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IoT Based Real Time Applications: Smart Irrigation in Agriculture

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ABSTRACT

By automating farm tasks, the agricultural sector can go from being manual and static to intelligent and dynamic, increasing productivity while requiring less human oversight. This study suggests an automated irrigation system that uses automatic watering to monitor and maintain the appropriate soil moisture content. The control unit is implemented using the Arduino Uno platform and microcontroller. The system makes use of soil moisture sensors to determine the precise moisture content of the soil. This number helps the system to use the right amount of water, preventing over- or under-irrigation. Farmers are informed of sprinkler status with the usage of IoT. The system makes use of soil moisture sensors to determine the precise the content of the soil. This number helps the system to use the right amount of water, preventing over under-irrigation. Farmers are informed of sprinkler status with the usage of IOT. This method saves labor as well as water. Using this strategy, water delivery will be based on crop the soil moisture sensor is designed to identify moisture for this independent system, and the ESP8266 Wi-Fi will receive the result.

Keyword-- Smart Irrigation, Soil Moisture, Internet of Things (IoT)

I. INTRODUCTION

Agriculture is one of the sectors of the economy that brings in money for our country. As per their catchphrase, "agriculture is life for more than 85%," the government has augmented its financial support for technological advancement in order to enhance agricultural productivity. Water conservation is the most important concern in dry lands. It is also essential to the plants' survival. In light of these facts, we decided to try and address a portion of the problem by increasing the water consumption effectiveness in irrigation systems. In the last fifteen years, farmers have begun to employ computers and software programs to better manage their financial information, track their dealings with outside parties, and keep an eye on their crops. Agriculture is quickly developing into a very data-intensive industry in the Internet age, where information is vital to people's lives. Farmers must gather and analyze vast amounts of data from a variety of devices (such as sensors, farming machinery, etc.) in order to improve production efficiency and convey pertinent information. Modern technological developments can enhance or completely

Replace conventional water delivery techniques. We plan to use it to provide easy programming, streamline irrigation management, and improve the efficiency of water distribution. The availability of inexpensive moisture sensors and open-source Arduino boards has made it possible to develop gadgets that can track the moisture level of the soil and irrigate farms or other areas as needed. The suggested system makes use of the microcontroller on the Arduino Uno platform and Internet of Things (IoT) to allow farmers to remotely monitor the state of the sprinklers installed on the farm by knowing the sensor values. This greatly eases the farmers' workload and allows them to focus on other agricultural tasks.

II. LITERATURE REVIEW

Easy-to-use and reasonably priced intelligent irrigation system. Tiny OS-based IRIS motes are used to simulate the system in an outdoor setting and measure the paddy field's moisture content. Soil moisture content is determined via moisture sensors. When the voltage above a threshold value specified by the device, it indicates the driest soil. The GUI for monitoring and visualization is improved in the suggested system. When the button on the visualization panel is pressed, the motor turns on automatically. The MOTEWORKS visualization tool is used by AIS to perform its functions. The visualization tool preserves soil moisture and makes the best use of fertilizer and water. [1]

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Using WEB and GSM technologies to develop agricultural automation systems. The goal of this embedded project is to create an inexpensive agricultural automation system based on an embedded platform. The primary goal of this system is to use water as efficiently as possible. In order to determine how much water is used in agriculture, this project uses temperature and soil moisture sensors. A water level sensor is utilized to determine the water level in a tank. Within this framework, we track the condition of the sensors using GSM and the Internet [2]. Here, a microcontroller allows for the online monitoring of temperature, soil moisture, and water level. Data is delivered via SMS. All of the sensor status information is available on this page. GPRS technology will be used to view this data from a distance. According to Rayala the system is practical and economical for maximizing water resources for agricultural output[5].These methods enhance maintenance and can be tailored to a range of crops. It is possible to use this technique with any kind of crop. These systems are to put it briefly, the only ways to turn on and off the motor in the current system are via the GSM module or Wi-Fi. Using GSM technology, they may also obtain the field's current state.

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, enabling also to control the activity of the sensors. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on. Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. Many routing, power management, and data dissemination protocols have been specifically designed for WSNs where energy awareness is an essential design issue. [8]

III. BENEFITS OF SMART IRRIGATION IN IOT

IoT systems for irrigation have a number of advantages, some of which include reduced water use overall, high cost and performance efficiency, reduced energy consumption, reduced crop waste, and more. The reduced water use is one of the key advantages of IoT systems for irrigation. Additionally, most irrigation-related tasks are automated using this method, resulting in minimal water waste and only the necessary amount of water being used for irrigation.

