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KRUSHI-MITRA : A Study on Machine Learning Algorithms for Precision Farming

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ABSTRACT

The demand for creative solutions to improve farming operations grows as the agricultural landscape continues to change. In order to provide farmers with personalized and data-driven crop recommendations, this research provides a Crop Recommendation System based on Artificial Intelligence and Machine Learning. The main objective is to promote more sustainable and effective farming methods, taking into account the particular difficulties farmers encounter in maximizing crop production. The suggested method makes use of cutting-edge AI and ML algorithms to examine various agricultural data sets, including soil properties, climatic trends, past crop performance, and other pertinent factors. The system uses cutting edge approaches like ensemble methods, decision trees, and predictive modeling to deliver precise and customized crop selection suggestions depending on the unique circumstances of each farm. Evaluation metrics, such as accuracy, recall and precision, are used to carefully evaluate the Crop Recommendation System's performance. Analyses conducted in comparison with baseline models demonstrate the efficacy and superiority of the suggested AI and ML-based method in terms of producing precise and trustworthy crop recommendations.

INTRODUCTION

The twin challenges of modern agriculture are resolving the environmental effects of farming practices and providing food for a growing world population. Innovative solutions that maximize crop choices, enhance resource efficiency, and support sus tainable agricultural methods are desperately needed to address these issues. The goal of this project is to modernize traditional farming methods and promote a more sustainable agricultural future through the creation and deployment of an AI and ML-based crop recommendation system

LITERATURE REVIEW

In order to maximize crop output rate through the use of machine learning tech niques, the paper presents the Crop Selection Method (CSM). Planning for agricul ture is essential to the economic development and food security of agro-based nations, and crop choice has a big impact on agricultural productivity. The main goal of the CSM approach is to forecast yield rates by taking into consideration a number of factors, including crop characteristics, soil type, weather, and water density. It then suggests a crop planting order to maximize net production rate throughout the grow ing season. The program provides a sequence that maximizes production per day across the season by taking into account variables such as sowing time, plantation days, and estimated yield rates for various crops. In agro-based nations, the strat egy has the potential to boost economic growth and agricultural productivity. This research contributes to the progress of precision agriculture by offering a thorough analysis and a workable crop selection method.[Rakesh Kumar et al.]

METHODOLOGY

Choosing an acceptable algorithm to generate suggestions and describing the corre lations between different parameters are the two main tasks of a mathematical model for a crop recommendation system

3.1 System Architecture

The architecture of KRUSHI-MITRA is divided into several interconnected modules:

1) Temperature (T): Average temperature in Celsius.

2) Humidity (H): Average humidity percentage.

3) Soil Nutrients:-Nitrogen (N): Soil nitrogen content. Phosphorus (P): Soil phosphorus content.-Potassium (K): Soil potassium content.

4) PH Level (pH): Soil pH level.

5) Rainfall (R): Average rainfall in millimeters. 3.3 Implementation Steps

1. Mathematical Model:

Determining the correlations between input characteristics and the output—that is, the suggested crop—is the first step in developing a mathematical model for a crop recommendation system. While a thorough model would rely on the particulars of your data and the machine learning algorithm that you have selected

1.1. Linear Regression Model:

$$Y = \beta0+\beta1 \cdot N + \beta2 \cdot P + \beta3 \cdot K + \beta4 \cdot Rainfall + \beta5 \cdot Humidity + \beta6 \cdot pH + \epsilon \quad (5.1)$$

Where:

Y is the predicted crop recommendation.
β0 is the intercept.
β1, β2,β3,β4,β5,β6 are the coefficients for the corresponding input parameters.
ϵ is the error term.

The machine learning model's training phase would determine the coefficients, or value. By adjusting these parameters, the model learns to minimize the discrepancy between the actual and forecast crop recommendations. The linear relationship between the input parameters and the output is assumed by this linear model, which, depending on the complexity of your data, may be a simplification

1.2.K Nearest Neighbor (KNN)

Let X represent the feature vector for a given sample (N, P, K, Rainfall, Humidity, pH), and Y be the corresponding crop recommendation.

1.3 Support Vector Machine

$$Y = \text{sign}(\text{n i=1 } \alpha i y i \langle Xi, X \rangle + b)$$

where:

αi are the Lagrange multipliers obtained during the SVM training, yi is the class label of the training sample Xi,
⟨Xi,X⟩ is the dot product of the feature vectors, b is the bias term

1.4 Random Forest :

1. Individual Decision Tree Model:

Yi = Ti(bootstrap sample,random subset of features)
The decision tree predicts Yi for a given input feature vector X

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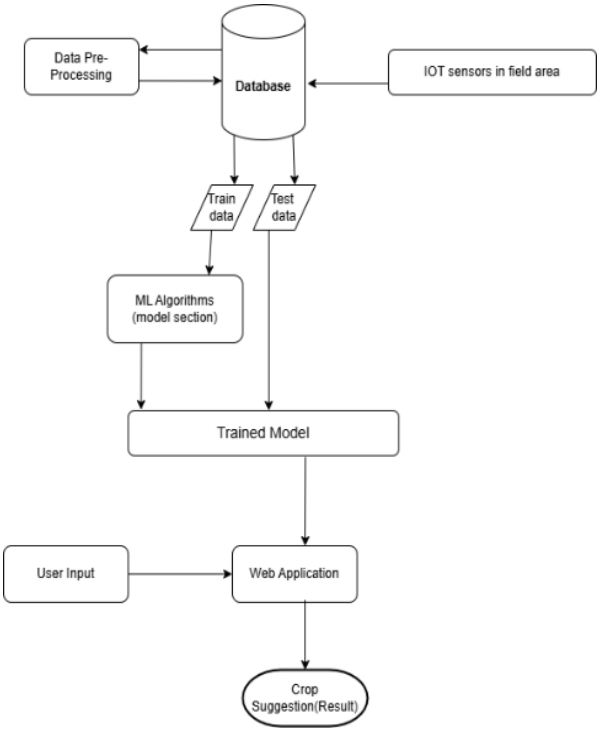

Fig. 1: Proposed System Setup

I. COMPONENTS USED

1. Hardware Components

- CPU, keyboard, laptop.
- Hard disk: 256 GB minimum.
- RAM: Minimum 4 GB.
- Processor: Any processor, for example, Intel(R) Core(TM) i3-4005U CPU 1.70GHz.
- Microphone and Speaker (Built-in or External).
- Internet Connectivity (for online data retrieval or updates).
- Display 64 bit color
- Cloud Infrastructure.
- Graphical Processing Unit

2. Software Components

- Operating System: Windows 10/11.
- Any version of internet explorer (Chrome ,Firefox).
- Backend – Python.
- Frontend - JavaScript, HTML, CSS.
- Libraries/Modules: -

CONCLUSION

We have created and implemented an intelligent system that can recommend crops that would be good for farmers all over India. This system would assist farmers in selecting the optimal crop by taking into account variables such as rainfall, humidity, temperature, PH value, phosphorus, potassium, and nitrogen. With the help of this project, we can profit from this technique and raise national productivity. By employing this method, farmer's can raise the nation's profitability and productivity. Farmers will be able to grow the right crop and raise both their own and the nation's earnings in this way. We have assessed various machine learning algorithms thus far

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