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IOT Based Smart Agriculture for Precession Irrigation - A Model

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Abstract: The rapid development of Internet of Things (IoT) technology across all industries, from the automotive to home automation, had an impact on the agriculture sector as well, commonly known as "Smart Agriculture," which moved the entire sector from statistical to quantitative methods. These innovative ideas modify agriculture's current practises, open up new prospects, and help this industry overcome a number of obstacles. This study shows a system that makes use of the possibilities of these IoT and wireless sensing devices as well as the difficulties encountered when fusing these technologies for mutual benefit. This essay demonstrates how to use a smart agricultural application that allows users to monitor and modify soil moisture, temperature, and humidity.The capacity to remotely direct water flow anywhere the user pleases without being present in person. This is accomplished by using a soil moisture sensor that can measure soil moisture, a DHT 11 for measuring temperature and humidity, an Arduino to link the entire system together, and the IOT cloud as the system's database. Our only goal is to create an automated solution for remote gardening that is user-friendly.
Index Terms: Remote gardening, Soil moisture sensor, Arduino cloud, IOT

I. INTRODUCTION

The Internet of Things (IoT) is a technology that fosters communication between digital and physical objects by enhancing their Internet connectivity. Users and devices exchange the collected data, and it is also stored and controlled in the cloud. As IoT advances, new options to boost agricultural output and lessen obstacles to crop growth will become apparent. The monitoring of weather forecasts, soil temperature and humidity, soil moisture level, remote water valves, and pest management can all be connected with the IOT.

The farmers are then provided with the data gathered from these IOT devices and sensors via contemporary devices and the internet. anywhere soil moisture is an important factor, both small and vast fields.

The Internet of Things (IoT) is revolutionising the agricultural sector and resolving the enormous issues or significant difficulties that farmers currently encounter in the field. To solve the issues, we created a low-cost system for monitoring agriculture farms and gardens that continuously measures the amount of soil moisture in the plants and enables users to maintain the soil at a particular moisture level. There are numerous ways to measure the moisture content of soil, but resistive and capacitive sensors are the two that are most frequently employed. Since capacitive sensors are resistant to rusting in wet soil, we employed them to monitor the moisture content of the soil.

After calibrating our sensors, we utilise them toUtilising an Arduino and Node MCU, create a soil moisture metre. So that we could observe all the specific information about soil moisture and water the plant automatically, we designed an automated watering system that makes use of an Arduino and a node mcu and operates on the Arduino IoT Cloud. We will be able to use this to keep our soil at a particular moisture level and remotely monitor it using a desktop or mobile interface from anywhere.

There are many different types of vegetable gardens available today, but the bulk fall into one of three categories. The three types of vegetable gardens that are most frequently found are raised bed gardens, container gardens, and in-ground gardens. All types of gardens can use our method.

A device that can be buried in the soil is a soil moisture sensor.The output of the module is high when the soil is dry and low when the soil is moist; this sensor can be used to measure the moisture content of the soil. Our technology includes physical contact-free automatic watering of plants. Our product is incredibly precise and uncomplicated.

The same effort done in remote gardening is highlighted in Section II. The methods used in our proposed study is explained in Section III using flowcharts and circuit diagrams. The outcomes of the System are described in Section IV. The entire system is summarised in Section V, which also covers the system's potential future applications.

II. LITERATURE SURVEY

Understanding how soil moisture affects performance is essential. This study suggested a solution for tracking soil moisture utilising an Arduino Uno board and a DIY soil moisture sensor. The most notable aspect of this system is its ability to assess soil moisture along depth, which can be used to calculate when water will be supplied to reach crop roots, as stated in Matti Satish Kumar's work[1]. This enhances cost effectiveness and water resource management. examination of several moisture sensor types in comparison to various soil types. It uses commercially available soil moisture sensors, galvanised steel nails, gypsum blocks, and other sensors. Clay and sandy soil were used in the experiment. FatihabintiAbdullah[2] provides following analysis thatMany provide a technique that can gauge the soil's moisture content. A Teensy 2.0 micro-controller with a dual output tap timer is used by Ibrahim Al-Bahadly[3]. As a result, the plant will provide water anytime the soil's moisture content drops. The most crucial factor in a plant's growth is watering. Water should therefore be provided to plants when they need it, no matter the time of day.

