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IoT-BASED SMART IRRIGATION SYSTEM USING ESP32

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Abstract:

The way we connect with our surroundings has been completely transformed by the Internet of Things (IoT). Agriculture, especially irrigation systems, is one of the industries where IoT has demonstrated enormous promise. In this project, we suggest an Internet of Things (IoT)-based smart irrigation system that makes use of a TDS (Total Dissolved Solids) metre, soil moisture sensors, and humidity sensors.

The current irrigation systems frequently rely on human scheduling and monitoring, which results in inefficient water use and both over- and under-watering of crops. By using IoT technology to enable real-time monitoring and autonomous irrigation management depending on crop demands, our suggested system seeks to overcome these concerns.

An ESP32 microcontroller, TDS metre, soil moisture sensor, humidity sensor, water pump, and solenoid valve are the primary elements of our smart irrigation system. As the central hub, the ESP32 connects to the sensors and actuators using various communication protocols including Bluetooth and Wi-Fi. The TDS metre detects the number of dissolved solids in the water, which is a crucial factor in figuring out the irrigation water's quality. While the humidity sensor gauges the degree of humidity during irrigation, the soil moisture sensor gauges the moisture content in the soil.

Keywords: IOT, ESP32, Soil Moisture Sensor, TDS meter, Smart Irrigation.

1. Introduction

This project's goal was to create an Internet of Things (IoT)-based smart irrigation system utilising an ESP32, a soil moisture sensor, a humidity sensor, and a TDS metre. To ensure that plants get the ideal quantity of water for healthy growth, the system is made to automatically water plants based on their moisture levels. As part of the system, humidity levels and TDS measurements are also monitored.

Large areas of land are used by the majority of farmers, making it incredibly challenging to access and navigate around every corner. Sprinkles of water may appear unevenly from time to time. Crops of poor quality are produced as a result, further contributing to financial losses. The use of the most recent IOT technology in the Smart Irrigation System is advantageous in this situation and makes farming easier.

The potential for automating the whole irrigation system is enormous with the smart irrigation system. Here, we're creating an Internet of Things-based irrigation system with the help of a DHT11 sensor, ESP32S Node MCU module, and water quality TDS. In addition to autonomously watering the plants depending on the soil's moisture content, it will also send data to the BLYNK server to monitor the state of the land. A water pump will be part of the system, and it

will be utilized to sprinkle water on the ground based on environmental factors including moisture, TDS, temperature, and humidity.

An analogous Automatic Plant Irrigation System that we've built before provides notifications through mobile but not the Internet of Things cloud. In addition to this, circuits and alerts aid in the construction of smart irrigation systems. The system starts by noting that various crops require various levels of soil moisture, temperature, and humidity. Therefore, in this project, we are employing cocopeat, which needs oil moisture of between 20 and 100%. Therefore, the motor pump will automatically switch on to sprinkle water when the soil moisture levels drop to less than 20%. The pump will continue to sprinkle water until the soil moisture levels rise again, at which point it will be shut off. The sensor data will be sent to IOT the Blynk Server at defined intervals of time so that it can be monitored from anywhere in the world.

2. Related Works

The works listed below are some similar ones that you might want to take into consideration for your final year project on an IoT-based smart irrigation system employing an ESP32, TDS, soil moisture, humidity, temperature, and atmosphere:

“Design and Implementation of Smart Irrigation System using IoT" This study presented a smart irrigation system that uses IoT technology to track soil moisture, temperature, and humidity. A cloud-based server and an ESP32 microcontroller were used to create the system. Development of an IoT-Based Smart Irrigation System for Precision Agriculture" This study suggested an Internet of Things (IoT)-based smart irrigation system that makes use of sensors to keep track of soil moisture, temperature, and humidity. A cloud-based server and an ESP32 microcontroller were used to create the system.

S. P. Patil and colleagues published "Smart Irrigation System Using IoT and Machine Learning" in 2016. In order to estimate soil moisture levels, this research effort developed a smart irrigation system that makes use of IoT technologies and machine learning algorithms. An ESP32 microcontroller and a cloud-based server were used to create the system. This research proposes a smart irrigation system that employs IoT technology to track humidity, temperature, and soil moisture levels. This study paper suggested an intelligent irrigation system that employs IoT technology to monitor soil moisture levels and meteorological factors. An ESP32 microcontroller and a server located in the cloud were used to construct the system. And also This article describes an Internet of Things-based smart irrigation system that use sensors to assess soil moisture, temperature, and humidity, as well as a microcontroller to regulate the water pump. A smartphone application for remote monitoring and control is also included in the system.

