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AI Based Crop Recommendation for Farmers

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ABSTRACT- ***Agriculture plays a significant role in the economic development and food security of many countries. Selecting the appropriate crop based on soil nutrients and climatic conditions is essential for achieving higher agricultural productivity and sustainable farming. However, traditional crop selection methods often rely on farmers' experience and manual analysis, which may result in poor crop yield and inefficient utilization of resources. To overcome these limitations, this paper presents an AI Based Crop Recommendation System for Farmers that utilizes machine learning techniques to recommend the most suitable crop for cultivation based on soil and environmental parameters. Three algorithms, namely Random Forest, Logistic Regression, and Support Vector Machine (SVM), are trained and compared to identify the model with the highest prediction accuracy. Farmers can securely register, log in, enter agricultural parameters, and receive instant crop recommendations along with cultivation suggestions. The system also maintains prediction history, enabling users to review previous results. By integrating artificial intelligence with agriculture, the proposed solution improves crop selection, enhances productivity, optimizes resource utilization, and supports sustainable farming practices.***

KEYWORDS: ***Artificial Intelligence, Machine Learning, Crop Recommendation, Soil Analysis, Random Forest, Support Vector Machine, Precision Agriculture, Sustainable Farming, Flask.***

INTRODUCTION

The AI Based Crop Recommendation System for Farmers is a web-based application developed to assist farmers in selecting the most suitable crop based on soil and climatic conditions. It enables users to register, log in,

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enter agricultural parameters, and receive instant crop recommendations with cultivation suggestions. The system uses machine learning algorithms such as Random Forest, Logistic Regression, and Support Vector Machine (SVM) to train and compare models, selecting the best-performing model for crop prediction. It is developed using Python, Flask, HTML, CSS, JavaScript, Bootstrap, SQLite, and Scikit-learn. The application provides secure user authentication, dataset upload and model training by the administrator, prediction history, and result management. It improves crop selection accuracy, supports data-driven farming decisions, optimizes resource utilization, reduces the risk of crop failure, and promotes sustainable and precision agriculture.

LITERATURE SURVEY

Recent studies on intelligent agricultural systems show that Artificial Intelligence (AI) and Machine Learning (ML) can significantly improve the accuracy and efficiency of crop recommendation. Researchers have developed web-based systems that utilize soil nutrients, climatic conditions, and environmental factors to recommend suitable crops for cultivation. Machine learning algorithms, particularly Random Forest, have demonstrated high prediction accuracy by effectively analyzing agricultural datasets and identifying relationships between soil properties and crop suitability. Other algorithms, such as Logistic Regression and Support Vector Machine (SVM), have also been widely used for crop classification and prediction. These studies indicate that integrating machine learning with web technologies can provide accurate crop recommendations, reduce farming risks, enhance agricultural productivity, and promote sustainable farming practices, which forms the foundation of the proposed AI Based Crop Recommendation System for Farmers.

RELATED WORK

Several researchers have developed web-based systems to assist farmers in selecting suitable crops based on soil and climatic conditions. Earlier systems mainly focused on analyzing agricultural data and providing crop recommendations using traditional machine learning techniques. The proposed AI Based Crop Recommendation System for Farmers utilizes Random Forest, Logistic Regression, and Support Vector Machine (SVM) algorithms to compare performance

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and select the best model for accurate crop recommendation. The system provides a secure web-based platform that enables farmers to obtain instant crop recommendations, helping improve agricultural productivity, optimize resource utilization, and support sustainable farming practices.

EXISTING SYSTEM

The existing crop recommendation process mainly depends on farmers' experience, traditional farming practices, and general agricultural knowledge. Farmers often select crops based on seasonal conditions or previous cultivation methods without thoroughly analyzing soil nutrients and environmental factors. This manual approach is time-consuming, less accurate, and may lead to improper crop selection, resulting in low crop yield, inefficient utilization of resources, and financial losses. They also lack secure user management, comparison of multiple machine learning models, and prediction history. As a result, farmers receive limited decision support, making it difficult to select the most suitable crop for changing soil and climatic conditions.

PROPOSED SYSTEM

The proposed AI Based Crop Recommendation System for Farmers is a web-based application developed to assist farmers in selecting the most suitable crop based on soil nutrients and climatic conditions. It allows users to register, log in, enter agricultural parameters, and receive instant crop recommendations through an intelligent prediction system. The application utilizes Random Forest, Logistic Regression, and Support Vector Machine (SVM) algorithms to train and compare models, automatically selecting the best-performing model for crop prediction. It provides secure user authentication, administrator-controlled dataset upload and model training, prediction history, and result management. The system improves crop recommendation accuracy, reduces dependency on traditional farming practices, supports data-driven decision-making, and optimizes resource utilization. It enhances agricultural productivity, promotes precision and sustainable farming, and provides a fast, reliable, and user-friendly platform for intelligent crop recommendation.

