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KISAN MITRA-INITIATIVE FOR FARMERS

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ABSTRACT

In India, the farming sector is highly crucial for the economic growth of the country. In India, agriculture provides a living for approximately 51% of the people. Agriculture provides the various opportunities for the villagers to work and contribute widely to the development of our country on a very huge scale, as well as it gives a massive boost to the economy. The research aims to assist the farmers in determining the quality of the soil and assessing its many parameters, as well as recommending crops and fertilizers depending on the outcomes acquired through machine learning technique. To improve the effectiveness of the Crop Recommendations Systems and Fertilizer Recommendation System, the system employs a number of Classification techniques. The assigned soil and fieldwork to anticipate a list of crops that is suited for the soil, as well as the knowledge on minerals that are insufficient in the soil. As a result, the user is free to choose which crop to plant. As a result, the approach aids farmers in gaining information. This research uses soil and PH data as inputs and uses a website to forecast which crops are suited for the soil and which fertilizers can be used as a remedy. The research also aims to assist the farmers by determining the disease occurring in the plant where the user just needs to click the picture of the leaf of the plant which is having the disease and the system predicts that what type of disease it is and what are the organic techniques to mitigate that plant disease and save the remaining crops.

Keywords: Agriculture, Crop Recommendation, Fertilizer Recommendation, Machine Learning, Plant Disease Detection, Recommendation System.

I. INTRODUCTION

In India, the agriculture industry is extremely crucial for the economic and social development. In India, the agricultural sector provides a living for almost 51% of the population. Most of the Indian population depends on agriculture for their livelihood. Agriculture gives a vast opportunity of employment to the villagers. The majority of farmers face the problem of planting an inappropriate crop for their land based on a conventional or non-scientific approach. This is the major challenged faced. The outcome of wrong crop selection is less yield and less profit. Machine learning, which is one of the applications of Artificial Intelligence, which is being used to implement the proposed system. Crop recommendation is going to recommend that which is the best crop that the farmer can grow in his land, as per the soil nutrition value.

Another major issue is that which is the best fertilizer to use to grow a particular crop, this is also a challenging task for the farmer. Another severe issued faced is when a plant gets caught by heterogeneous diseases that has a drastic effect on agriculture sector such as less amount of agriculture production. To overcome all these issues this recommendation has been proposed [1]. Crop recommendation is characterized by a soil database comprised of Nitrogen, Phosphorus, potassium in addition to climate conditions such as rainfall and Ph level. For fertilizer recommendation Database characteristics are Nitrogen, Phosphorus, Potassium, and crop. To improve crop productivity and best fertilizer use a smart recommendation system has to be built using the ensembles technique [2]. The model also assists the farmers by determining the disease occurring in the plant where the user just needs to click the picture of the leaf of the plant which is having the disease and the system predicts that what type of disease it is and what are the organic techniques to mitigate that plant disease and save the remaining crops.

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II. LITERATURE SURVEY

The paper [1], [2], and [3] mainly throw light on the recommendation of the crops that which crop to grow according to the soil's nutrition value and the weather conditions. In this paper, the author starts from the very basics of smart farming and further moves towards developing a model which will help the farmer to grow crops that are suitable according to the soil along with the weather conditions.

In the paper [4] the author uses the approach in which he has tried the various machine learning models based on the micro and macronutrients like Nitrogen, Phosphorus, pH level, Rain value in mm to predict the best suitable fertilizer for the selected crop. The performance matrix of the classification algorithm is compared based on accuracy and execution time.

The Machine Learning algorithm used for crop recommendation in this paper is SVM, Decision tree, KNN, ensembles. The conclusion is that the ensembles model is the best suitable for the crop recommendation model [2].

"Diseases Detection of Various Plant Leaf UsingImage Processing Techniques: A Review" paper [5] it presents a vivid representation of how that a plant disease can be detected using various techniques and how can an agricultural yield be improved. The author has tried to solve this issue by using the neural network state of the art technique.