DrashtiDivani[4] suggests employing sprinkler systems, pipelines, and a nozzle to create an autonomous plant watering system. An ATmega328 microcontroller is used to manage the entire system, and it is programmed so that it can sense the moisture level and water according to it. Using this method, water saving is thus attainable.The technique described by M. UshaRani[5] and G. Nisha[6] uses an Arduino cloud equipped with a grove moisture sensor and a water flow sensor to build a wireless sensor network. It uses the Zigbee protocol to communicate with the sensors, and a web site will display the system's current condition.

With the aid of GSM, notification of the water flow will also be transmitted to the user's phone. The strategy outlined by P. Divya Vani and K. Raghavendra Rao[7] calls for the creation of a system for tracking soil moisture levels combining IOT, mobile computing, and cloud computing.A soil moisture sensor is connected to the CC3200 launchpad, and data is stored in the AT&T M2X cloud technology. The user uses the blynk application on an Android phone to monitor the status anywhere and make prompt decisions.

We must use water extremely carefully in every part of our daily life as there are fewer and fewer water resources available. In order to decide on the optimal course of action, Nikhil Sukhdev[8] has tracked environmental variables such as soil humidity, temperature, and other aspects. They developed a mobile application with two buttons for manually managing the water: "ON" and "OFF." Additionally, there is software that periodically tests the components on their own. According to Mokh. SholihulHadi[9], the irrigation system for the garden is internet-connected, and not only can the water pump be operated remotely, but the soil moisture inside the garden is also monitored. Using an Internet of Things application, garden owners may measure and track the moisture levels in their plantings. As a result, real-time water usage management is effectively possible. When the soil moisture sensor detects low moisture levels, a water pump connected to the plant's water supply activates and rapidly sets the moisture parameter to the desired value. The owner of the garden can monitor the amount of moisture in the soil using a smartphone app. People expect automation to make things easy, enjoyable, quick, and efficient in the digital age. Our current system for supplying water to backyard gardens, farms, fields, etc. is being replaced by a smart automated system. In this system, which is positioned near the plant roots, professors Mitul Sheth and PinalRupani[10] use soil moisture sensor, temperature detectors, and humidity detectors. The system sends the identified values to the access point. The objective is to sync these values with the internet using WiFi to retrieve data. It notifies the user as soon as the water level falls below the specified point.

III. METHODOLOGY

Soil moisture sensors are used to gauge the soil's water content. Several soil moisture sensors make up a soil moisture probe. A capacitance sensor or another frequency domain sensor is a common form of commercially used soil moisture sensor. an alternate sensor that uses water's capabilities as a neutron moderator. We can determine the soil moisture by calculating the capacitance between two electrodes in the soil. In soils where free water constitutes the majority of the soil's moisture (such as sandy soils), the dielectric constant is directly proportional to the moisture content. The examination is frequently exposed to frequency stimulation in order to facilitate the measurement of the dielectric constant. Thus, our suggested system performed similarly.Initially, if the moisture reading fell below a predetermined threshold, water would immediately be pumped out of the pipe.

Sensors are used to measure temperature and humidity in order to determine whether the parameters are healthy for plants and within acceptable limits. Our IOT watering system was constructed using a node mcu esp8266. This allowed us to utilise an app to control our system over wifi. We employed a moisture sensor to determine the soil's moisture content, and we can turn on or off our motor based on this wetness. In reaction to one or more electrical parameters like voltage and current, we employed a relay to open or close the load connections. As a result, we are using this as a standalone. It directs us to start the motor when a particular circumstance takes place.

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We watered with a pump and measured the humidity and temperature with a DHT11 sensor.Control of the water pump was made possible by setting a starting threshold value for irrigation.When the sensors detect a moisture content below the threshold, the pump is activated and runs until the soil is completely saturated.

We are employing the esp8266 and Arduino for this implementation. For the actual implementation, especially for visualisation needs, and to turn on and off watering, we are using an Arduino board. We display the value of the current temperature and humidity on both the Arduino platform and the Blynk applications, from which we can control our watering application.If not, it immediately sends a report to the user, and if not again, the system ceases.

Use the MathType add-on (http://www.mathtype.com) or the Microsoft Equation Editor (Insert | Object | Create New | Microsoft Equation) if you're using Word to write equations in your article. The option "Float over text" shouldn't be chosen.

