Performance and Analysis of Smart Irrigation System Using Internet of Things

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***Abstract*— This study provides novel recommendations for improving irrigation effectiveness. The final product featured an ESP8266 Node MCU, moisture sensors, a relay system, and a submersible water pump. The Node MCU ESP8266 system will determine how much water to supply based on inputs from two moisture sensors that measure soil dryness at separate locations across the field. This system will continue to collect data from the sensors until there is a enough amount of moisture in the soil, at which point it will immediately shut off the pump. This inexpensive form of irrigation will lessen the burden on farmers, save them time, and boost their efficiency. In greenhouse operations, watering is the most time-consuming and consequential cultural practice performed daily. The task of watering plants while they're parched is made easier with the help of an automated watering system. Knowing when to water and how much water to use are two crucial aspects of irrigation. The purpose of the automated plant watering system was to reduce the complexity of gardening. Sprinklers, tubes, nozzles, and other devices are just some of the equipment used in automatic irrigation systems. A Node MCU ESP8266 board is used in this setup. It's set up to monitor the humidity of the plants and water them as needed.**

***Index Terms*—ESP8266 Node MCU, Sensor, Relay System.**

I. INTRODUCTION (HEADING 1)

The Decent Irrigation System is a computerized and efficient water delivery for agricultural areas that was developed as a student project in agricultural electronics. Several types of sensors, controllers, and actuators are required to monitor soil moisture levels and adjust irrigation accordingly. Farmers may save both time and money thanks to the system's intuitive and cost-effective design and ensure that their crops receive adequate watering. Due to rising demand and dwindling supplies, rapid advancements in food production technologies are essential. This phenomenon manifests itself only in agricultural settings. This is fundamental to human societies and contributes significantly to the ever-increasing demand for food production. Agriculture has a crucial role in the economy and prosperity of countries like India. Since there are fewer springs and less water naturally occurring on the land, landlords have found that they may profit from irrigation. Irrigation is the practice of artificially supplying water to soil or land, typically for the purpose of watering plants.

This cutting-edge technology can be used for routine plant care in both tiny and massive settings. Watering the plants twice a day, in the wee hours of the morning and the evening, is often necessary. Therefore, it is suggested to set the microcontroller to water the fragile plants in the greenhouse twice a day. However, many viewers have problems maintaining their health and staying alive. Ultimately, this robotic device is meant to help out University Park. The system's goal with this prototype is to allow people to cultivate plants without having to worry about things like forgetfulness or being away from home. Agriculture plays a vital role in India's development as a culturally and economically agrarian country. Our country's agriculture is overly reliant on the monsoons, resulting in insufficient irrigation. For agricultural lands, irrigation performs this function. Depending on the soil type, plants receive water through irrigation systems. In agriculture, it is helpful to establish information regarding the soil's fertility and the humidity content of the air. There are now alternatives to relying solely on rain for irrigation. Power and on/off timers are the primary drivers of this method. A gateway unit will monitor sensor data and relay it to the controller, which will then adjust the pump's water flow based on the conditions sensed by the plant and the module.

The Smart Irrigation System is tested to ensure the sensors, controllers, and actuators all work as intended, and that the system as a whole functions as expected. The system's ability to detect subtle changes in soil moisture, adjust irrigation accordingly, and respond to human control will be evaluated. Implementing the Smart Irrigation System in a farm field and monitoring its operation are examples of its field applications. This includes verifying not only the overall system's functionality, but also the accuracy of the sensors, controllers, and actuators. Testing for reliability and durability is also necessary to make sure the system can hold up in the harsh conditions of an agricultural setting. Monitoring the system is essential to ensuring it is operating as intended and yielding the anticipated outcomes.

II. LITERATURE REVIEW

In 2013, Awasthi, A., and Reddy, S. R. N. [1] investigated the utility of WSN in Indian agriculture. A multi-parameter monitoring system based on low-power ZigBee wireless communication technology is built with the sugarcane crop as its primary target.

