Abstract

Agriculture remains the backbone of the global economy, providing food security, raw materials, and employment to millions. However, the efficiency and productivity of agricultural practices often depend on the health of the soil and the compatibility of crops with the soil's chemical composition. In many rural and semi-urban regions, farmers face challenges in assessing soil fertility due to the lack of affordable and accessible testing facilities. Conventional soil testing methods involve manual sampling and laboratory analysis, which are time-consuming, costly, and fail to provide real-time insights. As a result, crop selection decisions are often based on traditional knowledge rather than scientific data, leading to reduced yields, soil degradation, and inefficient resource utilization. This project proposes the development of an **IoT-Based Soil Chemical Composition & Crop Recommendation System** that integrates modern sensing technologies with intelligent data analytics to deliver instant, accurate, and actionable recommendations to farmers.

The proposed system incorporates IoT-enabled soil sensors that measure key parameters essential for plant growth, including pH, nitrogen (N), phosphorus (P), potassium (K), and moisture content. These sensors are connected to a microcontroller unit, such as Arduino or Raspberry Pi, which acts as the central hub for data acquisition. The microcontroller gathers readings and transmits the data wirelessly to a cloud-based platform via Wi-Fi or GSM modules. The cloud infrastructure enables scalable storage, processing, and remote accessibility.

Once the data is collected, an intelligent algorithm analyzes the soil's nutrient profile against a database of crop requirements. This comparison generates a list of crops suited for the given soil conditions, along with recommendations for improving fertility if required. The processed results are displayed through a user-friendly dashboard accessible via web or mobile applications, providing nutrient level graphs, soil reports, and ranked crop suggestions.

The system operates in real time, offering timely feedback for planting decisions. Designed for scalability, it can integrate additional parameters such as temperature, humidity, and micro-nutrients in future upgrades. With its affordability and portability, the solution empowers farmers with technology-driven insights, promotes sustainable farming, optimizes resources, and supports long-term food security.