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Smart Farming using Internet of Things

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Abstract

Over the last decade, there has been an immense progress in science and technology. This has poured a great interest among scientists and researchers about designing smart farming system. The smart farming system can benefit us in various ways such as an increase in production, water conservation, real-time data and production insight, lowered operation costs, increase in quality of production, accurate farm and field evaluation, remote monitoring, equipment monitoring etc. Internet of Things has provided farmer better ways to install various sensors and are also provided with numerous data. But as these technologies are unable to reach the majority of the farmers, they are unaware of these useful and efficient techniques for farming. In this paper, a smart farming model is constructed which is based on Internet of Things (IoT). This proposed model is equipped with various sensors for measuring environmental parameters required for the crops. It includes node MCU and various sensors for executing the whole process. The various features of this system are to collect all the environmental data and give to the farmers so that they can take an accurate decision about farming. The system will execute the tasks such as soil moisture sensing, temperature, and humidity sensing, indicating water level, detecting an intruder in the field and switching an electric motor on/off manually and automation is also provided. The system which is proposed has been tested, readings have been monitored and obtained satisfying results will enable this system to be very useful in smart farming.

Keywords: IoT, Zigbee, Node MCU, Soil Moisture, Water-Level, Humidity, Sensors, Website, and Data.

INTRODUCTION

In most of the countries, agriculture has played a vital part in the economic development. In the developed countries farmers have been provided with various technology to increase the production. While in the under-developed countries farmers don't have enough knowledge about those technologies and so farmers are still relying on old techniques. They do not know about the power of emerging latest technologies which can drastically increase the crop production. Various factors contribute to the yield of crops such as proper soil preparation, different varieties of crops and respective techniques for production, chemical fertilizer's volume added to the soil, various natural hazards occurring in the cultivated place, number of seeds added in the related area, proportion of moisture in the fields, plant disease detection, adoption of modern technologies etc. Farmers lose a huge amount of money because of usage of wrong irrigation mechanisms, insect pests and attack of plant diseases, usage of the uncalculated amount of pesticides and insecticides, and inaccurate prediction of weather. Smart farming techniques enable the farmer to use latest technologies and increase the crop yield by eliminating various risk factors involved in the farming. The farming systems which are used currently is helping the farmers up to some extent by reducing labor costs but somehow these systems are unable to consider and predict the weather conditions suitable for the crop. Thus, the yield of crops is limited while we can still increase it. On the other hand, not every farmer uses this system as they are very expensive. Thus, there is a need of currently available wireless technologies and automation in farming which is not much expensive and every other farmer can use it. Various sensors such as water level indicator, soil moisture detection, temperature and humidity sensing, PIR (Passive Infrared sensor), LDR (Light dependent resistor) etc. can be used to collect various environmental data for accurate future decision making and replacing the labor work by automation. This will improve crop yield significantly. The most advanced technology which can be used in the farming is IoT (Internet of Things) which has revolutionized all major sectors such as industries and business across the world. Using IoT one can interact many things with each other to produce required information. It is used to determine the working status of the implemented system remotely from anywhere around the world. There are mainly four benefits that farmers get from IoT application in agriculture. First one is, increase in the yielding by making a better decision from the accurate data, the second benefit is the cost of production is reduced to a greater extent, the third benefit is it reduces the wastage coming from the production and it also automates the most of the processes.

RELATED WORKS

At present in many under-developed countries, farmer manually takes the data of the present environment in the field and thereby does the various tasks physically according to the data. [1] IoT technology gives ease in many manual processes by working from a longer distance without physical work. K. Lokesh Krishna [2] developed a smart agriculture system which sends all the data taken from the sensor and uploads to the website where the graphs are generated and the data are shown with the timestamp. [3] Dr. N. Suma have implemented a model on a land using the GSM module and microcontroller with various field sensors. The results are shown in the android application. [4] Hariharr C Punjabi have used the cloud platform named Thingspeak where data of all the hardware are uploaded On the Thingspeak, one can create a graph, take actions and also analyzes the data. [5] Anand Nayyar have implemented the Smart Sensor Agriculture Stick in the real-time situation and have used cloud computing to get all the data. Graphs were created from the data and analyzed on the cloud. [6] S.R Nandkumar have created a model of smart farming where the algorithm is developed by him in which the threshold is given and using that threshold the action is taken.

METHODOLOGY

In this model, Sensors like humidity, temperature, soil moisture and water-level are fixed in the required position like in the land soil moisture sensor is fixed, water-level sensor is fixed in the water tank and PIR, humidity and temperature sensor is fixed at the centre of the field in order to get the overall reading. Initially, the height of water tank is measured and according to that the water-level sensor readings are set. The sensors are attached to the Node MCU where the readings will be fetched.