SYSTEM ARCHITECTURE

The architecture of the AI Based Crop Recommendation System for Farmers

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consists of a user interface, application server, machine learning module, and database. The user interface allows farmers to register, log in, enter soil and climatic parameters, and receive crop recommendations. The administrator can upload agricultural datasets, train machine learning models, and monitor prediction results. The application server processes user requests and communicates with the machine learning module, where Random Forest, Logistic Regression, and Support Vector Machine (SVM) algorithms are trained and compared to select the best-performing model for crop prediction. The trained model analyzes parameters such as Nitrogen (N), Phosphorus (P), Potassium (K), temperature, humidity, soil pH, and rainfall to recommend the most suitable crop. All user details, prediction history, trained models, and agricultural data are securely stored in the database.

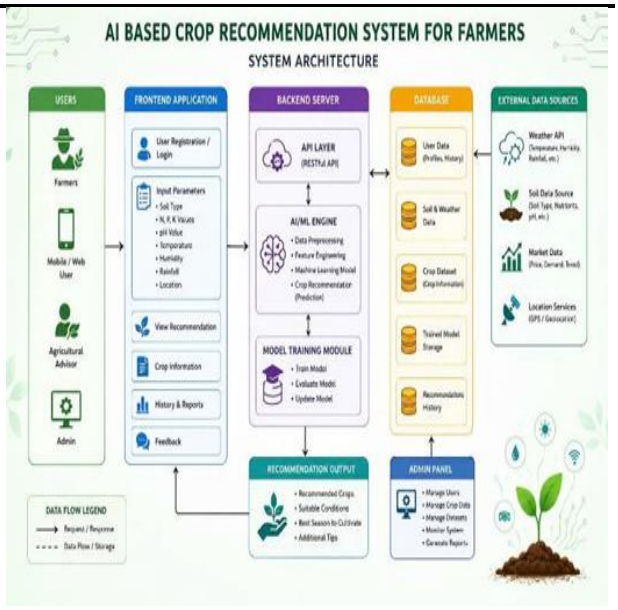

Fig 1: System Architecture

METHODOLOGY DESCRIPTION

The proposed AI Based Crop Recommendation System for Farmers follows a systematic approach to provide accurate crop recommendations using machine learning. Farmers first register and log in to the web application, where they enter agricultural parameters such as Nitrogen (N), Phosphorus (P), Potassium (K), temperature, humidity, soil pH, and rainfall. The administrator uploads the agricultural dataset through the web portal, and the data is preprocessed by removing duplicate records, handling missing values, applying Label Encoding, and performing Feature Scaling using Standard Scaler.

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Random Forest, Logistic Regression, and Support Vector Machine (SVM) algorithms are trained and evaluated, and the model with the highest prediction accuracy is automatically selected and saved for future predictions.

RESULTS AND DISCUSSION

Home Page

The Home Page is the main interface of the AI Based Crop Recommendation System. The page allows users to navigate to User Registration, User Login, and Admin Login. It also highlights the key features of the system, making it user-friendly and easy to access.

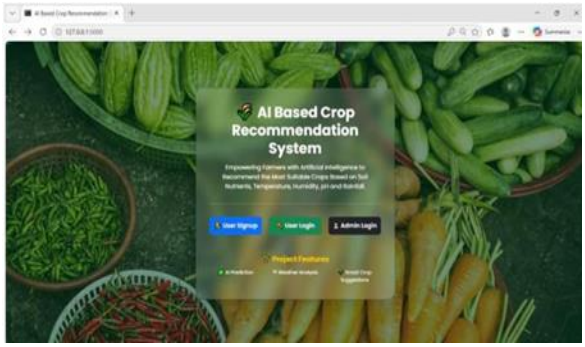

Fig 2: Home Page

User Registration Page

The User Registration page enables new farmers to create an account by entering personal details such as name, username, email, phone number, and password. The system validates the entered information before storing it securely in the database. This ensures secure access and prevents duplicate registrations.

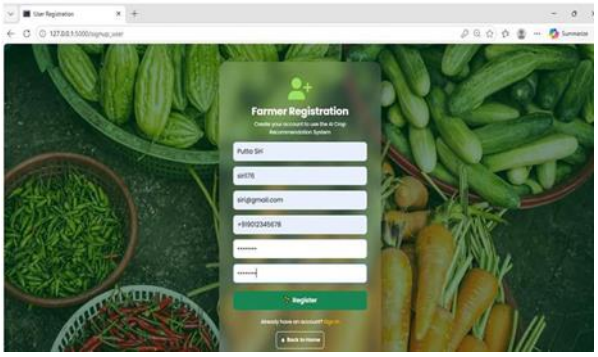

Fig 3: User Registration Page

Login Page

The User Login page provides secure authentication for registered users. Farmers can enter their username and password to access the crop recommendation dashboard. The system verifies the login credentials before granting access. This mechanism ensures that only authorized users can use the prediction and history features.