In the Smart Farming Prediction Using Machine Learning" paper [6] the needs and preparation needed to develop a modelling framework for smart agriculture is covered. It describes that how a model uses Precision Agriculture (PA) concepts to reduce variability on small, open fields at the single farmer and crop levels. In this they have tried to use the technologies such as short message service to send notifications to the farmer and whereby he gets all the real time updates on his mobile and through email as well.

III. METHODOLOGY

Developing a user-friendly web-based system for farmers. The farmers only need to enter their details of soil content like nitrogen, phosphorus, potassium, pH level and the farmer gets the idea of which crop is best for their soil. The farmer also gets the idea of which fertilizer is best for their crop. By providing an image of leaf of the plant having the disease the farmer gets an idea that which disease caught their crop and we also suggest them that how they can prevent the occurrence of the disease. The Dataset used in this project is imported from Kaggle.

Table 1: Dataset for Crop Recommendation [13]

Nitrogen (N)	Phosphorus(P)	Potassium (K)	Temperature	Humidity	pH	Rainfall	Label
90	42	43	20.87974371	82.00274423	6.50985292	202.9355362	Rice
85	58	41	21.77046169	80.31964408	7.038096361	226.6555374	Dal
60	55	44	23.00445915	82.327629	7.840207144	263.9642476	Wheat
74	35	40	26.49109635	80.15836264	6.980400905	242.8640342	Barley
78	42	42	20.13017482	81.60487287	7.628472891	262.7173405	Peas
69	37	42	23.05804872	83.37011772	7.073453503	251.0549998	Gram
69	55	38	22.70883798	82.63941394	5.70080568	271.3248604	Bajra
94	53	40	20.27774362	8289408619	5.718627178	241.9741949	Lentil
89	54	38	24.51588066	83.5352163	6.685346424	230.4462359	Jowar

Crop & Fertilizer recommendation: The following is a step-by-step strategy for building the recommendation mode (Fig l):

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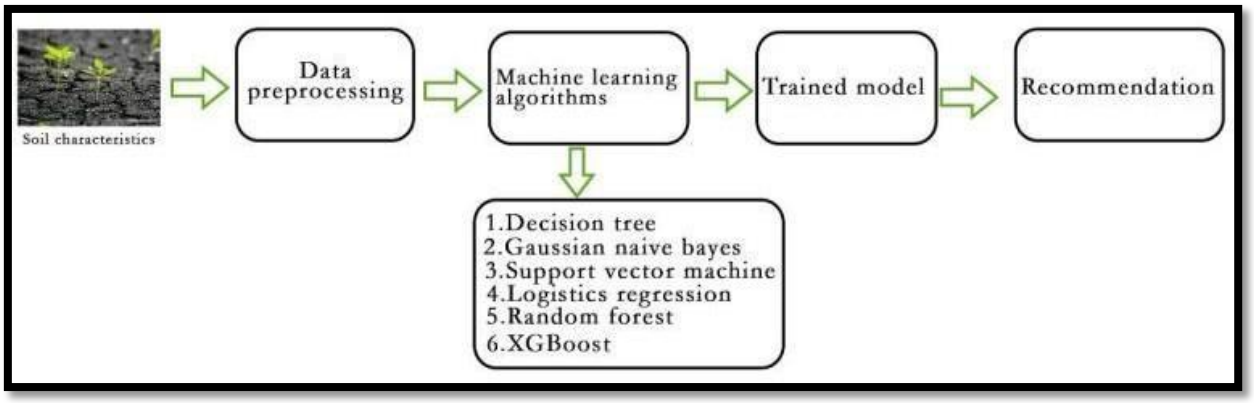

Figure 1: Flow chart of all the steps performed for the classification [13]

Step 1: Load the dataset:

The data has been collected this from the "Crop Recommendation System to Maximize Crop Yield using Machine Learning Technique" paper with dataset of crop recommendation (Table 1).

