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Web-based smart irrigation system for Lemon plants

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ABSTRACT

The field of agriculture has been greatly enhanced by the advanced modern technologies. Integrating smart technologies and devices, the automation process is combined to drive devices to work autonomously and communicate, enabling them to perform a variety of tasks without the assistance of a human being. Thus, by incorporating some associated electronic devices and other useful tools frequently used in the field of IoT, this work provides an autonomous irrigation system based on smart sensors that can be used in a reasonable and economical way to monitor lemons or any type of plants. . . This system includes a temperature sensor, a water flow sensor connected to the water pump drive valve, and a soil moisture sensor located in the root zone of the plant.

Keywords: Arduino, GSM, Temperature and Humidity sensor, Soil moisture sensor, Rain sensor

I. INTRODUCTION

Internet of Things is referred to as IoT. It is a network of real-world items that have been outfitted with sensors, software, and other technologies in order to connect to other systems and devices over the internet and exchange data with them. Real-time IoT operates and is soon becoming a reality. Since everything is online and becoming increasingly intelligent, from smartphones to smart cars, IOT can be witnessed everywhere [1].

Using IoT technology, an automated agriculture system is created to monitor and maintain key farming components such as soil moisture sensors, humidity sensors, and temperature sensors. The sensors were positioned in the proper locations and positions to sense and transmit the details utilizing cloud computing to the farmers' cell phones [2].

Water scarcity is a significant issue that requires farmers to use IOT technologies to best utilize their water supplies. Through application-specific heterogeneous sensors, the IoT offers superior solutions. IoT-based irrigation control systems assist in reducing water usage in agricultural production via a variety of means [3].

Smart irrigation is a type of irrigation system that uses data collection and algorithmic analysis to maximize the efficiency of the water distribution process [4].

Every drop of water must be conserved; therefore, when a farmer forgets to turn off the motor, water is wasted. To solve this issue, modern technology like IOT has replaced the conventional method of autonomous irrigation. The motor is designed to operate automatically, and its operation is mostly based on the output of sensors such as moisture sensors, temperature sensors, and sensors that measure the moisture content of the soil, which are placed close to the plants [5].

This paper presents an automated irrigation system, which is a mechanism that enables the lemon plant to be irrigated without the need for human intervention. In addition to monitoring the weather conditions of the plant and making the appropriate decision.

The remaining portions of the essay are structured as follows: Section 2 describes conventional irrigation techniques. The Smart Irrigation System is discussed in Section 3. Section 4 provides an explanation of related works. The proposed system is described in Section 4. Section 6 explains applications and outcomes. The conclusion is found in Section 7. Section 8 serves as the paper's conclusion.

II. TRADITIONAL IRRAGATION SYSTEMS

A traditional irrigation system refers to an irrigation method that has been in use for a very long time, maybe even centuries. Compared to contemporary irrigation techniques, these approaches are frequently economical, convenient, and environmentally beneficial. It is a method of supplying water to the land by artificial means, such as canals, ditches, sprinklers, or drips. It is used for agriculture and landscaping purposes, especially in areas or times of low rainfall.

Traditional irrigation systems have been created using surface and groundwater, as well as rainwater harvesting and utilization.

Traditional irrigation systems have several advantages. They are the best method of irrigation for leveled fields, do not require any technical knowledge, and are more useful in soils with less infiltration. In addition, rainwater stays in basins; hence, soil erosion is not caused. Traditional irrigation systems require less economic investment, irrigate more area, and provide crops with sufficient water.

In addition to the advantages of traditional irrigation systems, there are several challenges that must be taken into account. For instance, as population grows, so does the need for water for home use, hydropower, industry, mining, recreation, tourism and culture, agriculture, cattle, and fisheries, among other things [6].

III. SMART IRRAIGATION SYSTEM

Smart irrigation is a system that collects and analyzes physicochemical and climatic data while also providing irrigation water to the soil. It is an intelligent system that uses sensors, actuators, water storage units, and nozzles to collect weather and soil moisture data, analyze this data, and control the discharge of irrigation water based on the information derived. Intelligent irrigation systems automatically adjust watering schedules and run times to accommodate various landscape needs and can significantly reduce water consumption and preserve the quality of green spaces. A smart irrigation system should be set up with five main features that are shown in Fig. 1.

