Farm2Kitchen AI : A Multi-Modular Machine Learning Approach for Self-Sustainable and Organic Farming

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Introduction

One of the major issues in farming is the need to increase crop yields to feed a growing global population while dealing with the challenges of climate change and limited resources. Our Capstone initiative intends to optimise the farmer-to-consumer food supply chain by eliminating intermediaries and delivering fresh produce directly to consumers' kitchens. Farmers are provided with an Android application that stores all the data in a central cloud database and recommend the most profitable crops for farmers to cultivate.

Motivation

The major motivation of the project is to increase the profitability and self sufficiency of the agricultural business by enabling farmers to sell their goods directly and organically.

SCOPE of the Project

The scope of this project is to optimize the farmer-to-consumer food supply chain, and it aims to address the challenges faced by farmers by eliminating intermediaries and establishing a direct connection between farmers and consumers. The mobile application module provides a user-friendly interface for farmers to store data in a central cloud database and receive advice on optimal crop choices. The AI-assisted crop planning module recommends the best crops to grow based on factors such as soil health, weather, and market demand. The crop distribution module balances supply and demand by clustering farmers to grow specific crops efficiently. Finally, the organic crop production module promotes organic farming by assessing soil health and suggesting remedies if necessary.

Methodology

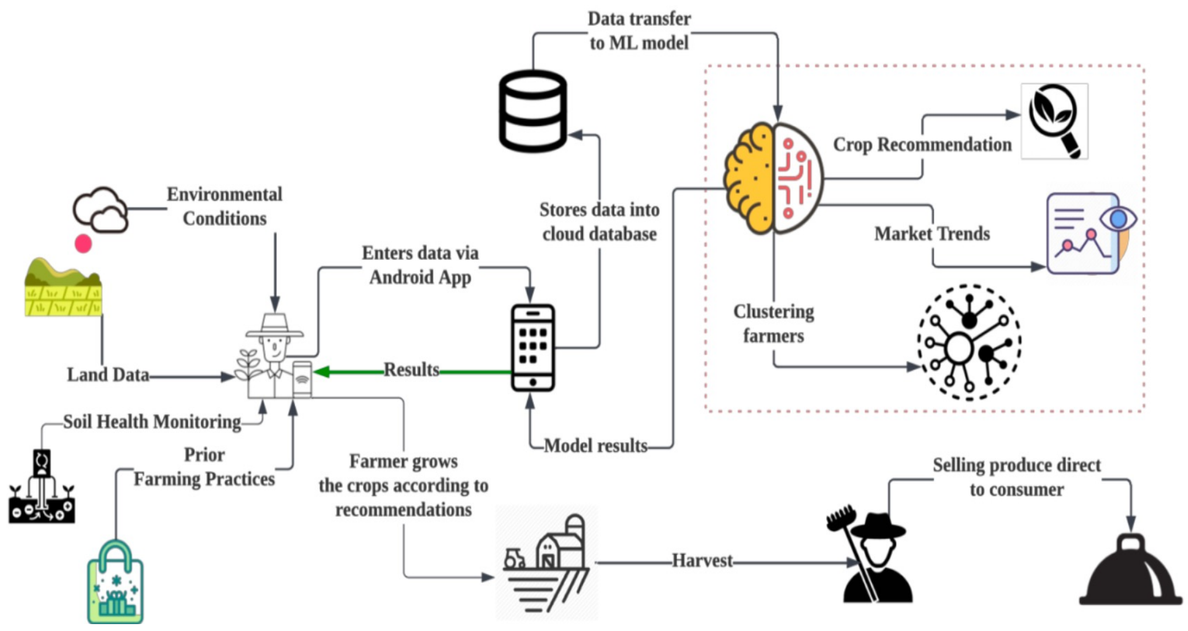


Fig. 1. Architecture Diagram

The proposed methodology includes the system architecture shown in Fig.1 which helps farmers harvest crops and sell them directly to the consumer to avoid intermediaries, who are a significant factor of price hikes and the resulting steady decline in production. It is further broken down into distinct modules which are then integrated into a centralized android application.

- **Crop Planning Module:** This module uses a deep learning-based ML model to analyse data entered by farmers and make intelligent crop recommendations based on factors such as soil health, weather, past crops, and market demand.
- **Android Mobile Application Module:** Flutter and Dart were used to develop a mobile app for farmers that includes a chat-to-speech option and machine learning to provide crop suggestions. The integration of Firebase ensures secure cloud storage.
- **Farmer's Distribution Module:** The K-means clustering algorithm is used to group farmers based on their unique farming conditions and experience. This approach can optimize resource utilization, and foster collaboration.
- **Organic Farming Module:** This module promotes organic agricultural practices and evaluates the pH level of soil and fertilizer use history. This promotes a more sustainable farming system with real-time feedback.
- **Farmer Customer Auction Module:** This module creates a direct selling platform for farmers and consumers, eliminating intermediaries and promoting transparency and fairness in pricing.

