IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

SMART IRRIGATION SYSTEM USING IOT

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Abstract: India is the second-largest irrigated country, but only one-third of the area is irrigated. It is due to uncertain rainfall and lack of water. Most of the areas need canals to be built for irrigation without being depending on the rainfall. The utilization of water is very important for irrigation. The implementation of IoT agriculture starts with intelligent irrigation for the majority of fields. Optimizing the water schedule and quantity of water helps us to save water, money, and have the best crop on the field. Sensor-based IoT technology gathers soil moisture, temperature, humidity data, and transmits this information to farm irrigation systems from sensors. A platform responds to these signals and the drip irrigation switches on as soon as there is insufficient water in the soil. The proposed system uses sensors like a soil moisture sensor, temperature, and humidity sensor. The microcontroller is used to send data to Blynk and Thing Speak, Blynk application is used to monitor the data, and Thing Speak cloud is used to store the data. This system provides a feasible monitoring platform and automates the irrigation process. This leads to a transition from traditional farming to modern farming.

Index Terms **- IoT, Automation, NodeMCU ESP8266, WiFi, DHT11, Thing Speak.**

I. INTRODUCTION

India is the second-biggest nation with irrigation, yet barely a third of its land is covered by irrigation. It is a result of the erratic rains and water shortage. The main portion of India's population depends mostly on agriculture, which also contributes significantly to the country's economy. However, India's agro sector must still develop and promote technological engagement and usability. Although the Indian government has also made a few efforts to provide farmers with internet and mobile messaging services connected to agricultural queries and agro-vendor information. According to the survey, agriculture provides 27% of the GDP and employs 70% of the Indian population. The majority of the places require the construction of canals so that irrigation can be done without relying on rainfall. The efficient use of water is crucial for irrigation. For the majority of farms, the adoption of IoT agriculture begins with intelligent irrigation. We can save water, and money, and have the best crop on the field by optimizing the water schedule and quantity. Sensor-based IoT technology collects soil moisture, temperature, and humidity data and sends it from sensors to agricultural irrigation systems.

The Internet of Things (IoT) is transforming the agricultural industry and enabling farmers to combat the enormous challenges they face. Agriculture must overcome increasing water scarcity and limited land availability while satisfying the world's growing consumption needs. These problems are being addressed by new cutting-edge IoT applications, which are also improving the quantity, quality, sustainability, and cost-effectiveness of agricultural produce. The foundation of the Indian economy is agriculture.

As the world's population is expanding quickly today, agriculture is becoming more crucial to supplying the demands of the human race. Agriculture does, however, require irrigation, and since we use more water each year than we do for precipitation, growers must develop ways to do so while still getting the best output possible. As data from the sensors is received by the central processing unit's communication device and conveyed to the user's device, it will also contain a communication device. A higher-level communication tool, such as a Wi-Fi module, will be used for this. The core module transforms the processed data into meaningful data that is then transmitted to the user. A portable device, like a cell phone or tablet, can be used by the user to examine the data. These days, farming is really concerned about water scarcity.

Using an automated irrigation system that is dependent on soil moisture, this initiative assists farmers in efficiently irrigating their farms. Temperature, moisture, and humidity data are continually recorded using sensors, and these readings are sent to the designated IP address. The data from that allocated IP address is continually collected by the Thing Speak cloud. The relay, which is coupled to the ESP8266 microprocessor, regulates the automation of the irrigation system using an IoT 79 motor if the soil moisture levels go beyond a specific limit.

II. LITERATURE SURVEY

Many academics discovered that the agricultural sector and its output are declining daily after doing comprehensive studies in the field. Using various technologies in agriculture allows us to both enhance output and decrease labour-intensive physical labour.

This article demonstrates IOT and automation technology applied in the agricultural industry.

2.1Research Papers

Chandan kumar Sahu proposed a system on A Low Cost Smart Irrigation Control System. The agricultural field is equipped with a number of wireless sensors positioned in various directions. The ATMEGA318 microcontroller, which is on the ARDUINO-UNO development board, receives data from each sensor through an inbuilt wireless networking device. The Raspberry Pi is used to transmit various forms of data, including text messages and graphics, to the microcontroller process via internet connectivity [1]

The main objective of this project is to determine how a person can use the automatic irrigation system of his own moderately economical facilities in a few hours to connect some electronic components and other materials. . An automatic irrigation system based on sensor-based systems has been designed and implemented as one of the most widely used and advantageous automatic systems [2]

Joauin Gutierrez attempted a paper that conducts research on an automated irrigation system that substitutes a wireless sensor network and GPRS module for the Raspberry Pi [3].