A. Precision agriculture

To increase the sustainability of agricultural production, precision agriculture is a farming management method focused on watching, measuring temporal and spatial variability, and taking action. To maximize input returns while protecting resources, precision agriculture aims to create a decision-making tool for overall farm management [7].

B. Smart schedules

Irrigation scheduling is the decision of when and how much water to apply to the field and thus has a direct effect on water use efficiency [8].

C. Remote control

Remote control in smart irrigation refers to the ability to control an irrigation system remotely, often through a mobile device. Smart controllers reduce outdoor water use by monitoring and using information about site conditions (such as soil moisture, rain, wind, slope, soil, plant type, and more) and applying the right amount of water based on those factors [9].

D. Notification system

The mobile of farms can alert him when the soil needs watering. The farmer or homeowner then sends an SMS message to the controller to start irrigation. After receiving an SMS message from the microcontroller informing him that the soil is saturated with water, the farmer or homeowner sends another SMS message to stop irrigation [10].

F. weather and environment analytics

Smart irrigation systems can use weather and environmental data to improve irrigation efficiency. For example, an IoT-enabled wireless sensor network framework can be used to acquire real-time farm information through multi-point measurement. This can include sensors for soil moisture, soil temperature, environmental temperature, environmental humidity, CO2 levels, and daylight intensity. A crucial first step in achieving sustainability and precision in agriculture is smart weather data management. It serves as a crucial input for a number of processes, including crop development, yield, and irrigation planning [11].

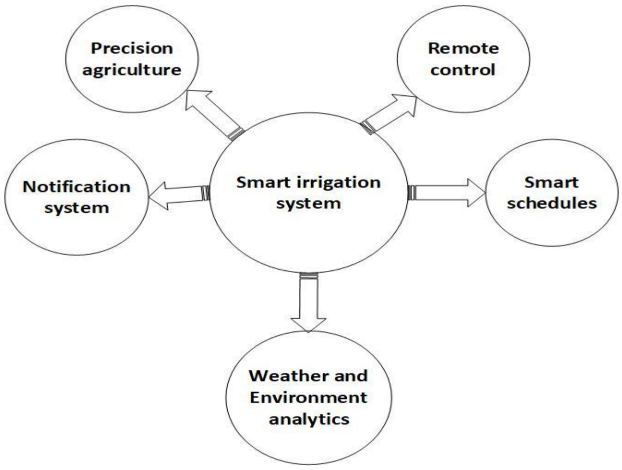

Fig.1. Smart Irraigation System [12]

IV. RELATED WORK

Kanderp Narayan Mishra et. al had stated A brand-new global network architecture called the Internet of Things (IoT) offers open services. These days, IoT-based applications are widely employed. A wireless sensor network connects the IoT devices, allowing them to communicate with one another. Since every gadget is connected to the internet, data may be transmitted between them at any time and from any location without the need for human interaction. The findings demonstrated the significance of IoT-based applications in all spheres of human endeavour. There are many different kinds of IoT-based applications where IoT strategies are crucial. Smart cities, connected cars, smart agriculture, connected buildings, industry, logistics, and other IoT-based applications are just a few examples [13].

Yemeserach Mekonnen et. al. had Proposed operate on distributed wireless sensor technology to schedule precise irrigation events by continuously monitoring and measuring several environmental factors including soil moisture and temperature. In order to reduce environmental impact and improve resource management decisions for things like water and electricity, the system also gathers current meteorological data. The users can obtain the information utilising an easy-to-use mobile application from the local and other databases where it has been collected. The smartphone app's purpose is to enable users to remotely view or interact with the farm infrastructure. In order to enable farmers and users to manage their farms, the complete system is built with design requirements to be power-efficient, cost-effective, and minimal maintenance [14].

T Setiaji et. al had stated IoT sensors may provide information on crop condition, smart agriculture is a new concept. IoT links agricultural equipment and gathers data. It can be used in many different contexts, including the connectivity of farms, smart environments, water management, measuring instruments, crop monitoring, and other agriculture automation systems. The linked devices have the ability to process aggregated data and deliver it to the monitoring center [15].

Xuebo Jin et .al. had declared The mobile Internet, cloud computing, and Internet of Things are all combined in the smart agriculture system. Massive time series can be acquired from a variety of sensor nodes and wireless communication networks, including environmental temperature , humidity and soil moisture [16].

