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Farming Made Easy using Machine Learning

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***Abstract* — Agriculture is the primary mainstay of the economy in our country. In recent years because of uncertain trends in climate and other fluctuations in the price trends, the price of the crop has varied to a larger level. Farmers remain oblivious of these uncertainties, which spoils the crops and causes massive loss. They are unaware of the crop type which would benefit them most. Due to their limited knowledge of different crop diseases and their specific remedies, crops get damaged. This system is handy, easy-to-use. It provides accurate results in predicting the price of the crop. This framework utilizes Machine Learning's Decision Tree Regression Algorithm to predict crop price. The attributes considered for prediction are rainfall, wholesale price index, month, and year. Consequently, the system gives an advance forecast to the farmers' which grows the speed of profit to them and consequently the country's economy. This system also incorporates other modules like weather forecast, crop recommendation, fertilizer recommendation, and shop, chat portal, and guide are also implemented.**

Keywords — agriculture, decision tree regression, price prediction, weather forecast, fertilizer, machine learning

I. INTRODUCTION

India being a rural nation, its economy transcendently relies upon agricultural yield development and unified agro-industry items. It is currently quickly advancing towards a specialized turn of events. India now is rapidly progressing towards technical development. Smart farming is changing the face of agriculture in India. Technology can provide a solution to most challenges farmers face. It can help them predict weather more accurately, decrease waste, boost output and increase their profit margins. In the status quo, the farmers and the consumers find it difficult in the real world to determine the accurate prices of crops without having prior knowledge of the fluctuating trend prices or weather conditions. Accordingly, innovation will end up being helpful to agriculture. The paper aims to predict crop prices in advance. This work is based on finding proper regional datasets that help us in achieving high accuracy and better performance. Our system, Agro-Genius, is using Machine Learning to build the Price Predicting Model.

In the past few years, a lot of fluctuation in the prices of the crop has been seen. This has increased the rate of crop damage produced each year. The main aim of this prediction system is to ensure that the farmers get a better idea about their yield and deal with the value risk.

Weather is also highly unpredictable these days. It also affects the crop production. The proposed system will also forecast the weather helping the farmer make correct decisions regarding field ploughing, field harvesting etc. Similarly, fertilizers play an important role. Fertilizers load the soil with the required nutrients that the crops eliminate from the soil. Crop yields and production will be fundamentally decreased if fertilizers are not used. That is the reason fertilizers are utilized to enhance the soil's supplement stocks with minerals that can be immediately assimilated and utilized by crops. Our system will provide fertilizer consumption based on different crops and provide a portal to buy the fertilizers and seeds from the user's location. They can even get the exact location along with the address of the fertilizer and seed shop. The provided fertilizers will get more profit to the farmers on the growing system suggested crop. It will also show the best suited crop based on cultivation date and month and location details, thereby maximizing the yield.

It will provide multilingual and region specific guide books for the farmers. Any farmer who is new to this field and who wishes to gain information from his ancestors but having the same methods documented will be highly beneficial. We have also provided maps for the farmers to gain knowledge. Our system will provide two different types of maps for the farmer to gain the knowledge about how the land and where they should start their farming. Irrigation maps show the irrigated-non irrigated area over the country. Agriculture land view map will provide an overview of agricultural land present in various states of India and help farmers to analyze the non Agricultural land which can further be improved. Maps make the farmers easy to understand they have to just hover on the state they are thinking of starting their farming and they will get the information about that state and they can decide whether they should change the place or should start farming. If the farmers are new in this field it is the best thing for them as the most important thing in farming is to firstly choose the land and place of farming.

Moving in the same direction, our system will incorporate a chat application which helps in information sharing. Often farmers have certain queries which cannot be solved due to their limited knowledge, hence we are building a platform where information can be exchanged. Language can pose as a barrier to the users. Since the majority of non-English speaking farm workers in India are native Hindi-speakers, we anticipate that once these resources are developed they might be translated to other languages as well. Hence, to make the website user friendly, we have provided language translation.

Farmers should know about their location, date of cultivation of their crop. Our system is a web application, which is developed based on machine learning concepts. The proposed system applies machine learning and prediction algorithms like Naive Bayers, Decision Trees and K-Nearest Neighbour to identify the most accurate model and then process it. This in turn will help predict the price of the crop.

