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IoT Based Remote Gardening

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Abstract*— The rapid emergence of the Internet of things(IoT) devices in all sectors from automobile to home automation also put an impact on the agriculture industry also known as "Smart Agriculture" which paced the whole industry from statistical approaches to quantitative approaches. Such new approaches transform existing methods of agriculture and help in creating new opportunities also overcoming a number of challenges in this sector. This paper highlights a system where the potential of these IoT devices and wireless sensing devices is used and also, the challenges faced when integrating this technology together for benefits. This paper shows the use of one of the applications of smart agriculture where the user can check out the moisture, temperature, and humidity in soil and adjust it along with the ability to control the water flow wherever the user wants remotely without being physically available. This is achieved by use of a soil moisture sensor capable of monitoring soil moisture, DHT 11 for temperature and humidity monitoring, and Arduino used for connecting the whole system to one another along with the IoT cloud as the database in this system. Our only ambition is to set up a user-friendly remote-gardening system and with an automated approach.

***Index Terms*—Automation, Arduino cloud, IOT, Soil moisture sensor, Remote gardening.**

I. INTRODUCTION

The Internet of Things (IoT) is a technology that improves Internet connectivity between digital and physical things and creates communication between them. The gathered data is exchanged between users and devices as well as saved and managed in the cloud. The development of IoT would lead to the discovery of new opportunities to increase agricultural productivity and reduce difficulties that reduce crop growth. With the IOT, it is possible to connect the monitoring of weather forecasts, soil temperature and humidity, soil moisture level, remote water valves, and pest management. Data collected from these IOT devices and sensors is then transmitted to the farmers via modern devices and the internet. On both small and large fields wherever soil moisture is a crucial element.

The Internet of Things (IoT) is transpiring the agriculture industry and solving the immense problems or the major challenges face by the farmers today in the field. To overcome the problems, we designed a low-cost system for monitoring the garden and agriculture farm which continuously measures the level of soil moisture of the plants and allows users to maintain soil at a specific moisture level. There are many methods of measuring the moisture content of soil, but the two types of sensors that are most commonly used are resistive and capacitive sensors. We have used capacitive soil moisture sensors to measure the moisture of soil, since capacitive sensors are immune to rusting in moist soil. After we get our sensors calibrated, we use them to build a soil moisture meter using arduino and node mcu. We then built an automated watering system that uses an Arduino and node mcu and works on the Arduino IoT Cloud so that we can see all the detailed information of soil moisture and watering the plant automatically. This will allow us to maintain our soil at a specific moisture level and monitor it from anywhere remotely, through desktop and mobile interface.

Nowadays Vegetable gardens come in a wide variety, but the majority can be divided into three groups. In-ground gardens, container gardens, and raised bed gardens are the most typical vegetable garden structures. Our system is built for all types of gardens.

A soil moisture sensor is a tool that can be buried in the ground to gauge the amount of moisture in soil. This sensor can be used to determine how moist the soil is; when the soil is dry, the module's output is high; otherwise, it is low. Automatic watering to plants without physical contact is present in our system. Our output is very accurate and straightforward.

Section II highlights similar work done in remote gardening. Sections III explains the methodology implemented in our proposed work by using circuit diagrams and flowchart. Section IV describes the results of the System. Section V concludes the whole system and also discusses the future scope the system can have.

II. LITERATURE SURVEY

Understanding the effects of the soil moisture on performance is crucial. This study proposed a system for monitoring the soil moisture using homemade soil moisture sensor and Arduino Uno board. The eminent feature of this system is to measure the soil moisture along the depth which can determine the time of water supply to reach the crop roots which is given in the work by Matti Satish Kumar[1], this improves the cost efficiency and water resources

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management.

The analysis of different types of moisture sensor compared to the different types of soil. It involves sensors such as commercialized soil moisture sensor, galvanized steel nails and gypsum block and soils taken in experimentation were clay soil, sandy soil. After analysis Fatiha binti Abdullah[2] describes that for real or actual implementation the combination of these three types of soil with different proportion ratio of each soil is the best soil for plant growth. At present, many garden centers make use of a timer-controlled sprinkler which automatically provides the supply of water crops irrespective of the content of moisture present in the soil that leads to over irrigation of plants**.**

Many present a system that is capable of measuring the soil moisture of the soil. Ibrahim Al-Bahadly[3] uses a Teensy 2.0 micro-controller with a dual output tap timer. Thus, the plant will supply water whenever the content of moisture in the soil becomes low. Watering is the most important aspect in the growth of plants. Thus water should be supplied at the right time whenever required by the plants.

