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IoT Based Monitoring and Controlling Smart Irrigation System Using Arduino

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Abstract – According to FAO, around 61% of the world population are farmers. These families depend on irrigation for their living. So, it is essential to develop and revolutionize the irrigation technologically. Usually, irrigation involves a lot of man work and need to be checked frequently for soil conditions. We propose a smart irrigation system for maintenance and surveillance using Arduino. The objective of this paper is to check the conditions of soil and control water for it automatically. It uses different sensors like soil moisture sensor etc. to receive data and send it from Arduino to cloud using a wireless network like ESP8266 wifi module and send a notification to the user.

Index Terms – Arduino, Soil Moisture Sensor, Wireless Network, ESP8266 Wifi Module.

1. INTRODUCTION

Technology is advancing by leaps and bounds in every field. So, its improvement is also done in the field of irrigation. But in countries like India which is vastly known for agriculture, it is still lacking in agricultural technology. It boasts a total of 17%-18% in total country's GDP but the farmers responsible for that are not economically stable. To reduce the risk factor of farmers losing everything and help them to get high yield and improve the irrigation technology we propose this system. In this paper, we demonstrate an economical and easy to use automated controlled irrigation system based on Arduino. The designed system relies on various environmental factors such as moisture, temperature, and nutrients present in soil which is measured using various sensors like soil moisture sensor, pH sensor etc... the data is updated to cloud/server by wifi module which can be easily accessed by the user through the website. It waters the soil automatically if it is below the preset value and sends a notification to the user through SMS. It collects environment data and saves it in a cloud so that user can access it and plant the crop suitable for that conditions. They can also take necessary precautions for better growth of the crop and get a better yield. The user can control the system through the server and it is bringing the field to the user/farmer.

2. RELATED WORK

2.1 Nikhil Agarwal and Smita Singhal proposed a paper in which the system consists of wired system with ethernet connection. Email and relay board is used to control the system. Again emails are sent as notifications.

2.2 G.Parameswaran and K.Sivaprasath proposed a paper in which they use wired microcontroller network. Zigbee communication model is used to interact and send/receive information.

2.3 Shweta B. Saraf and Dhanashri H. Gawali proposed a paper in which the system is made of wireless system and zigbee communication. User control the system from mobile through the communication model.

2.4 Wenju Zhao, Shengwei Lin, Jiwen Han and Rongtao Xu proposed a paper in which the system consists of LoRA network and GPS. It can be controlled through app remotely and check status of the system.

3. PORPOSED MODELLING

The proposed system helps the user to get high yield with minimal usage and remote surveillance of the soil and environment conditions. The system design shown in fig.1 contains the device with sensors, microcontroller & wifi module. The design also contains cloud/server and user-end.

Fig.1. System design

DEVICE

It contains different sensors and Arduino as microcontroller and wifi-module. The components used are.

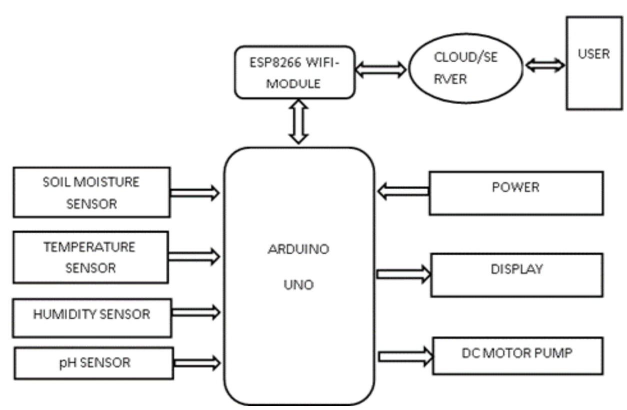

Fig.2. System Architecture

1. Soil Moisture Sensor: It is used to measure the automatic volumetric water content of the soil. The LM393 sensor is used in our system. It is attached to the Arduino board and sends data to it.