Fariza Sabrina et .al A hypothetical IoT-based smart agriculture scenario is provided to explain how our model functions. Data about the environment is gathered by the sensors and sent to the IoT gateway. An intelligent controller in the cloud is interconnected with the IoT gateway. For real-time decision-making, the intelligent controller keeps an up-to-date data store. Real-time communication of the decisions enables opportunity for prompt and effective action. However, we want to emphasise that our system is adaptable to include data from any type and number of sensors, even though the scenario only illustrates two types of sensors [17].

Pratik Mohanty et. al. had proposed strong, economical, and ensuring it needs minimal maintenance. The Internet of Things is at the centre of the project, allowing for the storing of agricultural data in the cloud for eventual use in data analytics and pattern recognition for new improvements. All of the data that can be retrieved from the soil is acquired and transmitted via the sensor nodes. These data are given to the Sink node, which transforms them into IP packets that can be transmitted to the cloud. The spectral image is sent to the cloud on its own by the Multispectral Image Module. The data is processed by the cloud before being sent to the user. Through a smartphone application, the user can see the condition of the soil and crops [18].

A I Rokade et. al. had growing interest in proposed green homes for plant growth is a result of more affordable technology that enables farmers to resume output. The greenhouse is a transparent building that can control temperature, moisture, light infiltration, and other factors for the best possible growth of plants. A method for identifying, observing, and responding to environmental changes is known as precision agriculture. This method of greenhouse temperature detection recognises the data and uploads it to the cloud, after which the agriculturist takes the right action in accordance with the data. This may be seen in the cutting-edge technology known as the Internet of Things (IoT), which employs web-based methods to connect any device to the internet [19].

V. THE PROPOSED SYSTEM

In this proposed smart irrigation system using IOT, the crop is automatically watered by sensing the quantity of soil moisture. The data will be recorded using the sensors. Soil moisture, rain sensors and GSM Modem are connected to the Arduino. GSM modem will send the values of soil moisture, temperature, humidity and rain or not to the website. GSM modem will send the values of soil moisture, temperature, humidity and rain or not to the website.
The moisture content value is forwarded to the user's phone. Based on the content the user will turn on the pump On/Off .When the moisture content is lower than the threshold value, the motor is turned ON and it is turned off when the moisture content goes above the threshold value
When using this method, irrigation of fields occurs automatically. In fields, human intervention is not necessary. The farmer can cut labor costs as a result. By using this method, the fields receive the appropriate amount of water, minimizing the problems brought on by under- and over-irrigation. There is therefore no chance of crop failure.
An IoT system's fundamental building blocks are sensors, processors, and applications. The proposed model, which illustrates how these blocks are connected, is depicted in the block diagram of Fig.2. Microcontroller and sensors are connected, and cloud storage is used to display sensor data. The cloud gives users access to continuously collected data from sensors, enabling farmers to take appropriate action to meet the requirements of the soil moisture level.

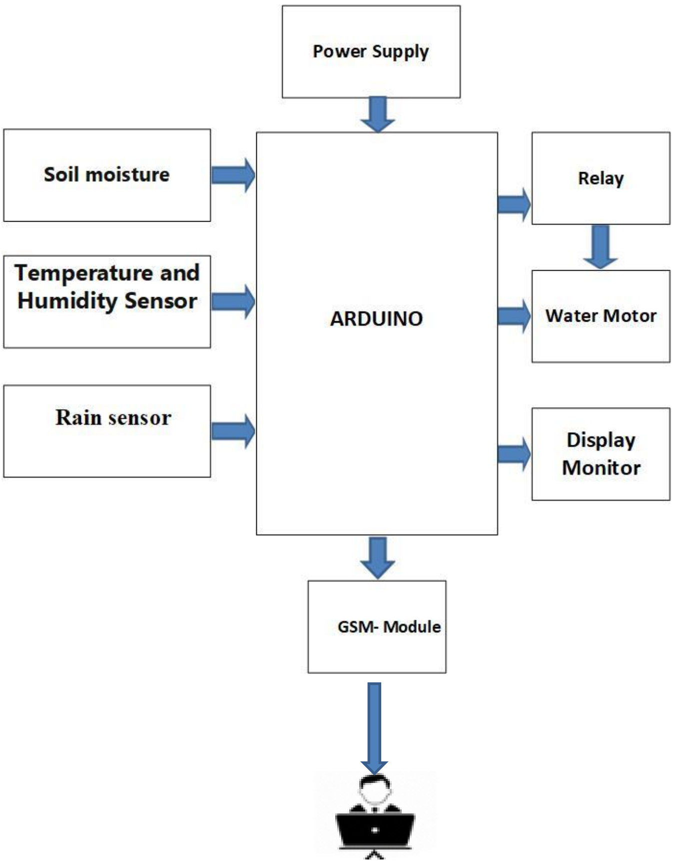

Fig.2.Block diagram of suggested system

Proposed system has three main stages:

1. Measurement of sensors.
2. Switch on relay for pumb motor
3. Sending and receiving notifications via web server and LCD Module. Figure (9) depicts the proposed system's flowchart.