A. Circuit Diagram

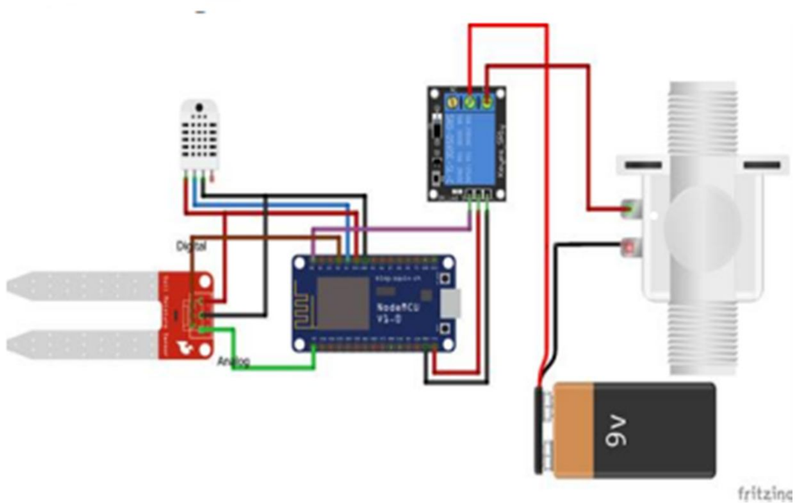

Fig . 1. This figure displays the circuit diagram of the required implemented system. The soil moisture sensor and DHT sensor collects data and transfers data to node mcu data. Node mcu compares with threshold value and then forwards data to the relay module so that it works according to the desired condition.

B. Flow Chart

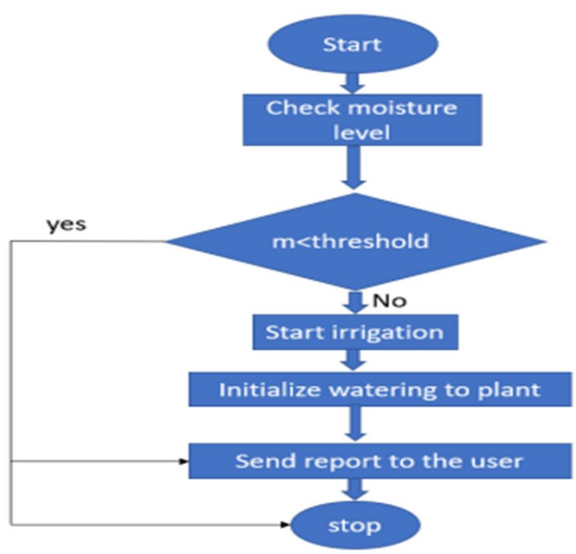

Fig .2 . Flowchart of Automated plant watering system

Figure 2. shows the flow diagram of the proposed system. First system starts with detecting the moisture level of soil. In this system we have given a threshold of 15. So if the soil moisture sensor detects the moisture level of soil lower than the threshold that we gave initially then it starts watering the plant and if not then it directly sends a report to the user and finally the system stops.

IV. RESULT AND DISCUSSION

To monitor the soil moisture of the plant and water it as necessary, the entire hardware and software setup has been completed. The system is possible to switch on and off manually or automatically thanks to the values collected from sensors. The watering of the garden can be observed remotely by a gardener. As a result, the technique helped create a smart landscape. We conducted a small-scale experiment by placing a moisture sensor in soil and observing the findings.OnBlynk, we develop the graphical user interface depicted in Figure 3.It displays three parameters: soil moisture, temperature, and soil humidity.Temperatureis displayed in degrees, and humidity is supplied as a number between 0 and 100. The soil moisture value was 92%, the temperatures were 27 degrees, andthe humidity level was 69%.Additionally, there is a button on the bottom that is used to turn the system on and off.Our solution displays the parameters on computers using IOT cloud and on Smartphones using the Blynk app. IOT cloud is a framework for virtualizing IOT devices and connecting them to the cloud as a database. Figure 4 displays a computerised image of an iot cloud with 34% moisture, a temperature of 22.1 degrees, and 30% humidity. Pump status displays the water pump's current status, which is on at the time.

