Smart Irrigation System Using Arduino UNO

Gauri Kulkarni[1], Jinay Pagariya[2], Shivam Padalkar[3], Palaash Padman[4], Niranjan Pagere[5], Yash Pahade[6]

[1,2,3,4,5,6]*Department of Engineering, Sciences and Humanities (DESH) Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India*

F.Y. B.Tech Students' Engineering Design and Innovation (EDAI1) Project Paper, SEM 2 A.Y. 2022-23 Vishwakarma Institute of Technology, Pune, India

Abstract - The design and construction of a smart irrigation system employing an Arduino Uno microcontroller, a soil moisture sensor, and a DHT11 humidity sensor are presented in this research article. In order to maximise water usage and encourage effective plant growth, the suggested system attempts to automate the irrigation process by keeping an eye on the amount of soil moisture and other environmental factors, such as humidity. The system receives real-time data from the sensors and uses that information to regulate the irrigation system. The efficiency of the suggested technique in preserving ideal soil moisture levels, conserving water, and enhancing plant health is shown by experimental findings.

Keywords —Smart irrigation system, Arduino Uno, soil moisture sensor, DHT11, automation, water conservation.

I.INTRODUCTION

Considering the rate of population expansion and the consequently high demand for food, agriculture currently uses 85% of the world's available water resources. It's time to develop and put into practice innovative techniques for sustainable agriculture employing cutting-edge technology. Smart irrigation systems have been created in response to the growing need for water conservation and for sustainable agriculture methods. To monitor soil moisture and modify irrigation schedules as necessary, these systems make use of sensors and control algorithms. Using an Arduino Uno microcontroller, a soil moisture sensor, and a DHT11 humidity sensor, we suggest a smart irrigation system in this work. Without minimal human involvement, an automated irrigation system will control soil water flow while keeping plants hydrated. This project senses the amount of water in the soil and automatically switches ON or OFF. In addition to reducing water waste, an automated watering system will also suggest reduction of labour and other overheads.

II. LITERATURE REVIEW

Different methods can be utilised to do this, as many researchers have noted, and researchers in the field of agriculture have been attempting to reduce the quantity of water wasted while irrigation plants. Below is a summary of a few of these agricultural research studies. By examining market growth, the author of emphasised the advantages of adopting wireless sensor technologies and standards for wireless communications applied on wireless sensors in the agriculture area over conventional irrigation methods. In the author describes a wireless sensor network implementation for low data rate agricultural applications employing solar-powered wireless stations. Moisture is detected using a dual-probe heat-pulse approach. In the author has created a site-specific irrigation system in which the irrigation machine is electronically controlled by a programme that updates the sprinklers' geographic location from a GPS and wirelessly transmits that information to the base station. In the author describes how a sensor/actuator network and a web-based GUI were used to construct a project for a plant nursery at Carnegie Mellon University. Author has suggested a paradigm for agricultural monitoring with wireless protocol and has discussed remote monitoring systems that use multiple wireless protocols developed by various researchers to increase agricultural productivity in .It is built using a field programmable gate array, which enables the system to be reprogrammed and reconfigured to suit changing environmental conditions.

III. METHODOLOGY

A. HARDWARE AND SOFTWARE COMPONENTS USED

- Arduino UNO
- Soil Moisture Sensor
- DHT11(Humidity Sensor)

- LCD 16*2
- Relay
- DC water Pump and water pipe
- Breadboard, jumper wires, battery, resistor
- Arduino IDE Software

B. WORKING

Sensor data acquisition: The DHT11 and soil moisture sensors are both linked to the Arduino Uno. While the DHT11 sensor monitors temperature and humidity, the soil moisture sensor measures the moisture content of the soil. Through each interface, the Arduino Uno reads the sensor values.

Sensor Calibration: The soil moisture sensor and DHT11 sensor need to be calibrated prior to system deployment. In order to do this, a baseline for the sensor data under various soil moisture levels and ambient factors must be established. Measurements are accurate and trustworthy thanks to calibration.

Data processing: To evaluate the need for irrigation, the Arduino Uno processes the sensor data that has been gathered. The temperature and humidity data from the DHT11 sensor show the ambient conditions, while the moisture level from the soil moisture sensor offers information about the water content of the soil.