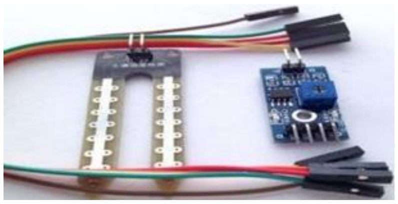

Fig.3. LM393 Soil Moisture Sensor

2. Temperature Sensor: It senses the temperature and sends data in different forms. We use the DS18B20 sensor. It is 1-Wire digital temperature sensor from Maxim IC. Reports degrees in Celsius with 9 to 12-bit precision, from -55 to 125 (+/-0.5). Each sensor has a unique 64-Bit Serial number etched into it - allows for a considerable number of sensors to be used on one data bus.

Fig.4. DS18B20 Temperature Sensor

3. Humidity Sensor: A humidity sensor measures, and reports the relative humidity in the air. It, therefore, measures both air and moisture temperature. The ratio of actual moisture in the air to the highest amount of moisture that can be held at that air temperature is called Relative humidity. As the temperature of air gets warmer, the more moisture it can hold. Capacitive measurement is used in humidity sensor, which relies on electrical capacitance. CL-M53R consists of a simple structure and its resistance value logarithmically changes in response to relative humidity. It offers highly accurate sensing and long-term stability.

Fig.5. CL-M53R Humidity Sensor

4. pH Sensor: It determines the pH values in the soil. The pH of the soil is an essential factor in determining which plants will grow because it controls which nutrients are available for the plants to use.

Fig. 6. pH Sensor

5. Arduino Uno: It is a widely used open-source microcontroller board based on the MicrochipATmega328P microcontroller. It stores and performs the program in it. The data is received and sent to cloud through it.

Fig. 7. Arduino UNO

6. Wifi-Module: It connects the Arduino board to the cloud/server. It is a low-cost WiFi microchip with full TCP/IP stack and microcontroller capability. It sends/receives data and helps in communication.

Fig. 8. ESP8266 Wifi-Module

Cloud is used to receive the data from wifi module. It saves the data and helps the user to access it from anywhere through its unique address. It also controls some part of the system by traversing the data received. SMS will be sent from it if the Arduino board sends the signal to it. In user end, the user can receive a message and he can access data using the unique address saved for it.

Firstly, to perform desired actions in our system we need to program our Arduino. It is connected to the system and then the required program is written on ARDUINO IDE and it is saved into the memory space in Arduino board. Required sensors and modules are connected using plugs to the pins on the board. A cloud is created with the unique id of wifi module and is made it is in working condition.

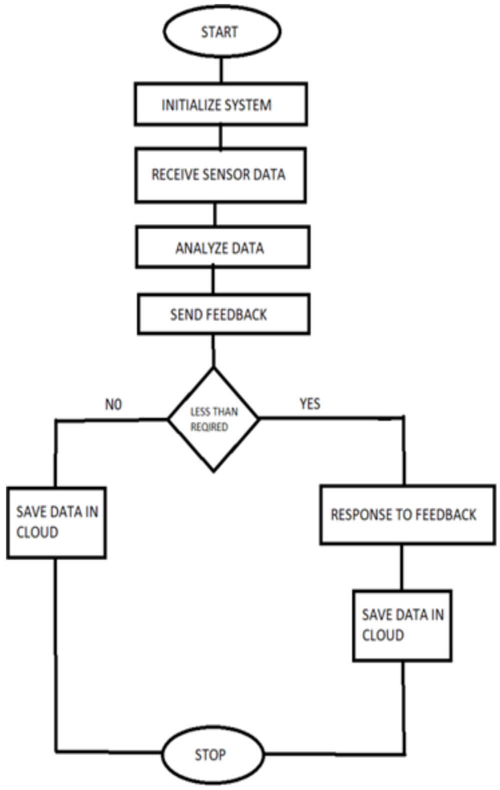

Fig.9. System Flow Chart

The algorithm involved in this system is

Step-1: Start the system.

