IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

ISSN: 2581-9429

Volume 5, Issue 5, April 2025

Impact Factor: 7.67

Automated Plant Irrigation System using Arduino and IoT Optimizing Water

Bruno De Cesar Faria, Melvin Da Graca C. Monteiro, Dr Syed Arshad Ali

Department of Computer Science & Applications

Sharda School of Engineering & Technology, Sharda University, Greater Noida, India

Abstract: *Water scarcity and inefficient irrigation methods have long challenged agricultural productivity, especially in regions where every drop counts. In this study, we present an innovative automated plant irrigation system that leverages Arduino microcontrollers, IoT connectivity, and sensor networks to optimize water usage while enhancing crop yields. Traditional irrigation techniques often lead to either overwatering or underwatering, resulting in diminished crop health and wasted resources. Our approach addresses these challenges by integrating real-time soil moisture monitoring, local weather data, and machine learning algorithms to control water distribution precisely.*

The system architecture is built around an Arduino Uno, which serves as the central processing unit. It collects data from a network of sensors—including soil moisture sensors, flow meters, and optional weather modules—and processes this information to determine the optimal timing and quantity of water delivery. The decision-making process is further enhanced by intelligent algorithms that adapt to both immediate soil conditions and historical environmental trends. This automated setup not only reduces human error but also offers scalability for farms of various sizes. A significant feature is its remote monitoring capability, achieved through mobile and web interfaces that allow farmers to oversee and control the system from virtually anywhere.

Field experiments were conducted over multiple growing seasons and under varied climatic conditions. Detailed analyses revealed that our automated system could reduce water consumption by up to 40% compared to conventional irrigation methods. In addition, the precision in water application contributed to an average increase of 20% in crop yields. These improvements were accompanied by a reduction in labor costs, with operational expenses dropping by roughly 15%. The system's ability to automatically adjust watering schedules during unexpected weather changes further underscores its robustness and practical utility.

A thorough investigation of the design, implementation, and performance of the system was undertaken. Several challenges were identified during the development phase, including sensor calibration issues, network connectivity constraints in rural areas, and the integration of diverse hardware components. Each challenge was addressed through a combination of hardware fine-tuning and software algorithm adjustments. The iterative design process not only refined the performance of the prototype but also provided valuable insights into the practical constraints of deploying advanced irrigation systems in real-world agricultural settings.

In addition to presenting experimental results, this study discusses the broader implications of integrating IoT technology into agriculture. By providing real-time data analytics, the system empowers farmers to make informed decisions that are critical to sustainability and resource management. Moreover, the system's modular design offers opportunities for future enhancements, such as incorporating renewable energy sources, expanding compatibility with different crop types, and leveraging advanced predictive algorithms. The potential for such systems to revolutionize agricultural practices—by conserving water, boosting crop productivity, and reducing costs—positions this research as a significant contribution to sustainable farming practices.

This abstract sets the stage for a detailed exposition on the theoretical foundations, experimental methodology, and comprehensive evaluation of the system. The subsequent sections will delve into the *research background, a review of relevant literature, the specifics of system implementation, detailed result analysis, and finally, a discussion on future research directions. Together, these elements form a robust narrative that underscores the transformative impact of technology-driven irrigation methods on modern agriculture.*.

Keywords*:* *Water scarcity*