A database is kept as a backup that contains information on the temperature, water level, and soil moisture. With full control over the crop's growth, this will enable us to harvest various types of produce in accordance with the varied weather circumstances.[4]

Karan Kansara proposed Sensor based automatic irrigation system with IoT, in this irrigation system, a rain gun pipe is employed, with one end attached to the water pump and the other to the plant's root. It just employs a soil moisture sensor and does not distribute water in the manner of a sprinkler or a natural downpour [5].

We must first determine how much water or moisture there is in the soil in order to guarantee the precise amount of moisture in the sand and to satisfy the need for water in the soil. We have soil moisture sensors that were utilised by the researchers in earlier investigations to accomplish this. The secret to increasing agricultural output and water conservation is effective soil moisture management through irrigation. Each soil moisture sensor has a range of moisture in the soil or agricultural land that it can detect up to[6]

In order to combat water shortages and unpredictable rainfall, which present serious obstacles to agricultural output, the research study focuses on the adoption of IoT-based intelligent irrigation systems in India. The article offers a thorough overview of IoT technology in agriculture, intelligent irrigation system design and execution, and the advantages and effects of IoT-enabled irrigation. It goes into more detail on the change from conventional farming to modern farming.

III. PROPOSED SYSTEM

The soil moisture sensors used in this experiment are buried with their probes. Depending on the kind of soil and the crops being cultivated, the soil moisture sensor is calibrated to a certain level. For crops that require regular watering with little amounts of water, this project is helpful. The sensor measures the soil moisture every time between measurements. The NodeMCU or the Wi-Fi module is then informed of the sensor's value. The sensor readings are compared to the preset value of reading since this functions like an Arduino but may be connected to Wi-Fi. A directive to shut down the motor pump is delivered if the soil moisture sensor's reading matches the predetermined value. The same precise information about the soil moisture level at that specific time and date is transmitted to the NodeMCU's associated Thing Speak Cloud. Typically, the motor pump is off. Then, after a certain amount of time, the moisture is examined. The NodeMCU instructs the motor pump to open if the soil moisture level is lower. The drip irrigation system begins to drip water to the roots as soon as the motor pump is turned on. Water is allowed for 30 minutes, then after 30 minutes, it is not allowed. The NodeMCU is sent a second check of the moisture level. The procedure is then repeated one more. The goal of this initiative is to provide farmers who are away from their fields the opportunity to monitor their plants and water use.

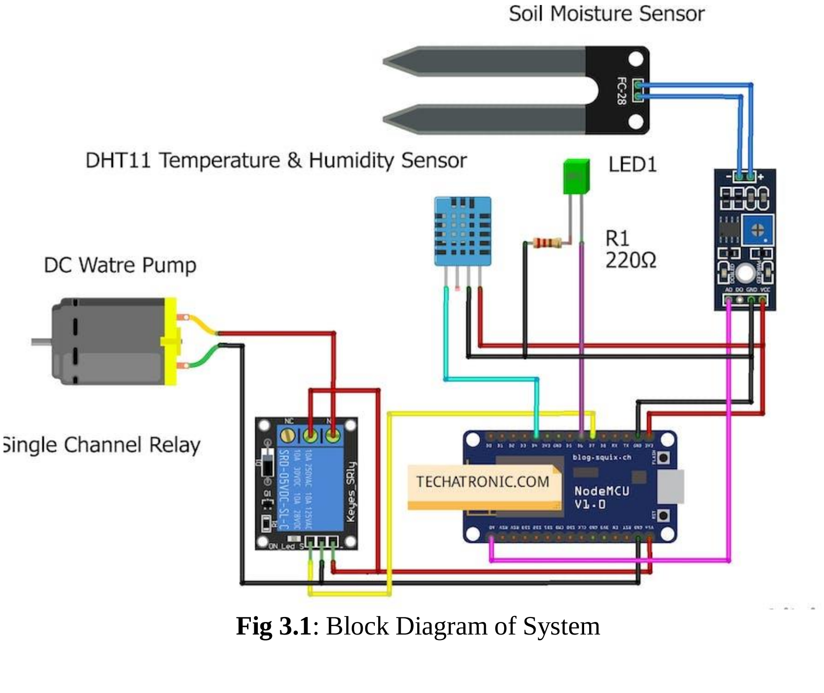


Fig 3.1: Block Diagram of System

Automation and Irrigation System: After receiving control through a web application or mobile application, the irrigation system was automated. By employing an Arduino microcontroller and relays, online applications may control electrical switches. Relays can be used to regulate circuits that use low-power signals.