By sensing a wide range of soil and weather conditions, Dahikar, S. S., and Rode, S. V. [2] offer an ANN-based modelling and crop prediction methodology for determining which crops will be the most productive. Soil properties in 2014 were measured for things like acidity, phosphorus, potassium, nitrogen, sulphur, manganese, copper, iron, depth, temperature, precipitation, and humidity.

A prototype model for automatically regulating irrigation water and water navigation was presented in 2015 by Pratik A.Patil et al. [3]. Essentially, it's a prototype that consists of a mobile phone, a controller node, an actuator node, a sensor node, and a communication node.

A smart irrigation system that is affordable for a middle-class farmer is proposed in a research paper by Chandan Kumar Sahu and Pramitee Behera [4]. The primary goal of this study is to automatically regulate the water motor and choose the pipe's water-flow direction based on the soil moisture level detected by a sensor. In 2015, users will be able to receive updates on motor operation and water field direction via text message and email.

A paper on smart irrigation systems is presented in 2015 by S. Darshna et al. [5]. They're looking for ways to save time spent on tasks like monitoring the situation constantly. It also aids in water conservation by delivering water to plants and gardens automatically in response to their individual needs.

In 2016, K K Namala et al. [6] offered a study on an intelligent and smart Irrigation system that could be utilised to regulate the watering of greenhouse crops like tomatoes and peppers.

In 2017, C. Devika et al. [7] published a study describing an automatic plant irrigation system that can determine whether or not irrigation is necessary based on the soil's moisture content.

In 2017, Srishti Rawal [8] presented her research on how automating farm tasks can change agriculture from a manual, static industry to one that is intelligent, dynamic, and conducive to greater output with less human oversight. The author suggests an automatic irrigation system that can measure soil moisture levels and water accordingly to keep them at an optimal level. The brains of the operation are microcontrollers programmed with the ATMEGA328P running on the Arduino Uno platform. analysis.

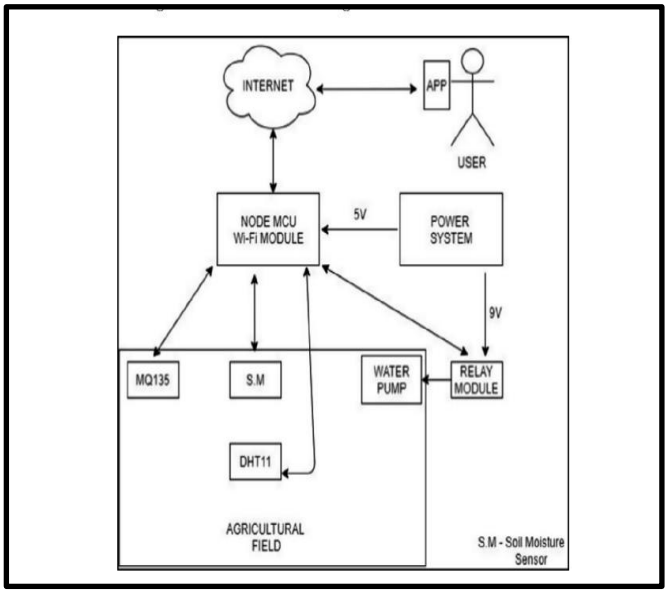
Using state-of-the-art tools like Arduino, IoT, and Wireless Sensor Network, Sushanth G. and Sujatha S. [9] propose a Smart Agriculture System for 2018. The purpose of this study is to use new methods of automation and Internet of Things (IoT) to agriculture.

III. PROPOSED METHODOLOGY

Block Diagram and Circuit Diagram of System

Connecting the NODEMCU board to various sensors and actuators allows you to create a smart irrigation system. Soil moisture, temperature, and humidity are only some of the sensor data that may be received by the board and then used to operate the actuators like pumps and valves. The board can also be used to regulate the watering schedule for the plants at predetermined intervals. A pump motor is an integral component of any high-tech watering system. It is used to transport water from a well, lake, or reservoir to the irrigation system for use. Usually, the pump is driven by an electric motor that is connected to a control system. The latter can be set to turn the pump on and off at certain intervals. In this way, the user can control the amount of water being delivered to the plants via the irrigation system. The pump's motor also allows the operator to keep tabs on water pressure in the irrigation system and adjust it as needed. Infrared sensors are rapidly gaining popularity in the agricultural industry due to their ability to provide accurate and timely data on crop health and soil conditions. Soil temperature, moisture, and other environmental conditions can be measured using these sensors, giving farmers more information with which to make informed decisions about their crops.