II. LITERATURE SURVEY

The following papers focused on predicting crop price using Machine Learning and providing results. In April 2019, the exploration targets foreseeing both the cost and benefit of the given harvest before planting. The preparing datasets so acquired give enough bits of knowledge to foresee the suitable cost and request in the business sectors[1]. The authors have predicted the most profitable crops and its expected price during harvesting time according to the location, by predicting different historical raw datasets using different machine learning algorithms. The work shown by Nishiba [2] is the expected utilization of data mining procedures in foreseeing the harvest yield dependent on the input parameters average rainfall and area of the field. The easy-to-use website page created for anticipating crop yield can be utilized by any client by giving the normal precipitation and region of that place. Different Data Mining techniques are applied to different datasets. This paper can also include certain modules [11] which can help farmers to make certain decisions based on the harvested area or current trends in the market. The system can be extended by visualizing the crop details in a map with details, which will help farmers to view the nearby district cultivation details. Proposed system can be enhanced by providing a graphical visualization of predicted prices for better understanding.

This system is proposed to provide help to the farmers for expecting the best amount for their crops and for predicting the best price for the crops. This also helps the farmers to check previous prices of different commodities. The system can predict crops using [9] Random forest, Polynomial Regression and Decision Tree algorithms. The best crop and its required fertilizers make the farmer more confident about the crop and its yield and also our system will do marketing work [4] by estimating total value of the crop based on current market price. The idea of the system can be extended by adding some extra features to the system like providing a nearby shop location portal for purchasing seeds and fertilizers.

These papers aim at predicting the price and forecast through web application and it runs on efficient machine learning algorithms like using an Autoregressive Integrated Moving Average (ARIMA) model,Traditional ARIMA [6], Support Vector Regression Algorithm[8], and technologies having a general easy to use interface to the clients. The training datasets [7] acquired give sufficient bits of knowledge to foreseeing the appropriate price [10] and request in the markets. The results are displayed as web applications in order that poor farmers can access easily. Models can be improved by integrating this with other departments like horticulture, sericulture, and others towards the agricultural development of our country. Different agriculture departments have various problems in the current time. Incorporating them will not only increase the scope but also help the farmers new to this part of the spectrum. Their work may be expanded by building a framework for suggesting agriculture produce and dispersion for farmers. Utilizing this framework, We ought to get the same accuracy indeed when an information autonomous framework is utilized. Further, can be enhanced by making an android application for the same.

III. PROPOSED SYSTEM

A. Description

We have used Python for basic programming in all modules. Flask is used for hosting. Socket Programming is used for a chat application. Chart.js is used for visualizing the maps. JavaScript is used for validation purposes.

For Weather Forecast [12] and fertilizer shop location, we have used APIs. Using the self-made dataset and concept of linear regression in machine learning we have implemented a Crop recommendation model so that a farmer can learn about the best suited crop for a particular region. In Fertilizer Recommendation we have used a dataset for predicting which fertilizer should be used for the disease present on crops. Socket programming is used for farmers interaction using provided chat application [3]. Google API is used for providing a multilingual website for ease to read.

Refer Figure no. 1 to navigate through the web application.

B. Comparison of Algorithm

TABLE I. COMPARISON OF THE ALGORITHMS

Parameter	KNN	Naive Bayes	Decision Tree
Deterministic/ Non-deterministic	Non-deterministic	Non-deterministic	Deterministic
Effectiveness on	Small data	Huge Data	Large Data
Speed	Slower for large data	Faster than KNN	Faster
Dataset	It can't deal with noisy data	It can deal with noisy data	It can deal with noisy data
Accuracy	Provides high accuracy	For acquiring great outcomes, it requires an enormous number of records	High accuracy

So, we will be using the Decision Tree Regression Algorithm for crop price prediction which gives approximately 95-97% accuracy.

C. Decision Tree Regression Algorithm

The decision tree regression machine-learning technique watches features of an item and trains a model in the structure of a tree to anticipate data later on to make significant nonstop output. Continuous output means that the output is not discrete, a known set of numbers or values.

The input to the algorithm is: -

1. Input parameter
2. Training dataset

Formulas used for prediction

$$SSE = \sum_{i\epsilon s1}(y_i - y1) + \sum_{i\epsilon s2}(y_i - y2)$$

Where y1and y2 are the values of the dependent variable in group s1and s2 that is wholesale price index parameter in the dataset

