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Crop Recommendation Using Machine Learning

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Abstract: Agriculture plays a predominant role in the economic growth and development of the country. The major and serious setback in the crop productivity is that the farmers do not choose the right crop for cultivation due to lack of information of soil contents and environmental factors. In order to improve the crop productivity, a crop recommendation system is to be developed that uses the classification techniques of machine learning. Agricultural domain has imbibed the machine-learning algorithm to produce efficient, effective solutions to the difficulties faced by the farmers. Some problems that identified in already implemented systems is that they concentrated on a single parameter (either weather or soil) for predicting the suitability of crop growth. However, in our opinion, both these factors should be taken together into consideration for the best and most accurate prediction for the crops. This is because, a particular soil type may be fit for supporting one type of crop, but if the weather conditions of the regions are not suitable for that crop type, then the yield will suffer. Similarly, there may be a case where the weather conditions are favorable but soil characteristics are not matching and, in some cases, farmers may face surplus problem if all the farmers from the region will grow the same crop.

To eliminate the above-mentioned drawbacks, we have proposed the system which provides a solution for Smart Agriculture by monitoring the agricultural field which can assist the farmers in increasing productivity to a great extent. We have proposed the system in the form of a website. The system integrated into two techniques. For the first technique, we have made use of 'Crop Features Data Set', This dataset encompasses rainfall, temperature, soil PH and humidity for particular crop and predicting crop using random forest classifier. For suggestions of crops soil type is vital factor, system is capable to predict soil type using teachable machine technique. To recommend the best crop system considered some other parameters like environmental characteristics, rainfall, soil characteristics (N, P, K, type), location, season etc. so by considering these parameters system provides farmers variety of options of crops that can be cultivated. For appropriate choice of crop user can see the previous prices of crop. Thus, our proposed system would help the farmers to make the right choice of crop suitability.

Keywords: Machine Learning, Random Forest, Teachable Machine, Crop Recommendation.

1. INTRODUCTION

Agriculture is an important sector for Indian economy and also human future. It is first and foremost work which is essential for life. It also contributes a large portion of employment. As the time passes the need for production has been increasingly exponentially. In order to produce in mass quantity people are using technology in a wrong way. New kinds of hybrid varieties are produced day by day. However, these varieties do not provide the essential contents as naturally produced crop. These unnatural techniques spoil the soil. It all leads to further environmental harm. Most of these Unnatural techniques are used to avoid losses. But when the producers of these crops know the accurate information on the crop yield it minimizes the loss. To achieve this project is made. Using past information on weather, temperature and several other factors the information is given.

1. RELATED WORK

Paper 1: Following frameworks or algorithms are used to form Crop Prediction System:

Ensemble Framework: The ensemble framework is of utmost importance. The ensemble framework is explained as follows. Before diving into the details of the ensemble framework, the actual meaning of assembling and the reason for its usage. Assembling is a technique of building a prescient model by incorporating multiple models. The main reason for using an ensemble framework is that it provides a classifier that outperforms each of the individual classifiers.

Naive Bayes: Naive Bayes is a classification algorithm for binary and multi-class classification problems. When binary or categorically input values are provided. The Naive Bayes classifier depends on the Bayes hypothesis and this technique is useful in the cases where the dimensionality of the sources of information is high. Naive Bayes has multiple applications such as for making predictions in real time, to predict the probability of multiple classes of target attribute, spam-filtering, and coupled with collaborative filtering helps to build recommendation systems.

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Linear SVM: Linear SVM is the current machine learning algorithm that is the quickest to solve the multiclass classification problems. Linear SVM is linearly scalable, this means that the SVM model is created in a CPU time that scales linearly with the training dataset size. The main advantage of Linear SVM is that it works well with extremely large datasets along with eminent accuracy. Linear SVM also provides better performance on working with multidimensional data.

Majority Voting: Majority Voting technique is one of the techniques of combining the class labels obtained as a result of the independent classifiers. In this combining plan, a classification of an unlabeled instance is performed by the class that gets the most astounding number of votes. This technique is otherwise called the plurality vote This methodology has been utilized much of the time as a consolidating strategy for looking at recently proposed strategies. This is the most frequently used combiner.

