

DESIGNING AND DEVELOPING AN IOT-BASED AQUAPONICS SYSTEM INTEGRATING ESP32 AND LORA MODULE FOR REMOTE MONITORING AND CONTROL

MUHAMMAD WILDANI KHOIRON

Electrical Engineering Study Program, Faculty of Science and Technology

University of Technology Yogyakarta

Jl. Ringroad Utara Jombor, Sleman, Yogyakarta

E-mail: wildanikhoiron38@gmail.com

ABSTRACT

Aquaponics systems, which integrate aquaculture and hydroponics into a unified ecosystem, present a sustainable solution for agriculture. However, traditional systems still rely heavily on manual processes, posing challenges in efficiency and real-time management. This study proposes the development of an IoT-based aquaponics monitoring and control system using ESP32 and LoRa modules to enable long-range communication without relying on internet connectivity. The system comprises two ESP32 nodes: a transmitter and a receiver. The transmitter node collects environmental data from pH, TDS, and water level (ultrasonic) sensors, along with time data from an RTC module, then transmits the information via LoRa to the receiver node. The receiver ESP32 displays the data on a 1602 I2C LCD and forwards it to a React-based MQTT dashboard for real-time monitoring and manual fish feeding control through a servo motor. Testing results confirm that the system operates effectively without an internet connection, achieving high accuracy and precision: nutrient levels and water height at 99.95%–99.99% accuracy, and water pH at 95.87%. This system enhances operational efficiency and is well-suited for deployment in areas with limited network infrastructure.

Keywords: *Aquaponics, Dashboard, ESP32, IoT, MQTT*