Drashti Divani[4] proposes an automatic plant watering system using sprinkler systems, pipes and a nozzle. For the control of the whole system an ATmega328 microcontroller is used and it is programmed in such a way that it senses the moisture level and water according to them. So conservation of water is possible by this approach**.**

The method discussed by M.Usha Rani[5] and G. Nisha[6] creates a wireless sensor network with the help of an Arduino cloud having a grove moisture sensor and water flow sensor. It makes use of a zigbee protocol for the communication among sensors and the current status of the system will be printed on a web portal.

The intimation about the water flow will also be sent to the users phone with the help of GSM. The approach given by P. Divya Vani and K. Raghavendra Rao[7] is to develop a system for monitoring the soil moisture content of soil by using IOT, mobile computing technology and cloud computing. CC3200 launchpad is interfaced with a soil moisture sensor and data is stored in the AT&T M2X cloud technology and blynk application is used in android phones by the user to check the status anywhere and make timely decisions.

It is essential that we utilize water very wisely in all aspects of our everyday lives as water resources grow more and more scarce. Nikhil Sukhdev[8] has monitored environmental factors like soil humidity, temperature, and other factors to determine the best approach to the issue. They created a mobile application which provides two buttons ‘ON’ and ‘OFF’ for manually controlling the water. There is also a self test software which tests the components periodically.

Mokh. Sholihul Hadi[9] has discussed the irrigation system for the garden that is connected to the internet of things, and the water pump is remotely controlled while the soil moisture inside the garden is also tracked. The owners of gardens may monitor and measure the moisture levels in the plantations using an Internet of Things application. The management of water usage in real time is therefore effectively possible. The water supply within the plant is linked to a water pump that, whenever the soil moisture sensor detects low moisture levels, activates and immediately sets the moisture parameter to the ideal value. A smartphone app may also be used by the garden's owner to keep track of the moisture level in the soil.

In the digital age, people anticipate automation to make tasks simple, pleasant, quick, and efficient. The goal is to transform our current system for distributing water to backyard gardens, farms, fields, etc. into a smart automated system. Prof. Mitul Sheth and Prof. Pinal Rupani[10] employs soil moisture detectors, temperature detectors, and humidity detectors in this system, which are positioned at the plant roots. The system transmits to the access point the values it has identified. The goal is to use WiFi to retrieve data and sync these values with the internet. As soon as the level of water drops below the defined point, it alerts the user.

III. METHODOLOGY

The amount of water content in the soil is measured by soil moisture sensors. A soil moisture probe is made up of several soil moisture sensors. A popular type of commercially utilized soil moisture sensor is a capacitance sensor or another frequency domain sensor. An alternative sensor that makes use of the neutron moderator properties of water. By calculating the capacitance between two electrodes that are present in soil, we can find soil moisture. The dielectric constant is directly proportional to the moisture content in soils where free water makes up the majority of the soil's moisture (such as sandy soils). To enable the measurement of the dielectric constant, the examination is often subjected to a frequency stimulation. So our proposed system did the same thing. Initially we were given a certain limit for moisture if reading is less than that level then automatically water coming out of the pipe using a pump.

Sensors are used for measuring humidity and temperature to check if the parameters are within range and suitable for plants. To build our IOT watering system we used a node mcu esp8266. We used this to control our system to wifi through an application. We used a moisture sensor for calculating the moisture of soil and according to this moisture we can turn on or off our motor.We used a relay to open or close the load connections in response to one or more electrical factors like voltage and current. Therefore, we are employing this as a self-contained switch. It leads us in turning on the motor when a specific condition occurs.We used a pump for watering and a DHT11 sensor for measuring humidity and temperature.Setting a starting threshold value for irrigation allowed for water pump control. The pump is turned on when the sensors detect moisture content below the

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threshold and runs until the soil is entirely soaked.

For implementing this we are using arduino and esp8266. We are using arduino for actual implementation and esp for visualization purposes and for controlling on and off watering. We visualize on both platform arduino clouds as well as blynk applications from which we can operate our watering application and see the value of current temperature, humidity.

