ABSTRACT

This research develops a wireless sensor on Geo-electrical Resistivity Meter (GERM) that utilizes a Wireless Sensor Network (WSN) to enhance subsurface electrical property measurements. Conventional geoelectrical resistivity methods involve extensive cabling, which complicates field setups and limits mobility. This study introduces a wireless approach to streamline the measurement process, reduce physical setup burdens, and improve effectivity. The new system, comprising a main unit block and a multinode block, implements the dipole-dipole electrode configuration using a TTGO LoRa ESP32 microcontroller for robust wireless communication. The main unit block features a high-voltage current injector capable of handling up to 400 volts, facilitating broad coverage for geo-electrical exploration, with four power injection selection. The multinode block employs the INA219 sensor, which has proven to measure potential difference with high accuracy, the error rate remains below 1% for the voltage above 300mV and 0,3% for 1 volt measurement. Significant advancements include the implementation of a time series strategy, ensuring precise synchronization of current injections with potential difference measurements across the network. The system's communication performance was rigorously evaluated, showing a high Packet Delivery Rate (PDR) and manageable latency. The systems succeed to predict subsurface structure, which has a similarity pattern of subsurface structure on Wireless-GERM with AGIS Supersting R8 during geo-electrical resistivity measurement at Cikeruh River in East Bandung Basin. Overall, the GERM system not only meets but exceeds conventional measurement methods by reducing physical constraints and enhancing feature of the resistivity measurement.

Keywords: Geo-electric, Resistivity, Wireless Sensor, LoRa Communication