ABSTRACT

Wind Power Plants hold significant potential as a renewable energy source in Indonesia. However, the main challenges in their operation lie in efficiency and real-time system monitoring. This study aims to design and implement an intelligent IoT-based electrical energy system in a laboratory-scale PLTB, focusing on selecting the optimal communication technology to support a Supervisory Control and Data Acquisition (SCADA) system. The Analytical Hierarchy Process (AHP) method is employed to determine the appropriate communication technology, which is then integrated with the MQTT protocol within the IoT system. The system incorporates components such as wind speed sensors, voltage sensors, current sensors, and a Programmable Logic Controller (PLC). Testing was conducted to analyze system performance, including sensor accuracy, latency, throughput, and device integration in IoT-based SCADA. The selection of communication technology was based on criteria such as data rate, latency, power consumption, and coverage, evaluated using AHP. The results indicate that the implementation of this system enhances operational efficiency, achieving an average latency of 1.573 ms, throughput of 0.11 Kbps, coverage of 49 dB (7.3 × 5 m), and a maximum power consumption of 1.3 W, which remains well below the 5.4 W threshold. WiFi, selected through the AHP process, proved effective in supporting real-time communication between devices, with the system capable of managing data efficiently and responding to variations in wind conditions.

Keywords—Analytical Hierarchy Process (AHP), Internet of Things (IoT), MQTT, Wind Power Plant, Smart Grid.