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Design and Implementation of an IoT-Based Soil Moisture Sensing System for Real-Time Agricultural Monitoring

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Abstract: *Efficient use of water has become one of the most critical challenges in modern agriculture. Conventional soil moisture measurement techniques provide only instantaneous readings and lack the ability to store or transmit data remotely. To address these limitations, this work presents the development of an IoT-based soil moisture sensing system using a capacitive soil moisture sensor and an ESP32 microcontroller.*

The system continuously monitors soil moisture levels and displays the values locally on a 16×2 LCD while simultaneously transmitting data to the Blynk cloud platform for remote access. A calibration-based approach is used to convert raw sensor readings into meaningful moisture percentage values. The entire system is powered using a rechargeable battery integrated with a Battery Management System (BMS), ensuring safe and reliable field operation.

Experimental observations indicate that the system provides stable performance, reasonable accuracy, and reliable wireless communication, making it suitable for practical agricultural applications.

Keywords: IoT, Soil Moisture Monitoring, ESP32, Smart Agriculture, Wireless Monitoring

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