The smart irrigation system circuit consists of eight components, as shown in Figure (10).

A. Arduino Uno

The ATmega328P is the core of the Arduino UNO microcontroller board. It has a USB port, a power jack, an ICSP header, a 16 MHz ceramic resonator, six analog inputs, fourteen There are six digital input/output pins that may be utilized as PWM outputs along with a reset button. all the components required to support the microcontroller is included; all you need to do to get started is connect it to a computer, an AC-to-DC adapter, or a battery via a USB cable.

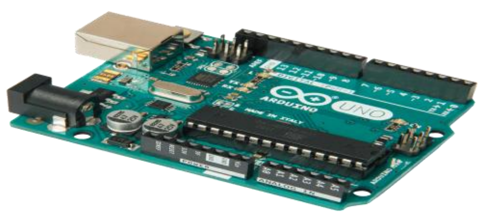

Fig.3. Arduino UNO

B. Temperature & Humidity

This module includes a DHT11 Temperature & Humidity Sensor. It features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability.

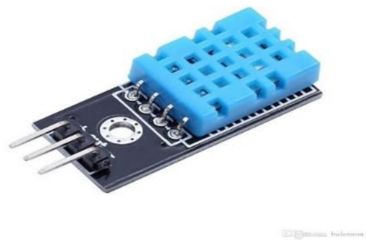

Fig.4. Temperature & Humidity

C. Soil moisture sensor

A soil moisture sensor can read the amount of moisture present in the soil surrounding it. It is ideal for monitoring garden, or your plant's water level

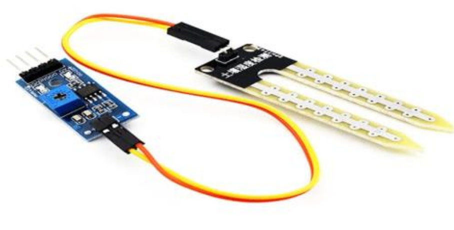

Fig.5. Soil moisture sensor

D. Rain sensor

is used for rain detection. It is also for measuring rainfall intensity. The module includes a rain board and a control board that is separate for more convenience.

Fig.6. Rain sensor

E. Pump motor

A water pump controlled by an Arduino microcontroller is a type of system that uses an Arduino to control the operation of a water pump. The Arduino can be used to turn the pump on and off, as well as to control the flow rate and direction of the water. This type of system can be used for various applications such as irrigation, water treatment, and industrial process control.

Fig.7. Pump motor

F. GSM Modem

It is an exceptional type of modem that perceives a SIM card and runs on an adaptable overseer enrollment, nearly equivalent to a cell phone.

