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Smart Irrigation System using IoT

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ABSTRACT—India has seen a long history of agricultural growth and agriculture is a core component that makes up a large chunk of our national GDP. With that said, the agriculture sector has been waiting for a technological revolution of sorts for years now. This paper explores the possibility of automating the irrigation process for cultivation of plants with the aid of IoT and suggests a method for accomplishing this.

Index Terms—IoT, Irrigation System, NodeMCU, DHT11 Sen- sor, ESP8266

I. INTRODUCTION

We propose building an IoT based Irrigation System using the ESP8266 NodeMCU Module and DHT11 Sensor. It will not only automatically irrigate the water based on the moisture level in the soil but also send the data to a dedicated server to keep track of the land condition.

The major goals we're trying to accomplish with this system are-

- To control the drip irrigation system in an automated fashion, but still be able to turn on individual zones manually when needed.
- Eliminate reliance on the cloud, this system should work over the local network.
- Being able to extend to any number of zones with relative ease.
- The complete autonomous operation via sensing soil moisture levels creating a hands-free experience for the farmers.
- Bring the overall cost of the system be feasible and accessible to the masses, while the system also must be reliable.

II. LITERATURE REVIEW

M. N. Rajkumar, S. Abinaya and V. V. Kumar, "Intelligent irrigation system — An IOT based approach," discuss the various possibilities for improving crop yeild and suggest a system for intelligent irrigation. [1]

The motivation for the review paper by Wei Li, Muhammad Awais, Weimin Ru, Weidong Shi, Muhammad Ajmal, Saad Uddin and Chenchen Liu came from the developing countries where the economy is mostly dependent on agriculture and climate conditions. Based on current conditions and historical records, profitability in production farming depends on making a right and timely operational decision. [2]

García L, Parra L, Jimenez JM, Lloret J, Lorenz P. Deter- mine the parameters that are monitored in irrigation systems regarding water quantity and quality, soil characteristics and Mweatherconditions. They provide an overview of the most utilized nodes and wireless technologies. They also discuss the challenges and the best practices for the implementation of sensor-based irrigation systems [3]

III. SYSTEM COMPONENT BREAKDOWN

1) NodeMCU
2) Relay Module
3) Soil Moisture Sensor YL-69
4) 12V 2A Power Supply
5) DC Motor
6) DHT11 Sensor
7) Servo Motor

A. Node MCU

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added. While testing on multiple other platforms, we found this platform as the most cost-effective and reliable option for our use case.

B. Modules, Motors and Sensors

A standard relay module, 12Volt power supply unit, appro- priate DC motors, servo motor for the purpose of manipulating the valves for water

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flow.DHT11 sensor and YL-69 Moisture sensor for logging in the data.

IV. PROPOSED SYSTEM

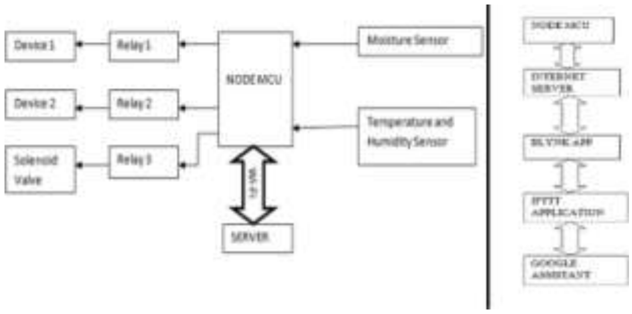

Fig. 1. System Block Diagram

Our system is based on an endless loop that essentially keeps measuring the moisture data to monitor soil health and once a drop below the threshold is detected we trigger the valves to release water. Once the moisture content reaches a threshold again, the water is stopped and a healthy level is maintained.

A. System Contruction

Step 1: The first step is to connect all the components as per the connection diagram. Start with connecting basic components like powering up the ESP32 module, sensors, and solenoid valve.

Step 2: Connect Sensors and relay board to general purpose input/output ports.