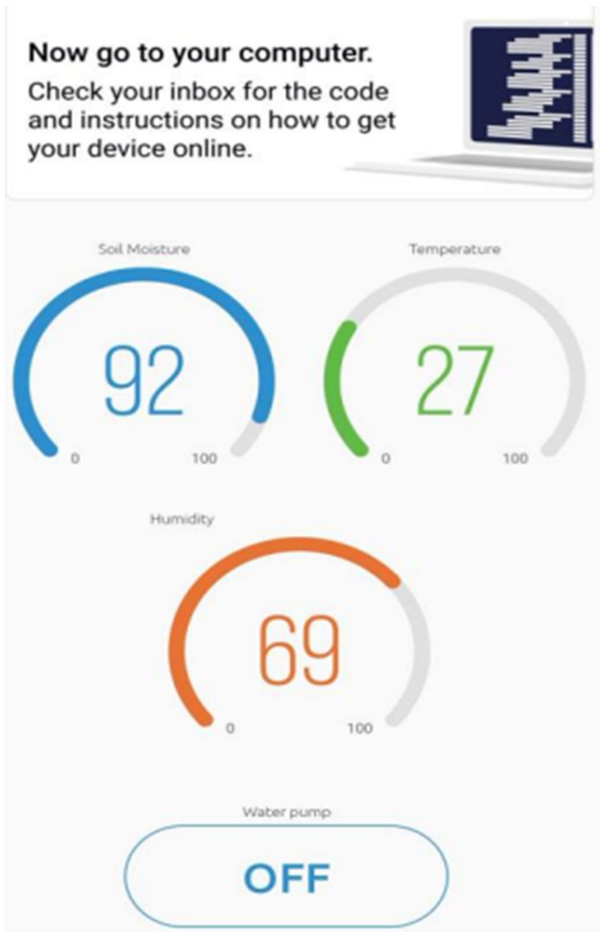

Fig. 3. Picture of reading

Our system shows the parameters on Smartphones using the blynk app as well on the computer using IOT cloud. IOT cloud is a platform for connecting IOT devices to the cloud as a database, also enabled with virtualization.The figure 4 shows image of iot cloud on computer which shows moisture of 34%,temperature of 22.1 degree and humidity of 30% and the pump status show current status of water pump which is on in current situation. We also check moisture levels for some days and display them in the form of a graph on screen.

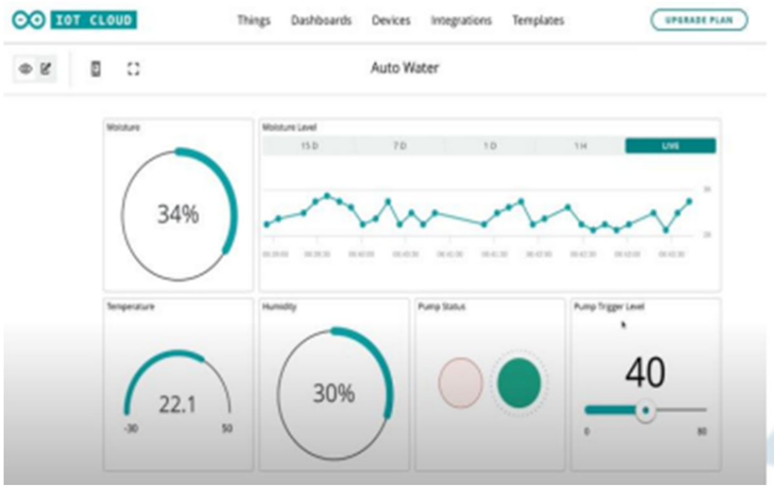

Fig. 4. Picture of data

Fig. 5

Figure 5 shows an actual image of our system. We apply our system on an actual plant and it is working accurately. When moisture level drops it automatically waters plants and also we can do it remotely.

V. CONCLUSION

This suggested strategy enables us to control both irrigation for agriculture and garden watering. It requires both the necessary internet modification to replace the GSM system and the proper application update to enable irrigation control. A fully working smart remote gardening solution is made possible by NB-IOT, which may be used to improve the app's usability, add a sprinkler system, and enabling users to access it from anywhere in the world when there is no signal. For high-speed water flow, the side of the machine also needs a stronger motor. New technologies could broaden the system's application in the corporate sphere and ensure the user's comfort at all times. This technology will undergo significant change and has enormous potential for the gardening industry. By measuring potassium and nitrogen, NPK sensors might also make it significantly more sophisticated, enabling nutrient levels to be changed for the benefit of fields and gardens. These changes can help the user get a fully functional system. The research offered the possibility to assess the advantages and disadvantages of the current strategies and to develop a method for monitoring soil moisture levels. It can be usefully used for watering the garden, which takes up the most time. One of the tasks that uses the most water is watering the garden. The system irrigates the soil using information from sensors that measure soil moisture.The method irrigates the soil in a way that reduces the possibility of either overwatering or underwatering the soil, both of which could be harmful to plants. The garden owners can check in on their garden from anywhere using a mobile or desktop interface. This example showed how the Internet of Things (IOT) and automation may significantly improve gardening. Therefore, the system offers a workable solution for the problems faced in the current manual and labor-intensive process of watering plants by enabling optimal use of water resources.

