ABSTRAK

PERANCANGAN SISTEM MONITORING IRIGASI LAHAN PERTANIAN BERBASIS *INTERNET OF THINGS* (IOT) PADA KELOMPOK TANI BAWANG MERAH DESA WONODADI KECAMATAN GADINGREJO KABUPATEN PRINGSEWU

Oleh

YUSUF ARIFIN

Pengelolaan irigasi bawang merah di Kelompok Tani Desa Wonodadi yang masih dilakukan secara konvensional sering kali memicu inefisiensi berupa pemborosan air, pembusukan umbi akibat penyiraman berlebih, hingga stres tanaman akibat kekeringan. Untuk mengatasi permasalahan tersebut, penelitian ini merancang sistem monitoring dan kendali irigasi otomatis berbasis *Internet of Things* (IoT) menggunakan metode logika *Fuzzy Sugeno* melalui pendekatan model pengembangan ADDIE. Arsitektur sistem diintegrasikan menggunakan *mikrokontroler ESP32* yang terhubung dengan sensor suhu DHT22, sensor kelembapan tanah kapasitif, sensor pendeteksi hujan, serta antarmuka pemantauan Node-RED yang berkomunikasi via protokol MQTT. Hasil kalibrasi dan pengujian lapangan menunjukkan kinerja instrumen yang sangat presisi dengan rata-rata tingkat *error* sensor kelembapan tanah sebesar 2,52% dan suhu 0,35%, serta latensi transmisi data *real-time* yang sangat responsif yakni 1,2 detik. Implementasi algoritma *Fuzzy Sugeno* terbukti adaptif dalam menentukan durasi penyiraman yang presisi—mampu memulihkan titik lahan terkering (29%) menjadi tingkat kelembapan ideal (69,3%) melalui aktuasi pompa 10 detik—sekaligus menghentikan penyiraman secara otomatis sebagai tindakan preventif saat hujan terdeteksi. Secara keseluruhan, inovasi irigasi cerdas ini tervalidasi lebih akurat, konsisten, dan efisien dalam menjaga stabilitas mikroklimat lahan dibandingkan metode manual, sehingga sangat potensial diimplementasikan untuk mendukung produktivitas pertanian presisi.

Kata Kunci: *Internet of Things* (IoT), Irigasi Otomatis, Bawang Merah, *Fuzzy Sugeno*, Node-RED, ESP32.

ABSTRACT

DESIGN OF AN INTERNET OF THINGS (IOT) BASED AGRICULTURAL AND IRRIGATION MONITORING SYSTEM FOR SHALLOT FARMER GROUPS IN WONODADI VILLAGE GADINGREJO DISTRICT PRINGSEWU REGENCY

By

YUSUF ARIFIN

The conventional irrigation management of shallots among farmer groups in Wonodadi Village often leads to inefficiencies, such as water wastage, bulb rot due to over-watering, and plant stress caused by drought. To address these issues, this study designed an Internet of Things (IoT)-based automated irrigation monitoring and control system using the Fuzzy Sugeno logic method, developed through the ADDIE model approach. The system architecture integrates an ESP32 microcontroller connected to a DHT22 temperature sensor, a capacitive soil moisture sensor, and a rain sensor, with a Node-RED monitoring interface communicating via the MQTT protocol. Calibration and field testing results demonstrated high instrumental precision, with average error rates of 2.52% for the soil moisture sensor and 0.35% for the temperature sensor, along with a highly responsive real-time data transmission latency of 1.2 seconds. The implementation of the Fuzzy Sugeno algorithm proved adaptive in determining precise irrigation durations—successfully restoring the driest soil conditions (29%) to an ideal moisture level (69.3%) through a 10-second pump actuation—while automatically halting irrigation as a preventive measure when rain is detected. Overall, this smart irrigation innovation is validated to be more accurate, consistent, and efficient in maintaining land microclimate stability compared to manual methods, showing significant potential for implementation in supporting precision agriculture productivity.

Keywords: *Internet of Things (IoT), Automated Irrigation, Shallots, Fuzzy Sugeno Node-RED, ESP32.*