

Scientiarum: A Multidisciplinary Journal
Vol. 2 No. S1 (2026): Supplement Issue
DOI: 10.54646/SAPARS.2026.65

IOT BASED SMART IRRIGATION SYSTEM

Ramya C [1]

Parnapalli Pushpanjali [2] MCA 2nd year [1] , Assistant Professor [2]

Department of Computer Science and Applications [2]

S.E.A College of Science, Commerce and Arts, Bangalore [1]

ramyac360@gmail.com [1]

pushparoyal777@gmail.com [2]

Abstract

Agriculture is characterized by the need for effective utilization of water to enhance the productivity of crops and limit surplus use of water. The traditional approach of irrigation relies heavily on manual checking and might lead to problems associated with over-irrigation, under-irrigation, and misuse of water. The study provides the novelty of the IoT Based Smart Irrigation System that helps to automate the process of irrigation by monitoring the soil moisture condition in real-time. The system utilizes Arduino Uno which is attached to the soil moisture sensor ensuring the obtaining of moisture information from the soil. In accordance with the specific moisture condition set in advance, the Arduino is responsible for triggering the water pump by means of the relay module, supplying water only when necessary. The data from the sensor is passed to the Node.js and Express.js servers and stored in the MongoDB database allowing collection and processing of information for further analysis and monitoring. The possibility to monitor and check the soil moisture level, the status of the pump, and irrigation information is supported with web-based dashboard developed in

HTML5, CSS3, and JavaScript technologies. The system is characterized by user authentication

Keywords: Internet of Things (IOT), Smart Irrigation, Arduino Uno, Soil Moisture Sensor, Water Pump, Node.js, MongoDB, Smart Agriculture.

Introduction

Agriculture relies heavily on effective water management, as improper irrigation could lead to water wasted as highly inefficient. Conventional irrigation systems depend heavily on manual supervision, which makes ongoing moisture measurement impossible.

However, the Internet of Things (IoT), with its devices and sensors connected to one another, offers an excellent solution to the irrigation problem due to continuous monitoring.

The research presents a smart irrigation system powered by the Internet of Things (IoT) that employs both the Arduino Uno and soil moisture sensor in terms of controlling the pump via the relay. Besides, the gathered information will be utilized with a web application developed through HTML5, CSS3, JavaScript, Node.js, and Express.js, while MongoDB will be employed for storing data.

This developed system allows monitoring moisture levels, pump operation and irrigation history through the web interface. The system will thus help considerably lower the amount of water consumed, and offer an automated approach to the irrigation process.

Problem Statement

Traditional irrigation systems often depend on manual monitoring and fixed watering schedules, which can result in over-irrigation, under-irrigation, and unnecessary water consumption. Farmers may also face difficulties in continuously monitoring soil moisture and controlling irrigation at the required time. Therefore, there is a need for an automated and IOT-based irrigation system that can monitor soil moisture in real time, control water supply accordingly, and provide remote monitoring of irrigation activities through a web-based platform.

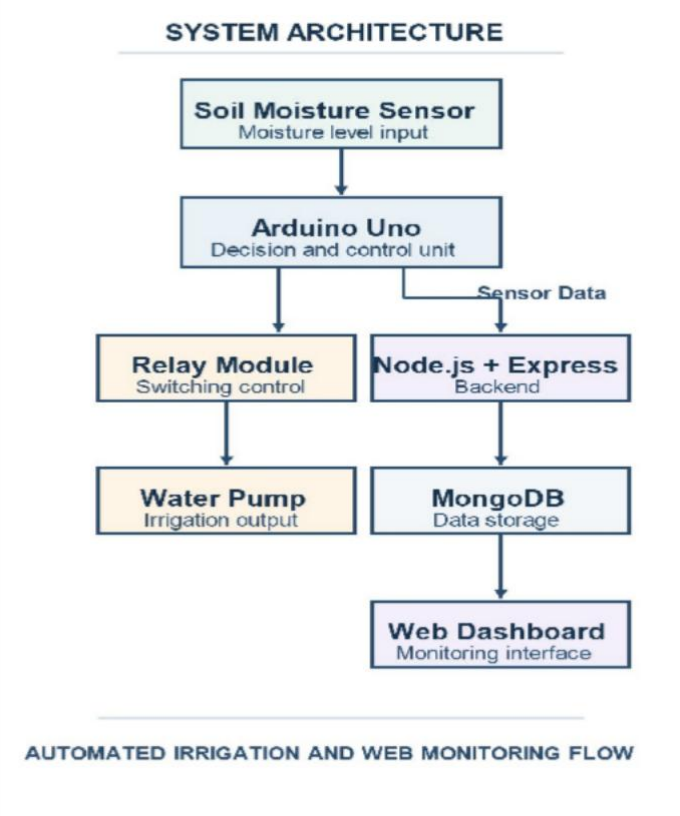
Literature Review

Earlier academic articles explained how IoT technology is useful for irrigation purposes in agriculture. Technically, these are automatic irrigation systems where soil

moisture monitor sensors and microcontrollers are used to detect soil conditions and manage water distributions.

