International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 06 | June - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

Smart Irrigation System Using Internet of Things

Aniket Nana Bagul
Student of ComputerTechnology
MVPS's RSM Polytechnic,Nashik
abagul631@gmail.com

Om Mukund Kulkarni
Student of ComputerTechnology
MVPS's RSM Polytechnic,Nashik
ommkulkarni2021@gmail.com

Harsh Dinesh Lohar
Student of ComputerTechnology
MVPS's RSM Polytechnic,Nashik
harshlohar102005@gmail.com

Guide

Prof R.S.Derle Lecturer,Computer Technology Department MVPS's RSM Polytechnic Nashik
rahul.derle@rsmpoly.org

***Abstract*—This paper presents The IoT-based smart irrigation system represents a breakthrough in modern agriculture, seamlessly merging sensor technology, weather data analysis, and remote control capabilities. Soil moisture sensors and weather stations continuously monitor environmental conditions, allowing for precise irrigation scheduling tailored to crop needs. The central control unit acts as the system's hub, employing machine learning algorithms to optimize water usage based on real-time and historical data. Actuators are then activated to deliver water precisely where and when needed. Through web or mobile applications, farmers can remotely monitor and adjust irrigation parameters, ensuring proactive management and resource conservation. This innovative system not only enhances crop productivity but also contributes to sustainable farming practices by reducing water wastage and operational expenses.**

The IoT-based smart irrigation system revolutionizes agriculture by integrating sensors, weather data, actuators, and a central control unit. Soil moisture sensors and weather stations provide real-time data, aiding in precise irrigation scheduling.

Keywords—smart irrigation, Esp32 Node Mcu, soil sensor, dht 11 sensor, water pump,Transformer.

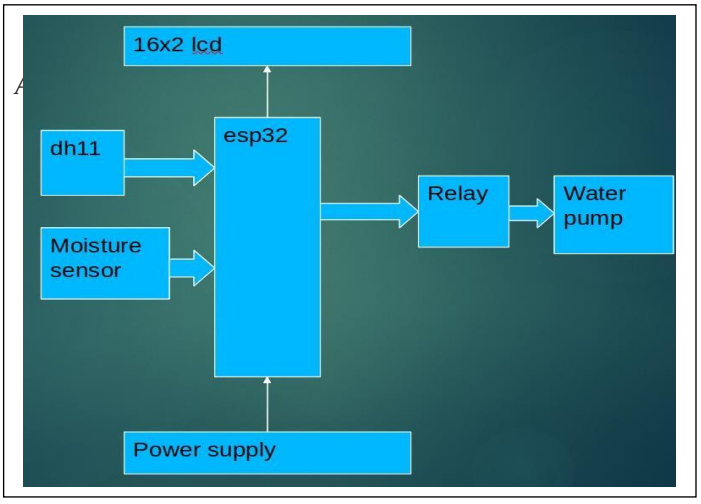
I. INTRODUCTION

In India, where 60-70 percent of the economy depends on agriculture, there is an urgent need to modernize conventional farming practices to enhance productivity and sustainability. Smart irrigation systems offer a promising solution to this challenge by revolutionizing the way water is managed in agricultural fields.

Unlike traditional irrigation methods, which often result in the overuse or underuse of water resources, smart irrigation systems regulate the supply of water based on real-time data and environmental conditions. The feedback mechanism of these systems typically involves sensors such as moisture sensors, temperature sensors, and humidity sensors. These sensors continuously monitor soil moisture levels, temperature variations, and humidity levels, providing valuable insights into the water requirements of crops.

One technology commonly used for moisture sensing is gypsum blocks. These blocks are buried in the soil and measure soil moisture levels based on changes in electrical conductivity. By incorporating gypsum blocks or similar moisture sensing technologies into smart irrigation systems, farmers can accurately determine when and how much water to apply to their fields, optimizing water usage and minimizing wastage.

Water scarcity is a significant concern in agriculture, particularly in regions like India where water resources are limited. Smart irrigation systems help address this challenge by ensuring that water is used efficiently and effectively. By delivering the right amount of water at the right time, these systems enable farmers to achieve higher crop yields while conserving water resources for future generations.



Moisture sensor: This sensor is inserted into the soil. It measures the moisture content of the soil and sends a signal to the ESP32 microcontroller.

