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Smart Automatic Irrigation System for Cotton Crop Using IoT

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Abstract——Irrigation plays a vital role in agriculture, it's been a central feature of agriculture for over 5,000 years and has been developed independently by several cultures across the world. This paper essentially demonstrates the effective use of irrigation in agriculture. Here we tend to build an IOT based irrigation system using ESP8266 NodeMCU Module and DHT11 sensor. It'll not only automatically irrigate the water based on the moisture level in the soil however additionally send the information to Thingspeak server to keep track of the land condition. The System will have a water pump that will be utilized to sprinkle water on the land based on factors such as humidity, temperature, and moisture content. In this paper we tend to work on an individual crop that is cotton crop. Thus during this project we are using a cotton crop which will require a certain soil moisture level. So

when the soil loses its moisture to less than the required value then motor pump will be activated automatically to sprinkle the water and it will continue to sprinkle the water until the moisture goes up to sufficient moisture level and after that the pump will be turned-off.

Keywords— Automatic Irrigation, Soil Moisture, Temperature, Humidity, ESP8266 NodeMCU, Thingspeak

I. INTRODUCTION

Farmers across the world face a lot of difficulties in growing crops because of unpredictable weather conditions and shortage of water. The manual irrigation system uses a more amount of water and supplies uneven water to corps. This affects the quality of crops. In the current phase, one of the world's major problems is lack of water and water is consumed abundantly in agriculture. Therefore an appropriate water consumption system is required. Currently, almost all irrigation systems are physically regulated. The transformation in the information technology has removed lots of impossibilities. In these years, the rise of our cell phones, tablets, automobiles, "smart" technology has expend the market and has transformed into another standard in the business. Internet of things empower the specific inter relationship among several appliances, equipment, and services based on Internet and this technology also helps further to provide comfort to people to do work faster. Smart irrigation is an innovative scenario where many researchers are taking interest and for decades it is developing and emerging.

Year	Population (million)	Water Availability (m^3)
1951	34	5300
1961	46	3950
1971	65	2700
1981	84	2100
1991	115	1600
2001	148	1200
2011	170	1050
2025	267	660

Source: UNDP Report (2005)

Pressure on the water distribution system is increasing and the significance of water management has increased due to the sustainability irrigated farming. Generally, the main purpose of smart irrigation is to reduce manpower, water resources and power consumption. The soil moisture based irrigation is managed using Tensiometric and volumetric approaches, which is almost simple yet similar to the characteristic curve of soil water that is distinct from the kind of soil.

Routine maintenance is required for the legitimate performance of all sensors. Intelligent irrigation systems water plants automatically without human supervision using moisture sensors.

Therefore, the main purpose of the work is to design the irrigation system, which provides all the above quality with the traditional feature available in irrigation system such as measuring moisture analysis of the area to prevent crop damage issue's. Temperature is observed so that the surrounding temperature can be examined as the crop temperature is also sensitive. Water is used by cotton during its entire life cycle as a result of the combined evaporation and transpiration processes.

Water use, Includes the amount of water transpired by the growing plant and evaporated from the soil in which it grows. It is therefore a function of weather variables (mainly solar radiation, wind, air temperature, and humidity), as well as soil characteristics, crop characteristics, and cultural practices.

II. LITERATURE SURVEY

An Arduino-Based Smart Irrigation System was designed and put into operation by Pushkar Singh and Sanghamitra Saikia. The purpose of the Arduino-based connection is to simplify function, application, maintenance, and cost. The system is dependable and entirely automated. Users are more productive because sensors communicate with the website's communication system at great distances in nanoseconds. The entire system is built on the Arduino, which uses a cheap microprocessor; it can cover enormous regions with a relatively minimal investment.

Smart Irrigation System was proposed by S. Darshna, T_Sangavi, Sheena Mohan, A. Soundharya, and SukanyaDesikan. Farmers saturate the soil at regular intervals using a manually controlled irrigation method in the current situation. Water loss results from the process' increased water evaporation. While irrigation is difficult and rainfall is scarce in dry locations. The amount of water required in the fields must therefore be precisely controlled and monitored by an automated system. introducing a time-saving, IOT-based smart watering system that ensures water is used wisely. Additionally, the Esp8266 WiFi module and microcontroller used in this design guarantee an increase in system life by reducing power consumption.