You can automate your irrigation system and guarantee that your plants receive the proper quantity of water at the right time with an IoT-based smart irrigation system based on ESP32. This may be an excellent project for IoT and agriculture enthusiasts or specialists.

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3. PROPOSED SYSTEM

Soil moisture sensor: The system will use a soil moisture sensor to measure the moisture level of the soil. The sensor will send data to the ESP32 board to determine whether to irrigate the soil or not**.** Automated watering schedule: The system will automatically irrigate the plants based on the watering schedule. The irrigation system will turn on and off the water pump based on the moisture level of the soil and the weather forecast.

Water flow sensor: The system will use a water flow sensor to measure the flow rate of water. This information can be used to detect leaks or other issues with the irrigation system.

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Alerts: The system can send alerts to the user's mobile device if the moisture level of the soil is too low, if there is a leak, or if the watering schedule needs to be adjusted.

Overall, this proposed system will provide an efficient and optimized irrigation system that can be remotely monitored and controlled. The system will reduce water usage and ensure that the plants receive the proper amount of water at the right time.

3.1 Working

The soil moisture sensor, humidity sensor, TDS metre, and ESP32-based smart irrigation system function by gathering data from multiple sensors and sending it to a cloud platform.

The system works in the following way:

1. The soil moisture sensor collects data from the earth and transmits it to the ESP32.

2. The humidity sensor collects data from the ambient and transmits it to the ESP32.

3. The ESP32 receives data from the TDS metre, which measures the total dissolved solids in the water.

4. Data is gathered from each sensor by the ESP32 and sent to the cloud platform.

5. Based on the moisture level in the soil, the humidity level in the atmosphere, and water quality, the cloud platform analyses the data and sends a signal back to the ESP32 to turn on or off the irrigation system

6. Based on the soil moisture, air humidity, and water quality, the cloud platform analyses the data and sends a signal back to the ESP32 to turn on or off the irrigation system.

7. Based on the signal, the ESP32 either turns on or off the irrigation system.

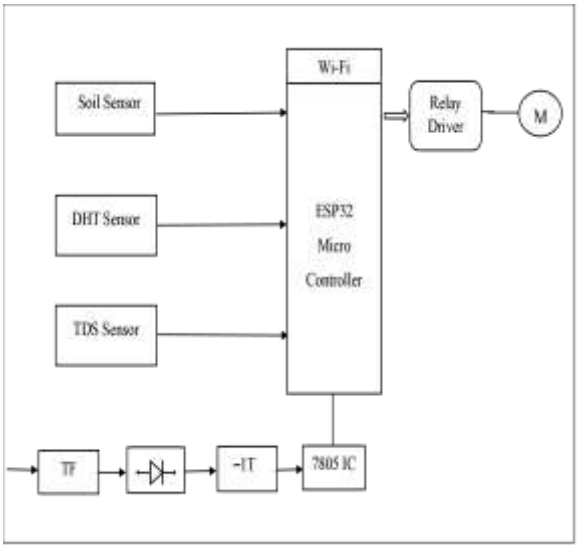


Figure 1: Block diagram of Proposed system

This is how the IoT-based smart irrigation system with ESP32, soil moisture sensor, humidity levels, and TDS metre helps to guarantee that plants get the correct quantity of water and nutrients for optimum growth.

The optimal PPM (parts per million) values for vegetables might vary based on the type of vegetable, stage of growth, and other environmental factors. However, here are some rough suggestions for PPM levels in popular vegetables: When employing an IoT-based smart irrigation system with an ESP32, you may use sensors to measure the PPM levels in the nutrient solution and change the levels as needed. You can programme your ESP32 to accept data from the sensors and use that data to trigger actions like as turning on a nutrient pump to add extra nutrients to the solution.

Drinking water with low TDS levels may be the finest water of all. A TDS level of 100 to 150 parts per million is considered soft water, while levels over 200 ppm are very hard. High TDS levels may be beneficial for plants.

