IoT Smart Agriculture & Automatic Irrigation System

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***Abstract*— Implementing IoT in agriculture will modernize agriculture. Sensors help us to monitor various parameters and their effects on the crop growth. Crop growth is dependent on many attributes. We focused on irrigation. There is uneven watering of the large agricultural fields which results in bad quality of the crops which further leads to financial losses. We used a resistive soil moisture sensor and a DHT11 humidity temperature sensor. The resistive soil moisture sensor measures the moisture content in the soil. When the moisture content in the soil is low, the motor which is controlled by the relay irrigates the field. The motor stops once the soil is wet. The water is efficiently utilized here without wastage. One can see all the information of this process using the Thingspeak server from across the world.**

I. Introduction

Agriculture is the backbone of the country. But it is not an easy task. Farmers have been facing so many problems for decades. With the emerging technologies, these problems can be solved. Agriculture can be made as Smart Agriculture by implementing IoT in farming. With this, the problem of wastage of resources can be solved. With the data collected by the sensors, we can make meaningful interpretations on the behavior of the growth of the crops and the external parameters affecting it which will help to improve the existing farming and irrigation methods, which will lead to the production growth. Smart Agriculture will help nation development.

II. Literature Review

WEMOS D1 Controller is used as the main component which receives input from sensors and controls the flow of water. The system was compared to manual irrigation and 24% of water was efficiently saved from being wasted [1].

An innovative irrigation system using a GSM/Bluetooth module has been proposed. The irrigation time window is fixed based on the humidity and temperature of soil which is detected by the sensors. The systems provide insights of water storage level, irrigation system state, temperature, humidity through SMS on GSM module [2].

A DDC (direct digital controller) system was implemented which collects data from sensors and storage tanks and transfers data using ZigBee to a monitoring computer which controls the flow of water. The system focuses on precision and stability of implementing IoT into agriculture [5].

Rain gun irrigation mechanism is used which uses a solenoid valve. The valve is controlled by the microcontroller. The system can be seen implemented in cricket stadiums and golf courses and public gardens for controlled automated irrigation which reduces the power consumption, which also removes human error [6].

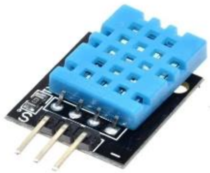
The proposed method consists of three sections, Sensor section, Control section, IoT section. Soil humidity sensors are placed in uniform distances which detects dampness and ATMEGA328P is used to control the ON/OFF function of motor based on senor values. IoT section comprises of Blynk app which has interface that enables manual on or off of motor from distance.[7]

In this paper the proposed module faced a loophole which is related to dissimilar results of sensors. Numerous sensors were used to test the module in agricultural field and the sensors at different points gave different outputs of soil humidity, dampness etc which resulted in partial failure of the module.[8]

The system in this paper uses a rain gun system which irrigates the part of land which is in requirement of water instead of whole piece of land. The IoT section of this system uses android application which is custom made using Android SDK. The system is not affordable by farmers and covers less range in irrigation.[9]

III. COMPONENTS

1. DHT11



A temperature and humidity sensor complex with a calibrated digital signal output is part of the DHT11 Temperature & Humidity Sensor. It guarantees high dependability and outstanding long-term stability by utilizing the unique digital-signal-acquisition technique and temperature & humidity sensing technology. This sensor connects to a high performance 8-bit microcontroller and combines a resistive-type humidity measurement component with an NTC temperature measurement component to provide great quality, quick response, interference resistance, and cost effectiveness.

2. Resistive Soil Moisture Sensor

A resistive soil moisture sensor measures the soil's moisture levels by utilizing the correlation between electrical resistance and water content. These sensors have two exposed probes that are put directly into the soil sample.

3. ESP8266 WiFi Module

A self-contained SOC with an integrated TCP/IP protocol stack, the ESP8266 WiFi Module allows any microcontroller to access a WiFi network. The ESP8266 is capable of offloading all WiFi networking tasks from another application processor or hosting an application. It is known as a standalone wireless transceiver and is very inexpensive.

4. Relay

An electrical switch controlled by an electromagnet is known as a power relay module. A separate low-power signal from a microcontroller activates the electromagnet. The electromagnet pulls to either open or close an electrical circuit when it is energized.

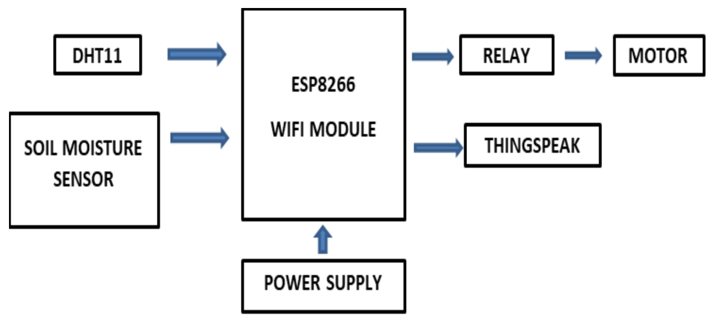
5. Motor

This DC 3-6 V Mini Micro Submersible Water Pump is a compact, inexpensive submersible pump motor that runs from a 2.5 – 6V power source. It can use up to 120 liters per hour and only use 220 mA of current.