Step-2: Sensor collects data.

Step-4: Cloud receives sensor data.

Step-5: It analyzes the data and sends feedback.

Step-6: If the data received is less than minimum then the feedback is sent to system else no feedback is sent.

Ste-7: The data saved in cloud.

The primary and essential part of this system is a soil moisture sensor. Its +5v is connected to pin2 and ground is connected to pin5 and 6. It checks for the soil moisture value in the soil and it sends it to the board. If the moisture value is less than the pre-programmed value, then the Arduino switches the motor pump for the required time to water the soil for the growth of plants.

The received data is sent to the cloud to be accessed later and it sends the status of the motor on/off to user through SMS. It saves the data of soil moisture graphically. Other sensors take the data of environment and soil frequently and send them to cloud.

4. RESULTS AND DISCUSSIONS

The soil moisture sensor sends moisture value to the cloud. If these value less than required value then motor is turned on. Moisture content data collected is shown in the form of graph. The pH sensor shows the availability of nutrients in the soil like in fig.10. This nutrients value is found after mixing the equal parts of the soil in distilled water and then placing the glass surfaced pH sensor in it. This data can be used to find deficient nutrients in the soil and take necessary precautions.

Humidity sensor collects the relative humidity data by collecting the moisture from the air which causes the change in voltage and senses the humidity value in air. It helps to check the conditions of the environment is favorable for which crop to get high yield.

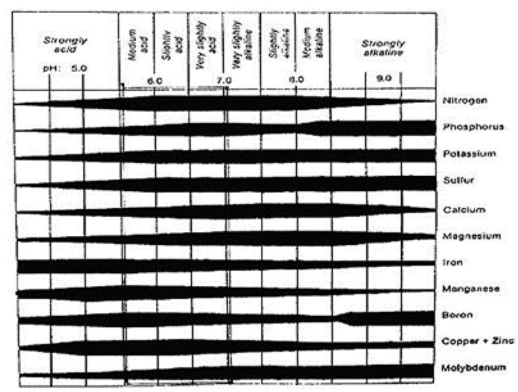

Fig.10. Nutrients values in soil

The Temperature sensor is used to get the temperature in the soil so that the user can keep check of temperature conditions for safe growth of plants. If the soil temperature is increased, it affects the growth of plants. It can be controlled by providing water to soil from more than required. We can also get good results if we plant crops which need high soil temperature as the condition. In fig.11 we can see the temperature graph.

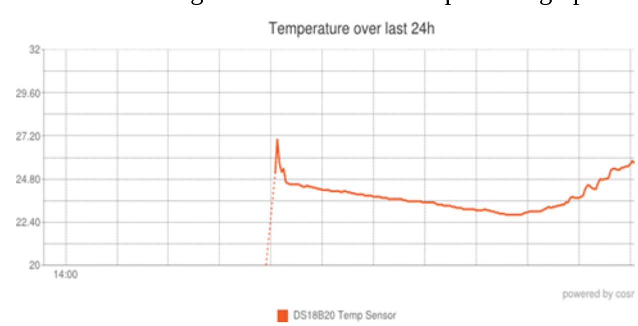

Fig. 11.Temperature graph using the temperature sensor

The total data is saved in the cloud and it can be accessed from it. The system can be controlled from the cloud and also notifies the user when the motor pump is on/off. In fig.12 we can see the web page of the system in the cloud.

Fig.12. Web page in the cloud

5. CONCLUSION

In this paper, we demonstrate a model for remote monitoring and automatically controlled irrigation system. This helps in improvement of irrigation through technology. Due to automatic control process, we can regulate the use of water and can get a better understanding of the environment of the field. It helps in increase of production rate and reduces the use of manpower and energy. Due to the cloud updates and availability of webpage user can know about the status of the field from anywhere and can control it from everywhere.

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