

Crop Recommendation App using Machine Learning

Umang Tiwari

01/07/2023

Task-0

Abstract

Machine learning is a growing field with many potential applications in agriculture. It finds its applications in seed sowing, soil quality tracking, weed removal, crop harvesting, and supply chain visibility. AI applications, systems, and devices will assist farmers in all ways. In the proposed crop recommendation app the attributes that have been considered are the soil type, rainfall, groundwater level, temperature, fertilizers, pesticides and season. The concept of this paper is to implement the crop selection method so that this method helps in solving many agriculture and farmers problems. This improves our Indian economy by maximizing the yield rate of crop production under different types of land conditions. The aim is to make a ML model which takes data(soil analysis, weather report etc.) and trains itself using various Machine Learning techniques and Algorithms(Random Forest, Decision Tree) and predict the yield and best fertilizer that suits for the crops in a virtual environment by considering the overall factors that contribute in his overall yield.

1.0 Problem Statement

The farming sector faces multiple risks and uncertainties due to changing climatic conditions and market trends, which results in significant production losses and wasted resources. With the ever increasing population as well as limited land resources there is a need to establish a system where maximum yield can be generated without over-utilizing the land in use. Therefore there is the requirement of knowing the soil type, weather conditions, previous cropping patterns beforehand so that our farmers are able to maximize their yield and minimize their losses which would be caused due to crop diseases, climate change and insect and pest attacks.

2.0 Market/Customer/Business Need Assessment

2.1 Market Assessment:

Agriculture and Agro-based Food Industry: The product would majorly benefit the agricultural industry as it would provide real-time data analysis related to crops. It would also benefit the companies that are involved in making products that make use of the agricultural produce. (Eg: Tea, Coffee brands)

2.2 Customer Assessment:

1. Farmers: The system is developed keeping the needs of the farmers in mind. Farmers can make use of the system to implement it on their agricultural land.
2. Botanical/Plant Shops: It can also be used by botanical shop owners or plant sellers that would provide them insights on what plants would be best to sell at a particular time of the year or what conditions would suit a particular type of plant.
3. Agricultural Institutions and Scientists can also make use of the app for research purposes as well as analyze data related to cropping patterns and soil conditions.
4. Based on the recommendation of the crop provided by the product, an extension feature can be provided which will provide consultation for the farmers to the agricultural consultants and hence providing for a partnership with the crop consultants.

2.3 Business Assessment:

3.0 Target Specifications

Farmers: The primary users of the app would be the farmers who would cultivate their crops. Although, they may have varying knowledge related to the crops the app would provide them suggestions based on scientific analysis of the surroundings.

Botanical Shops: The secondary users of the app will be plant shop owners who can use the app to get recommendations as to what sort of plants or crops will be suitable for selling in a particular area and hence utilize their resources in a well formulated manner.

Agricultural Scientists and Researchers: They can use the app to get various insights related to crop patterns, soil analysis, disease patterns in crops. They can also use the app for analyzing data and check for the accuracy of the app.

4.0 External Search

Sources used for preparation of the proposed system include:

- 1) Title: Machine Learning: Applications in Indian Agriculture, 2016.
Authors: Karandeep Kaur
- 2) Title: A Smart Agricultural Model by Integrating IoT, Mobile and Cloud-based Big Data Analytics, 2017.
Authors: S.Rajeswari, K.Suthendran, K.Rajkumar.
- 3) Crop Recommender System Using Machine Learning Approach
Link-<https://ieeexplore.ieee.org/document/9418351>
- 4) Crop Recommendation System Using Machine Learning
Link-<https://www.ijraset.com/research-paper/crop-recommendation-system-using-ml>

5.0 Benchmarking Alternate Products

Most of the contemporary products revolving around crop recommendations use time series modeling which basically involves collecting past observations of the same variable analyzing to develop a model describing the underlying relationship.

Time series modeling requires less onerous data input for regular and up-to date price forecasting. Hence there is a need for better classification which would be an ensemble or hybrid classification model.

Disadvantages Of Existing System:

- The existing system which recommends crop yield is either hardware-based being costly to maintain, or not easily accessible.
- Despite many solutions that have been recently proposed, there are still open challenges in creating a user-friendly application with respect to crop recommendation.

Features Of the Proposed System:

- Data analysis technology is used to update the crop yield rate change. ‘
- The quality of the crops are identified using a ranking process. By this process the rate of the low quality and high quality crop is also intimated.
- The usage of ensembles of classifiers paves a way to make a better decision on predictions due to the usage of multiple classifiers such as Decision tree and Random forest classifier.

Advantages of Proposed Product:

- Useful to people far away from towns/cities.
- Better time efficiency.
- Reduction of repeated work.

6.0 Applicable Regulations

- Data privacy and Protection Regulations.
- Safety Regulations
- Patents on ML Algorithms
- Agricultural laws and regulations imposed by the government

7.0 Applicable Constraints

- Software Requirements for developing and hosting the website and application.
- Requirement for infrastructure and workstations.