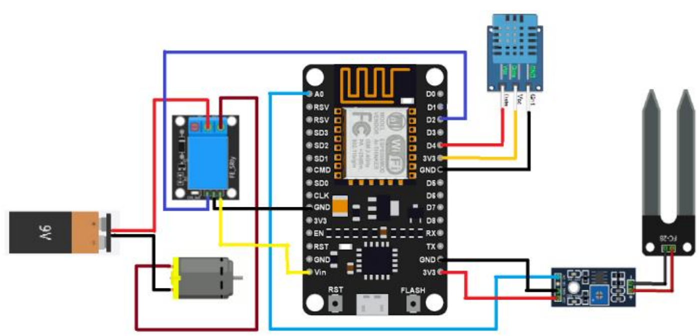
6. Thingspeak

With the help of the IoT analytics platform service ThingSpeak, you can gather, visualize, and examine real-time data streams online. From your devices, you can send data to ThingSpeak, visualize live data instantly, and issue alarms

IV. BLOCK DIAGRAM



V. CIRCUIT DIAGRAM



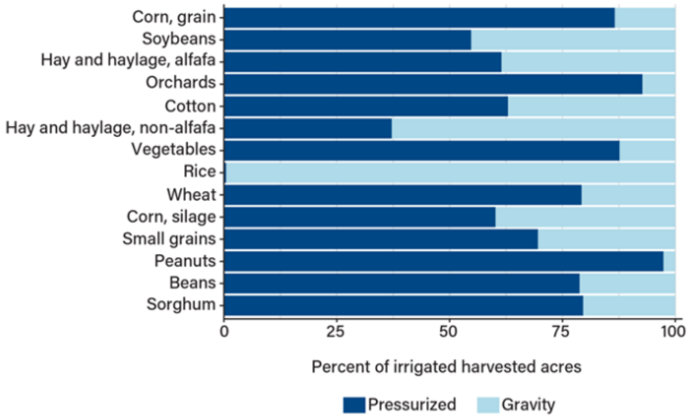
VI. PROCEDURE

In a resistive soil moisture sensor, the resistance varies with the amount of moisture in the soil. It is an analog sensor.

The resistance of the sensor corresponds to a maximum of 3 volts to minimum of 1.2 volts. The sensor should be calibrated before it is used in the field. An uncalibrated sensor provides faulty soil moisture values which will result in the motor turn ON. The calibration of the sensor is done by finding the peak of the analog output when the sensor is placed in open air and water. The DHT11 humidity temperature sensor uses a thermistor and capacitive humidity sensor to measure the temperature and humidity of the air. The capacitive soil moisture sensor and the DHT11 humidity temperature sensor should be connected to analog and digital pins of the NodeMCU. The relay is operated by the NodeMCU. The relay is connected to the digital pin of the NodeMCU. The motor is connected to the relay. The soil moisture sensor and the DHT11 humidity temperature sensor require 3.3V power, while the motor and relay require 5V power which will be supplied by the 5V pin of the NodeMCU. Thingspeak lets us monitor the moisture level of the soil, humidity and temperature of the air from anywhere in the world. With the data we obtain from the sensors, we can take the correlation between the parameters and understand the effect of each parameter on one another. The output characteristic graph can be observed in Thinspeak in the form of soil moisture, temperature, humidity and status of motor.

VII. THEORY

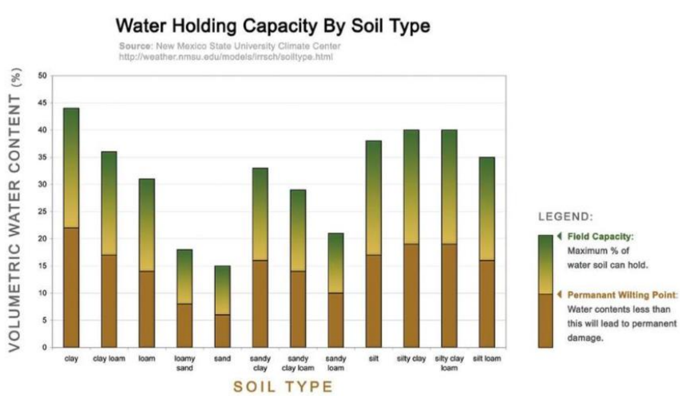
i)Variance of irrigation system types with crops



Pressurized Irrigation - Pressurized systems use pipes or other tubes to apply water under pressure directly to crops. Sprinkler and micro irrigation are both a part of this.