Step 2: Preprocessing of the input dataset:

In any machine learning project, the most important or the time-consuming process is that of preprocessing the data, in preprocessing step the missing values are filled using techniques like mean, mode, and median, scaling or transforming values into a certain range, cleaning the data, encoding of categorical data and check for correlation of variable.

Step 3: Exploratory data analysis:

In this step, univariate, bivariate, and multivariate analysis are performed to find the hidden patterns in the data and try to understand the data before getting hands dirty into model building.

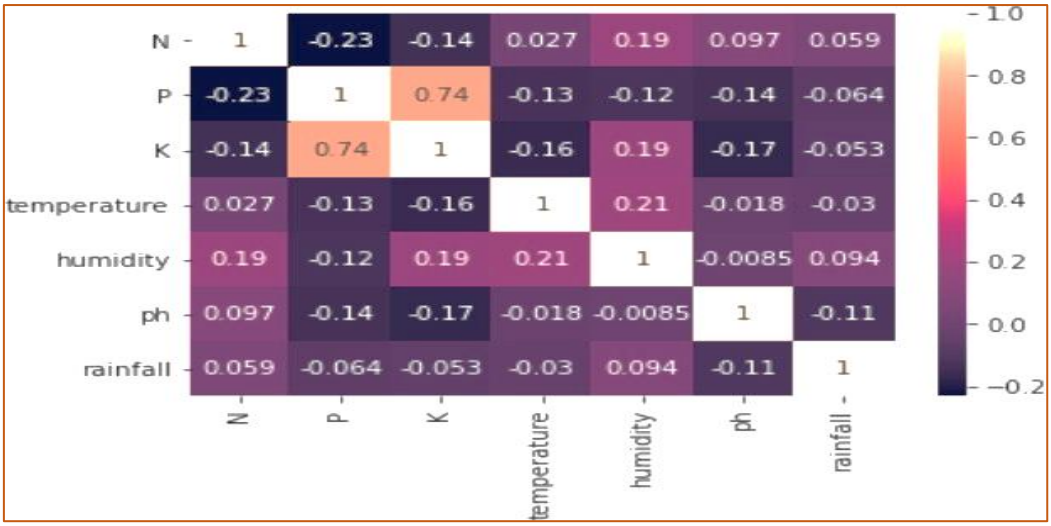

Figure 2: Correlational Metrics on the crop recommendation dataset[13]

Step 4: Splitting into training and testing data:

In this step, the preprocessed dataset is split into training and testing based on 80:20 ratios, which means 80% of the data is used for training the dataset and 20% is used for testing on the unseen dataset and cross-validation to find optimal hyper parameter.

Step 5: Building classification model on the training dataset:

In this step, the training dataset is given to the individual classifier and train the model on top of it.

The model to build the Crop recommendation system is:

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Decision Tree: A supervised machine learning algorithm known as a tree structure can be used for both classification and regression [6]. The structure of a decision tree is similar to that of a flowchart, with characteristics and class labels represented by a tree.

Gaussian Naive Bayes: Gaussian Naive Bayes is a machine learning approach that is both basic and straightforward. The Naive Bayes hypothesis is that characteristics must be independent of one another [7]. The Bayes theorem is used internally in Binary Classification, which is a statistical-based method. The model is known as Gaussian Nave Bayes if the features of the dataset follow a Gaussian distribution.

Support Vector Machine: A machine learning technique, SVM stands for SVM algorithm. First plot each data element in N Dimension space, and then choose a hyperplane that best segregates the two classes with the highest margin in the Linear Kernel [8]. Finding the best hyperplane in a Support vector machine is a difficult task.

Logistic Regression: Regression is a machine learning method that is used to classify data [9]. In logistic regression, examine each data point in n dimensions and attempt to locate a hyperplane that separates the two classes of data.

Random Forest: Random Forest is an ensemble-based machine learning system. Ensemble techniques are a form of technology that allows us to combine separate or similar algorithms to create a strong model [10]. Random forest is a compilation of several decision trees with the greatest depth till the nodes can split with the least variability and bias.