Using the conductivity levels of concern above, TDS levels should be below about 640 mg/L to

avoid problems in plugs and below about 960 mg/L to avoid problems with other plant growing conditions. TDS levels above about 2,000 mg/L are very likely to cause plant growth problems. Very High Salinity Water (Salinity Class C4) It is not suitable for irrigation under ordinary conditions but may be used occasionally under very special circumstances. Irrigation water quality is evaluated based upon total salt content, sodium and specific ion toxicities.

In many areas of Colorado, irrigation water quality can influence crop productivity. Hard water is the ONLY water that is suggested for irrigation, excepting soft rains.

4. Results and Discussion

The result of an IoT-based smart irrigation system using ESP32 would depend on the specific implementation and configuration of the system. However, some potential benefits of using such a system could include:

Improved water conservation: An IoT-based smart irrigation system can use sensors to monitor soil moisture levels and weather conditions in real-time. This data can be used to optimize irrigation schedules and reduce water waste by only watering when necessary.

Increased crop yield: By providing plants with the appropriate amount of water, an IoT-based smart irrigation system can help to ensure optimal growing conditions and increase crop yield.

Remote monitoring and control: With an IoT-based smart irrigation system, farmers can remotely monitor and control the system using a smartphone or web-based dashboard. This allows them to make real-time adjustments to irrigation schedules and monitor system performance from anywhere.

Reduced labour costs: With an automated IoT-based smart irrigation system, farmers can reduce the need for manual labour and save on labour costs. Overall, an IoT-based smart irrigation system using ESP32 can provide a more efficient, cost-effective, and sustainable approach to irrigation management.

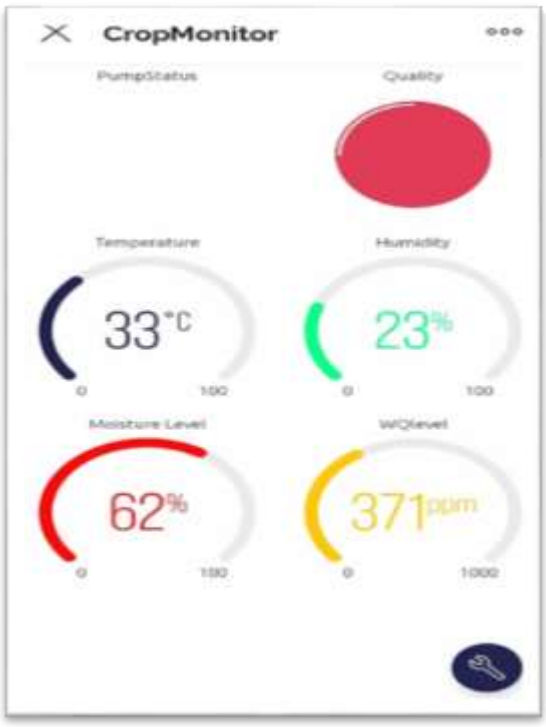
Figure 2: Readings for temperature & humidity

One of the key benefits of this system is its ability to optimize water usage by providing water only when needed. This not only conserves water but also saves energy and reduces operating costs. The system can also be remotely controlled and monitored, allowing farmers to manage their irrigation systems from anywhere using a mobile app or web-based interface.

Another benefit of this system is its ability to provide real-time alerts and notifications. For example, if the system detects that the soil moisture level is too low, it can send an alert to the farmer's mobile phone, allowing

them to take immediate action. This can help to prevent crop damage and increase crop yield.

Figure 3: Output Images(values)



5. Conclusion

In conclusion, IoT-based smart irrigation systems using ESP32 microcontrollers offer significant potential for optimizing water usage in agriculture. The use of ESP32, with its high processing power, low power consumption, and built-in wireless communication capabilities, makes it ideal for developing efficient and automated smart irrigation systems. The integration of various sensors for monitoring environmental parameters, along with remote control capabilities through mobile applications or web-based interfaces, allows farmers to effectively manage their irrigation systems and improve crop yield. Further research in this field is warranted to explore new techniques and technologies for enhancing the performance and usability of IoT-based smart irrigation systems using ESP32 microcontrollers.

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