A significant amount of water was lost throughout the irrigation process when human intervention was necessary in conventional irrigation methods where the majority of the handling and operations were done by hand. There is little to no human interaction when using smart irrigation, and the Water resources are only utilized to the degree that they are necessary. Moreover, it has excellent cost-efficiency since it uses less water and requires less precision during the process, which lowers overall costs. A certain length of time and prearranged breaks are used to reduce the energy used. Furthermore, as firms must restrict their expenses to a certain degree due to resource limitations, cost containment and resource conservation are essential. When smart irrigation is used, cost is taken into account, making it possible to complete related tasks efficiently and for less money. Finally, an additional benefit is that more efficient irrigation and water management mean that plants and crops only receive the necessary amount of water, which minimizes crop waste from either insufficient or excessive watering.

3.1 Water Management

When it comes to irrigation, water management could be regarded as a crucial idea. Global concerns over clean water scarcity have led to a need for the agricultural industry and other industries to pay close attention to this problem. Water management can be defined as controlling soil moisture to ensure that the proper amount and level of water is applied when it's needed. For the agriculture industry, efficient water management is vital since it can save costs and increase crop yield. Water management is also essential since it enables agriculture sector companies to properly manage resources and complete necessary tasks. Given that different projects are being undertaken at varying scales, Natural resource conservation has become the focus of an increasing number of organizations nowadays as a result of widespread concern over the depletion of these resources. Water is one of the most important and practical resources in this sense, and it must be preserved and safeguarded at all costs. Given that irrigation procedures require a significant amount of water, the organizations involved in and connected to these activities need to be extremely alert and thoughtful when devising strategies for optimizing water utilization. Thus, the agriculture business needs efficient water management technologies to reap several benefits. Understanding the fundamentals of soil, crop relationships, and water is seen to be one of the most important elements in effective irrigation water management. Ample knowledge of the procedures and end products must be obtained in order to properly perform one of agriculture's essential tasks, irrigation.

Only after acquiring such expertise would the necessary tasks be completed satisfactorily. Lack of knowledge and information would make it impossible to

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investigate how irrigation activities must be controlled and managed in challenging circumstances, which could ultimately result in a decline in overall performance. Ensuring the highest possible degree of job efficiency is only one of the many reasons why water management is so important. It could be able to ensure that agricultural crops receive the right amount of water in dry regions and during dry spells by using water management techniques. Since many projects are being implemented in places with limited water resources, attention must be paid to water management in order to distribute and apply water in a timely manner. Furthermore, rainfall is often quite insufficient in many places, thus a lot of water needs to be stored to ensure that the lack of rainfall can be made up for.

It is necessary to design strategies and tactics that will reduce waste and ensure effective resource usage. Furthermore, the necessity for water management grows even more given the possibility that a shortage of clean water could be a serious issue in the future. The agricultural industry uses a variety of approaches and techniques for managing water, and each of these approaches has advantages and disadvantages of its own. A few of these could be named as follows:

- Measure, meter, and manage
- Use water-smart irrigation and landscaping
- Regulate reverse osmosis
- Collect rainwater and construct reservoirs.

IV. PROPOSED SYSTEM

The main objective of our Project is to reduce water wastage and this technology can be applied to drip irrigation. Water is delivered to the field via a smart irrigation system using the Android app. We can choose a crop from the Android app, and that crop has already established its water level—that is, the quantity of water required for that particular crop. Plant roots will consequently only receive the minimum quantity of water required. When the water level crosses a predetermined threshold, the motor will cut off, and the app will display the current condition. This technique allows the farm to supply water without the need to travel and the main advantage of using smart irrigation is over traditional irrigation systems. Intelligent irrigation systems have the capability to modify water levels by considering several elements such as soil moisture. For this, wireless moisture sensors are utilized, which communicate with the smart irrigation controls to let the system decide whether or not to water the landscape. The smart irrigation system will make managing your landscaping and watering needs easier. You'll also feel more at ease knowing that it can make decisions on its own when you're not around. Your intelligent irrigation system will use resources as efficiently as possible to meet everyone's demands without creating waste, which will save you a lot of money on water bills.