Data Processing and Decision Making: The purpose of data processing is to compare the threshold values already established with the different sensor data that was received from the field. If the soil moisture reading drops below the threshold, the motor will automatically turn ON, and vice versa. Using a smartphone application, the farmer may even turn on the motor from their phone.

Thing Speak Cloud: The web application will be created to allow field and crop monitoring from any location with an internet connection. The website may interface with the Arduino processing IDE via the processing IDE.

Wireless Data Transmission: Using wireless transmission (ESP8266's WIFI module), the web server receives the sensor data.

Sensor Data Acquisition: The sensor uses a DHT11 temperature, humidity, soil moisture, and rain detection sensor to communicate with an Arduino Uno board.

IV. HARDWARE COMPONENTS AND SOFTWARE

The primary information needed for this project, in order to meet its objectives and needs, is the amount of moisture present in that particular soil, together with the temperature and humidity of the surrounding air. Based on these two variables, our system will respond as necessary. Therefore, the following hardware components are required for the project.

- **Soil Moisture Sensor**: The precise moisture content of the soil is provided by a soil moisture sensor. The sensor may output in both analogue and digital formats. The analogue output threshold can be changed, however the digital output is fixed. It operates on the open- and short-circuit principle. The motor will automatically start if the moisture content is less than 40%. The motor will automatically shut off if the moisture level exceeds that. The amount of water in the soil is essentially measured by its moisture content. Using soil moisture conducting probes that serve as a probe, this may be detected.

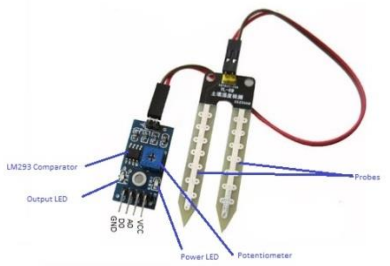


Fig 4.1: Soil moisture sensor

- **Temperature and Humidity Sensor:** A basic, extremely affordable digital temperature and humidity sensor is the DHT11. It measures the humidity and temperature of the air around it using a thermistor and a capacitive humidity sensor, and it outputs a digital signal on the data port without the requirement for analogue input pins. Initially The actual temperature and humidity in that location will be shown as soon as the board is turned on. Thus, this sensor aids in measuring both humidity and temperature.

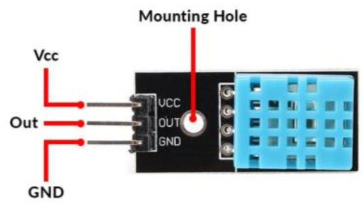


Fig 4.2: Temperature & Humidity sensor(DHT 11)

- **Communication Wi-Fi Module**: A self-contained SOC with an integrated TCP/IP protocol stack, the ESP8266 Wi-Fi Module enables any microcontroller to connect to your Wi-Fi network. The ESP8266 is capable of offloading all Wi-Fi networking tasks from another application processor or hosting an application. Data will be collected by the ESP 8266 and sent to the Thing Speak Cloud by the soil moisture sensor and the DHT 11 sensor.

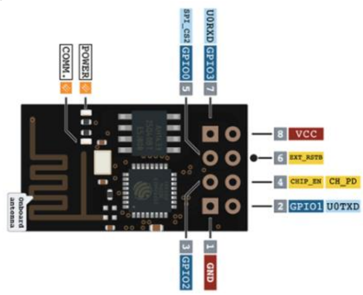


Fig 4.3: Wi-Fi module (ESP8266)

- **Relay Module:** The electro-mechanical component known as a relay serves as a switch in some situations. A separate low-power signal from a microcontroller activates the electromagnet. In order to open or close contact switches, DC is used to energise the relay coil. Typically, a single-channel 5V relay module consists of a coil and two contacts, such as no, and NC stands for typically open and closed, respectively.

