IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 5, April 2026
Impact Factor: 8.2

# Multi Sensor Soil Testing Model

**Aboli Sharad Datir[1], Sakshi Dnyaneshwar Avhad[2], Durva Nitin Khatale[3], Anushka Avinash Randhe[4], Prof. Atul E. Sonawane[5], Prof. Chetan B. Pagar[6], Prof. Prashant Chavan[7]**

Students, Department of Civil Engineering[1-4]
Lecturer (Guide), Department of Civil Engineering[5]
Lecturer (Co-Guide), Department of Civil Engineering[6]
Head of Department (HOD), Department of Civil Engineering[7]
Guru Gobind Singh Polytechnic, Nashik, Maharashtra, India

**Abstract:** *Accurate assessment of soil parameters is fundamental for precision agriculture, environmental monitoring, and geotechnical engineering applications. Conventional soil testing techniques are predominantly laboratory-based, involving significant time delays, higher operational costs, and limited spatial resolution. This paper presents the design, development, and implementation of a multi-sensor soil testing model for real-time, in- situ measurement and analysis of critical soil parameters.*

*The proposed system integrates a network of heterogeneous sensors, including capacitive soil moisture sensors, digital temperature and humidity sensors (e.g., DHT series), and electrochemical pH sensors, interfaced with a microcontroller unit (MCU) such as Arduino/ESP-based platforms. The system architecture enables continuous data acquisition, signal conditioning, and analog-to-digital conversion for precise parameter estimation. Calibration techniques are employed to enhance sensor accuracy and minimize environmental and instrumental errors.*

*The acquired data is processed and displayed locally and can be further transmitted to cloud-based platforms using IoT communication protocols (e.g., Wi-Fi, GSM) for remote monitoring and data logging. The model facilitates spatial and temporal analysis of soil conditions, enabling optimized irrigation scheduling, nutrient management, and early detection of adverse soil conditions. Experimental validation demonstrates that the system provides reliable and consistent measurements with acceptable error margins when compared to standard laboratory methods.*

*The developed multi-sensor soil testing model offers a scalable, low-cost, and energy- efficient solution for smart farming and preliminary geotechnical investigations. Its deployment can significantly enhance decision-making processes, promote sustainable agricultural practices, and reduce dependency on traditional soil testing methodologies.*

**Keywords:** Soil Testing, IoT, Soil Moisture Sensor, pH Sensor, Temperature Sensor, Smart Agriculture, Precision Farming.

## I. INTRODUCTION

Agriculture is a major contributor to India's economy, and soil quality plays a crucial role in crop production. Farmers often lack access to real-time soil data, which leads to inefficient use of water, fertilizers, and pesticides.

Traditional soil testing involves collecting samples and sending them to laboratories, which is time-consuming and costly. To overcome these limitations, this project introduces a Multi-Sensor Soil Testing Model that uses IoT technology to monitor soil parameters instantly.

This system provides a practical solution for farmers by offering accurate and real-time data, enabling better agricultural decision-making.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 5, April 2026
Impact Factor: 8.2

## II. PROBLEM STATEMENT

Accurate and timely assessment of soil properties is a critical requirement in agriculture and civil engineering, as soil characteristics directly influence crop productivity, irrigation efficiency, and structural stability. However, conventional soil testing methods rely heavily on manual sampling and laboratory analysis, which are time-consuming, labor-intensive, and often expensive. These traditional approaches also suffer from limited spatial and temporal resolution, as soil conditions can vary significantly across different locations and change dynamically over time. As a result, farmers and engineers frequently lack access to real-time and site-specific soil data, leading to inefficient decision-making, improper resource utilization, and reduced productivity.

## III. METHODOLOGY

The system is developed using multiple sensors integrated with a microcontroller to monitor soil conditions in real time.

**Soil Moisture Measurement**

A soil moisture sensor is used to determine the water content in the soil. It helps farmers decide when irrigation is required.

Output: Analog/Digital signal

Application: Efficient irrigation management

**Temperature and Humidity Monitoring**

Temperature and humidity sensors (such as DHT11/DHT22) measure environmental conditions affecting soil and crop growth.

Temperature affects root activity Humidity influences evaporation rate

**a. pH Level Detection**

The pH sensor measures soil acidity or alkalinity.

pH < 7 → Acidic soil pH = 7 → Neutral pH > 7 → Alkaline

This helps in selecting suitable crops and fertilizers.

**b. System Integration**

All sensors are connected to a microcontroller (such as Arduino). The system performs the following functions:

Collects sensor data Processes and displays values

Can be integrated with IoT platforms for remote monitoring

**c. Data Display**

The collected data is displayed on: LCD display / Mobile application Real-time monitoring system.

## IV. CONCLUSION

The Multi-Sensor Soil Testing Model provides a smart and efficient solution for real-time soil analysis. By integrating multiple sensors, the system helps farmers monitor key soil parameters instantly without relying on laboratory testing.

This project improves agricultural productivity by enabling better decision-making, reducing resource wastage, and promoting sustainable farming. It demonstrates how IoT technology can revolutionize traditional agricultural practices.

## V. ACKNOWLEDGMENT

The authors express their sincere gratitude to the faculty of [Your College Name], Nashik, for their valuable guidance and support throughout the project. Special thanks to our project guide and all those who contributed directly or indirectly to the successful completion of this work.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 5, April 2026
Impact Factor: 8.2

## REFERENCES

**[1].** Brady, N.C. and Weil, R.R. (2008). The Nature and Properties of Soils. Jones, J.B. (2001). Laboratory Guide for Conducting Soil Tests.

**[2].** Patil, V.C. et al. (2012). Precision Agriculture and its Applications. Arduino Documentation – Soil Sensor Integration

**[3].** FAO Reports on Soil Health and Agriculture