Paper 2:
K-NN: K-nearest neighbor method can be used for both regression and classification predictive problems. This method helps in interpret output, calculate time and predictive power. The Machine learning techniques are used in various fields. KNN is also one of the machine learning methods. This is also called as method of sample-based learning. This will contain the data of past datasets and can be used while predicting the new datasets. This will apply function called as distance function like Manhattan or Euclidean distance. This can be used to compute distance from samples to all other training samples. It calculates the target value for new samples. The target vale will be the weighted sum of target values of the k nearest neighbors. The valve of K can be directly proportional to the prediction. Whenever the valve of K is small this indicates there is high variance and there is low bias. If the valve of the K is larger than this indicates that there is low variance and high bias. The main advantage of this KNN is it does not require any training or the optimization. This KNN uses data samples when predicting the new datasets. Hence it is having higher complexity and also more time consumption.

Paper-3:
Proposed Approach: In our proposed research, both environmental and soil parameters are taken into account carefully. The reason behind this is a particular type of soil will support a crop whereas the weather conditions won't support that, such that the yield will suffer.

Linear Regression: Linear regression fits a straight-line between rainfall, temperature, pH, and production which would return a y-pred value for each crop. In the end, the crops are sorted based on the value returned by the linear regression model using quick sort giving the crop with the best score first in the list.

Neural Network: Our implementation of the neural network is facilitated with the help of the Keras module. A sequential model is implemented with 3 input layers and 15 output layers which gives the sustainability of each 15 crops given the input in terms of state, month, and soil.

Paper 4:
In this paper, we have proposed a model that addresses these issues. The novelty of the proposed system is to guide the farmers to maximize the crop yield as well as suggest the most profitable crop for the specific region. The proposed model provides crop selection based on economic and environmental conditions, and benefit to maximize the crop yield that will subsequently help to meet the increasing demand for the country's food supplies. The proposed model predicts the crop yield by studying factors such as rainfall, temperature, area, season, soil type etc. The system also helps to determine the best time to use fertilizers. The existing system which recommends crop yield is either hardware-based being costly to maintain, or not easily accessible.

Paper-5:
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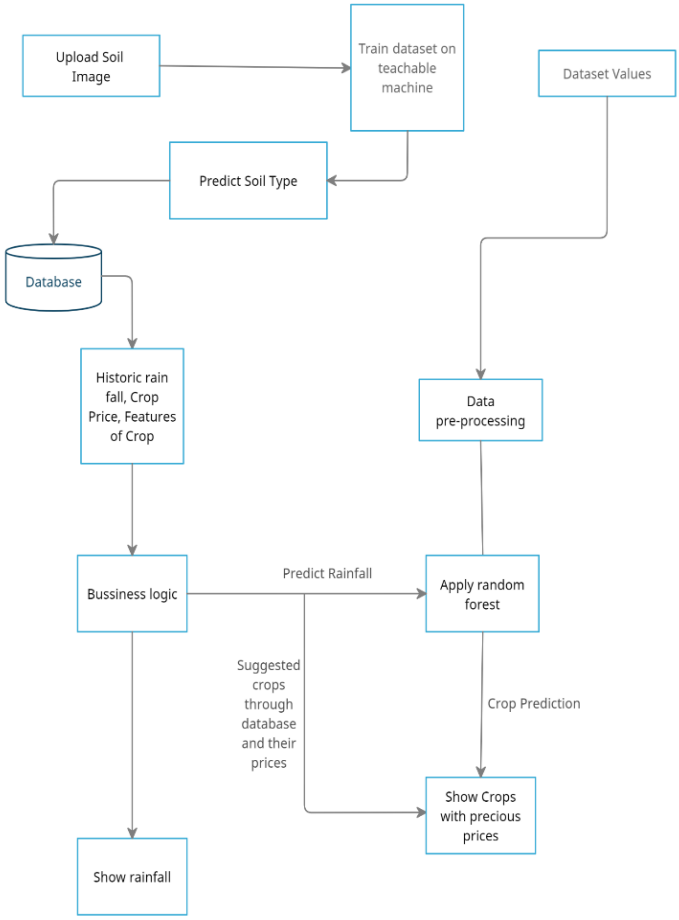
2. PROBLEM STATEMENT

