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Design and Implementation of an Arduino-Based Smart Irrigation System

A Project

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Abstract

Water scarcity is one of the most serious global challenges, significantly impacting agriculture and food security, particularly with the continuous increase in population and water demand. Traditional irrigation methods often depend on fixed schedules or manual operation, which do not consider real-time soil and environmental conditions. As a result, these methods lead to inefficient water usage, causing either over-irrigation that wastes water and harms soil quality, or under-irrigation that negatively affects crop growth and productivity. Therefore, there is a growing need for smart and automated irrigation systems that can optimize water usage and support sustainable agricultural practices.

This research presents the design and implementation of a smart irrigation system based on the Arduino Uno microcontroller. The system integrates soil moisture sensors to measure the water content in the soil, along with temperature and humidity sensors to monitor surrounding environmental conditions in real time. The collected data is processed by the microcontroller, which makes decisions based on predefined threshold values. When the soil moisture level drops below the required limit, the system automatically activates a water pump to irrigate the crops, and stops it once the optimal moisture level is reached.

The proposed system aims to reduce water wastage, minimize human intervention, and improve irrigation efficiency. It is designed to be low-cost, simple to implement, and suitable for small-scale farmers as well as wider agricultural applications. Experimental results demonstrate that the system uses water more efficiently compared to conventional irrigation methods, while maintaining proper soil conditions and supporting healthy crop growth.

In conclusion, the developed system provides a practical and effective solution for better water management in agriculture. It highlights the importance of integrating sensor technologies and microcontrollers in modern farming, and its future development could include advanced features such as remote monitoring and data analysis for even greater efficiency.

Keywords: Smart Irrigation System, Arduino Uno, Soil Moisture Sensor, Automated Irrigation, Sustainable Agriculture.