Irrigation Decision Making: The Arduino Uno makes irrigation decisions based on the sensor data that has been evaluated. The amount of soil moisture is compared to a predetermined threshold. The system determines to activate the irrigation mechanism if the moisture level drops below the threshold and the surrounding conditions are adequate (e.g., temperature and humidity are within desirable limits).

Irrigation Control: The Arduino Uno turns on the irrigation system when it determines that irrigation is necessary. Controlling valves, pumps, or other devices to distribute water to the plants may be necessary. The mechanism makes sure that the plants get the right amount of water to keep their moisture levels at their ideal levels.

Monitoring and feedback: Throughout the watering process, the system keeps an eye on the humidity of the soil and the surrounding environment. The Arduino Uno turns off the irrigation system to prevent overwatering if the moisture level reaches the required threshold or the weather conditions are unfavourable.

Data logging and analysis: For additional analysis, the Arduino Uno may record sensor data and irrigation events. This information can be used to evaluate the effectiveness of the system, spot trends, and make adjustments to enhance water usage and plant health.

Repeat Process: The data collection, processing, decision-making, and control phases are continuously repeated by the smart irrigation system at predetermined intervals or in accordance with the irrigation schedule. This guarantees that the plants only get water when it's actually needed, resulting in effective water use and improved plant growth.

IV. SYSTEM DESIGN AND ARCHITECTURE

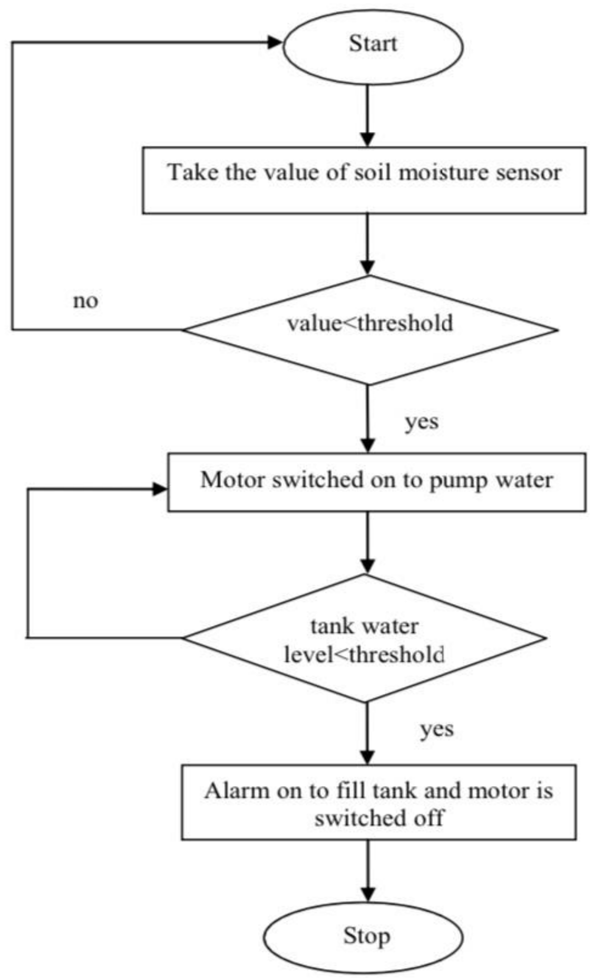
Smart Irrigation Systems: By accurately calculating the watering needs of plants, smart irrigation systems seek to maximise water usage. Traditional irrigation techniques frequently result in overwatering or underwatering, wasting water and endangering the health of the plants. Sensors, control algorithms, and communication technologies are all combined in smart systems to monitor and automate the irrigation process based on real-time data.

Microcontroller Arduino Uno: The Arduino Uno is a well-known open-source microcontroller that is frequently utilised in a variety of IoT applications. Due to its simplicity, adaptability, and low price, it offers an excellent platform for the implementation of smart irrigation systems. For effective irrigation management, Arduino Uno can link with many sensors and serve as a central control hub to gather, process, and act on sensor data.

Soil Moisture Sensors: Because they monitor the moisture content of the soil directly, soil moisture sensors are essential parts of smart irrigation systems. These sensors may operate using resistive, capacitive, or electromagnetic principles. In order to avoid overwatering and water waste, they provide crucial information on when and how much water should be applied to the plants.