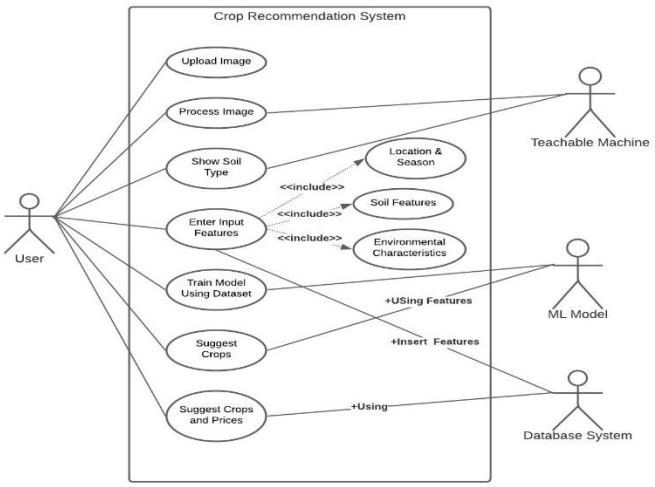
To design a system for recommending various crops to farmers. The system takes various parameters like soil quality, previous cultivated crop, rainfall prediction into consideration. The proposed system uses machine learning techniques (Random Forest Algorithm) for recommendation.

3. SYSTEM ARCHITECTURE



Architecture Diagram

Use case Diagram



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4. METHODOLOGY

The Crop Recommendation system is found to be:

1. Accurate i.e., the accuracy of the crop recommendation system based on random forest is as good as compared to another algorithm.
2. Scalable and reliable.

Random Forest

i. Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML. It is based on the concept of ensemble learning, which is a process of combining multiple classifiers to solve a complex problem and to improve the performance of the model.

ii. "Random Forest is a classifier that contains a number of decision trees on various subsets of the given dataset and takes the average to improve the predictive accuracy of that dataset."

iii. Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.

iv. The greater number of trees in the forest leads to higher accuracy and prevents the problem of over fitting.

Teachable Machine

i. Teachable Machine is a web-based tool that makes creating machine learning models fast, easy, and accessible to everyone.

ii. Train a computer to recognize your images, sounds, & poses, then export the model for projects.

Steps Involved in Teachable Machine

a. **Gather Data** – Gather and group data into classes and categories.

b. **Train Data** – Train the model, then instantly test it out to see whether it can correctly classify.

c. **Export model** – Exports trained model for projects.

5. ACKNOWLEDGEMENT

“Gratitude is not only the greatest of virtues, but the parent of all others.” Hence, it is great pleasure for me to acknowledge the assistance and contribution of number of individuals who helped me in developing “Crop Recommendation System” project. First and foremost, I wish to record my gratitude and thanks to Prof. P. D. Halle for her enthusiastic guidance and help in successful completion of seminar. I express my thanks to Dr. M. S. Rohokale (Principal), Prof. G. M. Kadam (Head of Computer Department) for their valuable guidance. I am also thankful to other teachers and non-teaching staff of Computer Engineering Department and Library for their co-operation and helping us and guiding us to complete our project accurately.

6. CONCLUSION

In this project we walk through the process of training a straightforward Random Forest model and evaluating its performance using multiple decision trees and crop suggestion reports.

The Random Forest is a powerful tool for classification problems, but as with many machine learning algorithms, it can take a little effort to understand exactly what is being predicted and what it means in context. Luckily, Scikit-Learn makes it pretty easy to run a Random Forest and interpret the results.

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Websites for Datasets:

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2. https://www.kaggle.com/datasets