Fig.8.GSM SIM800L Module

Fig.9. Implementation of the suggested system

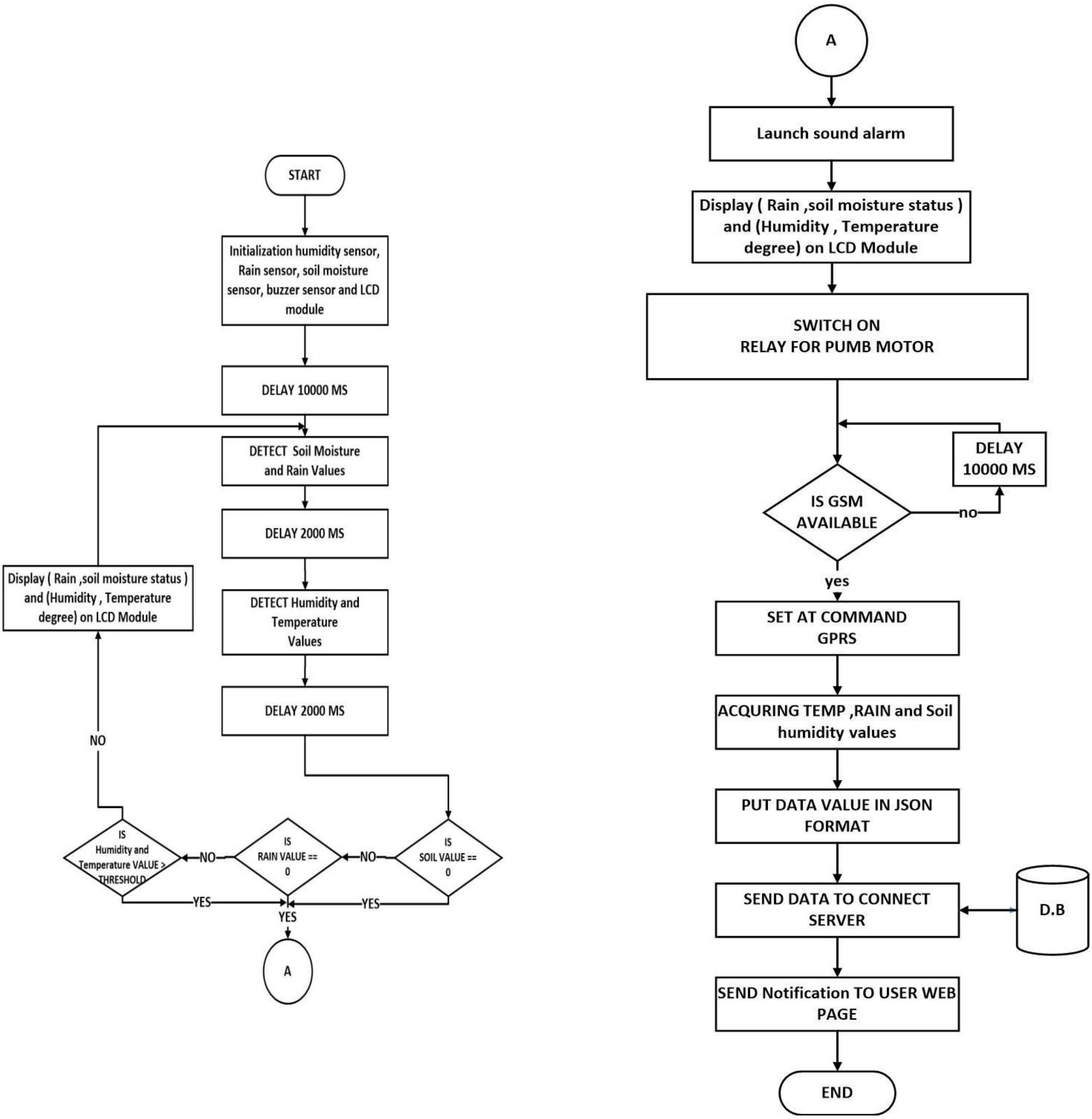

Fig.10.Flow chart of suggested system

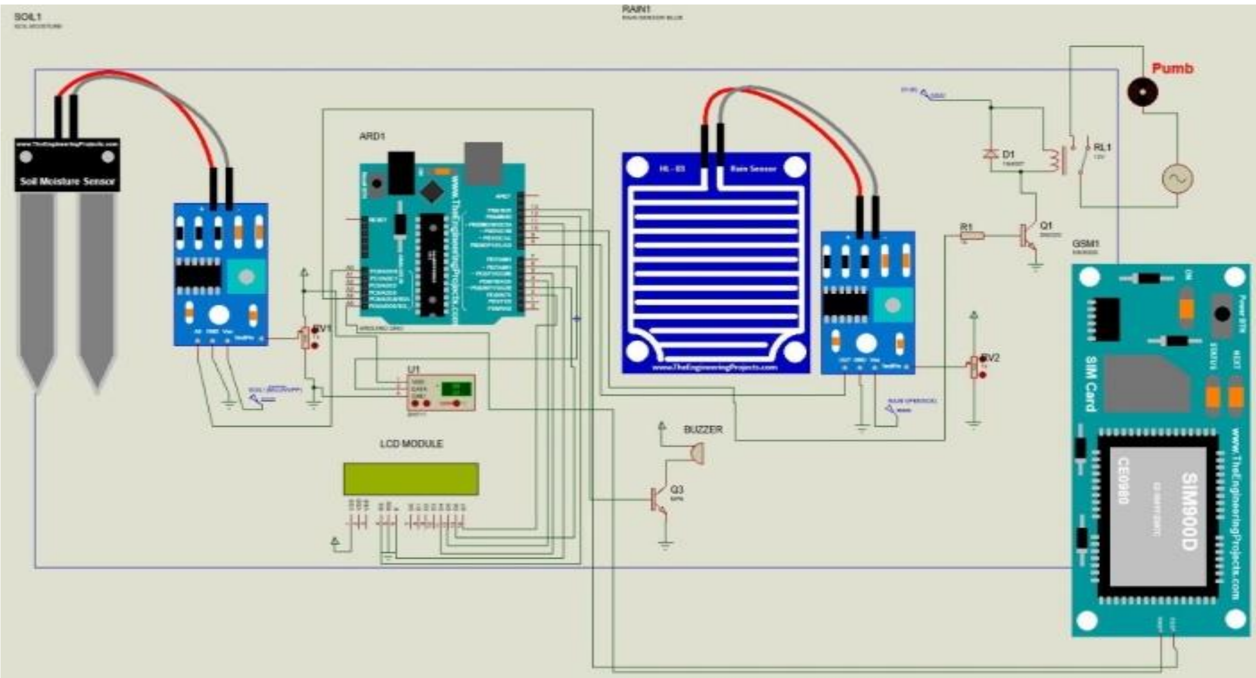

Fig.11.The Schematic for Smart Irragition System

Rules for turn on/ off the pump in the farm

According to Fig.11, the rules for opening the pump on/off the farm can be clarified as follows**.**

Rule

If soil moisture sensor value **==** 0

OR rain sensor value **==** 0

OR temperature, humidity sensor value > threshold

Sound Alarm

Switch on pump

send measure data to GSM to display GUI

ELSE

Switch off pump

Display measure data LCD Mmodule

End IF

VI. APPLICATIONS AND OUTCOMES

The primary objective of the suggested system will be to send the values recorded from temperature, humidity, soil moisture and rain sensors to the user's web page and based on the value of soil humidity the pump is turned on or off.