4.1 Block Diagram

The ESP8266 Wi-Fi module in the block diagram above receives instructions to turn on the motor via the app or manually via a switch after receiving electricity. The ESP8266 Wi-Fi module is a complete and self-contained Wi-Fi network solution that can carry software applications. The programme that was burned into the Wi-Fi module will be used by a relay to turn on the motor. An electromagnetic component called a relay is used to create a magnetic connection two electrically isolated circuits.

The soil moisture sensor provides data to the ESP8266 Wi-Fi module. The soil moisture sensor was used to determine the farm's moisture content. It measures the moisture content of the soil once it gets there. The soil moisture sensor provides data to the ESP8266 Wi-Fi module. The soil moisture sensor was used to determine the farm's moisture content. When it gets to the soil, it measures how much moisture is there.

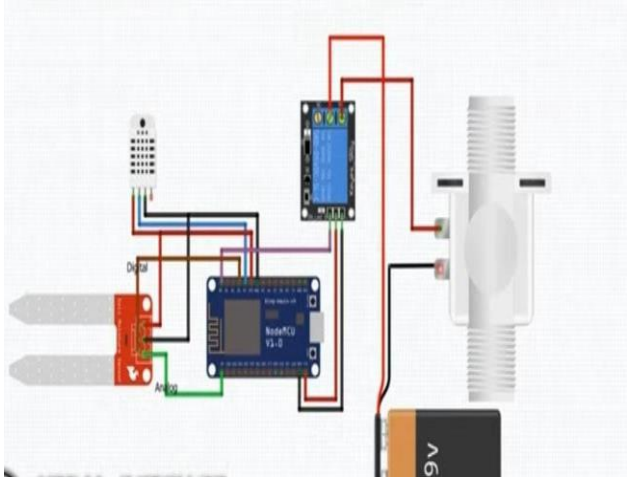

Figure 4.1: Circuit Diagram

V. SYSTEM SPECIFICATION

The Hardware and Software utilized in this project are explained as follows:

5.1.1 HARDWARE EQUIPMENT
5.1.1.1 Esp8266 Wi-Fi Module
5.1.1.2 Soil Moisture Sensor
5.1.1.3 Relay
5.1.1.4 Submersible Water Pump
5.1.1.1 Esp8266 Wi-Fi Module

Peer Reviewed & Refereed Journal
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Figure 5.1.1.1: Esp8266 Wi-Fi module

With the use of an alternative application processor, the ESP8266 is a complete and self- contained Wi-Fi network solution that can execute software programs or turn off all Wi-Fi networking functionality. The flash memory is the sole application that uses the application processor and can be started directly from an external move when the device is mounted. Thanks to built-in cache memory, system performance will be improved and memory requirements will be reduced. Another example is when a WiFi adapter serves as a wireless internet access device. It may be incorporated into any microcontroller-based design, and connecting to it is as simple as utilizing a central processor AHB bridge interface or an SPI/SDIO interface. Processing and storage capacity are made possible by the ESP8266's powerful component through the use of GPIO ports, sensors, and other application-specific hardware.

5.1.1.2 Soil Moisture Sensor

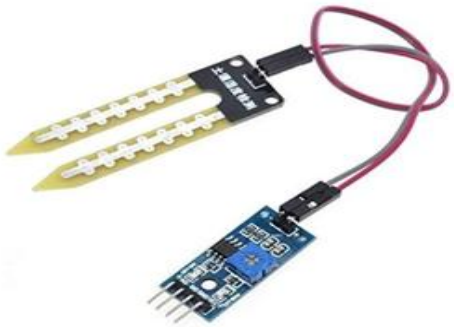

Figure 5.1.1.2: Soil moisture sensor

Soil moisture sensors (SMSs) measure soil moisture at the root zone and regulate the existing conventional irrigation timer, resulting in considerable water savings when installed and used properly. A customized soil water content threshold is set, allowing for dryer or wetter soil condition. SMSs function similarly to rain sensors by bypassing irrigation events under rainy conditions, but by measuring soil moisture at the root zone they are more effective at minimizing irrigation when plants do not need additional water. The soil's wetness can be measured using this sensor. The output of the module is high when there is a water scarcity in the soil; otherwise, it is low. One can automatically water the flower plant or any other plant that needs automatic watering by utilizing this sensor and high amount of resistance is output by the sensor module when the soil moisture content is low. The outputs on this sensor are both digital and analog. Although digital output is easier to use than analog output, it is less accurate. Since the Arduino Uno's Atmega 328P-PU microcontroller has an integrated 10-bit 6-channel analog-to-digital (A/D) converter, it can read analog signals given by sensors and output binary integers between 0 and 1023 on its analog input pin. Lower moisture content is implied by higher production.

