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Smart irrigation system for supplying and removing water using IoT technology

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ABSTRACT

Agriculture always had been an integral part of the world and the backbone for developing countries for the Indian Subcontinent, which plays an important role in the economic growth of the country. Agriculture is the largest source of livelihood for the developing country nearly about 70 percent of its rural household still depends on agriculture. It has been more than 50 years of the green revolution but still, farmers are dependent on the rainwater. The government has spent millions and billions of rupees over farming but still, the condition of farmers and farming is disappointing. So, to overcome this gigantic problem farmer should acquire new technologies in which it will help them for smart farming. So, our system is used to scrutinize the temperature of the agriculture field based on the temperature sensor value it checks whether the environment is summer or winter, based on that crops should be planted in the field. The system checks the moisture of the soil with the help of soil moisture sensor then the system automatically supplies water to the field whenever the moisture of the soil is less than a threshold value. It also pumps out extra water from the field when moisture value is more than a threshold value. For this, we have used a temperature sensor to scrutinize the temperature and soil moisture sensor to take a reading of the moisture of soil and relay to switch ON/OFF the water pump. Also, a GSM Module is used for providing information about the field to farmers and LCD (Liquid Crystal Display) is used to display the data of the field over the system. We have also used Arduino UNO to code our structure. The main objective of our system is to reduce the human effort in the field of agriculture and control over the gigantic problem of water in the field of agriculture.

Keywords— *Arduino Uno, Water supply pumps, Relay modules, GSM Module, Soil moisture sensor, Temperature sensor, Humidity sensor*

1. INTRODUCTION

The term "agriculture" is one of the most important aspects of human life. The world is dependent on agriculture but due to different types of crises in this field of agriculture, the farmer is facing problems in doing farming. The only change that we have implemented is that we use fertilizers more in comparison to what we did formerly. A famous phrase goes as "Water, Water everywhere but not a single drop to drink." The same situation goes for our country, too. Sometimes we have abundance of water in a particular area that it causes floods (the recent Bihar Floods have been the perfect example) and sometimes there is extreme necessity of water (the recent scarcity of water in Tamil Nadu and Maharashtra in which we also saw thousands of farmers protesting outside the parliament house in New Delhi). Farmer committing suicide every year is not even new to us. But we technicians, can we do something to help our society from such burning problems? Of course, we can, with the help of some gadgets and brains, we can do wonders.

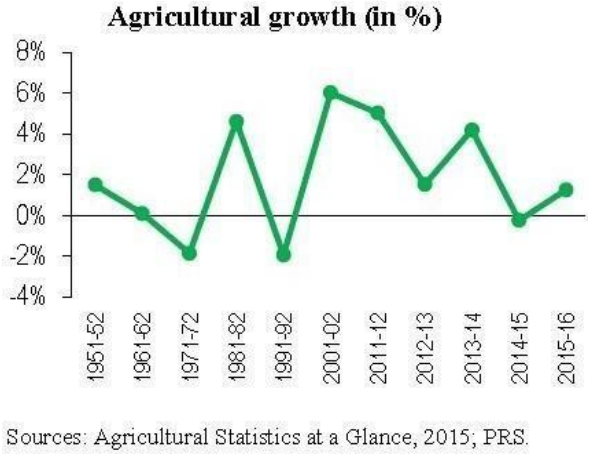

Fig. 1: Agriculture growth

The smart irrigation system is developed for supplying the water in the field using the soil moisture sensor by checking the threshold value the system will ON/OFF the pump to supply water in the field not only this much this system also used remote-controlled robot to scare the birds and animals from destroying the crops and a motion detection sensor to detect any kind of thief from the warehouse of

crops.[1]Smart drip irrigation system automatically and manually supplies the water to plant when the ultrasound distance sensor to sense the low amount of water then it generates a signal to the microcontroller and the microcontroller sends the signal to the raspberry pi. Pi instruct the relay to turn ON/OFF the Solenoid valve which is connected with 2 different 30 liters water storage tank and send the status of the watering of a plant to the user via email with the help of raspberry pi [2] A water pump controller system is made using Esp8266 NodeMCU-12E (IoT open-source platform) which receives the data from the soil moisture sensor to ON/OFF the pump. The data and status of the pump are displayed over the web application and mobile application using transport layer security and socket layer. [3] The system scrutinizes the humidity of the soil using the humidity sensor and temperature sensor based on the data from the sensor the Ardunio Mega switch ON/OFF the water pump and a phone call are made to the user to inform the status using the GSM Module. [4] Zigbee technology is used to transmit the sensor data i.e. soil moisture sensor, temperature sensor and humidity sensor to the master node. The master node sends the data to the cloud server which perform decision based on the threshold value as per the moisture required to the crops. After the decision taken by the cloud, the microcontroller controls the relay for watering and the information of watering is shared with the user android device. [5] Blue term an android application is used to control the motor for switch ON/OFF by checking the threshold value from the raspberry pi which gets the data from the humidity sensor and temperature sensor and also raspberry pi sends the sensor data to the cloud server. The status of the motor is sent to the user smart device using Wi-Fi technology which is provided by a raspberry pi.