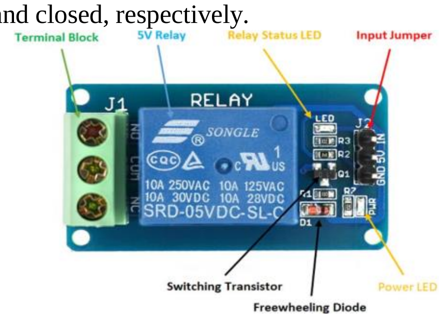


Fig 4.4: Relay Module

- **Water Pump:** A submersible pump, also known as a sub pump or electric submersible pump, has a hermetically sealed motor that is tightly connected to the pump body (figure 3.8). The entire assembly is dipped in the liquid that has to be pumped. This kind of pump's key benefit is that it avoids pump cavitations, a problem brought on by a significant elevation difference between the pump and the fluid surface. Little DC Unlike jet pumps, which must drag fluid to the surface, submersible water pumps push fluid to the surface.

Fig 4.5: Water Pump

- **Thing Speak Cloud:** Thing Speak is an open-source Internet of Things (IoT) application and API, according to its creators, that allows users to save and receive data from objects using the HTTP protocol through a local area network or the Internet. The development of sensor recording apps, location tracking applications, and a social network of objects with status updates are all made possible by Thing Speak. The IoT application support service Thing Speak was first introduced by ioBridge in 2010. The mathematical computer programme MATLAB from MathWorks is integrated with Thing Speak, enabling users to analyse and visualise submitted data using Matlab without having to buy a Matlab licence from MathWorks.

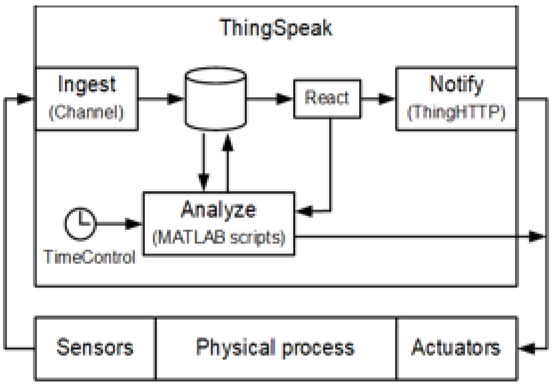
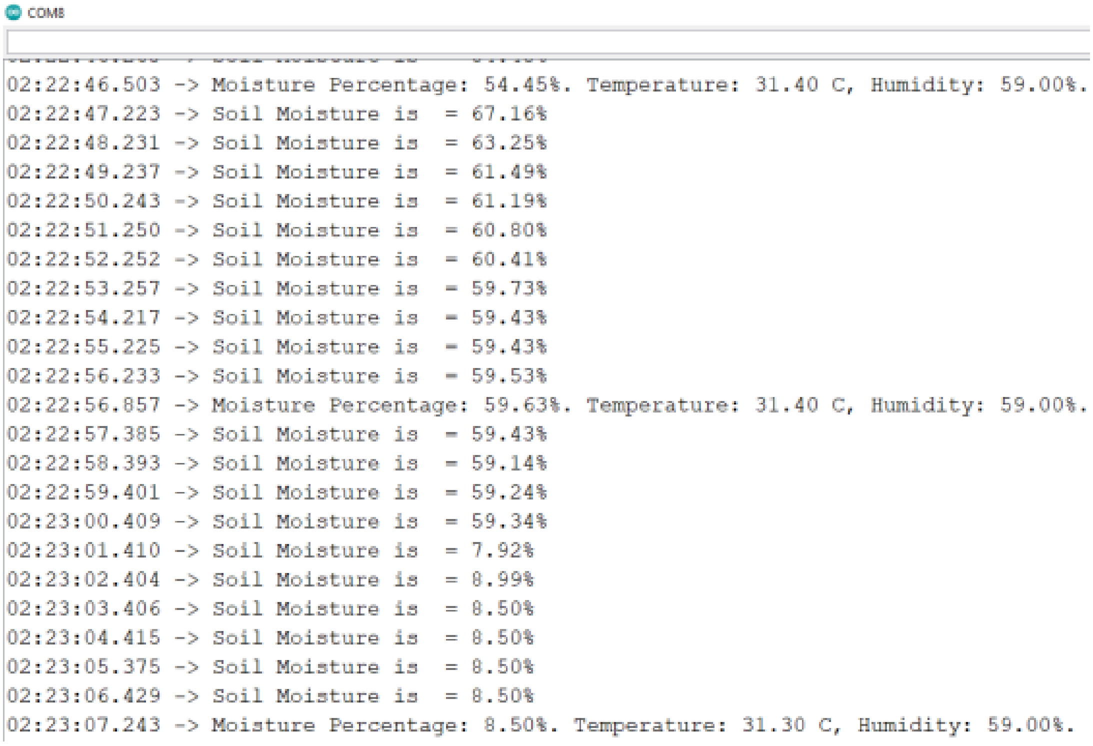