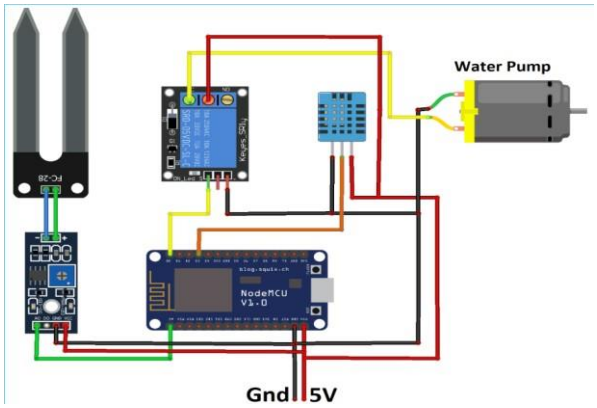
ESP32 microcontroller: The ESP32 microcontroller is the brain of the system. It receives the signal from the moisture sensor and determines if the soil is dry enough to require watering.

Relay: The relay acts as a switch that controls the water pump. When the ESP32 microcontroller determines that the soil is dry, it sends a signal to the relay, turning on the water pump.

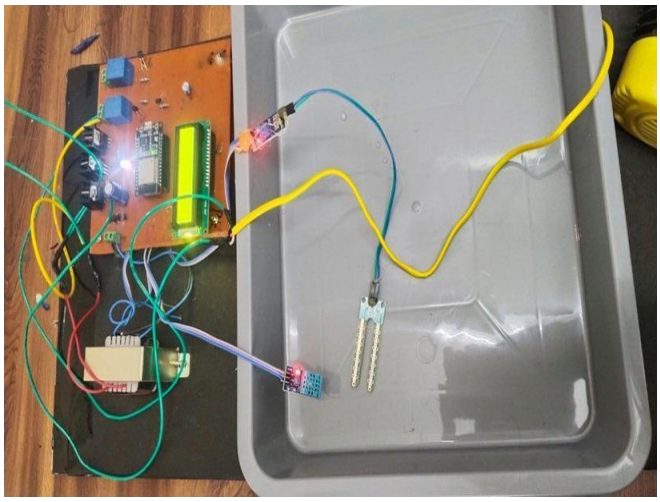
Water pump: The water pump pumps water to the plants.

Power supply: The power supply provides electricity to theentire system.

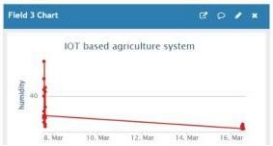
B. Circuit Diagram of irrigation System-



C. Project Hardware :



D. Project Output :



III.LITERATURE SURVEY.

1. Srishti Rawal (IOT based Smart Irrigation System 2017): Automation of farm activities can transform the agricultural domain from being manual and static to intelligent and dynamic leading to higher production with lesser human supervision.

2. m. gayathri(Smart Irrigation System using IoT 2021) :This provides a solution for the problems in developing a smart farming system.

3. Lorena parra (IoT-Based Smart Irrigation Systems 2020) :Water management is paramount in countries with water scarcity. This also affects agriculture, as a large amount of water is dedicated to that use.

4. Zuraida Muhammad, Muhammad Azri Asyraf Mohd Hafez, Nor Adni MatLeh, Zakiah Mohd Yusoff , Shabinar Abd Hamid [1]: The term "Internet of Things" refers to the connection of objects, equipment, vehicles, and other electronic devices to a network for the purpose of data exchange (IoT). The Internet of Things (IoT) is increasingly being utilized to connect objects and collect data. As a result, the Internet of Things' use in agriculture is crucial. The idea behind the project is to create a smart agriculture system that is connected to the internet of things. The technology is combined with an irrigation system to deal with Malaysia's variable weather.

5. Divya J., Divya M.Janani V. [2] : Agriculture is essential to India's economy and people's survival. The purpose of this project is to create an embedded-based soil monitoring and irrigation system that will reduce manual field monitoring and provide information via a mobile app. The method is intended to help farmers increase their agricultural output. A pH sensor, a temperature sensor, and a humidity sensor are among the tools used to examine the soil.