Using the MQTT Protocol, Ravi Kishore Kodali and Borade Samar Sarjerao present a low-cost smart irrigation system. With the help of the Esp8266 NodeMCU-12E, efforts have been made to create a simple water pump controller that is beneficial in the agriculture industry. Because the Esp8266 NodeMCU-12E is affordable, employs a small microcontroller, and requires less power, the suggested solution is appropriate for the specified operation. System security is provided by the cryptographic protocols Secure Socket Layer (SSL) and Transport Layer Security (TLS). The soil moisture sensor is very precise, providing analogue readings and taking accurate measurements of soil moisture. The soil moisture price and water pump state are displayed on this mobile app and website.

III. PROPOSED SYSTEM

The artificial method of watering crops in farms is irrigation. Since agriculture is the most cost-effective industry, there will be a clever way to check the loss of water in the irrigation system in the current situation where water shortages brought on by increased exploitation have prompted the development of new technology that can prevent water from being wasted.

Pressure on existing water allocation has increased and the significance of water management has been raised for the sustainability of irrigated farming. Making the irrigation system intelligent, autonomous, and effective would maximize the water supply to the crops and reduce the need for human intervention. It observes soil, climate, dehydration conditions and plant water consumption and automated adjustment of the water schedule. Therefore, smart irrigation has become a major concern

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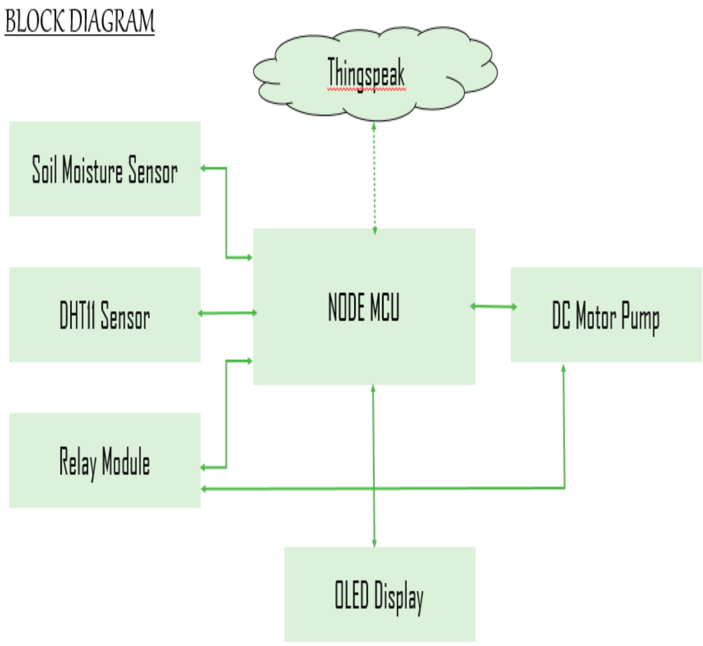
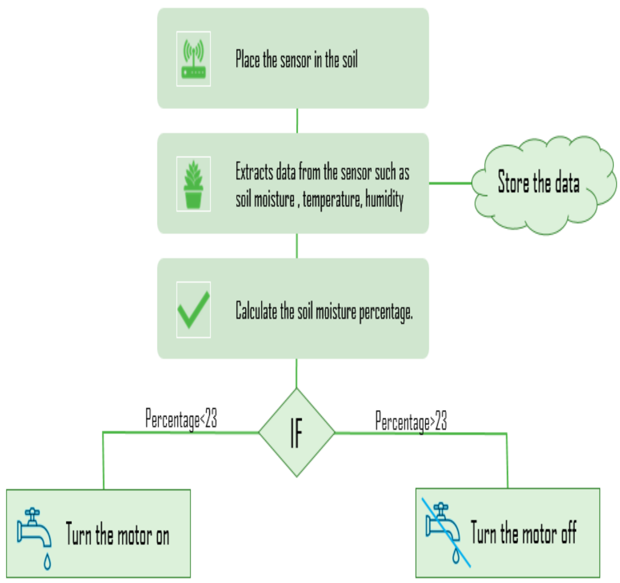
near the system so that a smart device can be given to the farmer who supports them in the production of quality crops.