Infrared sensors can pick up the heat given off by plants and soil. This radiation is then used to assess soil and plant conditions such as temperature and moisture. This information can be utilised for diagnostic purposes and to determine the health of the soil and crops. If the temperature is too hot or too low, or if the soil is too dry or too moist, for example, infrared sensors can detect these conditions. This data can be used to make adjustments to the timing of fertilisation and irrigation, as well as to detect problems at an early stage.



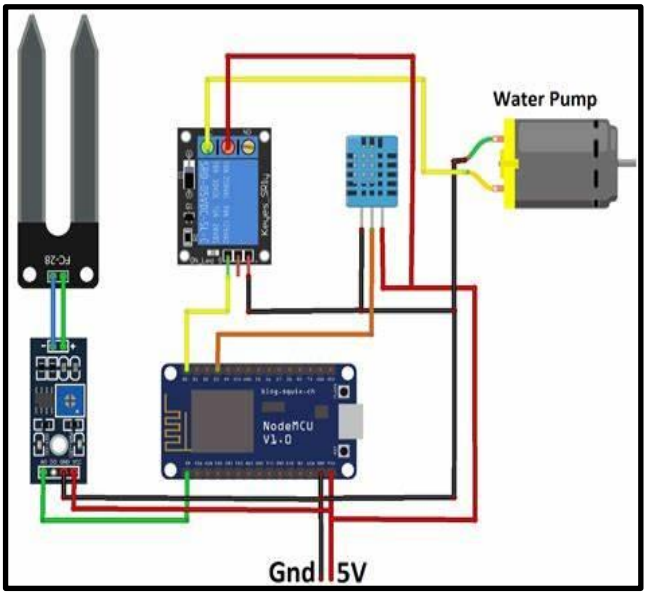


Fig. 3.1: Block diagram of smart irrigation system

Fig. 3.2: Circuit diagram of smart irrigation system

Sensors for temperature and humidity are essential components of any modern irrigation system. These sensors provide data to the system by taking readings of the ambient temperature and humidity. This information is used to determine the optimal watering schedule for the system's plants. The sensors allow for adjustments to be made to the irrigation system in reaction to changes in the environment, such as those in humidity or temperature. When the soil is too dry or too wet, the sensors can be utilised to adjust the watering schedule accordingly. This makes it simpler to provide plants with the correct amount of water. The sensors may also track ambient temperatures to adjust watering schedules accordingly. Because of this, the plants won't have to endure the extreme heat that could kill them. To keep an eye on and manage soil moisture levels, farmers and agriculturalists rely on soil moisture sensors. Soil moisture sensors can measure how much water is in the soil and how much water the soil can hold; with this information, farmers can optimize irrigation practices, boost crop yields, and cut down on water waste. Soil moisture sensors work by measuring the electrical resistance of the soil to determine how much water is in the soil. When the soil is wet, the electrical resistance is low, and when it is dry, the resistance is high.

The electrical resistance of the soil is measured by the sensor, and the resulting numerical value is utilised as a proxy for the soil's moisture content. The utilisation of ultraviolet (UV) light, a specific type of electromagnetic radiation, has a number of applications in farming. UV radiation has been used to increase crop yields, decrease pest infestations, and lengthen the shelf life of produce for quite some time. Recent advances in technology have allowed for more precise and efficient use of UV light in a variety of applications. This study will discuss the varied uses of ultraviolet (UV) radiation in agriculture, including its benefits and downsides.