All the sensor will send the data to the Node MCU. The values to be used as the threshold is calculated from the field and also according to the crop. These values will be used in automation of most of the processes and hence they are predefined in the Node MCU as the threshold for each and every sensor. Whenever any sensor reaches a threshold, the trigger is sent and in turn, it will On/Off the respective motor related to that sensor.

The Node MCU is connected to the hotspot from the mobile which is defined in the Node MCU and hence when that specific hotspot is available it gets connected to it. Whenever the internet connectivity is provided it starts sending the data to the web server. All the data fetched from instruments to the Node MCU is uploaded to the website after every one minute. The data of tasks performed on the detection of the threshold is checked and uploaded after every two seconds. The graphs of the data are represented on the website.

There are two modes in the model. First one is the automatic mode in which the Node MCU itself takes the action on detecting the threshold. Manual mode is activated when the user manually changes the status of various devices attached to the sensor. The manual mode is activated for one hour and it will not automate the process. After one hour the mode is set back to automatic mode. It will help the user if he forgets to On/Off the specific device. Those modes are the important features provided to the user. The following figure shows the basic connection of model.

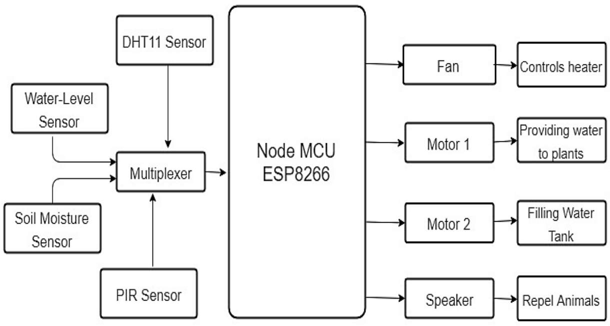

Figure 1. System design

HARDWARE USED

TEMPERATURE AND HUMIDITY SENSOR

Figure 2. Temperature and Humidity Sensor

DHT11 sensor measures temperature and humidity and send the digital signal to the Node MCU where it uses this data to do various tasks. The cost of this sensor is very low and can be fixed at any location. To measure the temperature, it uses a thermistor. and to measure the humidity it gives the capacitance value. Humidity indicates the amount of water vapor present in the air. This sensor measures the humidity present in the air and gives the result directly in a Node MCU (Integrated development environment).

SOIL MOISTURE SENSOR

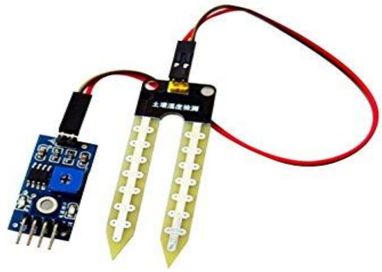

Figure 3. Soil Moisture Sensor

Using soil moisture sensor, we can get the data about the wetness and dryness of the soil. It represents value ranging from 0 to 1024. Where 1024 is the complete dry soil while 0 represents the highest proportion of water measured by this sensor. It uses the capacitance to calculate the proportion of water droplets in the soil. It gives the output in the form of analog signal and it is fetched by the Node MCU.

WATER LEVEL INDICATOR

Figure 4. Water level Sensor

To measure the amount of water present in the tank water level sensor comes into the use. This sensor senses the water and sends the analog signal according to the level of water. It can measure the water which has a small content of salt as ultra-pure water is an insulator.

PIR SENSOR

Figure 5. PIR Sensor

PIR is an abbreviate for the passive infrared sensor. It helps to detect any animal or human when they come in the radar of this sensor. Every living human and animal emits heat in the radiation form which can't be seen through the naked eyes but it can be detected by this sensor. It can detect any animal or bird within about 9 meters in the farm and gives output in the form of analog signal.

NODEMCU ESP8266

Figure 6. Node MCU

Node MCU is one of the best development board for IoT Project. It is very easy to use and is cheaper in comparison to combining the Arduino and the various wi-fi module or GSM module. There is no requirement of external prototyping board to process the data as it can itself process the data and can trigger the information just like Arduino, raspberry.

EXPERIMENTAL RESULTS:

The implementation of the model has provided various results that are shown in the figure. As shown in figure 7 all the data are uploaded to website "rahitechnolgy.xyz".

In order to take action manually, we can do that with the help of switch provided on the website that is shown in figure 8. It is provided with ajax functionality which will update without reloading the whole page.

On the other webpage, the data saved in the database are represented in the form of a graph which is shown in figure 9 and 100.Automation is provided in the Node MCU side which will act according to the threshold given to it.