Since India is an agriculture-based country and has plenty of water resources. But population expansion and over-utilization have led to a condition where the demand for water is exceeded then the supply. Different kinds of sensors are employed in the smart irrigation system to keep farmers informed about their land. Soil moisture, water flow, temperature are used to measure the water required by the area. A soil moisture sensor determines the moisture content in the field in order to forestall crops from water desertification problems and the temperature of the crops are monitored by the temperature sensor because crops are delicate towards temperature. Smart irrigation system warns farmers about the temperature of crops and provides instructions for motor to turn on/off the pump, so it will save the farmers' money along with crops. An attempt to create a system which can be operable from a longer distance, this can help farmers to monitor and control the area 24x7 during the whole year. An ESP8266wifi module is used to transmit and receive data.

A. Block Diagram



B. Flow Chart



IV. SYSTEM DESCRIPTION

We will use Capacitive Soil Moisture Sensor to measure moisture content present in the soil. To measure Air Temperature and Humidity, we use DHT11 Humidity Temperature Sensor. We shall regulate the water pump by means of a 5V Power relay.
The motor activates automatically any time the sensor determines that the soil has too

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little moisture. Consequently, the land will be automatically irrigated. The motor shuts off when the soil becomes damp. From anywhere in the world, you can use Thingspeak Server to remotely observe everything that is happening.

A proper algorithm is required to provide the desired output. There are following steps the algorithm consists of:

Step 1: Switch the power ON of the system that energies NodeMcu, sensors and other gadgets.

Step 2: Place the capacitive soil moisture sensor in the soil.

Step 3: Read the data from the sensor and analyze the data to check whether the user needs to be alerted or monitored continuously.

Step 4: Transmit the data to the user using the ESP 8266 and wait for the user to respond.

Step 5: If the response is YES, analyze the irrigation pumps, toggle the state and save the current state in the system configuration file.

The sensors using this prototype are as follows:

A. *Soil moisture sensor*:It is a low cost and userfriendly gadget, which is used to observe soil moisture value.It calculates the soil's volumetric water content. By employing a different soil characteristic as a stand-in for moisture content, such as electrical resistance, the dielectric constant, or neutron interaction, it is possible to determine the volumetric water content indirectly.

B. *Temperature Sensor:* The resistance temperature detectors (RTDs) measure resistance and conversion factor are used to find the temperature. Higher the resistance implies higher the temperature. The range of the temperature is 0 – 110 degree Celsius and belongs to the LM35 series.

C. *Water pump:* It is used to water the crops and the driver circuit operates it.

D. *Servo motor:*It manages to rotate from 0 – 180O and control the angular movement of the pipes to circulate water properly.

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E. *Power supply:* It uses a 5V power supply.

F. *ESP8266 WiFi Module:* This is a system on chip (SOC) and Wi-Fi networks that have software applications. It contains the TCP/IP protocol, which enabled access to the Wi-Fi connectivity. It has the ability to host an application or disable all Wi-Fi networking features on any other application processor. Flash memory allows for direct outside movement starting point. Built-in cache memory will reduce the amount of memory used and help improve system speed. Another instance is wireless internet connectivity, which can be added to any microcontroller-based design and allows for simple connection thanks to the SCI/SDIO interface.

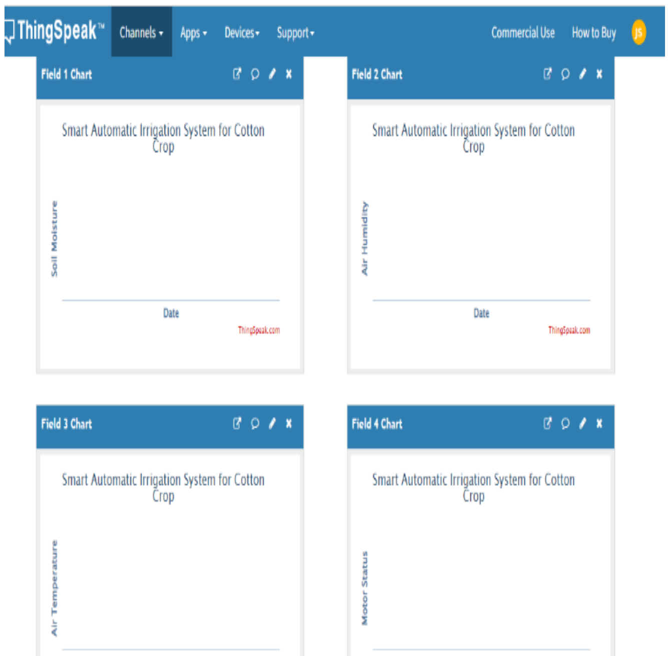
- *Thingspeak server:* With the help of the IoT analytics software service ThingSpeak, you can gather, visualize, and examine real-time data streams online. From your devices, you can send data to ThingSpeak, visualize live data instantly, and issue alarms.
  We have included four fields in our channel, they are:
  Field 1: Soil Moisture
  Field 2: Air Humidity
  Field 3: Air Temperature
  Field 4: Motor Status

