SmartAgriPredict:Machine Learning &AI-Enhanced Crop price prediction System

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Abstract

Agriculture plays a crucial role in the Indian economy; however, farmers continue to face significant challenges due to unpredictable crop prices and limited access to reliable market information. This paper proposes *SmartAgriPredict*, an intelligent agricultural system that utilizes Machine Learning (ML) and Artificial Intelligence (AI) to forecast crop prices and recommend profitable crops. The system employs advanced models such as Random Forest Regression and Decision Tree Regression, with real-time AI-driven market analysis. By combining historical data with live market trends, Minimum Support Price (MSP) updates, and commodity-related news, the platform generates accurate and actionable insights. Additionally, the system offers multi-year price trend analysis, profitability evaluation, and the crop recommendations to support informed decision-making. Experimental results indicate an accuracy of approximately 94%, highlighting the effectiveness of the proposed hybrid approach in improving agricultural planning and farmer outcomes.

keywords: Machine Learning, Crop Price Prediction, Artificial Intelligence, Agriculture

1.Introduction

Agriculture is the backbone of the Indian economy, employing a significant portion of the population. However, farmers often face uncertainty due to fluctuating market prices, climate variability, and lack of access to accurate information. Traditional farming decisions are largely based on past experience or advice from intermediaries, which may not always be reliable.

With the advancement of Machine Learning and Artificial Intelligence, it is possible to analyze large datasets and provide predictive insights. SmartAgriPredict aims to address these challenges by offering a data-driven platform that helps farmers make informed decisions regarding crop selection and market timing.

2.Related Work

Several studies have explored the use of Machine Learning in agriculture, particularly for crop yield and price prediction. Models such as Linear Regression, Decision Trees, and Random Forests have been widely used due to their efficiency and accuracy. Time-series models like ARIMA and LSTM have also been applied for forecasting agricultural trends.

However, most existing systems focus either on the prediction or advisory services, lacking integration real-time market intelligence. SmartAgriPredict overcomes this limitation by combining ML-based predictions with AI-driven real-time data analysis, making it more robust and practical.

[1] Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) have led to the development of intelligent systems for agricultural decision-making, particularly in crop price prediction. Various researchers have explored the use of algorithms such as Decision Trees, Random Forest, Support Vector Machines (SVM), and Linear Regression to analyze historical market data and forecast crop prices. However, many of these models face challenges such as limited accuracy due to insufficient datasets and inability to adapt to dynamic market conditions.

[2] Several studies have focused on agricultural advisory systems that provide farmers with crop recommendation and market trends. While these systems improve accessibility to information, most relay on static datasets and lack real-time updates reducing their effectiveness in rapidly changing market environments.

[3] Research has also been conducted on integrating real-time data collection techniques such as web scraping and API-based data extraction to obtain live mandi prices. These approaches enhance prediction reliability but are often not well integrated with machine learning models for comprehensive analysis. In addition, mobile and web-based applications have been developed to assist farmers by providing features such as weather forecasts, crop suggestions, and price information. However, many of these applications lack advanced analytics, interactive visualizations, and intelligent prediction capabilities

[4] Ensemble learning techniques like Random Forest have shown improved performance in prediction accuracy compared to traditional models. Despite this, existing systems often do not provide a complete integrated solution combining user interface, backend processing, predictive modeling, and real-time intelligence. Therefore, there is a need for an integrated system that combines real-time data extraction, machine learning-based prediction, and user-friendly visualization to provide accurate and actionable insights for farmers.

3.Materials and Methods

3.1 System Architecture

SmartAgriPredict System follows a layered architecture. At the top, the User Interface (React.js Tailwind CSS) allows users to enter inputs, view charts, and analyze trends. This interface communicates with the Backend API (Node.js + Express), which handles client requests, sends data to the machine learning components, and aggregates the results.

The core processing is done by the ML Prediction Engine, which uses techniques like Random Forest and Decision Trees for data preprocessing, price prediction, and trend generation. Supporting this is the AI Web Intelligence Engine (Gemini 2.5 Flash), which extracts real-time mandi (market) prices from the web. Overall, the system integrates frontend interaction, backend processing, machine learning and real-time data extraction to provide accurate agricultural predictions and insights

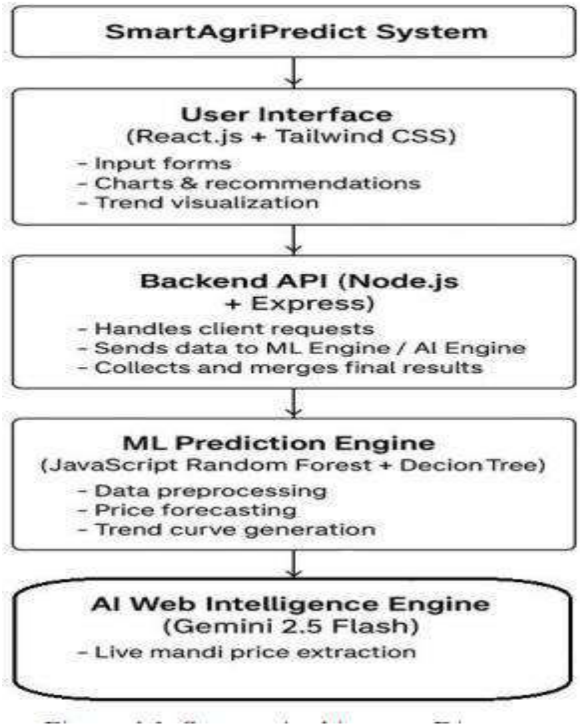

Figure 3.1 System Architecture

3.2 Algorithm

Random Forest Regression: is the basic crop price predicting algorithm. This project manually implements the Random Forest model in JavaScript on the client-side (browser) and server-side (Node.js). Random Forest is an ensemble learning technique that aggregates Decision Tree predictions to make a more accurate and stable forecast.

