



Soil Spectra

Real-Time Soil Quality Monitoring Device

Technical Brief

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Technology Summary

Soil Spectra is a robust, multi-parameter soil sensing device developed by IIT Ropar – Technology and Innovation Foundation (AWaDH). Designed for real-time, in-situ soil monitoring, it measures key agronomic parameters such as moisture, temperature, pH, electrical conductivity, and nutrient levels (N, P, K). Its compact, weatherproof build ensures compatibility with varied field conditions, and its data output can be accessed via smartphones, computers, or IoT systems enabling smart, data-driven decisions in farming and environmental monitoring.

Background

Agriculture in India and globally faces a critical data gap at the soil level, often leading to inefficient irrigation, overuse of fertilizers, and inconsistent yields. Traditional soil testing is manual, time-consuming, and infrequent, offering little support for dynamic, real-time decisions. With rising interest in precision agriculture and sustainability, there is a pressing need for real-time, field-deployable sensors that empower farmers and researchers with continuous soil health information.

Technology Description

Soil Spectra is a field-deployable, TRL-9 sensor that directly measures seven crucial soil parameters. It is embedded in the soil and continuously transmits readings via wireless protocols to mobile or web platforms. The sensor's durability, low power requirement, and multi-parameter capability make it suitable for both small-scale farms and large agricultural operations. The system is standalone and plug-and-play, offering end-to-end functionality without dependence on auxiliary infrastructure. It has been tested and validated under field conditions and is currently available for use.

Market Potential / Proposed Deployment

- Global Smart Soil Sensor Market projected to reach USD 1.2–1.5 Billion by 2030, growing at CAGR ~12–14%.
- India Market: With ~150 million hectares under cultivation, digital soil health solutions are in high demand under initiatives like PM-KUSUM, Digital Agri Mission, and State AgTech Missions.
- Target Segments:
 - Small and commercial farmers
 - Agri-Tech platforms and startups
 - Precision agriculture solution providers
 - Government and NGO-led soil health programs
 - Academic and environmental research institutions

Applications

- Smart Irrigation: Real-time data enables precision watering, reducing water wastage.
- Nutrient Management: Optimize NPK usage based on actual soil availability.
- Soil Mapping: Generate localized soil health maps for advisory and research.
- Remote Monitoring: Ideal for large or hard-to-reach farmlands and greenhouse use.
- Educational Use: Training tool in soil science, agri-tech education.

Value Proposition

- Multi-Parameter Sensing: Measures moisture, temperature, EC, pH, and NPK—integrated in one device.
- Real-Time Monitoring: Enables immediate corrective actions.
- Plug-and-Play: Works with minimal setup; connects to common devices.
- Low Maintenance & Durable: Built for rugged use in Indian and global field conditions.
- No Auxiliary Labs Needed: On-field data reduces need for lab-based testing.
- Versatile Use Cases: From small farms to research-grade environmental studies.

Technology Status

- Technology Readiness Level (TRL): 9 – Ready for commercial deployment.
- Deployment: Validated in field conditions; currently in-market use.
- IP Status: No patents filed yet.
- Licensing Interest: Open to Exclusive/Non-Exclusive Licensing, Co-development, or IP Sale.

