

ABSTRACT

Intercropping cultivation of grapevines and paprika requires an efficient environmental monitoring system to maintain optimal growing conditions and enhance productivity. This study aims to design and develop an Internet of Things (IoT)-based monitoring system capable of periodically observing environmental parameters at transmission intervals of 1 to 2 minutes. The system employs various sensors to measure air temperature, air humidity, soil moisture, soil pH, light intensity, and CO₂ levels. Data is transmitted by an ESP32 microcontroller via the MQTT protocol to a server and displayed on a Laravel-based web interface in the form of numerical data, graphs, historical tables, and irrigation status indicators. Testing results indicate that the developed system is capable of transmitting and displaying data with acceptable latency, with Publisher to Subscriber Latency (LPDS) ranging from 0.41 to 0.87 seconds, and a high data transmission success rate, with a Packet Delivery Ratio (PDR) ranging from 99.13% to 100%. The system also provides accurate and informative data visualization. The implementation demonstrates successful system design and highlights its potential for enhancing monitoring efficiency and data-driven decision-making in intercropping cultivation. The integration of IoT, MQTT, and Laravel technologies offers an intelligent solution for modern and sustainable agriculture.

Keywords: IoT, Intercropping, Laravel, Monitoring, MQTT, Smart Farming.