IV. SOFTWARE USED

Software Design

Programming microcontrollers like the Arduino Uno requires the usage of a piece of open-source software known as the Arduino IDE. It is an outstanding instrument for the development of projects such as the college project on "smart irrigation system." Using the Arduino IDE, users are able to generate code in C/C++ and then upload it to the microcontroller. The code can be used to control a variety of components of the irrigation system, including the water pump, valves, and sensors, amongst others. Using the code, it is also possible to read data from the sensors, and the results may be seen displayed on an LCD panel. The code can also be used to govern the scheduling of the irrigation system, which enables it to be programmed to water the plants at specific times of the day or night. Users of the Arduino IDE have the ability to debug their own code, which makes it much easier to tackle any potential issues that may arise. The next step is to create a graphical user interface (GUI) for the irrigation system using the Arduino Integrated Development Environment (IDE). This will allow users to control the system using a computer or mobile device.

ThingSpeak

Gathering, visualizing, and analyzing real-time data streams in the cloud is made possible by a service offered by an Internet of Things analytics platform called ThingSpeak. The data that is transmitted from your devices to ThingSpeak is immediately visualized by the platform.

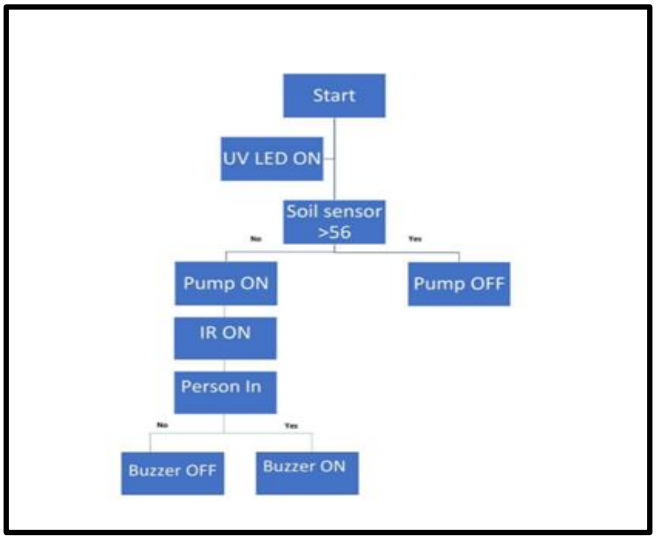


Fig. 3.3: Flowchart of smart irrigation system

Fig. 3.4: Prototype model of smart irrigation system

V. RESULTS

As we are aware, a soil moisture sensor can be used to estimate the amount of moisture that is currently present in a farm field, as is shown in figure 3.5. It has been determined that there is a moisture content of 94.94% in the soil, which places it in the range of 56% to 95%. It indicates that there is no requirement for us to start the motor. The temperature sensor that we have employed may be seen in Figure 3.6, which depicts the farm field chart 2 that monitors the temperature in the air. In the realm of agriculture, temperature is a significant aspect since it has an effect on the crops and can help determine the type of farming that should be done during a specific season or time period. Through the use of the Thingspeak application, it was discovered that the temperature in the atmosphere is 33%.