- Time requirement for gathering data sources, testing and debugging purposes.
- Communication with agricultural consultants for providing professional recommendations to the farmers.
- Abiding to the government's laws and regulations related to farm and agricultural laws.

8.0 **Business Model**

The monetization idea of the product would consist of the following:

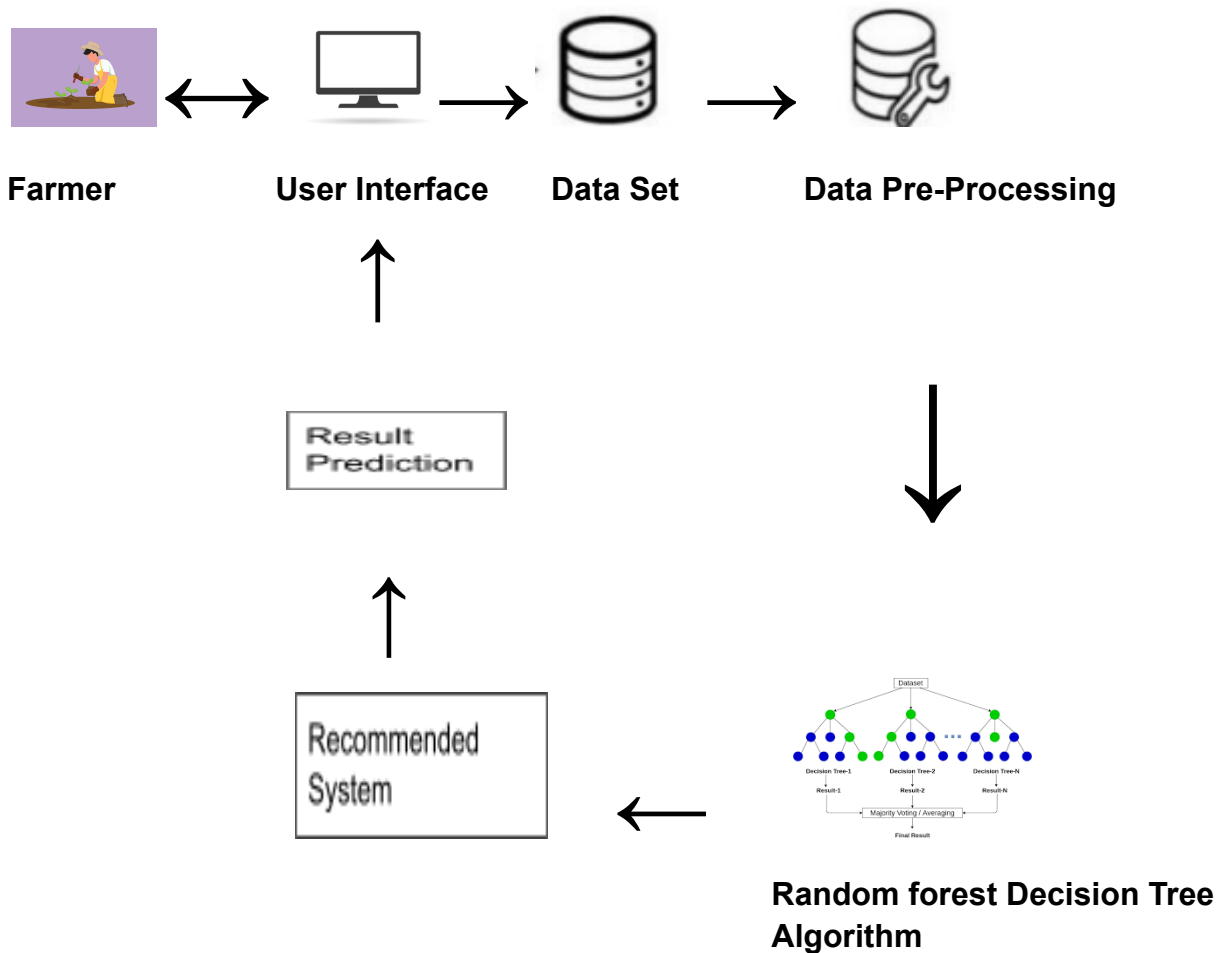
- A free version of the app will provide basic features like just recommending the farmer the crop for their required land. For more advanced features subscription fee will be charged
- The app will be based on two monetization models: a **subscription model** as well as a **pay-per-use** basis (provide features based on need of the user)
- **Advertising:** For the free version of the app, advertisements will be displayed that will consist of agricultural products, manures, fertilizers, etc. which will be done in partnership with the brands that manufacture these products. Partnership can also be done using Google Ad-Sense.
- **Subscriptions:** A significant mode for income generation will be the subscription services that the product provides. This will include in-depth analysis of the agricultural land, recommendation of the manure, fertilizers that will increase the yield, monthly update checking on the farmers' land and personalized help for the farmer with a partner agricultural consultant.
- **Pay-Per-Use:** This feature will provide the user with a feature that he/she wants to avail. For example, if the farmer wants to know recommended fertilizers and manure for their land then they will be charged only for that feature.

