Developing a Soil Moisture Content Monitoring System Based on Internet of Things Technology (IoT)

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Soil moisture content (SMC) is an essential parameter which influences the crop growth and ecosystem functions. Measuring the soil moisture content using sensors is advantageous as it allows obtaining SMC measurements at high spatial and temporal resolutions. Soil moisture sensors are costly to purchase and require technical expertise to calibrate. Therefore, this study aimed to develop a low-cost sensing system to measure, transmit, store, and analyze soil moisture content data obtained from field and laboratory experiments. The system consisted of three main components, a sensor component to generate a reading, the component to retrieve and send data to a mobile application and a mobile application to process, manage, and analyze the sensor data. Calibration relationships between soil moisture content measured using the sensor and oven drying method were established using repacked soil containers for four main soil great groups, namely Reddish Brown Latasolic, Immature Brown Loam, Red Yellow Podzolic, and Non-Calcic Brown. Calibration models of great soil groups were validated using an independent set of SMC measurements obtained by the oven-drying method. The high coefficient of determination (R^2) values (0.88 - 0.96) of calibration relationships indicated a strong relationship between the sensor-measured raw values and SMC. Further, new sensor showed less sensitivity for the measurement of SMC in dry soils. Low (<3%) root mean square error values resulted in the validation tests indicated high accuracy of SMC measurements made by the low-cost soil moisture sensor. Further, the low-cost sensor successfully communicated with the mobile application enabling storage, retrieval and analysis of data. It is suggested to test the performance of the low-cost sensor for a wide range of soils and to include a correction factor for saline soils.

Keywords: Mobile application, Sensor, Soil moisture content

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