[6] Raspberry pi receives the data from the soil moisture sensor, ultrasonic sensor and light sensor to inspect the threshold value of soil and water level in the tank and the day/Night status. After the data received from the sensor raspberry pi decides to switch ON/OFF the solenoid value. An android device is developed for remote control of the system for switching ON/OFF the solenoid value. The status of the solenoid valve is sent to the user email as a notification. [7] The data from the sensor like soil moisture sensor and humidity sensor is stored over the cloud server with the help of raspberry pi which is having an in-build feature of the internet. Cloud data can be access by the farmer through their mobile/PC. The threshold value is defined for the crop/field to the raspberry pi based on the threshold value it decides to switch ON/OFF the motor and an audio sound of buzzer played as a notification. [8] Temperature infrared thermopile sensor-TMP007, humidity sensor-HDC1010 and camera sensor MT9D111 is connected with CC3200 a single IC chip wireless microcontroller which receives the data and captured image of the field condition from the sensors.GPRS (General Packet Radio Service) is used to send the data and images of the field to the farmer's mobile phone. [9] Soil moisture, humidity, light sensor, and temperature sensor data is stored in the web server database using wireless transmission NRF24L01. The motor is automatically switched ON/OFF after Arduino comparing the sensor data with threshold value.farmer can control the motor manually with android devices after seeing the data of the field in the android application. [10] The fuzzy controller gets the multiple inputs of the sensor data at a time which checks the threshold value to switch ON/OFF the motor. The motor is switched ON/OFF based on the temperature value, humidity value, and light sensor value. Since the data of the sensor is stored over the webserver, so the data can be accessed by the user with their smart devices such as pc, tablet, and mobile phone. [11]

2. OBJECTIVES

- Conventional management of water Automatic system for supplying and drain out water
- Boost up the production of crops Climatic suggestion based on temperature Aggrandize the quality of crops
- Share the information of field to farmer's Human intervention can be reduced

3. SYSTEM ARCHITECTURE DIAGRAM

Fig. 2: System Architecture

The system architecture diagram of a smart irrigation system for supplying and removing water explains that the temperature sensor, soil moisture sensor, and humidity sensor sends the data of the field to the Arduino. The temperature sensor says the climate which will be very much helpful for farmers to takes decisions for planting crops according to the climate. According to the climate threshold value is assigned to the Arduino UNO which is the brain of the system that processes the soil moisture sensor data to check whether the data of the field is beyond the threshold value, less than the threshold value or equal to it. Humidity sensor in the system used to scrutinize the dampness present in the air which will help the farmers to know the situations of the planted crops and field based on the dampness farmers provides pesticides in their field to improve the quality and quantity of the crops or fields. After these data gets processed, Arduino, instruct the relay 1 or relay 2 to power ON/OFF for supplying or removing water. The water pump supplying is connected with the source of water like a pond, river, etc. and the water removing pump is placed in the field. The information on supplying and removing water is shared with the farmer as a text message on their smartphone with the help of the GSM module. The value of soil moisture, humidity and temperature are displayed in the Liquid Crystal Display (LCD) which is placed over the system for instant information of the field.

Table 1: For Soil Range of summer (Temperature > 25^{o}C)

Condition	Range
Normal	400 - 1000
Supply	<1000
Remove	>400

Table 2: For Soil Range of winter (Temperature < 25^{oC})