3.3 Methodology

- Data Collection
- Data Preprocessing
- Model Training
- Prediction
- AI Validation
- Output Generation

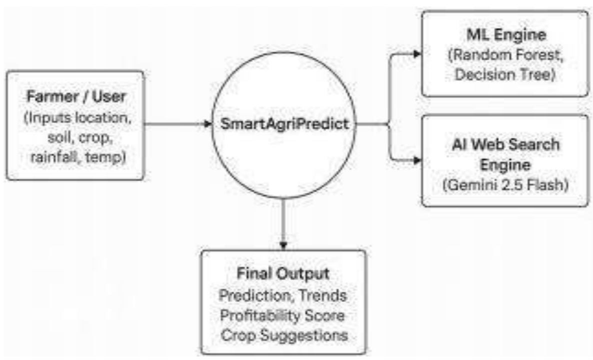

Figure 3.2 Data Flow Diagram

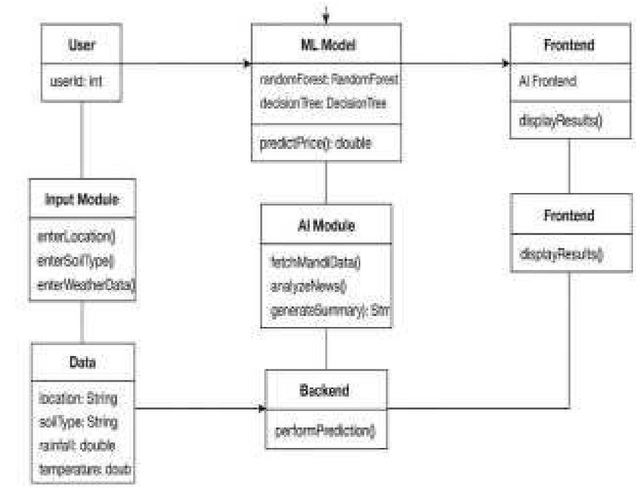

Figure 3.3 UML Diagram

3.4 Features

- Crop recommendation
- Price prediction
- Profitability score
- 3-year trend analysis
- Real-time price comparison

4. Result and Discussion

The system exhibits robust performance, with a prediction accuracy of roughly 94% and enhanced model efficiency through JavaScript optimization. The portal offers farmers action outputs, including recommendations for the most suitable crop for their conditions, an alternative crop option for the flexibility, three-year price trend analysis for long-term planning, a profitability score to evaluate economic viability, and real-time price comparisons to facilitate informed market decisions. This amalgamation of precision, efficacy, and pragmatic insights guarantees that farmers obtain dependable counsel customized for both present and prospective agricultural requirements.

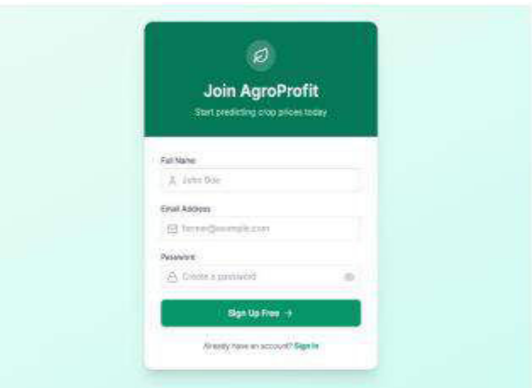

Figure 4.1 sign up page

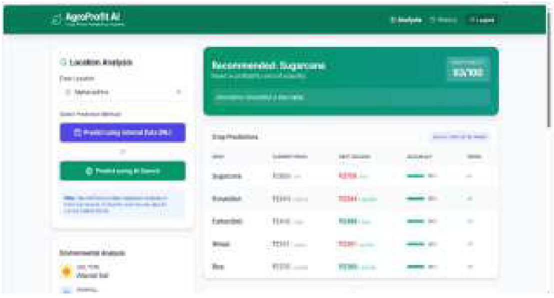

Figure 4.2 Crop predicting using ML

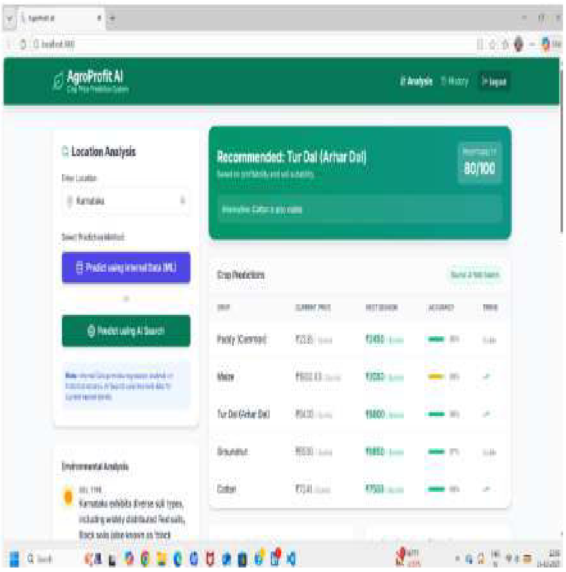

Figure 4.3 Crop predicting using AI

5.Conclusion

SmartAgriPredict demonstrates the potential integrating Machine Learning and Artificial Intelligence in agriculture. By combining predictive models with real-time market intelligence, the system provides accurate and actionable insights for farmers. This approach not only reduces uncertainty but also enhances profitability and promotes data-driven farming practices.

Future Scope

- Integration with IoT sensors
- Mobile application development
- Use of deep learning models like LSTM
- Weather-based prediction enhancements
- Expansion to global agricultural markets

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