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AI-Based Crop Recommendation for Farmers

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ABSTRACT-

Agriculture is one of the most important sectors that supports the economy and provides food for the growing population. However, many farmers face difficulties in selecting the right crop because soil conditions and weather factors vary from place to place. Choosing an unsuitable crop can reduce productivity and increase financial loss. This project presents an AI-Based Crop Recommendation System for Farmers that uses Artificial Intelligence (AI) and Machine Learning (ML) to recommend the most suitable crop based on soil and environmental conditions.

The system analyzes important factors such as nitrogen (N), phosphorus (P), potassium (K), temperature, humidity, soil pH, and rainfall to predict the best crop. Different machine learning algorithms, including Random Forest, Decision Tree, and K-Nearest Neighbors (KNN), are* trained and *compared to select the most accurate model.

The selected model is integrated into a simple web application developed using Python and Flask, allowing users to enter input values and receive instant crop recommendations.

The proposed system helps farmers make informed decisions, improve agricultural productivity, reduce the risk of incorrect crop selection, and encourage sustainable farming through accurate, reliable, and data-driven recommendations.

Keywords: ***Artificial Intelligence (AI), Machine Learning, Crop Recommendation, Smart Agriculture, Soil Analysis, Precision Farming.***

INTRODUCTION

Agriculture plays a vital role in supporting the economy and providing food and employment for millions of people, especially in India. One of the biggest challenges farmers face is choosing the right crop for their land. The success of a crop

depends on several factors, including soil nutrients, temperature, humidity, rainfall, and soil pH. Selecting an unsuitable crop can lead to lower yields, reduced income, and inefficient use of resources.

Advancements in Artificial Intelligence (AI) and Machine Learning (ML) are helping make farming more efficient by providing data-driven solutions. This project introduces an AI-Based Crop Recommendation System for Farmers that analyzes important soil and environmental parameters to recommend the most suitable crop. The system uses machine learning algorithms such as Random Forest, Decision Tree, and K-Nearest Neighbors (KNN) to compare prediction performance and identify the most accurate model. A simple web application allows users to enter the required values and instantly receive crop recommendations.

By supporting farmers with quick and reliable suggestions, the proposed system aims to improve agricultural productivity, encourage informed decision-making, and promote sustainable farming practices.

LITERATURE SURVEY

Recent advancements in Artificial Intelligence (AI) and Machine Learning (ML) have introduced new ways to support farmers in selecting suitable crops. Many researchers have developed crop recommendation systems that analyze soil nutrients and environmental conditions to provide accurate crop suggestions. Unlike traditional methods, which mainly depend on farmers' experience, these systems use data-driven techniques to improve decision-making and reduce the risk of incorrect crop selection.

Several studies have applied machine learning algorithms such as Random Forest, Decision Tree, and K-Nearest Neighbors (KNN) to predict suitable crops using factors like nitrogen (N), phosphorus (P), potassium (K), temperature, humidity, soil pH, and rainfall. Among these algorithms, Random Forest has shown strong performance due to its high accuracy and ability to handle complex agricultural data.

Inspired by these studies, this project develops an AI-Based Crop Recommendation System that compares multiple machine learning models and selects the most accurate one for crop prediction. The system provides quick and reliable recommendations through a simple web application, helping farmers make informed decisions and improve agricultural productivity.

RELATED WORK

In recent years, Artificial Intelligence (AI) and Machine Learning (ML) have been widely used to improve agricultural practices, especially in crop recommendation. Researchers have developed intelligent systems that analyze soil and environmental conditions to recommend suitable crops, helping farmers make better decisions. These systems provide a more reliable alternative to traditional crop selection methods, which mainly depend on experience and local knowledge.

Many studies have used machine learning algorithms such as Random Forest, Decision Tree, and K-Nearest Neighbors (KNN) to predict suitable crops based on factors like nitrogen (N), phosphorus (P), potassium (K), temperature, humidity, soil pH, and rainfall. Among these algorithms, Random Forest has shown better performance in terms of prediction accuracy and reliability.

Building on these studies, this project develops an AI-Based Crop Recommendation System that compares different machine learning models and selects the most accurate one for crop prediction. The system provides quick and reliable crop recommendations through a simple web application, helping farmers improve productivity, make informed decisions, and adopt smarter farming practices.

EXISTING SYSTEM

The existing crop selection process mainly depends on traditional farming practices, where farmers choose crops based on their experience, local knowledge, or suggestions from others. Although these methods have been used for many years, they may not always provide accurate results because important factors such as soil nutrients, temperature, humidity, rainfall, and soil pH are not fully considered. As a result, farmers may select crops that are not suitable for their land, leading to lower crop yields and financial losses. Some existing agricultural systems provide weather information or basic farming guidance, but they offer limited support for personalized crop recommendations. A few machine learning-based systems are available, but many are difficult to use or focus on a limited number of crops and input parameters. These limitations reduce their effectiveness in real farming conditions.

Therefore, there is a need for an intelligent and user-friendly crop recommendation system that can analyze soil and environmental data to provide accurate crop

suggestions. Such a system can help farmers make better decisions, improve productivity, and use available resources more efficiently.

