

ABSTRACT

Soil Water Content (SWC) mapping on both small and large scales is crucial in creating a precision agriculture ecosystem. Currently, mapping and detecting SWC are generally done traditionally using gravimetry. However, this method requires much time and labor, making the detection process inefficient. Based on these issues, this research proposes a system to monitor SWC automatically, in real-time, and remotely controllable.

The SWC mapping and detection system is developed using Ground Penetrating Radar (GPR) with the Stepped-Frequency Continuous Wave (SFCW) method. This radar system is equipped with a GUI application called SWAM-Radar, developed using the Python programming language with the PyQt5 framework for automating real-time SWC detection and mapping. The radar system is modeled using a Vector Network Analyzer (VNA) that can be remotely controlled to collect data in agricultural or plantation fields. The Global Positioning System (GPS) also detects location coordinates, aiding in accurate and efficient SWC mapping. Additionally, a remote-controlled mobile robot is used as a moving vehicle during the mapping process, allowing for remote control.

The research results show the successful integration of the radar system, GPS, SWAM-Radar application, and robot car. The radar system successfully detected SWC values with an average accuracy of 96.46%. The GPS effectively detected location coordinates, supporting more accurate mapping processes. The SWAM-Radar application features two main functionalities: 'Grafik KAT' and 'Pemetaan KAT'. The 'Grafik KAT' feature visualizes the received radar signals, displays the position and values of the detected Peak-To-Peak signals, and estimates the SWC values with an average computation time of 0.0452 seconds. The 'Pemetaan KAT' feature provides visualized data coloured according to the SWC values at the GPS coordinates traversed by the system, with an average computation time of 0.0570 seconds. The mobile robot is also used as a platform for performing SWC mapping remotely. Using GPR technology with the SFCW radar system and an easy-to-use GUI application facilitates the automatic and real-time monitoring of SWC.

Keywords: Application, Mapping, Soil Water Content (SWC), Radar, SFCW, GPR