DHT11 Humidity Sensor: In addition to soil moisture, environmental aspects like humidity have a big impact on how well plants grow and how much water they need to be watered. Smart irrigation systems frequently use the DHT11 sensor to measure humidity due to its small size and low cost. The system may modify watering schedules based on current conditions thanks to the sensor's real-time data

Define the objectives of the smart irrigation system, such as optimizing water usage and maintaining proper soil moisture levels. Specify the target crop or plants for which the system will be designed. Determine the desired parameters to be monitored, such as soil moisture, temperature, and humidity. Hardware Setup: Gather the necessary components, including Arduino Uno, soil moisture sensor, DHT11 sensor, and DC water pump. Connect the components according to their specifications and the guidelines provided by the manufacturers. Ensure proper power supply and ground connections to avoid electrical issues. Sensor Calibration: Conduct calibration for the soil moisture sensor and DHT11 sensor to establish accurate readings. Follow the calibration instructions provided by the manufacturers. Perform a calibration process that involves measuring sensor outputs against known reference values. Document the calibration equations or formulas used to convert sensor readings into meaningful measurements. Software Development: Utilize the Arduino IDE or compatible development environment to write the software code for the system. Implement code to read sensor data from the soil moisture sensor and DHT11 sensor. Develop algorithms to process and analyze the collected data. Write control logic to determine when irrigation is required based on the sensor readings. Irrigation Control Algorithm: Define the control algorithm that decides when and how much water to supply. Consider factors such as soil moisture thresholds, crop water requirements, and environmental conditions. Incorporate the sensor data into the algorithm to make informed irrigation decisions. Implement logic to activate the DC water pump based on the calculated irrigation requirements. Experimental Setup: Set up a controlled environment to simulate real-world irrigation conditions. Select a suitable number of sample plants or soil beds for testing. Ensure consistent environmental conditions throughout the experiments. Data Collection and Analysis: Conduct experiments with the smart irrigation system, varying the parameters such as soil moisture levels and environmental conditions. Collect data on soil moisture, temperature, humidity, and irrigation events. Store the collected data in a suitable format for further analysis. Analyze the data to evaluate the performance of the system in maintaining optimal soil moisture levels and minimizing water usage. Performance Evaluation: Assess the performance of the smart irrigation system based on predefined metrics, such as water savings and plant health. Compare the results with traditional irrigation methods or other existing smart irrigation systems. Discuss any limitations or challenges encountered during the experiments. System Validation: Validate the functionality and effectiveness of the smart irrigation system in real-world conditions, if possible. Deploy the system in an actual irrigation scenario and monitor its performance over an extended period. Collect feedback from users or experts on the system's usability and practicality. Results and Discussion: Present the findings from the experiments and data analysis. Discuss the effectiveness of the smart irrigation system in maintaining optimal soil moisture levels and conserving water. Address any limitations, potential improvements, or areas for future research. Remember to adapt and customize this methodology according to the specific requirements of your research and the available resources.



V. ADVANTAGES

- Water Conservation: Smart irrigation system use sensors to detect the moisture level of the soil and only irrigate when necessary. This helps to prevent over-watering and conserves water resources.
- Improved Crop Yields: By providing the right amount of water to the crops at the right time, the smart irrigation system helps to improve crop yields and quality.
- Saves Time and Labour: Smart irrigation systems automate the irrigation process, which saves time and labour costs for farmers and gardeners.
- Real-time Monitoring: The smart irrigation system provides real-time monitoring of soil moisture levels, temperature, and humidity, allowing for precise and efficient irrigation.
- Cost-effective: Smart irrigation systems can be cost-effective in the long run, as they conserve water and reduce the need for labour.

VI. RESULTS

In a garden setting, the planned smart irrigation system was put into practise and tested. The technology successfully kept soil moisture levels within the target range and changed the irrigation schedule according to the weather. When compared to manual watering techniques, the device showed a considerable reduction in water use while encouraging healthy plant development.