The tests listed in Table 1 are carried out to determine whether the suggested smart irrigation is effective. The table clearly shows that when the moisture level is lower, the motor is turned ON, and when the required moisture level is reached, the motor is turned OFF.

S. No.	Type of soil	Moisture content (%)	Pump ON/OFF
1	Wet soil	80	OFF
2	Partially Wet soil	50	ON
3	Dry soil	40	ON

Table1: Performance test on different soils.

To register a new user or login to the user page by e- mail and password , as shown in Figure (12).

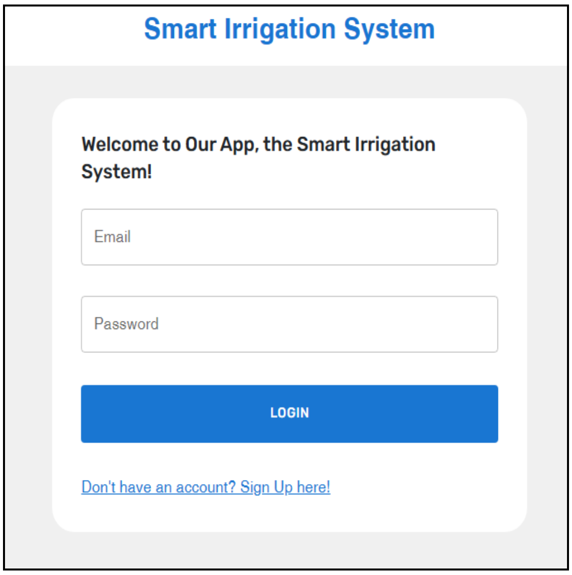

Fig.12. Start page to register a new user or login to the user page if you have already registered

After recording, the user's dashboard shows the values of humidity, Temperature, soil moisture, rain sensors and a chart for all values , as shown in Figure (13).

