

## 49. Revolutionizing soil quality monitoring with IoT: a comprehensive system design

Dismas Kitaria, Stephen Mutua and Amos Chege Kirongo

<sup>1</sup>School of Computing and Informatics, Meru University of Science and Technology, Meru, Kenya

\*Corresponding author email: teddismas@gmail.com

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### Abstract

In the era of precision agriculture, the need for real-time soil quality monitoring has become increasingly crucial. This study presents the design of an innovative IoT-based soil quality monitoring system that integrates advanced sensor technologies, efficient data collection mechanisms, and robust data analytics techniques. By leveraging the power of the Internet of Things (IoT), this system aims to revolutionize the way farmers and agronomists assess and manage soil conditions, ultimately enhancing productivity and sustainability in the agricultural sector. The proposed system employs a multi-layered approach, combining sensor integration, cloud computing, and mobile applications to create a comprehensive monitoring solution. Sensors for measuring soil quality parameters are strategically deployed in the soil, with a microprocessor and microcomputer collecting and transmitting real-time data to a cloud platform via wireless communication. A mobile application serves as a user-friendly interface, allowing remote access to soil data and ensuring low power consumption for extended operation. To enhance the accuracy and reliability of soil quality predictions, the study introduces a novel data prediction strategy based on the deep Q network (DQN) reinforcement learning algorithm. Towards achieving real-time monitoring with the required accuracy, the system will maintain a 3-second window of the soil properties exact acquisition moment, ensuring timely and precise data for informed decision-making. In conclusion, this IoT-based soil quality monitoring system represents a significant advancement in the field of precision agriculture. By integrating cutting-edge sensor technologies, efficient data collection mechanisms, and advanced predictive models, the system enables farmers and agronomists to diagnose soil conditions with unprecedented accuracy, ultimately supporting sustainable agricultural practices and enhancing overall productivity.

**Keywords:** *Internet of Things (IoT), Soil Quality Monitoring, Sensor Integration, Data Analytics, Precision Agriculture, Sustainable Agriculture*