ABSTRACT

This research develops a LoRaWAN-based public street lighting monitoring system using PZEM-004T sensors to measure current, voltage, and power, aiming to improve the effectiveness of lamp malfunction detection and handling. The goal is to support real-time monitoring for the public and officials. Data from the PZEM-004T sensor is sent to the ESP32 microcontroller, which processes the data and sets power control. The Light Dependent Resistor sensor activates the lights based on ambient light. Information is displayed on a 16x2 Liquid Crystal Display, and data is sent to the Telkom IoT *Platform Console via RFM95 as a Long Range Wide Area Network transmitter. Tests were conducted using 6 loads to evaluate sensor performance, calculate errors, and compare accuracy with a power meter. Energy efficiency was evaluated through 2 PZEM-004T sensors in 6 tests each. Measurement precision was assessed using standard deviation and relative standard deviation. Network communication performance was evaluated through measurements of Received Signal Strength Indicator, Signal to Noise Ratio, and Quality of Service at 4 locations with varying distances to determine delay and packet loss. Results show high accuracy in voltage (98.13%-99.85%), current (95.63%-100%), and power (94.08%-99.54%). Delay varied from 0.305 ms to 1.008 seconds and packet loss from 1.67% to 76.67% between locations. Overall, the system achieved voltage accuracy of 99.46%, current accuracy of 97.63%, and power accuracy of 97.49%, with relatively small delay and packet loss. Variations in RSSI (-90 dBm to -120 dBm) and SNR (-17 dB to 10 dB) were observed, maintaining communication stability for real-time monitoring.*

Keywords: ESP32, LoRa, LoRaWAN, PZEM-004T