Fig 4.6: ThingSpeak Cloud DataFlow

V. RESULTS

The major goal of our research is to use moisture data and environmental conditions for various crops to maintain the water level in that specific area of land. After connecting all of the components with jumper wires and a breadboard, the programme from the Arduino IDE is now built and transferred using a data cable to the ESP 8266 Wi-Fi module. after the upload of the programme is complete. We first determine if the system is operational or not, and the Arduino IDE's serial monitor provides this assurance. For that, we used the "isnan" function in the "void loop()" method to assign one condition. Once our system is operational, serial monitors display the temperature, humidity, and moisture levels.



```
COM8
02:22:46.503 -> Moisture Percentage: 54.45%. Temperature: 31.40 C, Humidity: 59.00%.
02:22:47.223 -> Soil Moisture is  = 67.16%
02:22:48.231 -> Soil Moisture is  = 63.25%
02:22:49.237 -> Soil Moisture is  = 61.49%
02:22:50.243 -> Soil Moisture is  = 61.19%
02:22:51.250 -> Soil Moisture is  = 60.80%
02:22:52.252 -> Soil Moisture is  = 60.41%
02:22:53.257 -> Soil Moisture is  = 59.73%
02:22:54.217 -> Soil Moisture is  = 59.43%
02:22:55.225 -> Soil Moisture is  = 59.43%
02:22:56.233 -> Soil Moisture is  = 59.53%
02:22:56.857 -> Moisture Percentage: 59.63%. Temperature: 31.40 C, Humidity: 59.00%.
02:22:57.385 -> Soil Moisture is  = 59.43%
02:22:58.393 -> Soil Moisture is  = 59.14%
02:22:59.401 -> Soil Moisture is  = 59.24%
02:23:00.409 -> Soil Moisture is  = 59.34%
02:23:01.410 -> Soil Moisture is  = 7.92%
02:23:02.404 -> Soil Moisture is  = 8.99%
02:23:03.406 -> Soil Moisture is  = 8.50%
02:23:04.415 -> Soil Moisture is  = 8.50%
02:23:05.375 -> Soil Moisture is  = 8.50%
02:23:06.429 -> Soil Moisture is  = 8.50%
02:23:07.243 -> Moisture Percentage: 8.50%. Temperature: 31.30 C, Humidity: 59.00%.
```

Fig 5.1: Serial Monitor Data

If the moisture level of the soil is below the specified level, the water pump will start and water will be applied to that soil or land. The moisture sensor reads data from its two probes put into soil samples. After that, when we reach the appropriate amount of moisture, the water pump turns off automatically. We receive information on the surrounding area's temperature and humidity simultaneously. The serial monitor also shows that information. Moisture Level, Temperature, and Humidity data are delivered to the Thing Speak Cloud every 10 seconds. Data transferred to the cloud is shown graphically and includes the date and time.

Fig 5.2: ThingSpeak Cloud Data

VI. CONCLUSION

Thing Speak API is keeping an eye on the farming sector. The ESP8266 is the device at the field end that receives messages from the Thing Speak API network, manipulates them, and carries out the specified function. The messages will then be sent to the Thing Speak API network and published to the Client (user end) as a result. The most effective hardware for IoT applications is the ESP8266 because it has enough GPIO pins to be used, is tiny, compact, lightweight, easily programmed, and can be installed.

In order to maximize the use of water resources for agricultural output, the smart irrigation system is therefore practical and affordable. This kind of irrigation system makes it possible to cultivate in dry areas, enhancing sustainability.

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