  With ThingSpeak, you can gather, display, and examine real-time data streams online. The following are the primary abilities of ThingSpeak.

1. Popular IoT protocols can be easily configured on devices to connect with ThingSpeak.
2. Visualization of your sensor data in real-time.
3. Compile data from external sources as needed.
4. Use the power of MATLAB to make sense of your IoT data.
5. Base your IoT analytics on schedules or occurrences.
6. IoT solutions don't require web servers or software development to be prototyped and built.

V. RESULTS

Based on the values read by the sensor the soil moisture percentage is calculated. Based on this value it is decided whether the motor should be turned off or on. The output is noted on the Thingspeak server.



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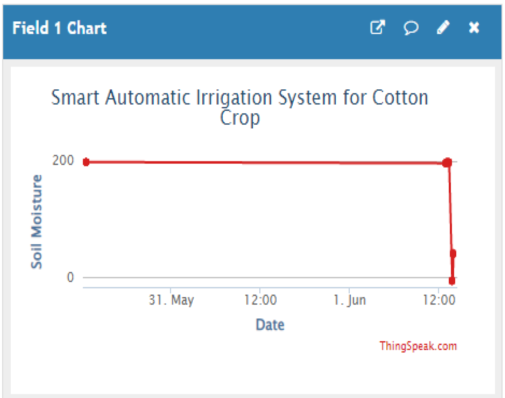
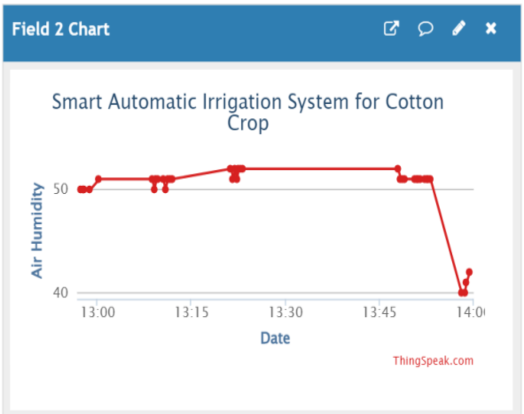
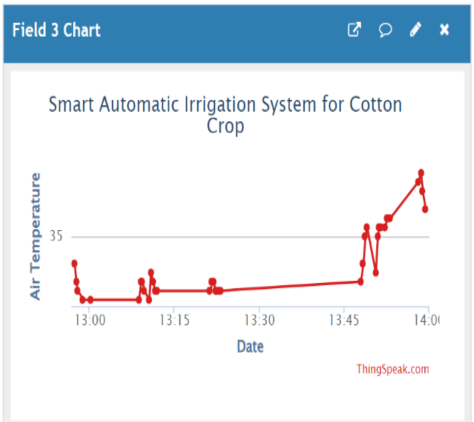
A. *Soil moisture output:*