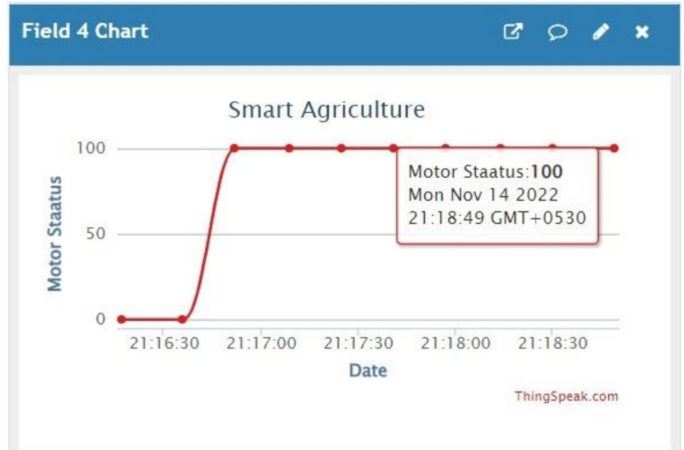
Gravity Irrigation - Field furrows, basins, or poly-pipe are used in gravity irrigation systems to control how the water is distributed throughout the field solely by gravity.

ii) Water holding capacity



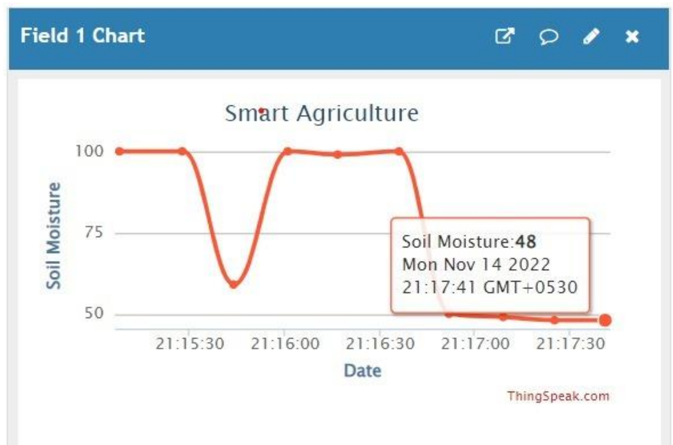
(NMSU Climate center, 2014)

VIII. RESULTS



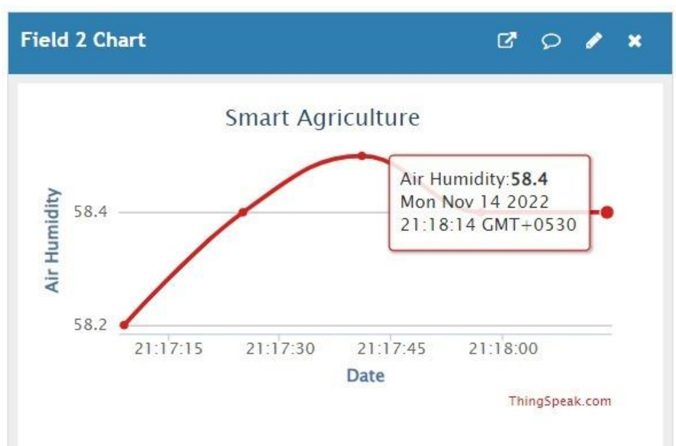
(i)Soil Moisture Graph

The graph depicts the moisture percentage of soil with respect to date. Here, the moisture is 48% which is less than 60%. This will induce the start of the motor.



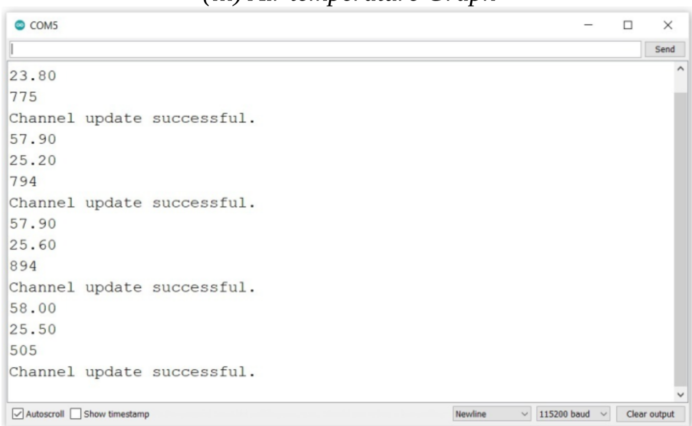
(ii) Motor Status Graph

As mentioned in (i), the motor is activated and is high since the moisture detected is less than 60%.



(iii) Air Humidity Graph

(iii) Air temperature Graph



(iv) DHT11 Sensor Output

The DHT11 sensor's output is displayed in the serial monitor of the Arduino IDE. The first, second and third value displayed corresponds to humidity, temperature and moisture of air respectively.

IX.

X. Conclusion

Smart Agriculture is very useful. It uses the resources efficiently which reduces the wastage. It makes much of the work automatic like irrigation. The data collected by the sensors are very useful. It can help us to find new methods and techniques of farming. We can also know the correlation between the various parameters like humidity of the air, temperature of the air, moisture of the soil etc. This helps to increase the production of the crop.

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