A Review on Fertilizer Recommendation System

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ABSTRACT

Our project introduces a Fertilizer Recommendation System (FRS) using advanced Machine Learning (ML) techniques to help farmers maximize crop yield while minimizing the environmental impact of fertilizer use.
Analyzing soil data stored in a database generates personalized fertilizer recommendations based on specific soil conditions and historical crop performance. It employs various ML models like decision trees and neural networks, enhanced through feature engineering, to establish patterns linking soil properties to nutrient requirements. Soil sensors fetch real-time data, enabling accurate recommendations. The evaluation shows our ML-based FRS outperforms traditional methods, promising improved agricultural productivity and ecological sustainability by guiding farmers in efficient nutrient management for optimal crop growth and environmental conservation.

Keywords: Agriculture, Machine Learning, Fertilizer Recommendation ,NPK, Cloud ,Flutter.

INTRODUCTION

Agriculture plays a pivotal role in ensuring global food security and supporting economies, yet it faces challenges in balancing resource utilization and minimizing environmental impact, especially in fertilizer application. To address these challenges,integration of advanced technologies, such as Machine Learning (ML), becomes imperative.

This paper introduces a novel approach to tackle these issues through a Fertilizer Recommendation System (FRS) powered by ML. Unlike traditional methods that often lack personalized advice for specific soil and crop needs, the FRS utilizes ML algorithms, including the decision Tree Classifier, to analyze diverse datasets and generate tailored fertilizer recommendations.

Furthermore, to enhance accessibility and usability, the ML model is integrated with the Flutter framework using TFlite, enabling seamless integration into mobile applications. This advancement represents a significant leap in sustainable farming practices, as the FRS empowers farmers recommendations, with optimizing personalized resource utilization and contributing to enhanced crop yield, environmental conservation, and the promotion of sustainable agriculture worldwide.

LITERATURE REVIEW

(Gray and morant, 2003, laekemariam et al.,2017, yageta et al., 2019); desbiez et al., 2004. [1] Farmers and scientists assess soil quality using various methods, combining both qualitative and quantitative measurements. Farmers, drawing on years of experience and local knowledge, evaluate soils holistically, considering many environmental factors. In contrast, scientists often use a reductionist approach, examining soil characteristics individually, such as their impact on crop performance and soil structure.

Lieven van Reeuwijk, "Procedures for Soil Analysis" (6th ed.), Wageningen, Netherlands: International Soil Reference and Information Centre (ISRIC), 2002 [2] Soil samples are air dried and sieved in a lab, and various parameters like pH, cation exchange capacity, and nutrient levels are analyzed. Measurements of phosphate, potassium, and accessible nitrogen are also taken. These analyses are typically conducted in specialized laboratories.

September 29, 2023, Journal of Development Economics[3] In a study conducted in Bangladesh, researchers investigated the impact of different fertilizer recommendations on crop yield and profitability. They found that while most types of fertilizers used by farmers were not significantly affected by the recommendations, phosphate fertilizer usage decreased following the intervention. Farmers also adjusted their seed choices based on the fertilizer recommendations provided.

Intelligent insecticide and fertilizer recommendation system based on TPF-CNN for smart farming Volume 3, February 2023, 100114 Tanmay Thorat, B.K. Patle, Sunil Kumar Kashyap[4] This paper proposes a dual-operator approach integrating Transition Probability Function (TPF) and Convolutional Neural Network (CNN) to swiftly and accurately identify pests in agriculture, recommending insecticides in under 10 seconds. Additionally, it employs soil NPK sensors for rapid soil nutrient analysis, facilitating fertilizer recommendations within 80 seconds. Achieving over 90% accuracy in identifying five key pests, this method outperforms traditional techniques like ANN, SVM, and KNN. By optimizing pesticide and fertilizer usage, it aims to enhance crop quality and yield, ultimately uplifting farmers' livelihoods and fostering economic growth.

L.van Reeuwijk,Procedures for soil analysis (6th ed.), International Soil Reference and Information Centre (ISRIC), Wageningen, Netherlands (2002) [5] In the laboratory, soil samples were air-dried and passed through a 2 mm-mesh sieve. Laboratory analysis was performed for various soil properties, including soil organic carbon (SOC), pH, particle size distribution (clay, silt, sand), cation exchange capacity (CEC), and exchangeable cations (Ca, K, Mg. Available soil nutrients were determined, including phosphorus (P), potassium (K) and available nitrogen.

All the soil analyses were carried out in the laboratory of the Hungarian University of Agriculture and Life Sciences in Gödöllő, Hungary. Soil pH in H2O was potentiometrically measured in the supernatant suspension of a 1:2.5 soil: extractant mixture. Soil N was determined using the Parnas-Wagner apparatus, with NaOH as the extraction reagent and Boric acid as an indicator solution using the micro Kjeldhal method. Soil available K and P were determined using ammonium lactate acetate solution method. The distribution of clay, silt and sand particles was determined by mechanical analysis using the pipette method.

WORKING

This integrated system seamlessly combines hardware, cloud-based storage, Machine Learning, and mobile technology to provide farmers with actionable insights for optimizing fertilizer usage and enhancing agricultural productivity.

Data Collection: Soil data is gathered using an NPK sensor, which measures key nutrient levels (Nitrogen, Phosphorus, Potassium) along with other relevant soil parameters.

Data Processing and Storage: The collected data undergoes processing by a central processor. Processed data is securely stored in Firestore, a cloud-based NoSQL database, ensuring accessibility and reliability.

Android App Development: An Android application is developed using Flutter, a versatile framework for building cross platform mobile apps. Flutter ensures consistent performance across different devices and platforms.

Machine Learning Integration: Within the Flutter app, a Machine Learning model is integrated. This model is trained on historical soil data and fertilizer effectiveness provide accurate recommendations.

Pre-processing and Recommendation Generation: The ML model preprocesses the data fetched from Firestore, including normalization and feature engineering. Based on the processed data, the ML model generates personalized fertilizer recommendations tailored to specific soil conditions and crop types.

User Interface: The Flutter app presents the fertilizer recommendations in a user-friendly interface, ensuring ease of access and understanding for farmers.

CONCLUSION

In conclusion, the fertilizer recommendation system using machine learning represents a promising and transformative approach to modernize agricultural practices. Its ability to enhance precision, optimize resource usage, and improve overall crop productivity positions it as a valuable tool in the pursuit of sustainable and efficient agriculture. As technology continues to evolve, ongoing research and development in this field hold the key to further refining and expanding the impact of ML-based fertilizer recommendations in the agricultural landscape.

FUTURE SCOPE

. We can make it IOT enable by integrating android application and cloud for more easy use .
. It will be more beneficial for the farmers for making appropriate use of fertilizer.

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