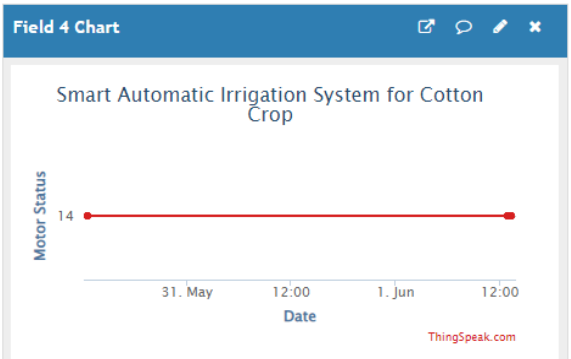
B. *Air Humidity output:*



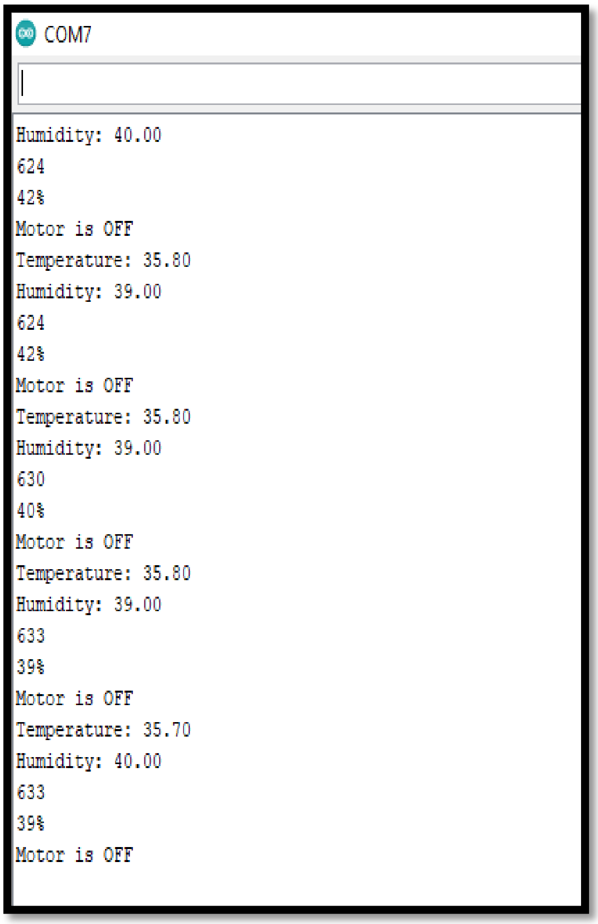
C. *Air temperature output:*



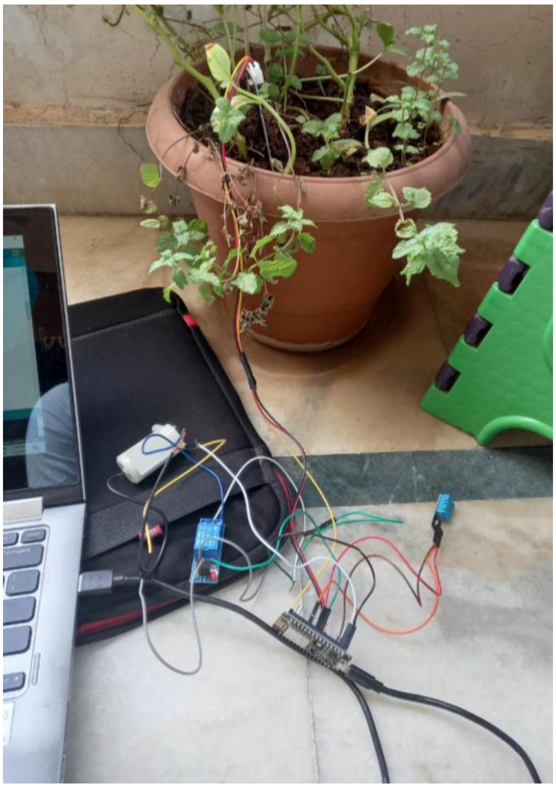
D. *Motor status:*



E. *Serial monitor output screen:*



The graphical representations shown above show the real-time air temperature, humidity, and soil moisture content that have been gathered from the sensor and communicated to the ThingSpeak server on the web for soil moisture content monitoring. The output screenshots you see above were taken across a variety of times.



VI. CONCLUSION

Currently, farmers control irrigation method manually and irrigate their area at a systematic time. These mechanisms deplete high amount of water and the outcome is water loss. While dry areas have less rainfall and irrigation is challenging. Therefore, ESP8266 Wi-Fi based communication system has been taken because of the ease of application, maintenance and price. The device is automated that will correctly monitor and control the water requirement and reliable. The communication through the websites authorizes the user to interact with sensors from anywhere in the world in nanoseconds which is fruitful for the user.

VII. FUTURE SCOPE

This research is limited to a single crop; future improvements can be achieved by using machine learning algorithms to identify the crop type and automate irrigation for that crop, as well as by applying this to several crops.

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