the secure the crops from the animals, so that, the productivity of the crops can be enhanced. It eventually maximizes the profit of farmers. For the proper growth development of the crops, the fertility of soil is must. To ensure that is appropriate for the cultivation, there is need to monitor the soil parameters and enhance the cultivation rate.

7. FUTURE SCOPE

In future, this project can be incremented to next level, and we can employ this project with the sensors like NPK sensor, pH sensor and so on. This will ensure the proper readiness of soil for cultivation. The fertility of soil will be increased, and its degradation will be prevented. Hence, it will maximize the production rate of crops.

For securing the crops from the system, we can employ the system with cameras. When any animal approaches towards the field, then system will be directly activated through wireless sensor network.

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