6.Rakesh Kumar et al. (2019): In their paper titled "IoT Based Smart Agriculture Monitoring System," the authors propose an IoT-based solution for monitoring and managing agricultural parameters. They focus on integrating various sensors to monitor soil moisture, temperature, humidity, and light intensity. The system provides real-time data to farmers, allowing them to make informed decisions regarding irrigation, fertilization, and pest control, ultimately improving crop yields and resource efficiency.

7. Ramesh et al. (2020): The study titled "Design and Implementation of Smart Irrigation System Using IoT" presents a comprehensive framework for an IoT-based smart irrigation system. The system incorporates soil moisture sensors, temperature sensors, and a microcontroller-based control unit. Through a web or mobile application, farmers can remotely monitor soil conditions and control irrigation schedules, enhancing water efficiency and crop productivity.

8. Sathya et al. (2021): In their research on "IoT-Based Smart Irrigation System Using Machine Learning," the authors explore the integration of machine learning algorithms into smart irrigation systems. By analyzing historical data and environmental factors, the system predicts future water

requirements and adjusts irrigation schedules accordingly. This predictive approach improves water management efficiency and crop yield prediction accuracy.

9. Sharma et al. (2018): The paper "Smart Irrigation System for Efficient Water Management in Agriculture Using IoT" focuses on developing an intelligent irrigation system capable of conserving water while maintaining optimal soil moisture levels. The system employs IoT-enabled sensors to monitor soil moisture and weather conditions, enabling automated irrigation control based on preset thresholds. This approach minimizes water wastage and ensures sustainable agriculturalpractices.

10. Banerjee et al. (2022): In their recent study titled "Enhancing Agricultural Productivity through IoT-Based Smart Irrigation Systems," the authors investigate the impact of smart irrigation systems on agricultural productivity and resource utilization. Through field experiments and data analysis, they demonstrate the effectiveness of IoT-enabled irrigation in improving crop yields, conserving water, and reducing operational costs, highlighting its potential for widespread adoption in agricultural practices.

IV.BENEFITS

Water Conservation: By using sensors to measure real-time soil moisture levels, these systems deliver water only when and where it's needed. This can significantly reduce water waste compared to traditional timer-based systems.

Improved Efficiency: Smart irrigation automates watering schedules, freeing up time and effort for managing other aspects of your landscape or farm.

Precision Watering: These systems can consider various factors like weather data, plant types, and soil conditions to deliver the optimal amount of water for each area. This promotes healthier plant growth and reduces the risk of disease caused by overwatering.

Remote Monitoring and Control: Using a mobile app or web interface, you can monitor soil moisture, weather conditions, and system status remotely. This allows you to make adjustments to the watering schedule from anywhere, ensuring your plants get the care they need even when you're away.

Energy Efficiency: By accurately timing watering based on real-time data, smart irrigation systems can reduce energy consumption associated with water pumps and sprinkler systems.

V.FUTURE SCOPE

Precision Agriculture Integration: Integrating IoT-based smart irrigation systems with other precision agriculture technologies, such as drones and satellite imaging, can provide farmers with comprehensive insights into crop health, soil conditions, and water distribution across large agricultural areas. This integration enables more precise decision-making and resource allocation, leading to further improvements in productivity and sustainability.

Crop-Specific Optimization: Tailoring irrigation strategies to the specific water requirements of different crops can optimize resource usage and maximize yields. Future developments may involve incorporating crop-specific data and models into smart irrigation systems to deliver customized irrigation schedules and recommendations based on the type of crop being cultivated.

Predictive Analytics: Leveraging advanced data analytics techniques, such as machine learning and predictive modeling, can enable smart irrigation systems to anticipate future water requirements and optimize irrigation schedules proactively. By analyzing historical data alongside real-time sensor inputs, these systems can forecast irrigation needs with greater accuracy, thereby enhancing efficiency and resource management.Integration with IoT Ecosystems: Expanding the connectivity and interoperability of smart irrigation systems with broader IoT ecosystems can unlock additional functionalities and benefits. For example, integrating with smart farming equipment, such as automated tractors or robotic harvesters, can streamline farm operations and enhance overall efficiency.

Water Resource Management: Beyond individual farm-level applications, IoT-based smart irrigation systems can contribute to broader water resource management initiatives. By aggregating data from multiple farms and geographic regions, these systems can support policymakers and water authorities in making informed decisions about water allocation, conservation measures, and drought mitigation strategies.

