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Soil Type Detection and Crop Recommendation Using IoT and Machine Learning

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Abstract: *The integration of the Internet of Things (IoT) and Machine Learning (ML) in agriculture has revolutionized farming practices by enabling precise soil type detection and crop recommendation. This research paper explores a system that employs IoT devices for real-time soil data collection and ML algorithms for analyzing the data to recommend suitable crops. The proposed system aims to enhance agricultural productivity, reduce resource wastage, and promote sustainable farming practices. This study evaluates existing systems, identifies their limitations, and presents a novel framework for accurate soil classification and efficient crop recommendation.*

Keywords: Internet of Things

I. INTRODUCTION

Agriculture is the backbone of many economies, and optimizing its processes is critical to meeting global food demands. Traditional methods for soil analysis and crop selection are often labor-intensive, time-consuming, and prone to errors. IoT and ML technologies offer the potential to automate and improve these processes by leveraging real-time data and predictive algorithms. This research focuses on developing a system that integrates IoT sensors with ML models to provide actionable insights for farmers, ensuring better yield and efficient resource use.

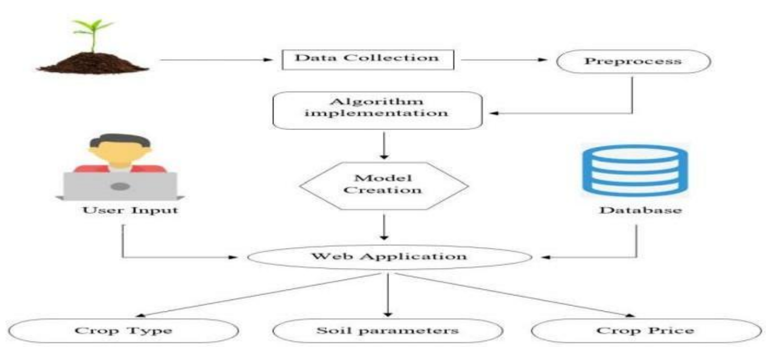
II. LITERATURE REVIEW

IoT has been widely adopted in agriculture for monitoring environmental conditions, automating irrigation, and managing livestock. Studies show that IoT devices can accurately measure parameters such as soil moisture, pH, and temperature, which are critical for crop growth. Machine learning algorithms, including decision trees, support vector machines (SVM), and neural networks, have been utilized to analyze soil data and predict suitable crops. Researchers have demonstrated that ML models can achieve high accuracy in crop recommendation.

Existing System

Existing soil type detection systems rely primarily on laboratory testing or standalone IoT devices. These methods often lack integration with advanced analytics, limiting their utility in dynamic agricultural scenarios. Moreover, most crop recommendation systems are rule-based and fail to adapt to changing environmental conditions, leading to suboptimal outcomes.

Proposed System



Problem Statement

Current agricultural systems do not fully leverage IoT and ML's capabilities to provide real-time, accurate, and adaptable solutions for soil analysis and crop recommendation. There is a critical need for a comprehensive system that combines these technologies to enhance decision-making in farming.

III. RESEARCH METHODOLOGY

The proposed system architecture comprises the following layers:

IoT Layer: Sensors collect soil parameters (e.g., pH, moisture, temperature, and nutrient levels).

Data Transmission: Data is transmitted to a cloud-based server via IoT gateways.

Machine Learning Model: The collected data is processed using ML algorithms like Random Forest or Gradient Boosting for soil classification and crop prediction.

User Interface: Farmers access recommendations through a mobile application or web dashboard.

The research involved collecting a dataset of soil samples with corresponding crop yields. Data preprocessing included normalization, handling missing values, and feature selection. Various ML models were trained and evaluated for performance.

IV. RESULTS

The proposed system was tested on a dataset comprising various soil types and climatic conditions. The Random Forest classifier achieved an accuracy of 92% for soil type detection, while the crop recommendation model achieved 88% precision in suggesting optimal crops. The system demonstrated the ability to adapt to real-time changes in environmental conditions, providing dynamic recommendations.

V. FUTURE SCOPE

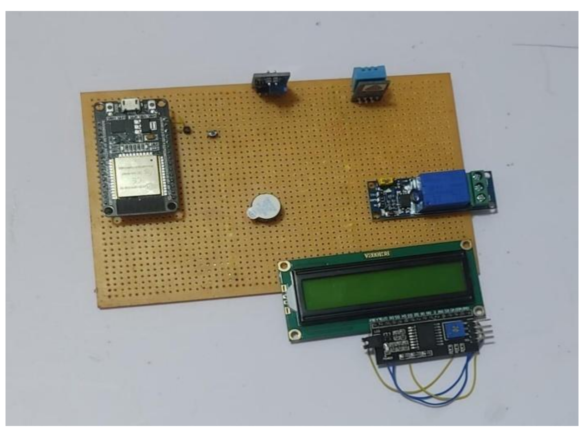
Integration with Weather Data: Incorporating weather forecasts to refine crop recommendations.

Scalability: Extending the system for large-scale farming operations.

Advanced Models: Utilizing deep learning for more accurate predictions.

Cost Optimization: Developing cost-effective IoT devices to increase adoption among small-scale farmers.

IOT hardware device



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