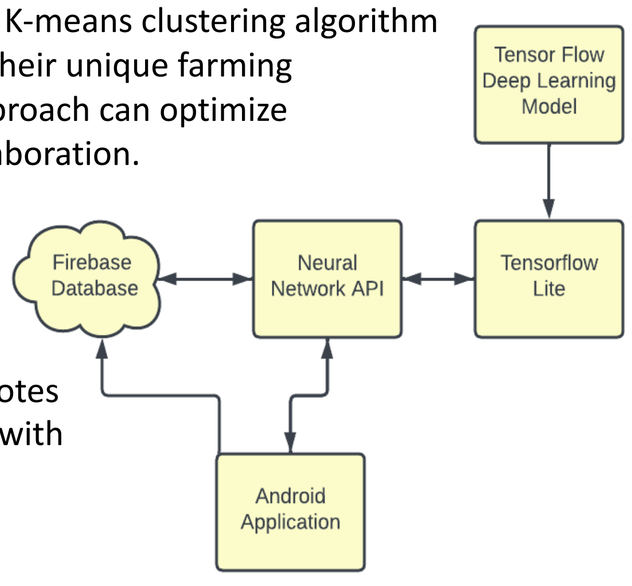


Fig. 2. Methodology Adapted

The Android application utilizes the Firebase ML Kit API and a custom TensorFlow Lite model for crop recommendation based on soil and environmental conditions as shown in Fig.3. By configuring the API and leveraging the converted model, the app generates predictions and displays recommended crops to farmers, facilitating efficient crop suggestions with speed and precision.

Results

The project results demonstrate an impressive accuracy rate of 98.6% for the supervised machine learning model used in planning profitable crops, further emphasizing the reliability and precision of the system. The integrated Android application successfully combines this high accuracy with the optimization of resource utilization, organic farming promotion, and transparent farmer-customer auction module, thereby enhancing profitability, efficiency, and sustainability in the agricultural sector. By empowering farmers with accurate recommendations and direct connections to consumers, the system facilitates informed decision-making and contributes to the overall success of the agricultural business bolstering profitability, efficiency, and sustainability in the agricultural sector.

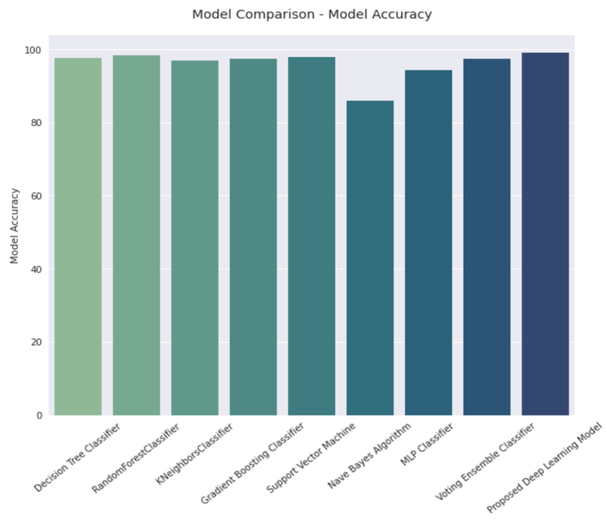


Fig. 3. Model Performance

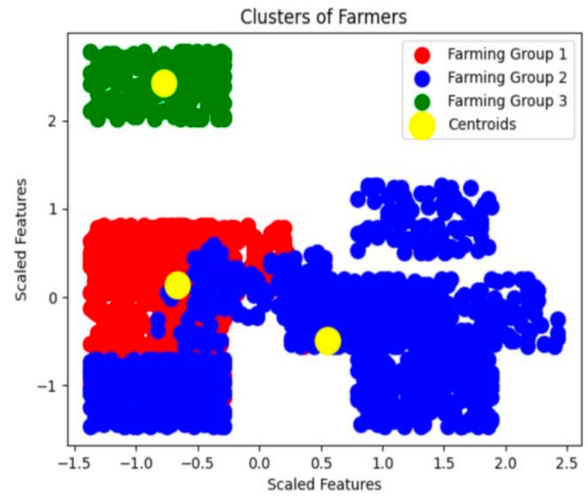
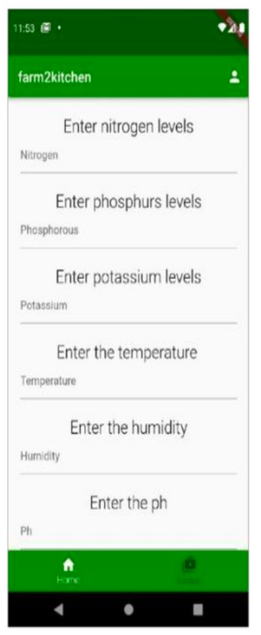