5.1.13 Relay

Figure 5.1.1.3: Relay

Relays have a very basic function. Lamps and other high-power circuits cannot be turned on or off using an Arduino or Raspberry Pi. Typically, these gadgets have 3 or 5 volt connectors and no other way to swap circuits. Relays can also be used to switch on and off existing wiring in your house, like sprinkler systems, without making too many changes. There is a location where water sprinkler wire was previously run.. It really is that simple after which turning on the light. Relays are electromagnetic switches that are powered by relatively small amounts of electric current and have the ability to turn on or off much larger electric currents. The brains of a relay are electromagnets.

5.1.1.4 Submersibile Water Pump

Figure 5.1.1.4: Water Pump

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A device with a hermetically sealed motor firmly fixed to the pump body is known as an electric submersible pump, or subs pump for short. The liquid that needs to be pumped is immersed throughout the entire assembly. The main advantage of this kind of pump is that it doesn't suffer from pump cavitation, which is caused by a large elevation differential between the fluid surface and the pump. Small DC submersible water pumps force fluids to the surface as opposed to jet pumps, which must pull fluids. Submersible pumps are more efficient than jet pumps. Usually, it operates on voltages of three to twelve.

5.1.2 Software Equipment

5.1.2.1 Blynk App

5.1.2.2 Arudino IDE

5.1.2.1 Blynk App

Blynk is an IoT platform for iOS or Android smart phones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets. Key functions of Blynk App are

- Configuration of connected devices on the platform, including application settings.
- Device, data, user, organization, and location management.
- Remote monitoring and control of devices.

5.1.2.2 ***Arduino IDE***

The Arduino IDE (Integrated Development Environment) is used to write the computer code and upload this code to the physical board. The Arduino IDE is very simple and this simplicity is probably one of the main reason Arduino became so popular.

- It increases the readability of the code.
- It conceives and organizes the program.
- It reduces the chances of errors.
- It makes the program compact and small.
- It avoids the repetition of the set of statements or codes.
- It allows us to divide a complex code or program into a simpler one.

VI. APPLICATIONS OF SMART IRRIGATION

- Depending on the crop and kind of soil, the system must be able to control every last drop and determine the actual amount of water needed. This is a highly useful feature that enables waste-free water conservation.
- Both small and large fields can be used with this technique.
- A trustworthy and effective method for monitoring environmental parameters
- Easy and convenient garden maintenance.
- Ensures efficient water and nutrient supply. Automated operations help save efforts and labor resources. Farmers don't have to step out every time to operate the irrigation system.
- The IoT system can enable farmers to analyze the soil moisture content, crop growth phase, and corresponding water requirement.

VII. FUTURE SCOPE

The following suggestions can be taken into account to increase the system's efficacy and efficiency. The farmer can be given the option to manage the water pump, meaning that he can turn the pump on or off to begin or stop irrigation without having to physically be at the property. The farmer may decide to halt crop development, or unfavorable weather circumstances may cause crop damage. The farmer could have to remotely stop the system in such circumstances. The concept of utilizing IOT for irrigation can be expanded to include other farming tasks including climate control, fire detection, and cow management. This would reduce the amount of time that people spend farming.

VIII. CONCLUSION

The project gave researchers the chance to examine the benefits and disadvantages of the current methods and design a system to track the soil moisture. The suggested technique can be used to automatically turn on and off the water sprinkler based on the moisture content of the soil, which will automate one of farming's most time-consuming tasks: irrigation. Among the uses of water that is most prevalent is agriculture. Utilizing data from soil moisture sensors, the system irrigates the soil in a way that helps to prevent crop damage by not irrigating the soil excessively or too little. Via a website, the farm's owner can keep an eye on the proceedings online. It is possible to deduce from this experiment that farming can advance significantly by the usage of automation and IOT. Thus, by facilitating the effective use of water resources, the system offers a viable remedy for the issues associated with the laborious and manual irrigation method currently in place.

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