PROPOSED SYSTEM

The proposed AI-Based Crop Recommendation System for Farmers is designed to help farmers choose the most suitable crop based on soil and environmental conditions. By using Artificial Intelligence (AI) and Machine Learning (ML), the system provides accurate crop recommendations instead of relying only on traditional farming experience. This helps farmers make better decisions and improves the chances of achieving higher crop yields.

The system analyzes important factors such as nitrogen (N), phosphorus (P), potassium (K), temperature, humidity, soil pH, and rainfall. It trains and compares machine learning algorithms, including Random Forest, Decision Tree, and K-Nearest Neighbors (KNN), and selects the model with the highest accuracy for crop prediction.

A simple web application developed using Python and Flask allows users to enter soil and environmental values and instantly receive the recommended crop along with the prediction confidence and model accuracy. The proposed system helps farmers improve productivity, reduce the risk of selecting unsuitable crops, and encourage the use of modern technology for more efficient and sustainable farming.

SYSTEM ARCHITECTURE

The system architecture of the AI-Based Crop Recommendation System for Farmers shows how the application works from receiving user input to generating a crop recommendation. The system uses a crop recommendation dataset containing important parameters such as nitrogen (N), phosphorus (P), potassium (K), temperature, humidity, soil pH, and rainfall. The data is preprocessed and used to train machine learning algorithms, including Random Forest, Decision Tree, and K-Nearest Neighbors (KNN). The algorithm with the best prediction accuracy is selected as the final model.

The trained model is integrated into a web application developed using Python and Flask. Users enter soil and environmental values through a simple interface, and the system quickly analyzes the data to recommend the most suitable crop. It also displays the prediction confidence and model accuracy. This architecture provides a simple, fast, and reliable solution that helps

farmers make informed decisions and improve agricultural productivity

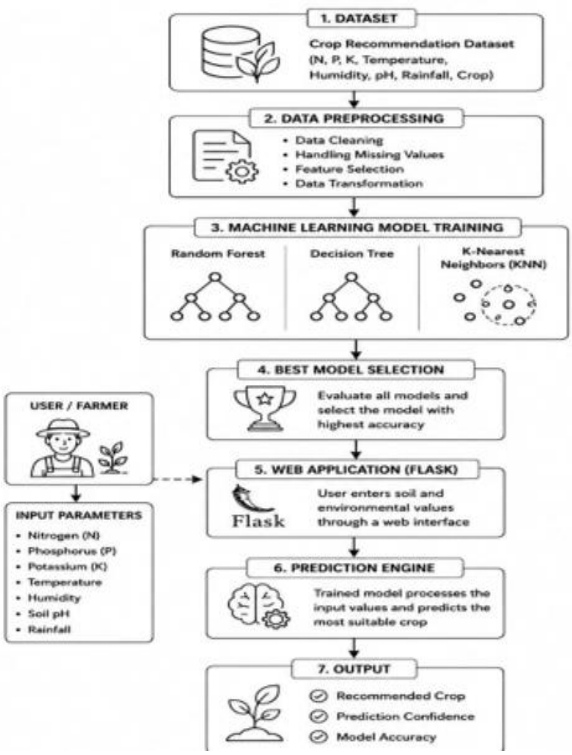


Fig 1: System Architecture

METHODOLOGY DESCRIPTION

The AI-Based Crop Recommendation System collects soil and weather data, including Nitrogen (N), Phosphorus (P), Potassium (K), temperature, humidity, pH, and rainfall. The data is preprocessed and used to train machine learning models. The best-performing model is selected to predict the most suitable crop based on the farmer's input. The system then displays the recommended crop with high accuracy, helping farmers make better cultivation decisions.

RESULTS AND DISCUSSSION

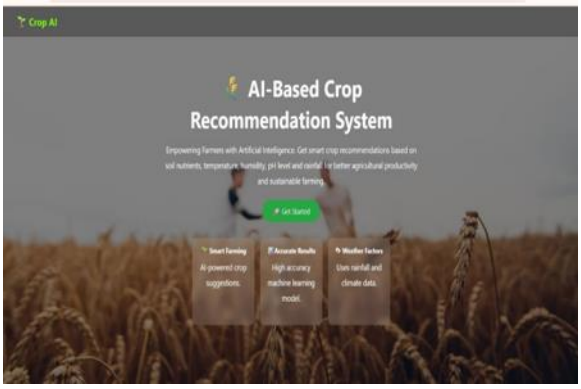
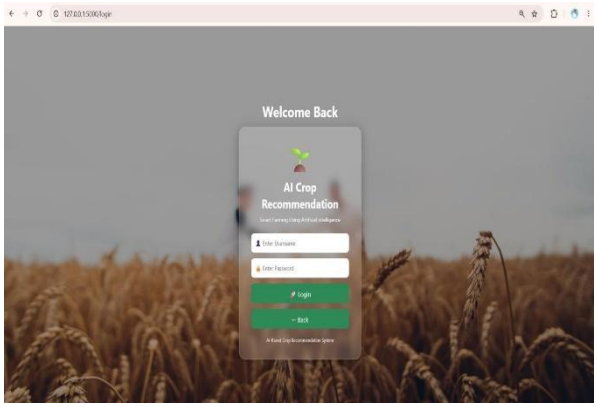


Fig 2: Home page

The home page of the AI-Based Crop Recommendation System provides a simple and user-friendly interface for farmers. It introduces the purpose of the application, highlights its key features, and allows users to begin the crop recommendation process using soil nutrients and environmental parameters to receive accurate crop suggestions.

