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Smart Vertical Farm Using IOT

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ABSTRACT: Internet of Things (IoT) is network featuring interconnected devices making physical world transparent with less human effort. Submerging of this technology in the field of agriculture is bringing enormous changes. By the end of 2050, world population reaches 9.7 billion with additional land of 109 million needed if conventional farming practices are continued. This paper mainly focuses on implementation of vertical farming using IOT based monitoring which overcomes existing issues with vertical farming. The main drawback of the conventional farming is it requires vast amount of water and acquisition of land for production; it is completely dependent on seasonal production and the yield of crops grown under different environment conditions. This leads to degradation of the food production with inefficient consumption of natural resources. With the integration of vertical faming type of agriculture and IOT technology, we are automating the farm activities with less human intervention and eradicating all the issues caused.

KEYWORDS: Internet of Things, sensors, microcontroller, Smart agriculture.

I. INTRODUCTION

Conventional farming have already acquired 80% of soil and mainly 65-70% of Global fresh water is used for soil based farming of which 45-67% is lost due evaporation and runoff. Due to undesired and constant changes in weather and environment leads to unsustainable usage of resources and would see an end with supply chain. Statistical analysis with growth of crops and initial plantation, there is lot of difference when analyzed. These data are then compared with several other similar datasets collected over large sectors of crops. Based on several inspection with considerations of certain parameters like environment circumstances – weather aspect, soil quality variation, water consumption etc. - are collected for further evaluation to deduct and predict How does farming criterias can vary and formulate?. The Behavioral patterns are recognized based continuous evaluation and formulate the farming approach to fetch maximum efficiency over all the aspects of agriculture and its production. These assessing and formulating processes cannot be achieved without prior base knowledge of the theme works. So we are adopting new arrival of farming technique called Vertical Farming where it comprises various genre Hydroponics, Aeroponics, but on integrating conventional soil based farming is been adopted in this paper as an initial prototype.

Accounting few notions of conventional farming guidelines we are embracing both food production with IOT for assessing the farm activities to completely automate. We are implementing several hardware devices which monitor agriculture variables like soil moisture, temperature, humidity, light exposure, intruder detection and an are integrated with software conceptualization and other technology services. These integrations are accomplished by IOT, Cloud computing and basic digital communication making entire agriculture to revolutionize into more sophisticated approach of food production. By this kind of implementation we are taking off the traditional method of agriculture to extent where there is no human intervention in growing crops with efficient utilization of natural resources. By adopting this technology we can reduce the wastage of resources and also provide the proper care for the growth of the crop or plants.

II. RELATED WORK

Various researches give importance on providing an e-agriculture system by using the portable sensors with the help of recent advancement in information and communication technologies. An attempt to get the temperature and humidity in the air of the agriculture field and then send the information to the farmer through MMS is described in

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[1].An IOT based smart agriculture using PH, electric conductivity and also android application which provides the information to the farmer about the temperature , humidity , PH level of the soil through android application is represented in [2]. Smart agriculture system that is build on by using raspberry pi, GPS system and using the zigbee modules which provides the information regarding the location of the sensor and low usage of electric power is represented in [3]. More sensors are made to work efficiently by using the microcontroller with RS232 for central monitoring and also using the PIR sensor to detect any unknown intruder is provided in [4].

The safeguarding of the crops and grains from the rodents and the intruder are done by using the proper sensor. The system provides the message or notification as soon as the sensor finds any intruder or any damage occurred to the field [5]. In this the system controls the irrigation field by using temperature sensor, soil moisture sensor. The data that is collected from the sensors are sent to web server using wireless method and JSON format is used for maintaining the data in the web database .When the moisture or the temperature get below the given frequency then the proper action will be automated. The notifications are sent to farmers mobile after a particular interval of times [6].

III. IOT FOR SMALL AGRICULTURE

IoT is a most used promising technology driver for automation and control in the market. It has been extensively researched over the past couple of years. The farmers are still using the traditional method for the irrigation purpose which as been reason for the low yield of crops. So the crop yield can be increased by using the modern technology and machines. Thus by using the IoT we can increase the crop yield as we can monitor the rainfall, soil moisture , temperature and humidity , thus can take the proper measures to take care of the crops and provide the required amount of nutrition at the proper time.

