

INTISARI

Budidaya tanaman sawi membutuhkan presisi irigasi dan pemupukan yang akurat untuk mencapai produktivitas maksimal. Penelitian ini bertujuan mengembangkan sistem pemantauan dan kontrol otomatis berbasis *Internet of Things* (IoT) menggunakan jaringan sensor topologi *tree* untuk meningkatkan efisiensi pemeliharaan tanaman.

Sistem dirancang menggunakan komunikasi serial RS485 berjenjang melalui medium transmisi kabel tembaga spesifikasi AWG 22. Sensor kelembapan tanah kapasitif dan sensor warna TCS3200 didistribusikan ke dalam beberapa *node* untuk mengakuisisi data menuju mikrokontroler pusat. Manajemen lalu lintas transmisi menerapkan metode *Round Trip Time* (RTT) dan sterilisasi *buffer* guna mencegah terjadinya tabrakan data (*data collision*).

Hasil pengujian menunjukkan keandalan lapisan fisik dan jaringan komunikasi yang sangat optimal, dibuktikan dengan keberhasilan transmisi sebesar 100% (*error rate* 0%) serta redaman hambatan kabel yang sangat minor, yakni 0,015 dB pada jarak operasional maksimal 21,5 meter. Sistem kontrol terintegrasi sukses menjaga stabilitas kelembapan tanah pada rentang histeresis 60% hingga 90% dan memutus aliran pupuk secara presisi guna mencegah *over-dosis* nutrisi. Secara kuantitatif, implementasi sistem irigasi cerdas berbasis IoT terbukti memberikan margin keunggulan agronomis yang terukur, yakni menghasilkan selisih keunggulan tinggi tanaman sebesar 3,1 cm dan ekspansi lebar daun sebesar 1,6 cm dibandingkan dengan metode pemeliharaan konvensional.

Kata kunci: *Internet of Things*, RS485, Topologi *Tree*, Sensor TCS3200, Tanaman Sawi

ABSTRACT

Mustard green cultivation requires precise irrigation and fertilization to achieve maximum productivity. This study aims to develop an automated monitoring and control system based on the Internet of Things (IoT) using a tree topology sensor network to improve crop maintenance efficiency. The system is designed using multi-level RS485 serial communication through AWG 22 specification copper wire transmission medium. Capacitive soil moisture sensors and TCS3200 color sensors are distributed across several nodes to acquire data towards the central microcontroller. Transmission traffic management implements the Round Trip Time (RTT) method and buffer sterilization to prevent data collisions. The test results show highly optimal reliability of the physical layer and communication network, evidenced by a 100% transmission success rate (0% error rate) and a very minor cable resistance attenuation of 0.015 dB at a maximum operational distance of 21.5 meters. The integrated control system successfully maintained soil moisture stability within the 60% to 90% hysteresis range and precisely cut off the fertilizer flow to prevent nutrient overdose. Quantitatively, the implementation of the IoT-based smart irrigation system has been proven to deliver a measurable agronomic advantage, specifically resulting in a 3.1 cm superiority in plant height and a 1.6 cm expansion in leaf width compared to conventional cultivation methods.

Keywords: *Internet of Things, RS485, Tree Topology, TCS3200 Sensor, Mustard Greens*