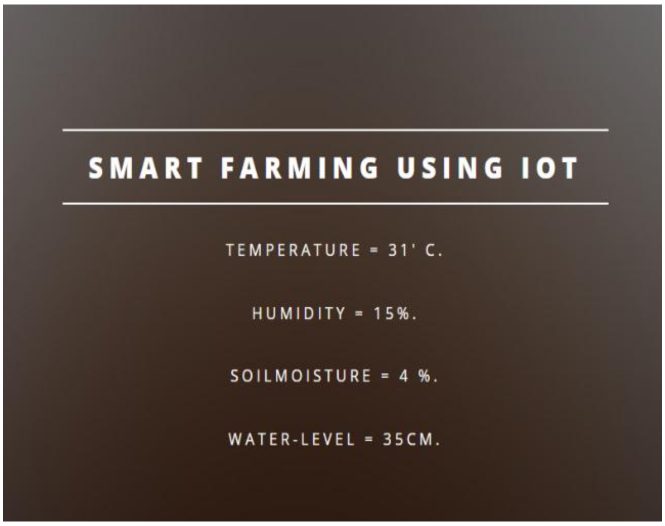

Figure 7. All Data

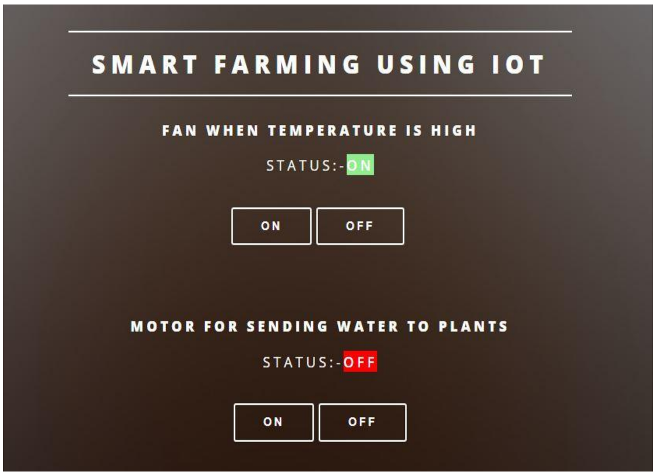

Figure 8. On/Off Switch

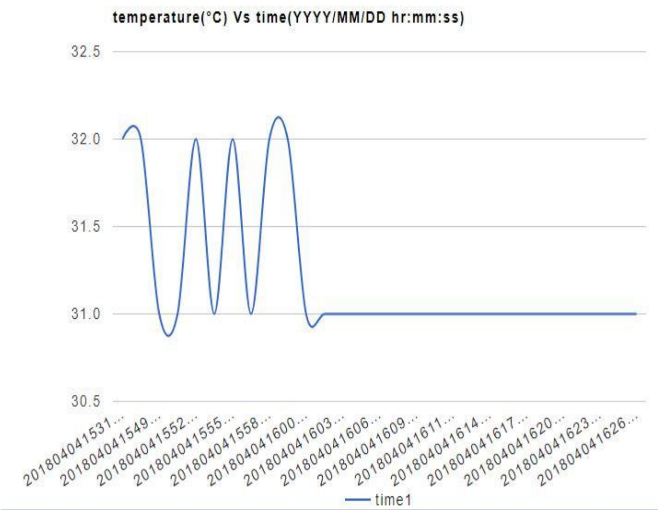

Figure 9. Temperature vs Time

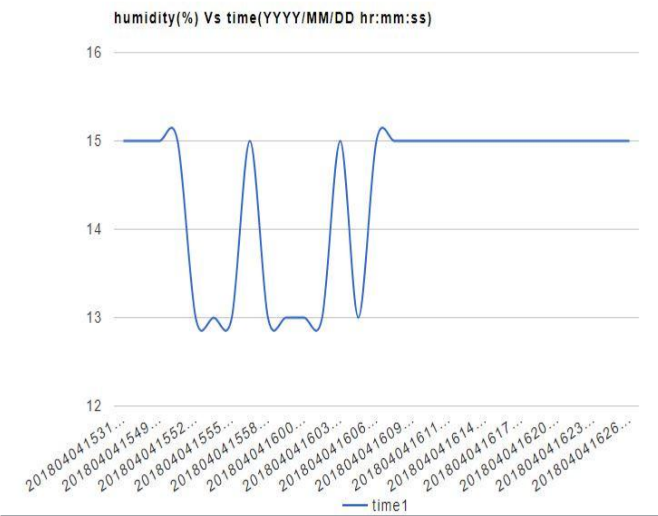

Figure 10. Humidity vs Time

CONCLUSION

We have proposed modern approaches of smart farming which will result in the good and higher crop yield that will ultimately benefit the farmers who will be able to take out a higher profit. The best thing is that now they don't have to do the labor work. Our system has provided manual support as well as automation for various tasks.

FUTURE WORK

In future, all the data collected from the sensors will be processed and mined on the cloud. This mined data will be very helpful in determining the future condition of the crops and also will tell that which place will be much suitable for the particular crops so that there is less probability of loss.

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