Some technologies contain an Arduino microprocessor, which measures moisture content of soil, making the corresponding water pumps work automatically. There are also cloud applications, which allow farmers to control the agricultural parameters. Nevertheless, the majority of the technologies today are limited in terms of how they can be used either for irrigation automation or for remote monitoring, as they do not combine the monitoring functions with irrigation capability into a single system.

Figure 1: System Architecture



Skill Gap / Difference From Existing Systems

The above-mentioned technologies generally use soil moisture readings for irrigation automation, while some of them offer remote monitoring via cloud systems. Namely, the

technology we advocate offers not only the irrigation automation, but also the web monitoring and historical data collection on the irrigation system.

In this way, we use Arduino Uno microcontroller, soil moisture sensor, relay operated electric pump, web application, and MongoDB data base for gathering the data and its further processing. Unlike that, existing systems require only turning the

System Architecture

The system architecture comprises components such as sensors, controls, backend systems, databases, and user interface. The soil moisture sensor sends soil condition data to the Arduino Uno, which acts as the control unit for the water pump through a relay module. The data is processed in the backend by Node.js and Express.js, stored in MongoDB, and displayed on the web dashboard.

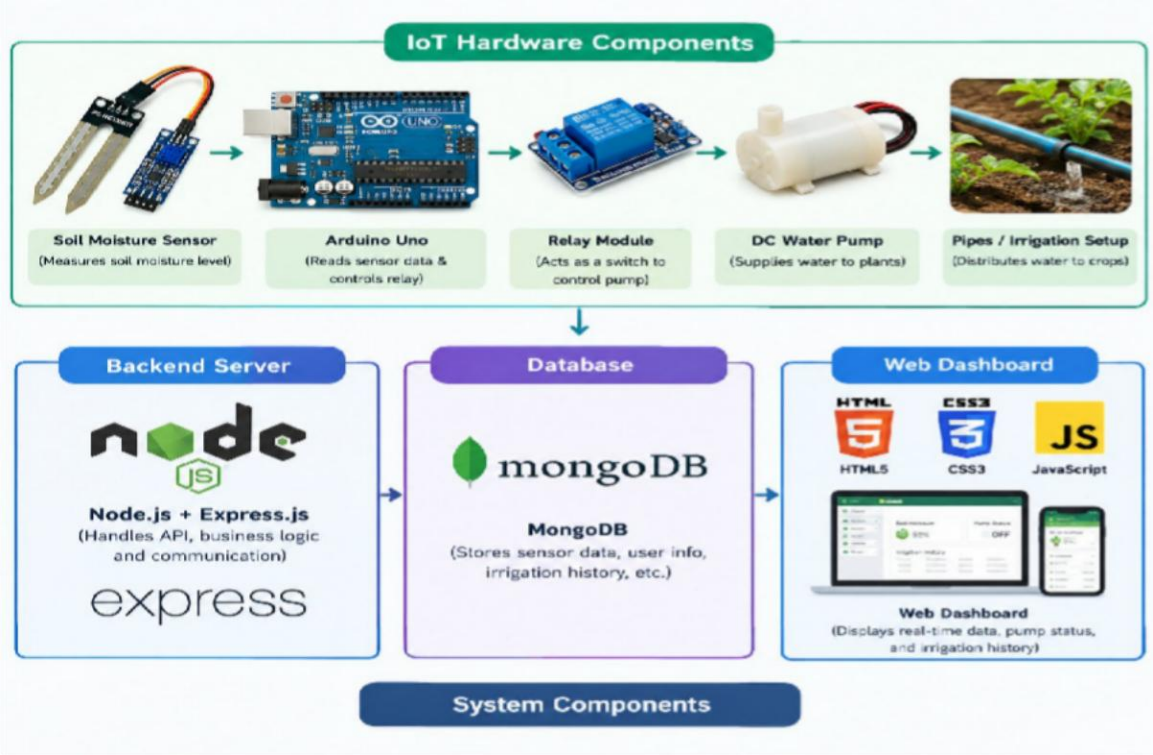
System Components

The IoT Based Smart Irrigation System discussed in this paper includes the components mentioned below:

1. Arduino Uno – This component collects readings of soil moisture through the sensor and it regulates irrigation.
2. Moisture Sensor – The moisture content of soil is measured by this tool.
3. Relay Module – The device controls the pump according to the output received from the Arduino.
4. Water Pump – The component is responsible for irrigating the plants at the right time.
5. Node and Express.js – The backend processing is done by the mentioned frameworks.
6. MongoDB – To keep a record of moisture readings, pump status, user details as well as irrigation history.