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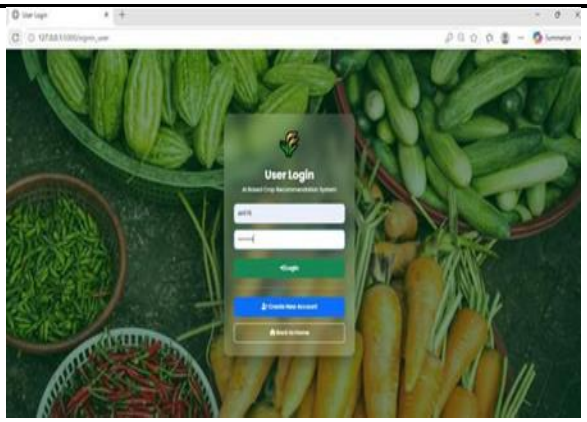

Fig 4: Login Page

Train Page

The AI Model Training page is accessible only to the administrator. It allows the admin to upload the agricultural dataset and train multiple machine learning algorithms, including Random Forest, Logistic Regression, and Support Vector Machine (SVM).

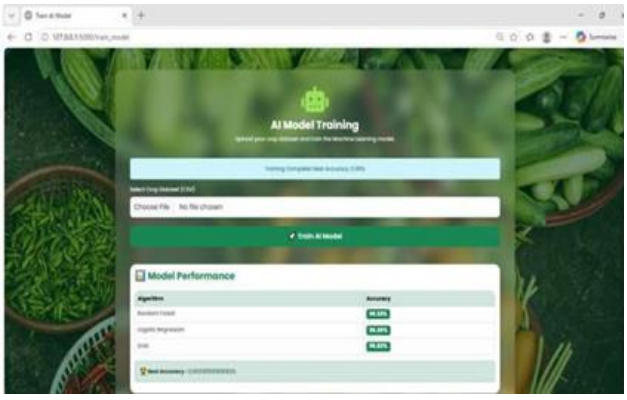

Fig 5: Train Page

Training Graphs

The Training Graphs page displays graphical representations of the agricultural dataset used for model training. Histograms illustrate the distribution of important features such as Nitrogen (N), Phosphorus (P), Potassium (K), Temperature, Humidity, and Soil pH.

Fig 6: Prediction Page

Crop Recommendation Dashboard

The Crop Recommendation Dashboard allows farmers to enter soil and climatic parameters, including Nitrogen, Phosphorus, Potassium, Temperature, Humidity, Soil pH, and Rainfall.

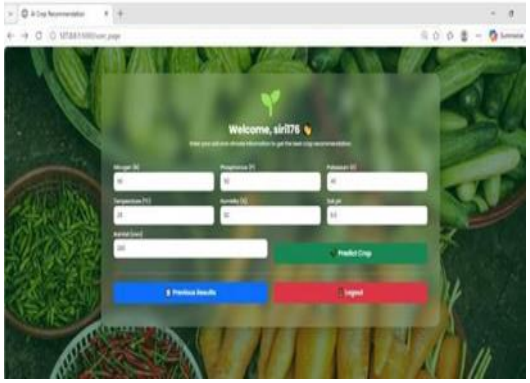

Fig 7: Crop Recommendation Dashboard

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Crop Recommendation Result

The Crop Recommendation Result page displays the predicted crop along with a farming suggestion based on the entered soil and climatic conditions. The prediction is generated using the trained machine learning model with the highest accuracy. This helps farmers make informed decisions for improving agricultural productivity and sustainable farming practices.

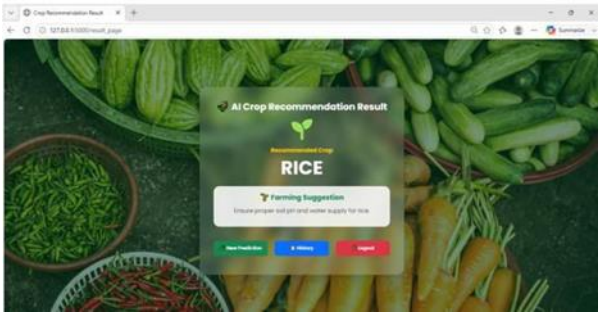

Fig 8: Crop Recommendation Result

CONCLUSION

The proposed AI Based Crop Recommendation System for Farmers provides an intelligent and efficient solution for selecting suitable crops based on soil nutrients and climatic conditions. By comparing Random Forest, Logistic Regression, and Support Vector Machine (SVM), the system selects the best-performing model to improve prediction accuracy. The generated crop recommendations and farming suggestions help farmers make informed decisions and optimize resource utilization. Overall, the proposed system reduces dependency on traditional crop selection methods and promotes precision and sustainable agriculture through reliable and user-friendly technology.

FUTURE SCOPE

The proposed system can be enhanced by integrating real-time weather forecasting and IoT-based soil sensors for more accurate crop recommendations. Future versions may include fertilizer recommendation, pest and disease detection, irrigation management, and crop yield prediction to provide complete agricultural support. The system can also be integrated with government agricultural services and larger datasets to further improve prediction accuracy.

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