Condition	Range
Normal	350 - 900
Supply	< 900
Remove	>350

4. FLOWCHART

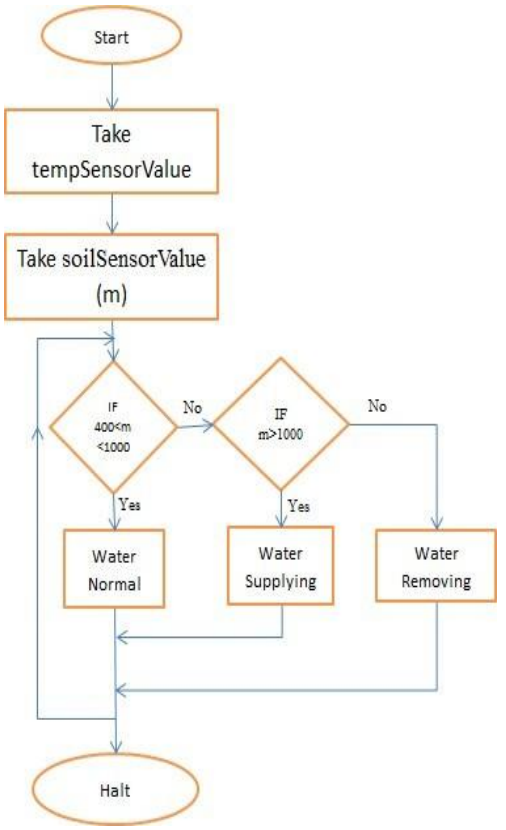

Fig. 3: For the summer season

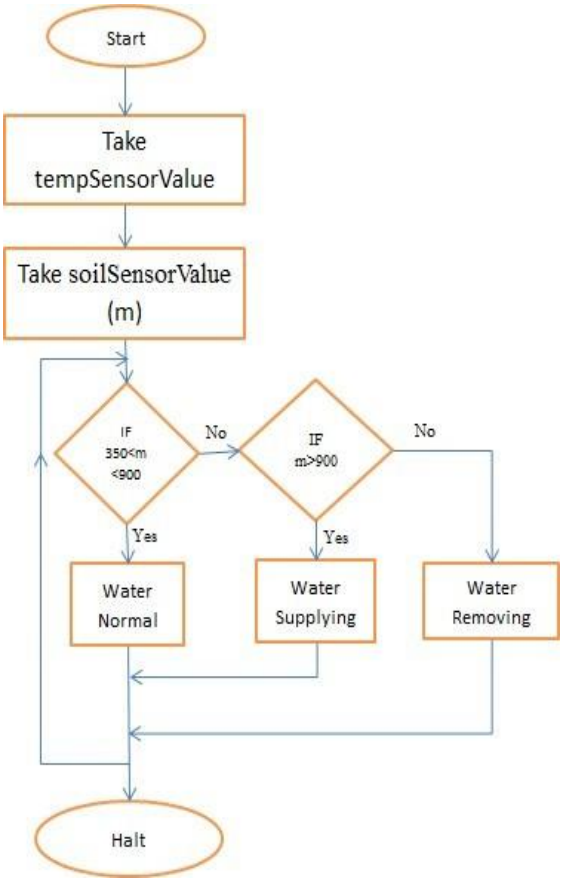

Fig. 4: For the winter season

5. SYSTEM IMPLEMENTATION AND TESTING

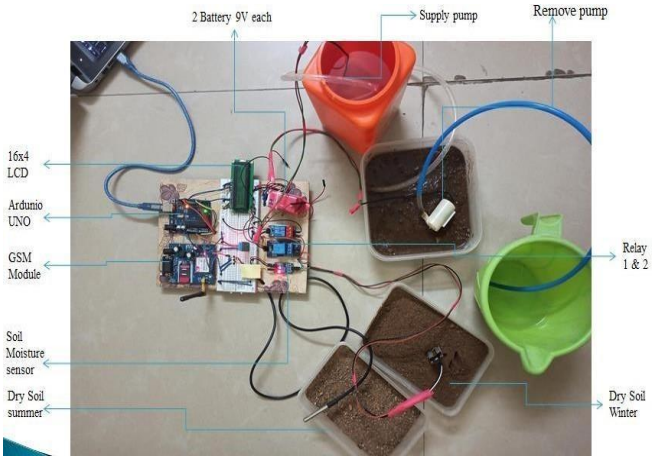

Fig. 5: System set up

The sensor and other hardware devices are installed with Ardunio with the support of jumper wires as shown in fig.5.1. USB cable connected with PC supplies 5V power to Arduino, an adaptor of 2AMP is used to power the GSM module and 2 batteries of 9V each are used to power up the relays. The data of temperature sensor is processed by Arduino which takes decision based on the predefined value which is greater than 25^{oC} for summer and less than 25^{oC} for winter.

Soil moisture sensor gives the field moisture data to the Arduino which checks the threshold value for supplying and removing the water. Here the normal condition range for summer as shown in Table 1 of the field is 400 – 1000 and if the data from the field in beyond 1000 then relay 1 get instructed to switch on the water supply pump for supplying water in the field until the field comes at normal state but the data is less than 400 then it instruct relay 2 to switch ON water removing pump for drain out the extra water from the field until the soil arrives at the normal condition. Similarly, when the season is winter (Temperature >25oC) then the normal condition range as shown in Table 2 of the field is 350 – 900 else if the value is beyond 900 then relay 1 get instructed to switch on the water supply pump for supplying water in the field until the field comes at a normal state. Relay 2 gets instructed to switch ON the pump when the data is less than the threshold value. Humidity sensor checks the dampness present in the air and soil which helps farmers to monitor their crops in real-time. The value of temperature, soil moisture and humidity is displayed over the 16x4 Liquid Crystal Display (LCD). GSM module sends the text message to the farmers about the pump whether it is in supplying condition, normal condition or at the removing condition.