7. Web Dashboard – Designed using HTML5, CSS3, and JavaScript in order to communicate moisture content.

Figure 2: System Components



Methodology

The method used in this proposed system to execute irrigation is based on sensor technology. The soil moisture sensor is used to assess the moisture content of the soil and communicate it to Arduino Uno, which performs computations and operates the relay module to turn the pump ON or OFF, based on the level of moisture requirement.

The readings taken from the sensor and status of the pump are sent to the Node.js and Express.js based backend. The application created using HTML5, CSS3, and JavaScript shows the moisture content, as well as status of the pump.

Methodology Flow:

Soil Moisture Measurement → Arduino Processing → Relay Control → Water Pump →Backend → MongoDB → Web Dashboard

Limitations

1. Accuracy and reliability of soil moisture sensor are assumed for the system functioning.
2. Supply of reliable energy source for the Arduino, relay and water pump is needed.
3. Internet connection is necessary to enable data transmission and monitoring through the internet.
4. Readings of soil moisture mainly determine the operation of the system while not taking into account other factors which are influencing the irrigation process, for example, rainfall or other meteorological conditions.
5. Regular maintenance of the sensor, pump and irrigation connections may be needed.

Challenges

1. Sensor Precision: Keeping consistent readings of soil moisture across various types of soil.
2. Hardware Combination: Proper wiring of the Arduino, the sensor, the relay and the water pump so that everything works correctly.
3. Real-Time Transfer: Making sure that the data delivered by the sensor reaches the IoT hardware and the server correctly.
4. Data Handling: Organizing the sensor readings and the history of irrigation within the MongoDB in a proper manner.
5. System Functionality: Providing uninterrupted functioning of the water pump and the monitoring system without any failures.

Outcomes

1. The system enables automatic irrigation which depends on the moisture content of soil.

2. The status of soil moisture and pumps can be monitored through a web interface.
3. The system avoids overuse of water by providing water only when it is necessary.
4. Irrigation readings and history are stored and retrieved using MongoDB.
5. The system requires less human intervention and solves irrigation management problems.

Future Scope

1. Utilization of Weather Data: Weather and rainfall related information can be included to enhance irrigation management.
2. Creation of Mobile App: Mobile application can be created for remote monitoring.
3. Use of Additional Sensors: Sensors such astemperature, humidity and water level can also be used for effective monitoring.
4. Use of AI and Machine Learning: Machine learning methods can be applied for predicting irrigation requirements with the help of past and environmental data.
5. Large-Scale Implementation: The system can be implemented in various fields and irrigation areas.

Conclusion

The suggested IoT Based Smart Irrigation System provides an automated method of irrigation by observing soil moisture and controlling the pump based on the soil. With the use of the electronics like Arduino Uno, soil moisture sensor, relay module, Node.js, Express.js and MongoDB, the data is available in real-time through the dashboard of system made on web-based technology.

The system reduces management interference and avoids unnecessary use of water as it provides water when needed.

Thus, the proposed smart irrigation system is a demonstration of IoT technology in development of an efficient solution for smart irrigation and water management in agriculture.

References

Benzaouia, M., Hajji, B., Mellit, A., & Rabhi, A. (2023). Fuzzy-IoT smart irrigation system for precision scheduling and monitoring. *Computers and Electronics in Agriculture, 215*, Article 108407.

Enhancing water management in smart agriculture: A cloud and IoT-based smart irrigation system. (2024). *Results in Engineering*, Article 102283.

An IoT-based smart irrigation system. (2024). *Engineering Proceedings, 66*(1), Article 13.

IoT-enabled adaptive watering system with ARIMA-based soil moisture prediction for smart agriculture. (2025). *IEEE Access, 13*, 27714–27728.

IoT-enabled solar-powered smart irrigation for precision agriculture. (2025). *Smart Agricultural Technology, 10*, Article 100773.

Low power IoT electronics in precision irrigation. (2023). *Smart Agricultural Technology, 5*, Article 100310.

Smart agriculture using IoT for automated irrigation, water and energy efficiency. (2025). *Smart Agricultural Technology, 12*, Article 101081.

Togneri, R., Prati, R., Nagano, H., & Kamienski, C. (2023). Data-driven water need estimation for IoT-based smart irrigation: A survey. *Expert Systems with Applications, 225*, Article 120194.