XGBoost: XGBoost is a monitored machine learning method. XGBoost is a widely used gradient boosting implementation of a decision tree-based machine learning method [6]. XGBoost uses a more advanced tree-based machine learning technique.

Accuracy Comparison between all the algorithms (Fig. 3):

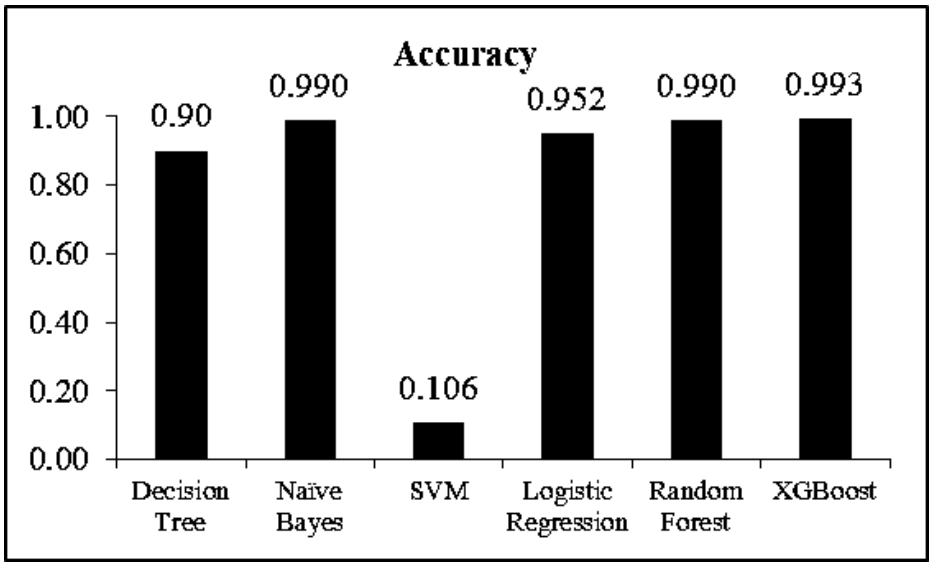

Figure 3: Accuracy comparison chart of different algorithms used in the classification model[13]

Step 6: Testing the data on each of the classifiers:

In this step, the query point is given to each and every classifier and obtains the class label from every model.

Step 7: Ensemble the individual's classifier output using the majority voting technique:

The last step is to get the class label from every classifier after then do majority voting to get the final prediction.

IV. RESULTS AND DISCUSSION

The following are the services which our website provides for the farmers which are the crop recommendation system, fertilizer recommendation system and crop disease detection system.

1. The farmer needs to put the value of Nitrogen, Phosphorous and Potassium (NPK) Values of his soil.
2. He will get an output on the screen stating that what crop he can grow on that soil.

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3. If the farmer wants to grow a particular crop in his soil, then by entering the Nitrogen, Phosphorous and Potassium (NPK) Values of his soil the model predicts which organic fertilizer is the best for growing that particular soil.
4. The salient feature of our model is that if the plant has caught a disease the farmer needs to click a picture of the plant leaf having disease and attach the image and submit it. Our model will predict what it is the disease and what to do in order to circumvent the disease and protect the remaining crop.

