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Crop Recommendation Assistant Using Machine Learning

Aman Sinha[1], Pallavi Sinha[2], Ritika Rajani[3*], K. A. Sumithra Devi[4]
[1,2,3]B.E. Student, Department of Information Science and Engineering, Dayananda Sagar Academy of Technology and Management, Bengaluru, India
[4]Professor & HoD, Department of Information Science and Engineering, Dayananda Sagar Academy of Technology and Management, Bengaluru, India

***Abstract*: Agriculture has a vital role in India's economy. The most common issue that Indian farmers face is that they are not able to choose the right crop for their soil. Because of this approach, the likelihood of soil degradation is reduced, and crop health is improved. Precision agriculture has the potential to solve the farmers' predicament. A soil database acquired from the farm characterizes exact agriculture. The information gathered by these sensors is stored in the microcontroller and analyzed by using machine learning techniques such as random forest to produce crop growth recommendations. This project emphasizes engaging a convolutional neural network as a primary method for deciding whether a plant is at risk of disease [1].**

***Keywords*: Identification of soil nutrients, crop recommendations and plant pathology, Machine Learning, Convolutional Neural Network, K- Nearest Neighbor, Nitrogen-Phosphorus-Potassium.**

1. Introduction

India is a major agricultural powerhouse in the world. The agriculture sector is critical to the country's economic development. Crop selection is the focus of the suggested research article because it is the most significant step in the agricultural development process. Because soil is the basis of the nutrients, we need to grow crops, it is a critical component of successful agriculture. Farmers must follow certain procedures to ensure that the soil is properly cared for. Following best practices for crop production is critical, but first and foremost, the appropriate crop for the fertile lands must be chosen to maximize the benefits of the procedures used. As a result, the System concentrates on crop selection because it directly impacts crop production rate.

Precision agriculture has offered farmers a solution to their problems. Farmers must increase productivity in order to make more money with the same amount of land and less work. Precision agriculture makes it possible. Crop recommendation is one of the most important aspects of precision agriculture.

Many studies are being conducted in an attempt to develop an accurate and efficient crop prediction model. Ensembling is one of the techniques used in these types of studies. In this field, a variety of machine learning approaches are used. Ensembling methods are a technique that combines the strength of multiple models to create better prediction and efficiency than any of them could do individually.

Precision farming is the use of a precise and suitable amount of input, such as pee, fertilizers, soil, and so on, to the crop at the appropriate moment in order to boost output and productivity. All precision agriculture systems aren't created equal. However, agriculture is a different story, it is critical that the advice offered is exact and precise, as errors can result in significant material and capital loss.

Among the different machine learning strategies being utilized in this field, this research presents a system that uses the voting method to produce an efficient and accurate model. Precision agriculture allows farmers to make better use of inputs to boost crop output and quality while being ecologically friendly. Precision agriculture technologies can help enhance productivity, and improve the use of natural resources while reducing environmental harm. As a result, strictness agriculture has become a critical component of agricultural long- term viability. Data mining technologies are integrated with machine learning to improve accuracy in soil categorization and crop production prediction [2].

Machine learning techniques can handle huge non-linear problems autonomously utilizing input from a variety of sources. Crop recommendations are influenced by rainfall, soil quality, crop cycle, land preparation, and uncontrollable factors such as weather. With the help of the Crop Recommendation system.

Farmers in India can make educated selections about which crops to plant on their land. Crop selection and cropping system selection are important factors in increasing farmer productivity and profitability.

2. Related Work

Suresh, G., A. Senthil Kumar, S. Lekashri, and R. Manikandan, Efficient Crop Yield Recommendation System Using Machine Learning for Digital Farming.

Based on specified data, this proposed technique is utilized to identify a certain crop. To improve precision and productivity, a Support Vector Machine was deployed. The focus of this research was on two datasets [3].

3. Related Work

In our framework, we have proposed a process that is divided

*Corresponding author: ritikarajani06@gmail.com

into different categories as shown in Figure 1.

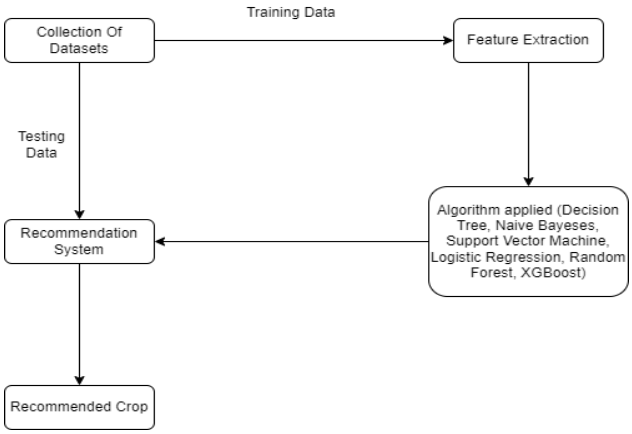

Fig. 1. Methods of proposed method

The five phases are as follows:

The flow of the Proposed System: As determined in the figure, the methods to extract the belief holds the various steps:

1) Data collection

"Nitrogen(N), Phosphorous (P), Potassium (K), soil PH value, Humidity, Temperature, and Rainfall" are among the factors included in the dataset. The datasets were downloaded from Kaggle. The data set contains 2200 instances or data culled from historical records. "Rice, maize, chickpeas, kidney beans, pigeon peas, moth beans, black gram, lentil, pomegranate, mango, grapes, watermelon, muskmelon, apple, orange, papaya, coconut, cotton, jute, and coffee" are among the eleven crops represented in this dataset. [4]

2) Pre-Processing (Noise Removal)

Pre-processing is essential for a successful application. Data obtained from many sources is sometimes in an unprocessed state. It could include data that is partial, redundant, or inconsistent. As a result, such redundant material should be filtered in this stage. The information should be standardized. [5]

3) Feature Extraction

This stage focuses on discovering and applying the dataset's most relevant attributes. For the application of classifiers, this method eliminates irrelevant and superfluous data.

i. *Methodology:* Differing machine intelligence algorithms were used such as "Decision Tree, Naïve Bayes (NB), Support Vector Machine (SVM), Logistic Regression (LR), Random Forest (RF), and XGBoost."

ii. *Decision Tree:* The greedy approach is used by decision tree classifiers. It's a supervised learning system that uses a tree to represent attributes and class labels. The basic purpose of a Decision Tree is able to create an instruction prototype that may be used to predict the class of target variables by learning decision rules that came from past training data. Decision nodes and leaves are two different types of decision nodes in a decision tree. The leaves are the outcomes or the final outcomes. [6]

iii. *Naive Bayes (NB):* For binary and multi-class arrangement challenges, Naive Bayes is an order computation. When input values are presented in binary or categorical form, the Naive Bayes technique is quite simple. The presence of a given component in a class isn't at all associated with the presence of another element in Naive Bayes. The Bayes theory is used by the Naive Bayes classifier, which is useful when the dimensionality of the data sources is high. Naive Bayes has a variety of uses, including creating real- time predictions, predicting the probability of many classes of target attribute, spam filtering, and assisting in the development of recommendation systems when used in conjunction with collaborative filtering. Initially, the likelihood. [7]

iv. *Support Vector Machine (SVM):* SVM stands for Support Vector Machine and is a learning machine learning module or model that can be used to solve planning and retrieval problems. We use it a lot in the difficulty of classifying, however. SVM is often presented as a set of training data points spaced apart by a reasonable gap as wide as possible. Each data object is represented as a point in an n-dimensional space in the SVM path, and each element value represents the value of a specific link. The classification is then done by finding a higher plane that better separates the two categories. [8]

v. *Logistic Regression (LR):* The Logistic Regression is a statistical method used to predict the outcome of a Dependent variable base on previous observations. In Regression Analysis, Logistic regression is a type of Binomial regression that predicts the parameters of a logistic model. it's a method for predicting a categorical dependent variable from a set of independent variables. a categorical dependent variable's output is predicted using logistic regression. as a result, the result must be a discrete or categorical value.

vi. *Random Forest (RF):* Random Forest is a machine learning algorithm. All the while the preparation phase, a lot of decision trees are created, and the yield is divided into two classifications: classification and class prediction (regression). The number of trees is corresponding to prediction accuracy. Rainfall, perception, temperature, and production are among the variables in the dataset. These variables in the dataset are used in the training process. Only two-thirds of the dataset is considered. The remaining data set is used as a testbed. [9]

vii. *XGBoost:* XGBoost is a flexible and advanced translation algorithm to increase the gradient designed for performance, computer speed, and model performance. XGBoost is best known for providing better solutions than other machine learning algorithms.

4. Result Analysis

Based on the result analysis of the algorithm vice accuracy result in percentage, XGBoost Algorithm has the highest accuracy [99.31%], and the Support Vector Machine (SVM) has the lowest accuracy [10.68%].

Table 1
Algorithm wise accuracy result in percentage

Algorithm	Accuracy
Decision Tree (DT)	90%
Naïve Bayes (NB)	99%
Support Vector Machine (SVM)	10.68%
Logistic Regression (LR)	95.22%
Random Forest (RF)	99%
XGBoost	99.31%

5. Conclusion

We have successfully suggested and implemented an intelligent crop recommendation system in this work, which may be used by farmers all throughout India.

We can boost the country's production and profit by utilizing this research. In this way, farmers can plant the appropriate crop, enhancing their production and the country's total profitability. Various machine learning methods such as 'Decision Tree, Nave Bayes, Support Vector Machine, Logistic Regression, Random Forest, and XGBoost' were used to represent the recommendations of various Indian crops. The study was administered on these six types of machine intelligence algorithms, with XGBoost achieving the highest accuracy among them. [10]

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