IV. PROPOSED SYSTEM MODEL

Figure 1 shows the block diagram of proposed system model.

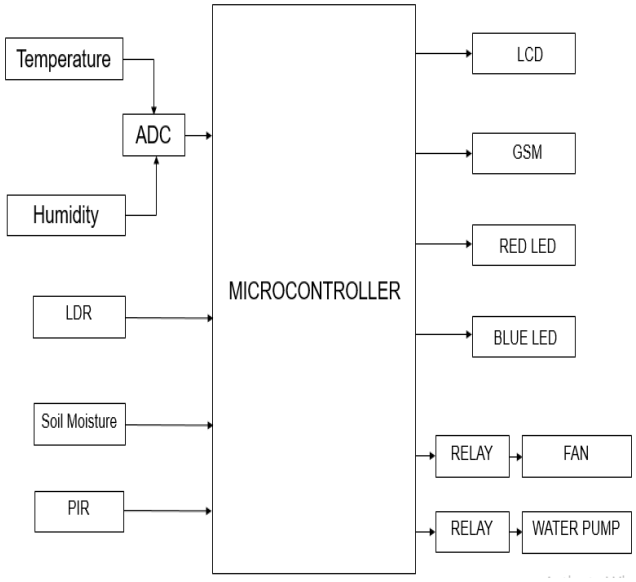

Figure 3.1: Block Diagram of Proposed System

AT89C52 is the microcontroller used here and it responsible to take the data from the sensor and take the proper actions that are required effectively. Temperature sensor LM35 can be used to measure temperature which provides the output in degree Celsius (in °C). It provides a precise temperature in comparison with a thermistor. This sensor doesn't need any kind of amplifier which must use along with thermistor. The LM35 has an output voltage that is in the Celsius temperature. The soil sensor gets the water level in the soil and if it is low then it sends an notification to the farmer

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about it . By getting the data from soil sensor the automated action can be carried out . This provides the output in three ways where digital data is simple to understand, analog data is accurate and the serial data is more dependable than other output.

The LDR is made of a highly resistant semiconductor. If light falling on the device is high then the LDR sensor doesn't take any action, if the light intensity is less than the series of led lights will be on. PIR sensor provides infrared rays for a range of distance to check whether there is any intruder to the field. If there is any intruder then it sends an notification to the farmer and it also provides an siren sound. Humidity sensors detect the humidity level of the environments in which they are placed. They are capable of measuring both the moisture and temperature in the air and express relative humidity as a percentage of the ratio of moisture in the air to the maximum amount that can be held in the air at the current temperature .The humidity changes with the temperature, if the temperature increases the humidity level in the environment also increases. GSM is a mobile communication system; it is stands for global system for mobile communication (GSM). GSM system uses a digital based time division method that is TDMA. GSM is capable of digitalizing the data and by which the data size will be reduced and also the data will be sent through a channel, the data rate can ary from the channel we use.

In this we have also developed an android application to reach the information to the farmer and this data are stored in the cloud so that it can be used for the future analysis when required. The information to the farmer is also providing through SMS so that the farmer can access the data when there is low internet connection. The farmer also can get the data stored in the cloud for any date by providing the range of days, so that he can know what amount of water is used by the crop in the given period of time.

This proposed system aims at reducing the human interference thus also reducing the error and the wastage of resources. In this all the required actions are automated because of which the farmer can take the required action from a remote location itself.

V. WORK FLOW OF THE SYSTEM

The workflow of the System mainly consists of five modules they are the Temperature, Humidity, Soil Moisture, Light Intensity, Intruder detection. To sense the temperature of the environment we make use of the Temperature module, it consist of a LM35 temperature sensor which detects the temperature and the output of these sensor are in the form of analog signals but for microcontroller to understand it need digital signals. Hence an ADC(Analog-to-Digital Converter) is used which convert the analog signal to digital signal and then is passed to the microcontroller in which suitable comparison are made and if the temperature is more than the specified range, a fan will be made to actuate for a specified time. Similarly in the Humidity module, the sensor senses the humidity and the corresponding analog signals are converted into digital using ADC. In case of extension of the humidity valve from the specified range, an actuation of the sprinkler is done until a specified amount of time in order to reduce the level of humidity.