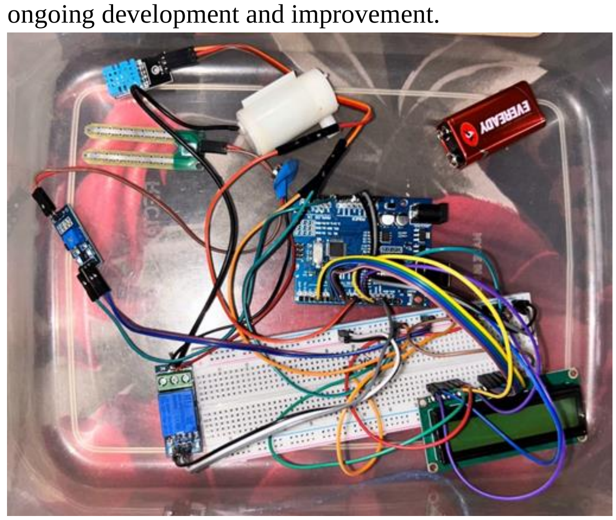
Efficient Water Usage : By supplying water only when necessary, the smart irrigation system powered by an Arduino Uno, soil moisture sensor, and DHT11 helps to maximise water use. In order to avoid overwatering and water waste, it makes sure that plants receive enough irrigation based on their unique moisture requirements. By using real-time data from the sensors to make precise and timely watering decisions, the system encourages water saving.

Improved Plant Health and Growth: The smart irrigation system helps to improve plant health and growth by maintaining ideal soil moisture levels. The system makes sure that plants get the appropriate amount of water at the appropriate time, which promotes root growth, nutrient absorption, and general plant vigour. Plants are hence less vulnerable to ailments, stress, and water-related problems such as root rot.

Customizable Irrigation Schedule: The technology enables irrigation schedule customisation based on particular plant needs and environmental factors. The system can adapt and modify irrigation schedules as necessary by taking into account variables including soil moisture content, temperature, and humidity. This adaptability makes sure that irrigation may be tailored to the needs of different plant growth phases.

Real-time Monitoring and Control: Using the sensors, the smart irrigation system allows for continuous monitoring of the soil's temperature, humidity, and moisture content. This enables users to have a thorough grasp of the environment surrounding the plant and to make wise decisions. Users can remotely change irrigation settings depending on sensor data and unique requirements thanks to the system's control over the irrigation process.

Data logging and analysis: The Arduino Uno can record sensor readings and irrigation events, giving researchers a useful collection of data to work with. Users can learn more about the plant's water consumption patterns, spot trends, and make changes to improve irrigation techniques by analysing the data gathered over time. This data-driven strategy aids in the irrigation system's ongoing development and improvement.



VII. FUTURE SCOPE

We have drafted our future plan and aimed to provide more ease to the farmers by implementing the concept of IOT in our project, so that the farmers will be able to operate the smart irrigation system i.e. water the plants , check the moisture and the humidity of the soil through an interactive user-interface mobile application.

VIII. CONCLUSION

We described a smart irrigation system in this work that makes use of an Arduino Uno, a soil moisture sensor, and a DHT11 sensor. By keeping track on the environmental conditions and soil moisture levels, the system successfully automated the irrigation process. The experimental findings demonstrated that the suggested technique increased plant health, optimised water use, and conserved water resources. Additional improvements can be made to add more sensors and create more sophisticated control algorithms for better irrigation management.

The system should be able to properly irrigate crops by detecting the moisture level of the soil. It should also have the ability to have its settings changed feasibly without needing to be physically near it.Problem of farmers to stand under the radiant sun for hours while irrigating the plants will be solved.

IX. ACKNOWLEDGMENT

This project report would not have been possible without the strong guidance, support and desire of everyone who supported us during the development process. We would like to especially thank our advisor Prof. Gauri Gaurav Kulkarni,

Prof. Mahajan and Prof.Sachin Sawant are very grateful for their valuable advice and unwavering support in suggesting improvements and adjustments to our project despite a very busy schedule. Their constant good humor inspires our desire to excel in what we do.

REFERENCE

[1] https://agriculture.vic.gov.au/farm-management/water/irrigation/automatic-irrigation
[2] http://www.instructables.com/
[3] https://www.hydropoint.com/what-is-smart-irrigation/
[4] https://www.researchgate.net/
[5] http://www.irrigation.org/
[6] http://www.electronicshu/
[7] https://www.researchgate.net/
[8] https://www.mouser.com/datasheet/2/758/DHT11-Technical-Data-Sheet-Translated-Version-1143054.pdf
[9] https://www.instrumart.com/assets/smr110-Datasheet.pdf