

ABSTRACT

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Title : *SYSTEM PRECISION FARMING: OPTIMALISASI PERTANIAN BERKELANJUTAN BERBASIS IoT DENGAN ESP32-S3, DATA SENSOR, DAN API CUACA*

Conventional irrigation systems that rely solely on local sensor readings often lead to water and energy waste, particularly when watering occurs right before rainfall. This research aims to develop and evaluate a smart irrigation system based on the Internet of Things (IoT) using the ESP32-S3 microcontroller, implementing a data fusion method. The system integrates primary data from a soil moisture sensor with secondary data, specifically the probability of precipitation, retrieved from a cloud server via the OpenWeatherMap API. Given that the seamless execution of data fusion heavily depends on internet connection stability, this study also conducted a quantitative network performance evaluation through Quality of Service (QoS) analysis using Wireshark software, benchmarked against the international TIPHON standard (ETSI TR 101 329). The data fusion logic testing demonstrated a 100% success rate across 4 environmental scenarios, where the system successfully overrode and delayed watering even in dry soil conditions when rainfall was predicted. Meanwhile, the QoS metric analysis from 30 data samples showed an average delay of 145.3 ms, jitter of 17.7 ms, absolute packet loss at 2.49%, and an average throughput of 7,3 Kbps. According to the TIPHON standard, the overall network performance is classified as Good. In conclusion, the designed data fusion architecture exhibits high overhead efficiency, and the local network infrastructure used is highly reliable in ensuring the transmission integrity of JSON documents without syntactic corruption, thereby guaranteeing the optimal and continuous operation of the smart irrigation system.

Keywords: *Data Fusion, Internet of Things, Quality of Service, Smart Irrigation, Wireshark.*