9.0 **Concept Generation**

Agriculture sector is the largest provider of livelihoods in rural India. The agriculture sector is also a significant contributor factor to the country's Gross Domestic Product (GDP). However, the yield per hectare of crops in our country fails in comparison to international standards. This is one of the possible causes for a higher suicide rate among marginal farmers in India. Farmers also take loans in order to get the required manure and fertilizers which puts them in a debt trap and if their plan fails they are forced to pay their loans within a short period of time. Existing farming practices have marginal use of technological tools which can enhance productivity of their land. Hence there is a requirement of inculcating better technology into the hands of our

farmers. Machine Learning can prove beneficial to boost the productivity of the agricultural land because analysis is done by taking into consideration large data sets and prediction for the best crop to sow is made taking into consideration environmental factors as well as soil analysis of the land. Hence the productivity of land increases thus boosting the income of the farmers.

10.0 Final Product Prototype with Schematic Diagram



11.0 Product Details:

The various sections provided in the product are:

- Admin Login:

This is the first activity, Admin needs to provide a correct contact number and a password, which the user enters while registering, in order to login into the webpage.

- Metadata:

All the main data used in the data set are initialized with the number to use in the algorithm. In this metadata, we are going to initialize all the crop names with the numbers. This data makes us use the data easily in the algorithm. Here the metadata of all the crops is given with a particular number.

- Data Pre-processing:

Here the raw data in the crop data is cleaned and the metadata is appended to it by removing the things which are converted to the integer.

In this pre-processing, we first load the metadata into this and then this metadata will be attached to the data and replace the converted data with metadata. Then this data will be moved further and remove the unwanted data in the list and it will divide the data into the train and the test data.

- Crop Prediction Section:

Based on the data, the crop prediction module will provide the details of the crop which will be best suitable for the conditions as provided by the farmer. This way we can help the farmers to grow the crop which gives them better yield.

- Crop Recommendation Section:

A ranking for the suitable crops can be provided here and based on the ranking a recommendation is provided to the farmer and another feature can be provided wherein the farmer can virtually connect with an agricultural consultant to verify the results.

The product can be summarized as follows:

Input Data —> Preprocessing —> Training —> Prediction using Decision Tree
Classification —> Recommendation and Consultation

11.1 Financial Feasibility

Most of the cost incurred during the setup of the system is based upon the research and development section.

Most of the software and technologies used are freely available hence the app is sustainable and feasible.

Datasets for various locations can be found through various sources either paid or freely available on the internet.

11.2 Algorithms Used

Random Forest Algorithm

Random Forest is a popular machine learning algorithm that belongs to the supervised learning technique. Machine learning algorithm that belongs to the supervised learning technique. It can be used for both Classification and Regression problems in ML.

Random Forest works in two-phase first is to create the random forest by combining N decision trees, and second is to make predictions for each tree created in the first phase.

The Working process can be explained in the below steps:

Step-1: Select random K data points from the training set.

Step-2: Build the decision trees associated with the selected data points.

Step-3: Choose the number N for decision trees that you want to build.

Step-4: Repeat Step 1 & 2.

Step-5: For new data points, find the predictions of each decision tree, and assign the new data points to the category that wins the majority votes.

Decision Tree

Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems. In a Decision tree, there are two nodes, which are the Decision Node and Leaf Node. Decision nodes are used to make any decision and have multiple branches, whereas Leaf nodes are the output of those decisions and do not contain any further branches.

A decision tree simply asks a question, and based on the answer (Yes/No), it further splits the tree into subtrees.

The complete process can be better understood using the below algorithm:

Step-1: Begin the tree with the root node, says S, which contains the complete dataset.

Step-2: Find the best attribute in the dataset using Attribute Selection Measure (ASM).

Step-3: Divide the S into subsets that contain possible values for the best attributes.

Step-4: Generate the decision tree node, which contains the best attribute.

Step-5: Recursively make new decision trees using the subsets of the dataset created in step -3.

Continue this process until a stage is reached where one cannot further classify the nodes and call the final node as a leaf node.

11.2 Team requirement

- 1) Machine learning Engineer
- 2) App developer
- 3) Web Developer
- 4) Data Scientist
- 5) Software Tester
- 6) Customer Care Operator

13.0 Conclusion

This product proposes a system which will benefit the farmers' production . Further improvements for the app includes big data analysis technology that can effectively improve crop yield production. This project proposes a novel intelligent system for agricultural crop prediction. This system can be further used to predict the cost of the crop rate. The solution will benefit farmers to maximize productivity in agriculture, reduce soil degradation in cultivated fields, and reduce fertilizer use in crop production by recommending the right crop by considering various attributes. This would provide a comprehensive prediction on the basis of geographical, environmental and economic aspects.