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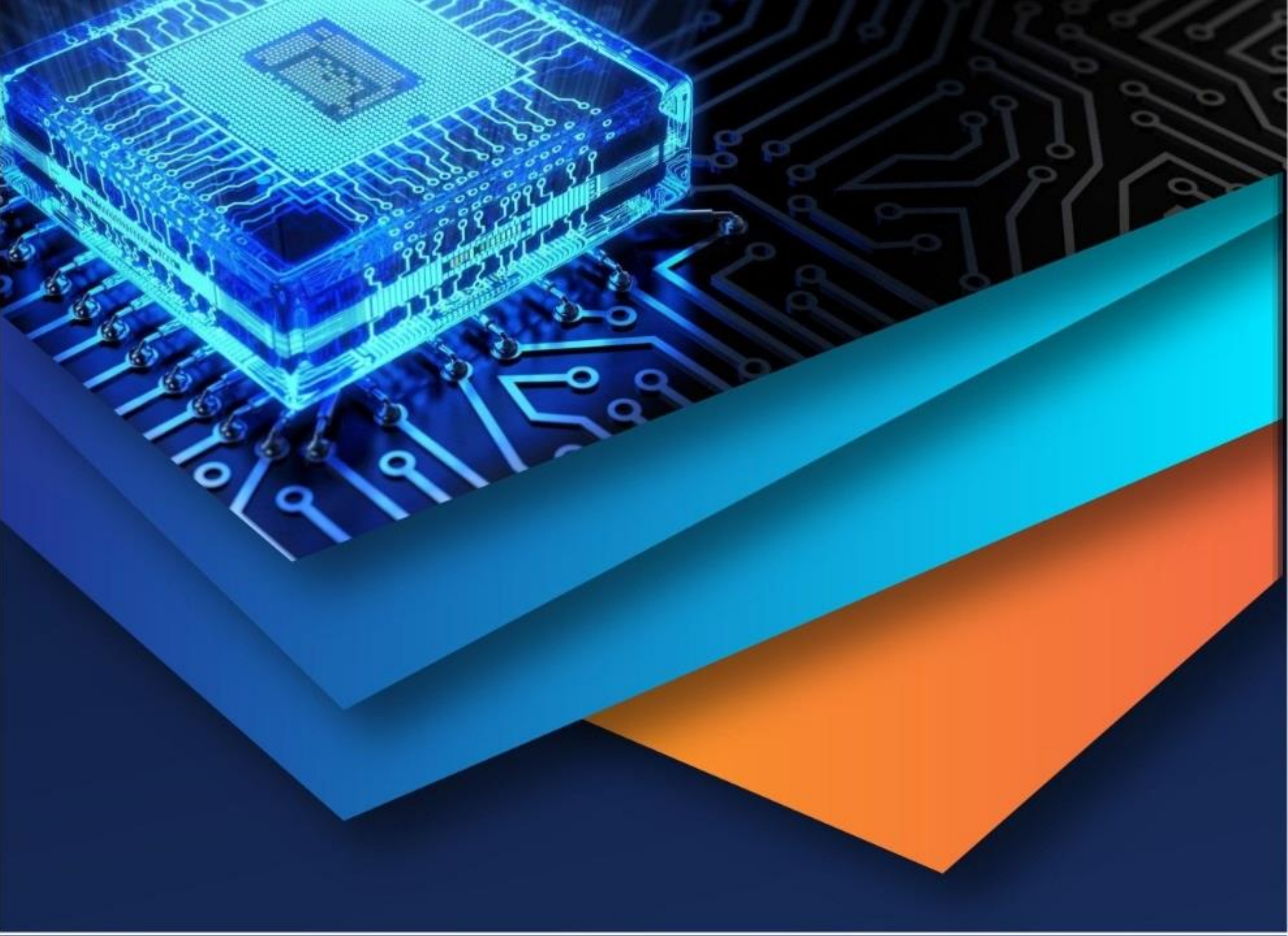

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