Fig. 2. Circuit diagram for the proposed system

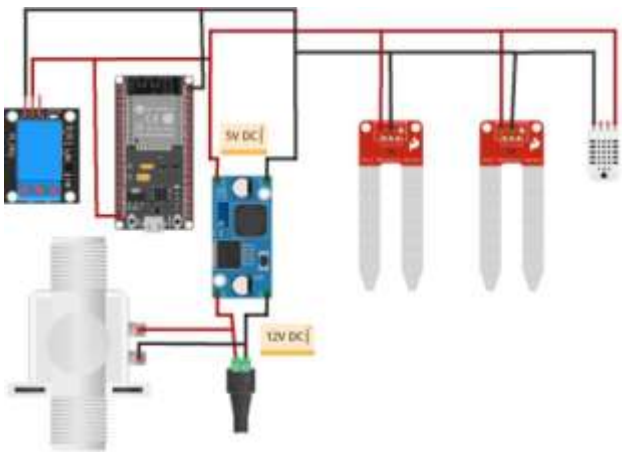

Fig. 3. Connection of sensors and relay board to I/Os

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Step 3: After connecting the peripheral to the ESP32. Connect the USB cable to the ESP32 and upload the given code.

V. ALGORITHM

The basic underlying algorithm that keeps looping over infinitely to make the irrigation system function the way we want it to be:

1) The YL-69 Moisture Sensor detects the moisture level of the soil.
2) This reading is sent to the Microcontroller (NodeMCU).
3) The value received is checked against a threshold over and over again in short intervals.
4) The servo is triggered to operate the valve and then accordingly water supply is stopped/started.

VI. SOFTWARE STACK

The following software stack was utilized-

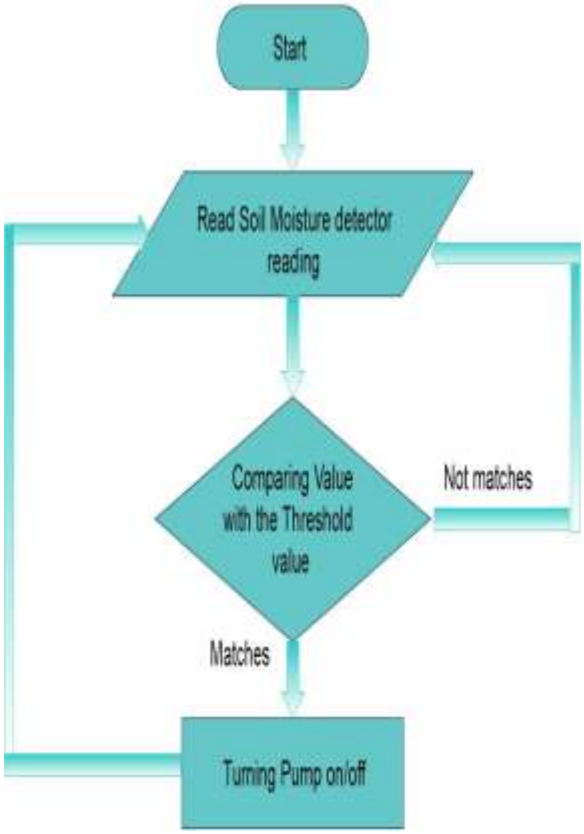

Fig. 4. Flowchart demonstrating the basic algorithm

A. Arduino IDE

For configuring and programming on the NodeMCU plat- form we ended up using the Arduino IDE as it is compatible with the platform and comes with some utility libraries that come in handy.

B. Blynk

Blynk is an IoT development solution for mobile platforms. The main reason to choose this platform was the stability and performance optimization that's offered along with the quick shipping of application packages and in-built support for NodeMCU.

This is also the solution we're using to build our monitoring dashboard and emergency manual controls and kill-switch.

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VII.SCREENSHOTS

Fig. 5. Dashboard for monitoring the readings and the kill switc

Fig. 6. Live readings when the irrigation pump is in the "ON" state.