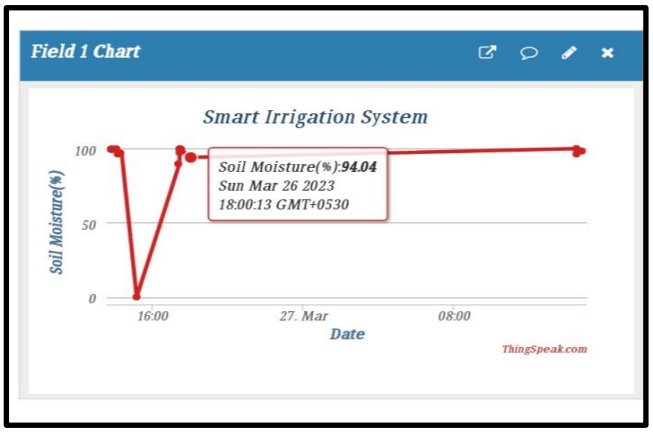


Fig. 3.5: Farm Field Chart 1

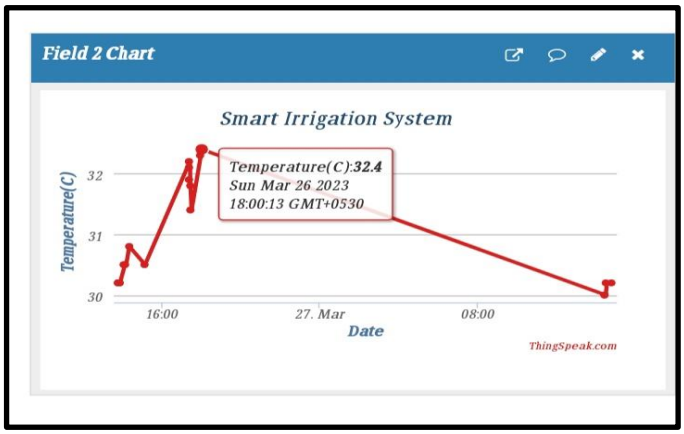


Fig. 3.6: Farm Field Chart 2

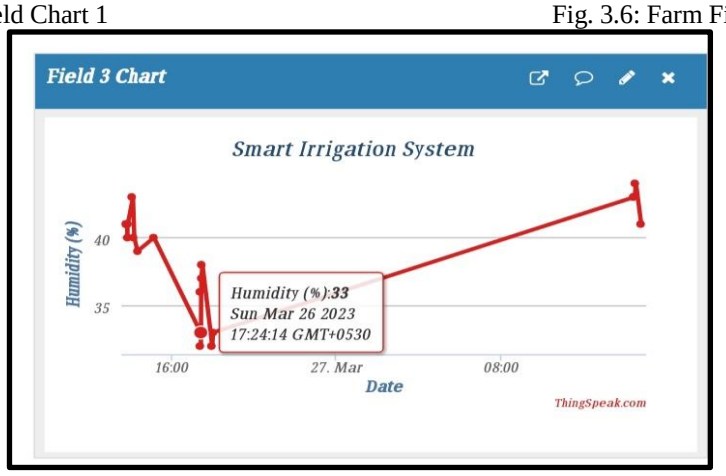


Fig. 3.7: Farm Field Chart 3

The farm field chart 3, which monitors the relative humidity in the air, is shown in Figure 3.7. To do this, we made use of a humidity sensor. In the realm of agriculture, humidity is a significant component since it has an effect on the crops and can help determine the type of farming that should be done during a specific season or time period. Using the application Thingspeak, it was discovered that the relative humidity of the atmosphere is 33%.

VI. CONCLUSION:

In comparison to other systems that are presently in use, the newly created system offers a number of benefits and is more cost-efficient. Because of its adaptability, this system can be beneficial in a diverse array of ecosystems, ranging from arid to humid environments. This solution is accessible and inexpensive to farmers that are interested in increasing their output via the use of automation technology. This project offered a good opportunity to learn more about existing systems, including their benefits and drawbacks, as well as the technique that will be used to track soil moisture. It is possible to turn on or turn off the sprinkler system by utilizing the way that has been suggested. In agriculture, irrigation is one of the most time-consuming processes, but it might be automated so that it occurs in reaction to changes in the moisture content of the soil.

One of the most significant users of water is the agricultural sector. The signals from the soil moisture sensors are used by the technology to calculate how much water should be applied to the crops. This prevents the crops from being over- or under-watered. The farmer may view step-by-step instructions for the process on the internet. According to the findings of this research, the incorporation of automation technology and the Internet of Things into agricultural production may offer significant advantages in the future. The fact that the technology makes better use of available water resources means that it has the potential to be an answer to the challenges presented by the traditional way of irrigation.

As a consequence of this, this effort has the potential to be of great assistance to all farmers who wish to make a contribution to the agriculture of the nation but are unable to do so owing to a lack of available labour or other commitments. Because this initiative has the capability of monitoring both the workers and the crops, it will be possible to prevent suffering losses as a result. After the

first installation, it does not need any maintenance and can be operated by anyone who has a smartphone because of how easy it is to use.

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