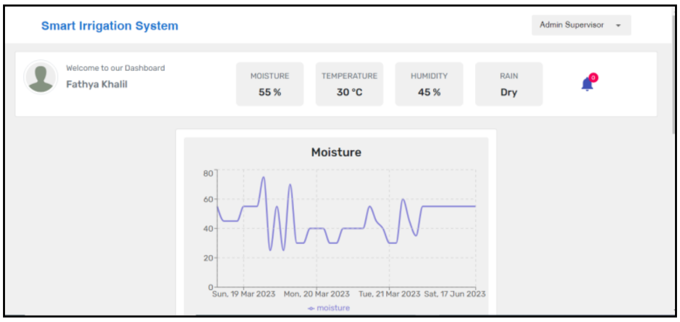

Fig.13. The user's dashboard

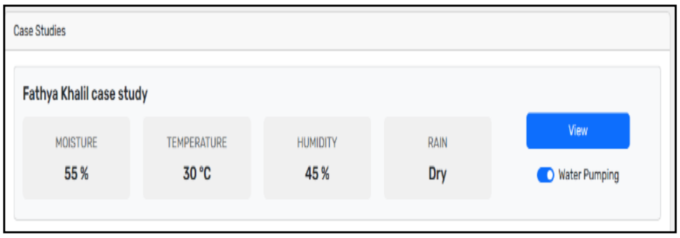

Fig.14. Control of water pumping

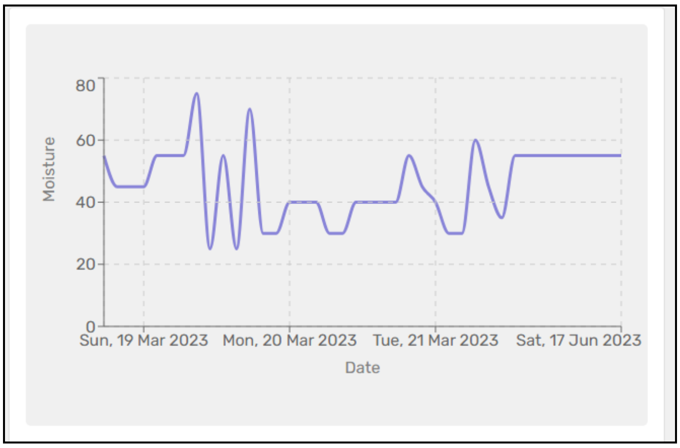

Fig.15. Graphic representation of soil moisture

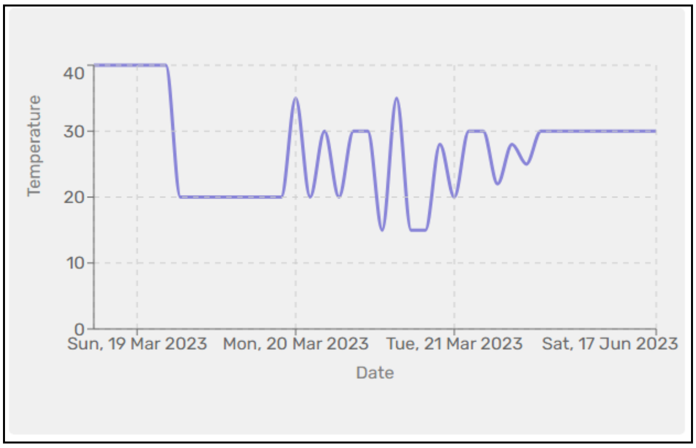

Fig.16. Graphic representation of Temperature

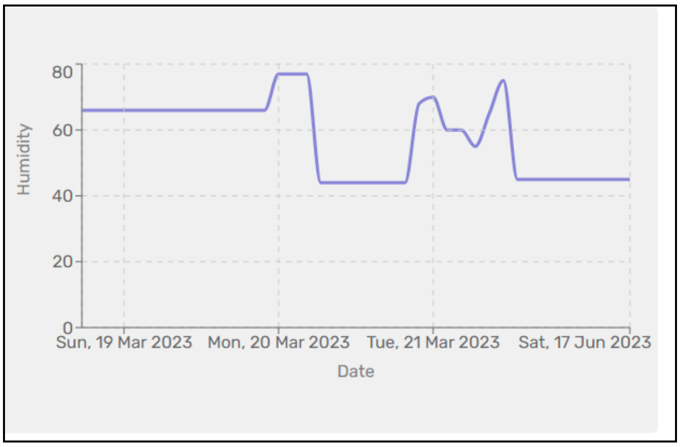

Fig.17. Graphic representation of Humidity

VII. CONCLUSION

In this paper, it was presented how IoT technology has been introduced into smart irrigation. By leveraging real-time data and analysis, these systems can help farmers improve water use. The pump can be automatically opened without interference from the human element .To irrigate when needed, thereby saving and not wasting water.

VIII .REFERENCES

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