Fig. 4. Farmers Distribution



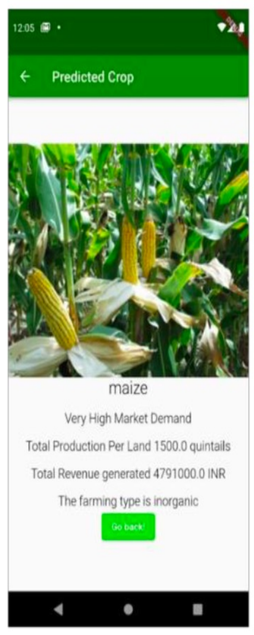


Fig. 5. Crop Planning Module

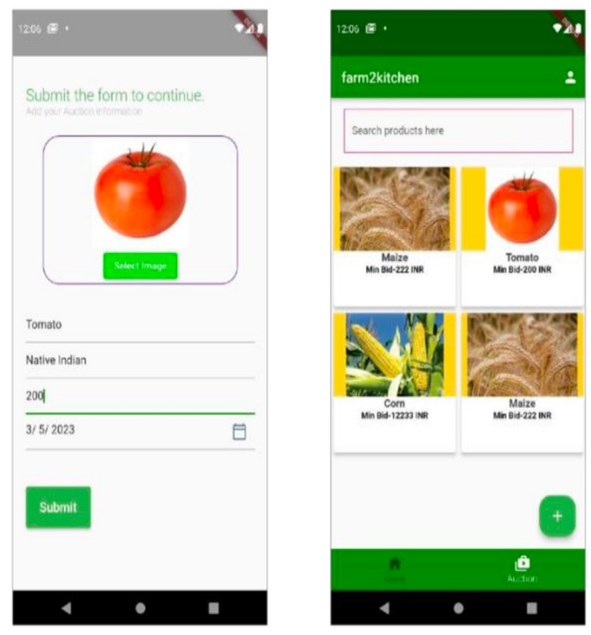


Fig. 6. Farmer-Consumer Auction Module

Table 1. Comparative Analysis

Related Works	Methodology	Accuracy Score
Proposed Work	**Custom Deep Learning Model**	**98.6%**
Reference [1].	Random Forest and BigML Model	97.5%
Reference [2].	Ensemble Model	98%
Reference [3].	Random Forest Model	95%
Reference [4].	Hybrid LSTM, RNN, SVM Model	97%

Based on the analysis conducted, the proposed deep learning-based model for crop planning exhibits exceptional performance, surpassing recent works with an impressive accuracy rate of 98.6%. This high level of accuracy highlights the model's efficacy in providing precise and reliable crop recommendations, while incorporating multiple models. The project's superiority lies in its unique features, including a user-friendly interface with multilingual capabilities and chat-to-speech functionality.

Conclusion

In conclusion, the proposed work effectively tackles challenges faced by farmers by eliminating intermediaries and utilizing deep learning model to recommend profitable crops based on expertise and farming conditions, thereby enhancing self-sustainability and cost reduction. The developed Android application, equipped with multilingual capabilities and chat-to-speech functionality, empowers farmers and promotes self-sustainability. The integration of a custom neural network architecture further enhances the precision of the crop planning module, resulting in am accuracy of 98.6%, surpassing prior work. The project's future prospects involve providing enhanced assistance to farmers, promoting sustainable farming methods, and boosting overall efficiency and profitability in the agricultural industry through further exploration of these domains.

References

[1] Adebiyi, Marion & Ogundokun, Roseline & Abokhai, Aneoghena. (2020). Machine Learning–Based Predictive Farmland Optimization and Crop Monitoring System. Scientifica. 2020. 1-12. 10.1155/2020/9428281.

[2] Kundu, Seeboli & Ghosh, Anupam & Kundu, Avisek & Girish, G P. (2022). Ai Enabled Ensemble Model for Predicting Agricultural Yield.

[3] Priya, P., Muthaiah, U., & Balamurugan, M. (n.d.). Predicting Yield of The Crop Using Machine Learning Algorithm. International Journal of Engineering Sciences & Research Technology, 7(4),1-7.

[4] Agarwal, Sonal & Tarar, Sandhya. (2021). A Hybrid Approach for Crop Yield Prediction Using ML And Deep Learning Algorithms. Journal of Physics.