To find the level of moisture in the soil we make use of the Soil Moisture module, which detects the moisture level in the soil and the corresponding signals which are in the digital form are directly connected to the microcontroller and is compared with the specified range of values. If the values are less than the given range the microcontroller sends a signal to the relay to switch on the motor which pumps the water until a specified time in order to water the plants and maintain the specified range of the soil moisture.

For the crops to produce good yield plants need a good amount of light for the processes like photosynthesis and in order to maintain the intensity levels of light we have a Light Intensity module which has a LDR sensor which senses the intensity of light and if it varies outside the specified range, we have provided a series of Red and Blue LED strips as plants mainly absorb these intensity of lights for the better yield of the crops. We have also provided with a intruder detection module which contains a PIR sensor which detects the intruder and sends an SMS alert and a notification through the mobile application. The values of all the sensors are collected and sent to the microcontroller to perform the specified operation respectively. We have provided a GSM system using which SMS alerts are sent to the user to keep him informed about the vertical farm land.

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VI. EXPERIMENTAL RESULT

The Proposed system has a mobile application which is used to inform the user about the variations that occur in the vertical farm fields. The values of the sensors are stored in the IOT cloud and these values can be fetched from the cloud through the mobile application and the alerts of a particular date can be displayed as shown in Figure. 2.

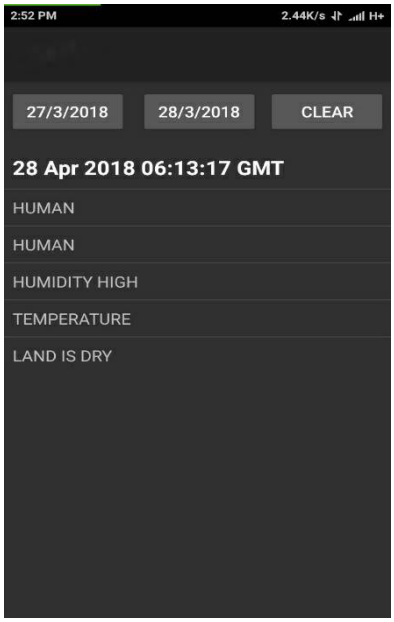

Figure 2: The Display Of Alerts In Mobile Application.

In the Figure 3. We can see that the mobile application is provider with a feature using which the user is able fetch the data of the vertical farm field of the previous dates. This provides the user to analysis the variations in the farm field that has been sensed by the sensor and the corresponding values are stored in the IOT cloud.

In this, we are provided an area to enter the start date and an end date where the end date cannot exceed the current date. As we provide the start date and the end date, we are able see the alerts that had been occurred in range of the specified date and clear button is provided to erase the start date and the end date that had been entered by the user.

We have also provided with a feature of SMS notification through which the user gets a SMS notification when there is any variation in the farm field. As we have provided with an actuation for each module whenever a variation occurs in the farm field the proposed system is capable of bringing the situation into a stable state by which we can yield good production without much intervention of the user.

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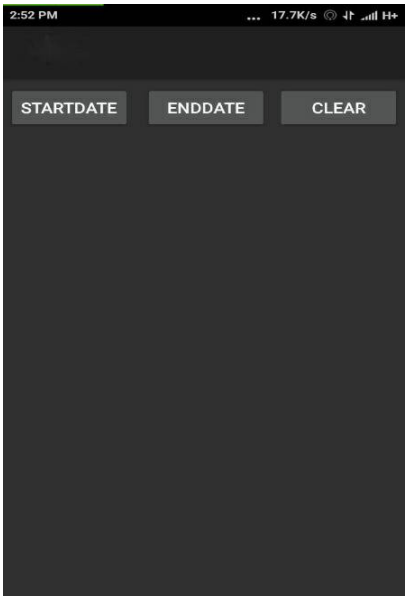

Figure 3: To Display Alerts Of Specified Dates.

VII. CONCLUSION

In the work, the proposed system has been successfully developed in which the sensors and the microcontrollers are successfully interfaced with the wireless monitoring of the vertical farm. Each sensor is provided with a suitable actuation by which the farm field can be well maintained without much intervention by the user. With the Implementation of the proposed system in the field we can see the increase in yield of production with the minimum involvement of the user in the vertical farm field.

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