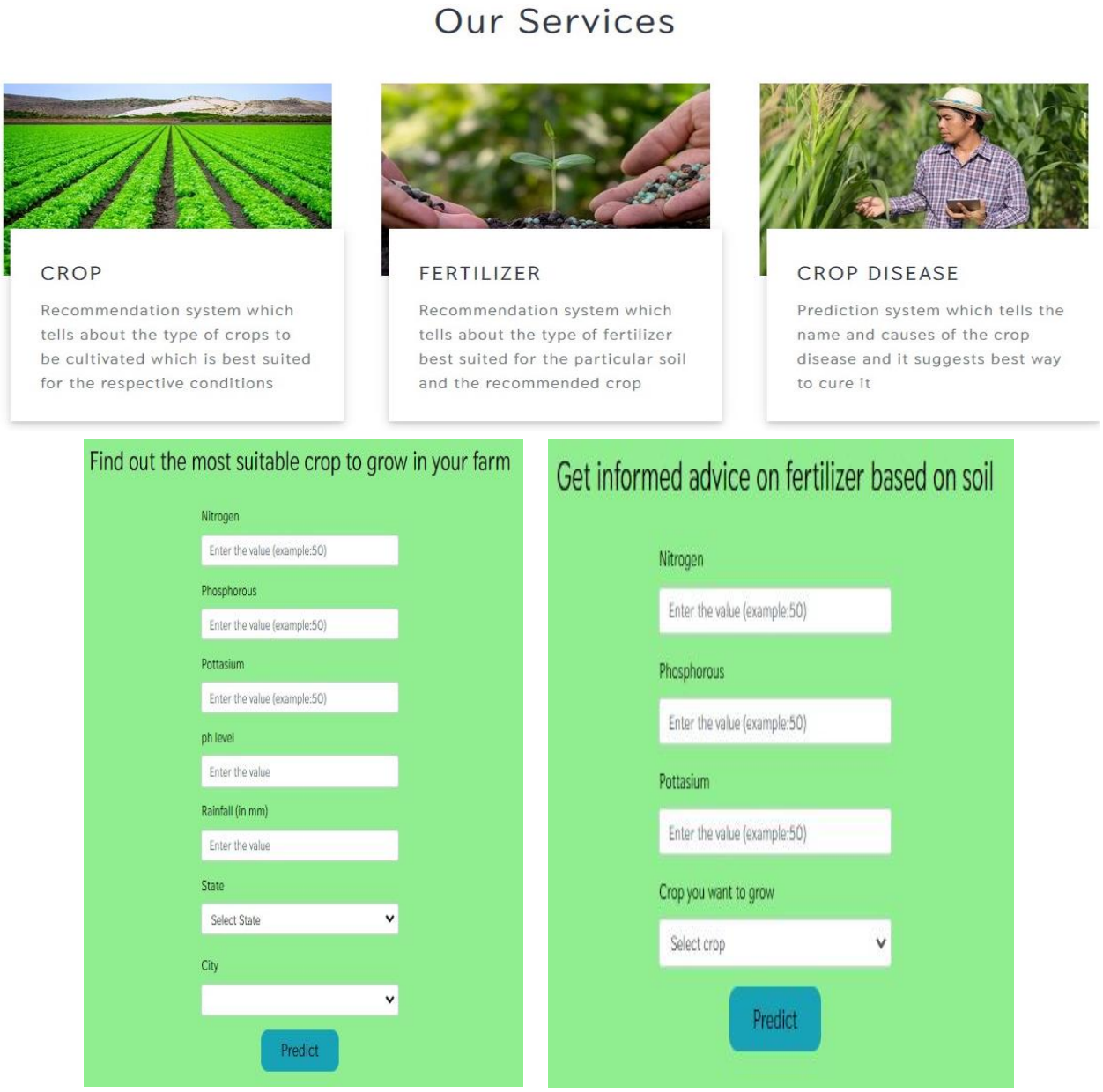

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Figure 4: Results

V. CONCLUSION

Our web application successfully recommends the best crop to grow inland, along with that recommending the best fertilizer to use in order to grow a specific crop in that soil and also detects the disease occurring in the plant and how to mitigate the same by using organic techniques. This web app can be easily used by the farmers in order to take a decision which crop to grow and maximize the yield according to the soil nutrition value and climate in that region. The farmer simply just needs to put the values of the Nitrogen, Phosphorous and Potassium content of his soil and he will get the recommendation from our website that which crop to grow according to the soil nutrients content and which are the best fertilizers to use. By just uploading a picture of a leaf of the plant having a disease the website will predict what type of disease it is and how to mitigate that disease. The website will help them to get a high crop yield and by using organic fertilizers recommended by the system they can also grow organic crops and along with that the threat of diseases occurring in the plant is also mitigated with the help of our website.

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