Fig 3: Login Page



The **Login Page** provides secure access to the AI-Based Crop Recommendation System. Users enter their username and password to

access the application. It features a clean, user-friendly interface with Login and Back buttons, ensuring easy navigation and a smooth user experience.

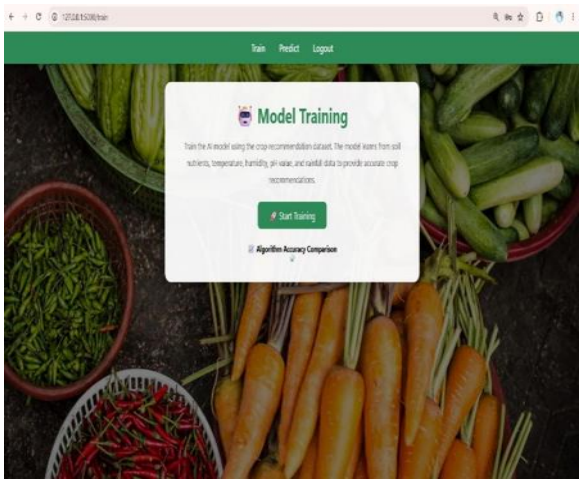


Fig 4: Training page

The **Model Training** page allows users to train the AI model using the crop recommendation dataset. After clicking **Start Training**, the system processes the data, trains the machine learning model, and displays algorithm accuracy results for evaluating model performance.

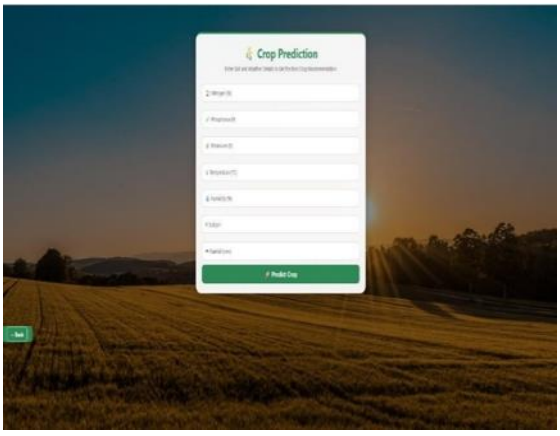


Fig 5: prediction page

The Crop Prediction page enables users to enter soil nutrients, temperature, humidity, pH, and rainfall values. After clicking Predict Crop, the AI model analyzes the inputs and recommends the most suitable crop, helping farmers make informed agricultural decisions.

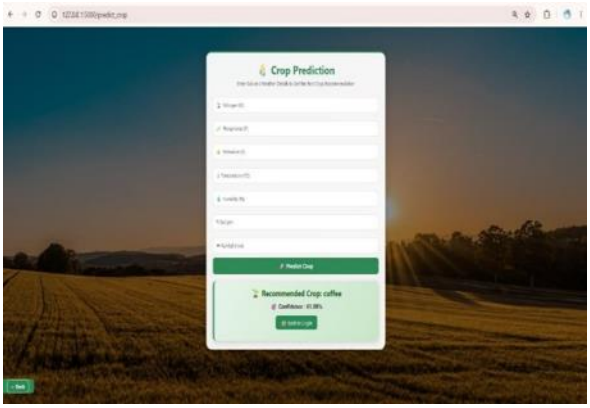


Fig 6: predicted crop

The **Prediction Result** page displays the recommended crop based on the soil and weather parameters entered by the user. It also shows the model's confidence score, allowing users to understand the prediction reliability and make better farming decisions.

CONCLUSION

The AI-Based Crop Recommendation System uses machine learning to recommend the most suitable crop based on soil nutrients (Nitrogen, Phosphorus, Potassium), temperature, humidity, pH, and rainfall. The system provides quick and accurate predictions, helping farmers make informed

decisions that can improve crop productivity and reduce the risk of selecting unsuitable crops. The user-friendly web interface makes the application simple to use, even for users with limited technical knowledge.

FUTURE SCOPE

The future scope of the AI-Based Crop Recommendation System focuses on improving accuracy and usability by integrating advanced technologies. The system can include real-time weather APIs for better crop suggestions, fertilizer and pesticide recommendations for improved farming decisions, and a mobile application for easy access. Regional language support can help more farmers use the system effectively. Disease detection using image processing and deep learning can identify crop diseases early and suggest solutions. Continuous model updates with new agricultural datasets will further enhance prediction accuracy and adaptability to changing environmental conditions.

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