Energy Efficiency and Sustainability: Exploring renewable energy sources, such as solar power, to meet the energy requirements of smart irrigation systems can further enhance their sustainability and reduce operational costs. Additionally, incorporating water-saving technologies, such as drip irrigation and soil moisture retention techniques, can complement smart irrigation systems to achieve even greater water efficiency and environmental sustainability.

Adoption of Blockchain Technology: Implementing blockchain technology to secure and streamline data exchange within smart irrigation systems can enhance data integrity, transparency, and trust among stakeholders. By enabling tamper-proof record-keeping and traceability of irrigation activities, blockchain can facilitate compliance with regulations, certifications, and sustainability standards.

Expansion to Urban Agriculture: Extending the application of smart irrigation systems beyond traditional rural farming to urban agriculture settings, such as rooftop gardens, vertical farms, and hydroponic systems, can promote sustainable food production in densely populated areas. IoT-enabled irrigation solutions tailored to urban environments can optimize resource usage and support the cultivation of fresh produce locally.

VI. CONCLUSION

IoT-enabled smart irrigation systems offer farmers valuable information on crop health, soil moisture levels, and weather patterns. This knowledge enables them to make informed decisions, optimize resource allocation, and increase crop yields while minimizing water usage and environmental impact. As technology continues to advance and IoT solutions become more affordable and widespread, the potential benefits for agricultural sustainability and productivity are immense. By embracing these innovations, farmers can not only enhance their own livelihoods but also contribute to global efforts towards sustainable development and food resilience for future generations. Thus, the integration of IoT technologies in agriculture represents a pivotal moment in the evolution of farming practices, promising a more efficient, resilient, and environmentally conscious approach to food production.

In conclusion, the implementation of IoT-based smart irrigation systems represents a transformative leap forward in agricultural technology. By leveraging remote accessibility, data analytics, and real-time monitoring, these systems empower farmers of all sizes to optimize water usage, improve crop yields, and mitigate environmental impact. The scalability and adaptability of IoT technologies ensure that these benefits are accessible to farmers worldwide, regardless of their resources or location. As we continue to confront the challenges of water scarcity, climate change, and food security, the integration of IoT in agriculture offers a beacon of hope, demonstrating the potential of technology to drive sustainable solutions and foster resilience in the face of uncertainty. By embracing innovation and collaboration, we can harness the full potential of IoT-based smart irrigation systems to cultivate a more prosperous, equitable, and resilient future for agriculture and beyond.

An IoT-based smart irrigation system offers a compelling solution for optimizing water usage and promoting sustainable agricultural practices. By leveraging sensors, microcontrollers, and cloud connectivity, this system automates irrigation based on real-time soil moisture levels, weather conditions, and plant needs. This not only conserves water but also enhances crop health and yield.

REFERENCES

[1] K. Masaba, A. Ntakirutimana, and T. S. Ustun, “Design and Implementation of a Smart Irrigation System for Improved Water-Energy Efficiency,” 4th IET Clean Energy Technol. Conf. (CEAT2016), p. 100 (5 .)-100 (5 .), 2016.
[2] B. Khelifa, D. Amel, B. Amel, C. Mohamed, and B. Tarek, “Smart irrigation using internet of things,” 2015 4th Int. Conf. Futur. Gener. Commun. Technol. FGCT 2015, no. Fgct, pp. 91–96, 2015.
[3] “The Advantages of Irrigation Systems | Home Guides | SF Gate.” [Online]. Available: http://homeguides.sfgate.com/advantages-irrigation-systems-43960.html. [Accessed: 15-May-2018].
[4] T. Sahu, “Automated Smart Irrigation System using Raspberry Pi,” vol. 172, no. 6, pp. 9–14, 2017.
[5] Venkata Naga Rohit Gunturi “Micro-controller based automatic plant irrigation system,” International Journal of Advancement in Research and Technology, Vol.2, issue 4, April 2013 p. 194-198.
[6] Srishti Rawal, “IOT based Smart Irrigation System,” vol. 159, no. 8, pp. 1–5, February 2017.
[7] Lala Bhaskar, Barkha Koli, Punit Kumar, Vivek Gaur, “Automatic Crop Irrigation System”, IEEE Conference Publications, 2015.