6. DATA ANALYSIS

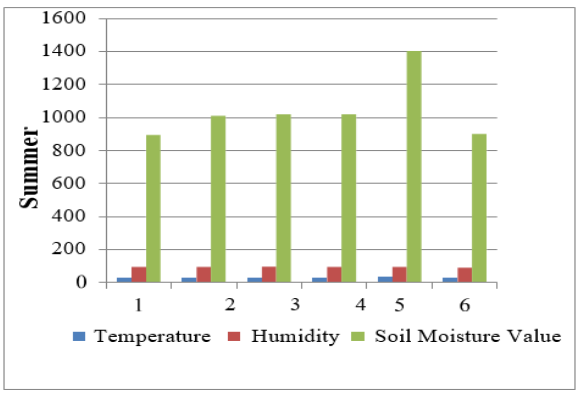

Fig. 6: Data analysis for summer season

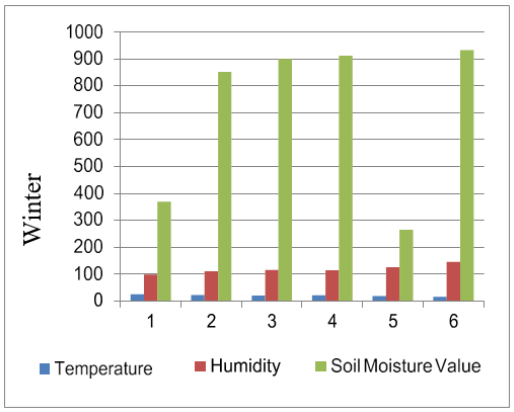

Fig. 7: Data analysis for winter season

7. OUTPUT MONITOR

Fig. 8: Output of supplying condition

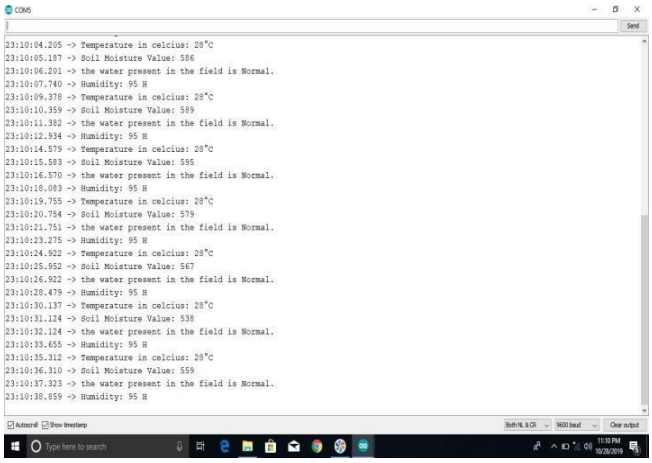

Fig. 9: Output of Normal condition

Fig. 10: Output of removing a condition

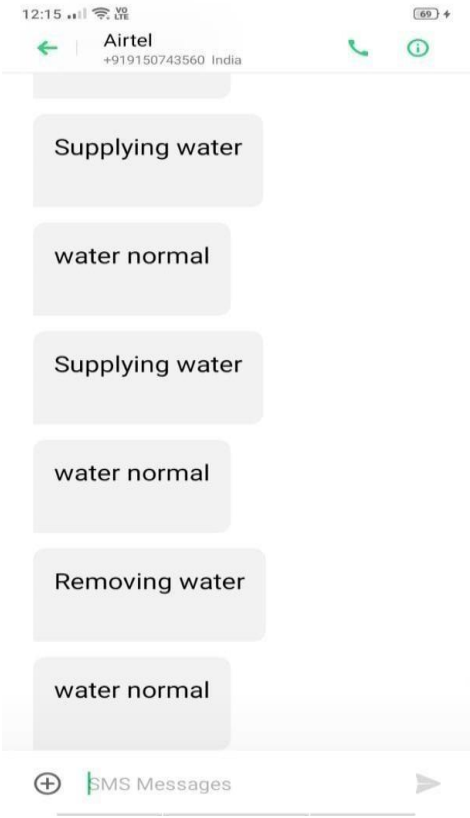

Fig. 11: Message in Mobile phone

8. CONCLUSION AND RESULT

The sensors and hardware devices are installed successfully with a microcontroller. GSM module is improving the system for wireless communication with the farmers. During the testing and implementation process, the output from the sensors completely helpful for smart irrigation this boosts up in the production and quality of the crops. Pumping of water and draining out extra water from the field is based on the temperature sensor and soil moisture sensor. Dampness present in the soil and air is analyzed by a humidity sensor. The limitation of the system is that the sensor's data can be computed to the cloud. Computing this data to the cloud help to analyze the production of crops. Also, the removed water from the field can be stored properly which helps for further supplying of the water.

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