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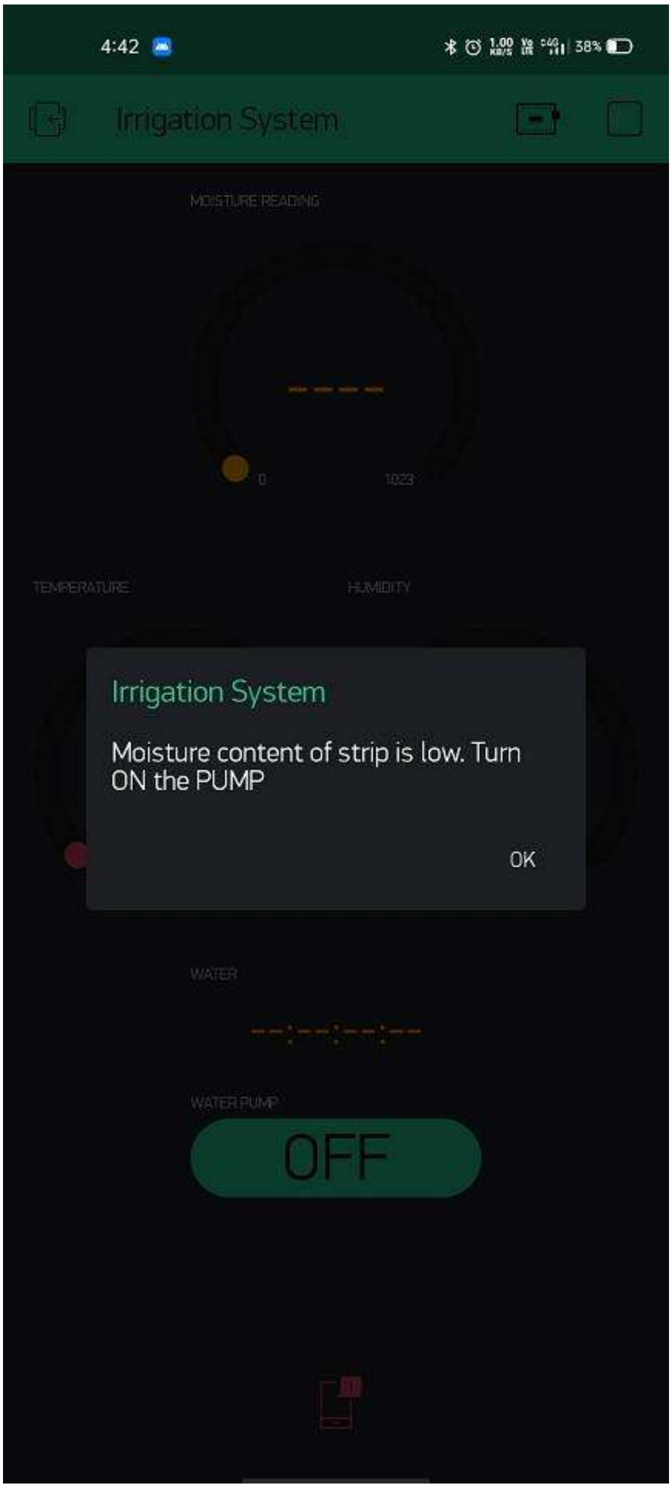

Fig. 7. Low Moisture Content Alert when read value is lower than the threshold

VIII. FUTURE SCOPE

The system will produce a considerable amount of data within a reasonable amount of time, and we propose the possibility of utilizing this data to produce a dataset of plant health measured against soil moisture.

There is also the possibility of easily expanding to more types of sensors and various other types of plant health metrics to be checked with minimal overhead to installation and operation costs of the system currently proposed.

Perhaps we could explore moisture content as a parameter to a deep neural network and learn the appropriate value of moisture for particular plant species. The possibilities are endless once we have enough data and deep learning is involved.

IX. CONCLUSION

The Smart Irrigation System using IoT that we've proposed is reliable, cost-effective and easily maintainable. There are considerations for various fails as manual controls are in place for any emergencies. As discussed in the previous section, the future scope of this system is intriguing to say the least.

This is a hands-free system in the world's truest sense. It eliminates quite possibly the most mundane task of agriculture and reduces cost of produce by removing the extra capital spent on hiring people for irrigation in more manual solutions for this task and allows the people involved to spend time in more productive tasks.

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