

Phase 1 Document

Title

IoT-Based Soil Nutrients Monitoring and Management System

Problem Statement

Modern agriculture faces challenges in optimizing crop yields due to inadequate knowledge of soil health. Excessive or insufficient use of fertilizers can degrade soil quality and impact productivity. Farmers lack real-time insights into soil nutrient levels and conditions, leading to inefficient practices and environmental harm.

The problem is to develop a system that provides accurate, real-time data on soil nutrients and health to help farmers make informed decisions, reduce costs, and promote sustainable agriculture.

Target Audience

- Small and medium-scale farmers aiming to improve crop yield and reduce waste.
- Agricultural research centers for experimentation and data analysis.
- Agri-tech companies developing smart farming tools.
- Government and environmental agencies promoting sustainable agriculture.

Objectives

- To monitor key soil parameters (NPK levels, pH, moisture, temperature) in real time using IoT sensors.
- To suggest optimal fertilizer types and quantities based on soil conditions.
- To provide remote access to data and alerts via a mobile/web dashboard.
- To promote sustainable farming by reducing excessive chemical usage.

Design Thinking Approach

Empathize:

Farmers struggle to assess soil health manually, often relying on periodic and costly lab tests. The goal is to ease their burden through technology that's easy to use, cost-effective, and accurate.

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Key User Concerns:

- Understanding and trusting sensor data.
- Cost and maintenance of the system.
- Compatibility with existing farming routines.

Define:

The solution should collect real-time soil data, process it using algorithms, and present actionable insights. It must be robust in the field, easy to install, and support multiple crops and soil types.

Key Features Required:

- Soil nutrient sensor integration (NPK, pH, moisture, temp).
- Wireless communication module (e.g., LoRa, Wi-Fi).
- Cloud-based analytics dashboard with alert system.
- Fertilizer recommendation engine.

Ideate:

Potential solution ideas:

- Solar-powered IoT sensor nodes for remote farm operation.
- Mobile/web interface with soil health trends and alerts.
- API for agricultural consultants and researchers.

Brainstorming Results:

- Auto-generated soil health reports.
- Multi-language support for regional farmers.
- Integration with weather APIs for better planning.

Prototype:

Develop a working model using:

- Arduino/Raspberry Pi with NPK & soil sensors.
- Wireless module for data transmission.

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- Firebase or Thingspeak for real-time data visualization.
- Simple mobile/web app to show data and suggestions.

Test:

Test the prototype in a small farm or agricultural lab setup with real users.

Testing Goals:

- Verify sensor accuracy and data transmission.
- Assess user understanding of dashboard insights.
- Measure impact on decision-making and fertilizer use.