A Circuit Diagram

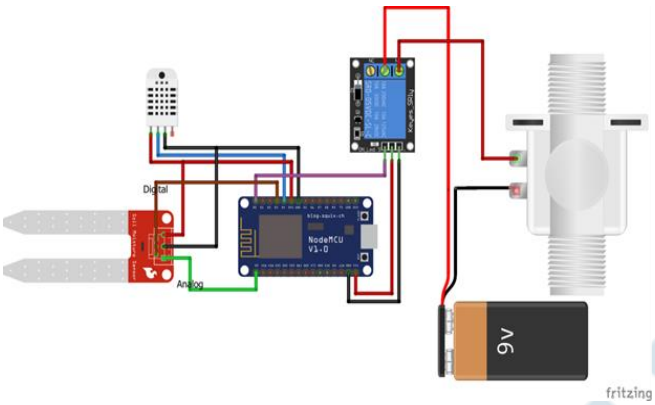

Fig 1: Circuit diagram of system

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

B Flow chart

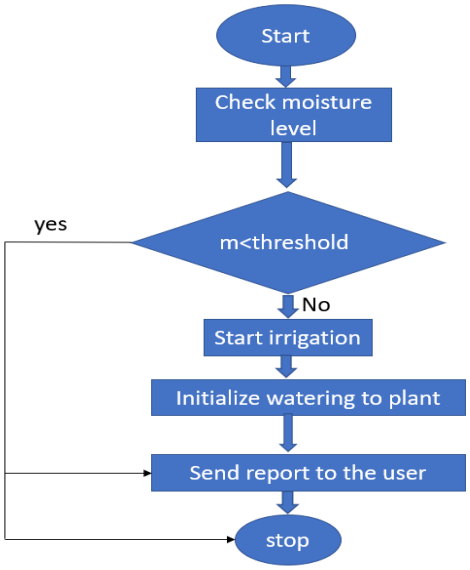

Fig2: Flowchart of Automated plant watering system

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.

If you are using *Word*, use either the Microsoft Equation Editor or the *MathType* add-on (http://www.mathtype.com) for equations in your paper (Insert | Object | Create New | Microsoft Equation *or* MathType Equation). "Float over text" should *not* be selected.

IV. RESULT AND DISCUSSION

The complete hardware and software setup have been done to monitor the soil moisture of the plant and water plant if needed. The values obtained through sensors enable the system to switch on and off automatically and manually. A gardener can remotely monitor the watering process in the garden. Hence, the system contributed to making a smart garden. We have tested on a small scale by inserting a moisture sensor into soil and visualizing the readings. .We create a graphical user interface on blynk which shows in figure 3.It shows three Parameters like Soil Moisture ,Temperature and Humidity of the soil.Temperature shows in degree and moisture,humidity given in range 0 to 100. We got the value of soil moisture 92%, temperature values 27 degree and humidity value 69%..Also there is a button on the downside from which we switch on and off the system.

Fig 3: picture of reading

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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.

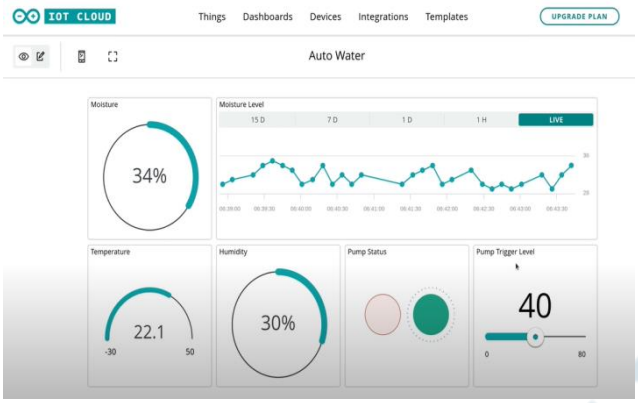

Fig 4: Picture of display of data

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.

Fig 5: Actual model

V. CONCLUSION

With this suggested approach, we are able to manage agricultural irrigation in addition to garden watering. It needs the appropriate application update to allow for irrigation control, as well as the requisite internet modification to replace the GSM system. In addition to making the app more user-friendly and adding a sprinkler system to the device, NB-IOT may be utilized to enable users to access it from anywhere in the world when there is no signal, allowing for a fully functional smart remote gardening solution. A stronger motor is also required on the side of equipment for high-speed water flow. This system can't stop there; new technologies can expand its use in the business world and provide the user with comfort at all times. This technology will be drastically altered and has a lot of potential in the domain of gardening. Additionally, NPK sensors may make it much more advanced by detecting potassium and nitrogen, allowing nutrient levels to be altered for the benefit of fields and gardens. These adjustments can assist in giving the user a fully functional system.

The project provided the chance to evaluate the benefits and drawbacks of the existing approaches as well as the creation of a system to track soil moisture levels. Watering the garden, which takes up the most time, may be done effectively using it. Watering the garden is one of the activities that consumes the most water. Using data from soil moisture sensors, the system irrigates the soil in a way that lessens the chance of overwatering or underwatering the soil, which might harm plants. The garden owners may access a mobile and desktop interface to monitor their garden online from anywhere. This demonstration demonstrated how well the Internet of Things(IOT) and automation may dramatically enhance gardening. Therefore, by permitting optimal use of water resources, the system provides a viable remedy for the issues encountered in the current manual and labor-intensive procedure of watering plants.

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