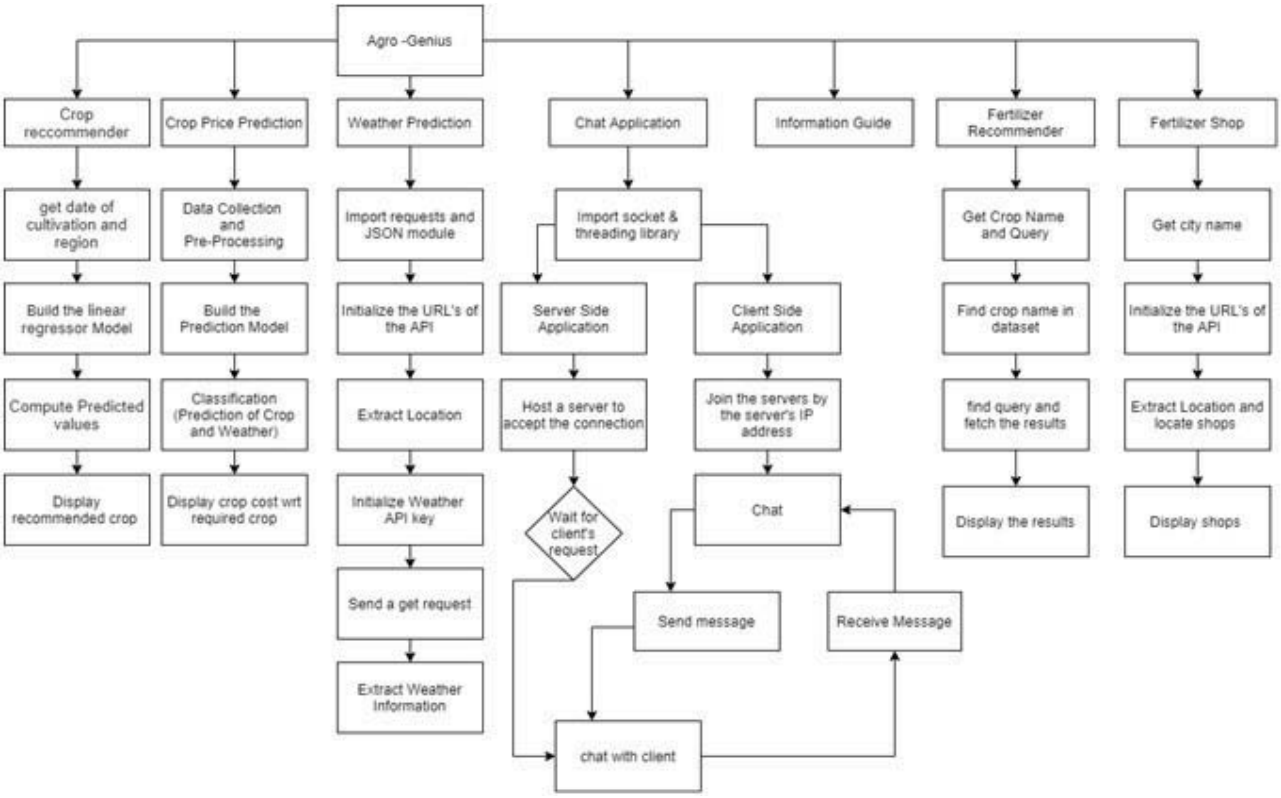

Fig. 1. Flow Diagram of AgroGenius (all modules)

For bunch s1 and s2 that is rainfall, it will recursively part the indicator esteems inside gatherings. The process stops when the sample size of the split group falls below a certain threshold.

Steps to Implement the Algorithm

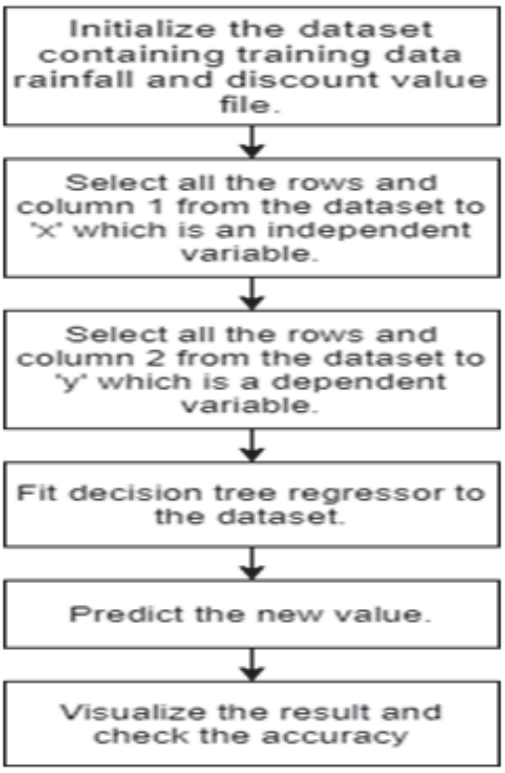

Fig. 2. Steps to Implement the Algorithm

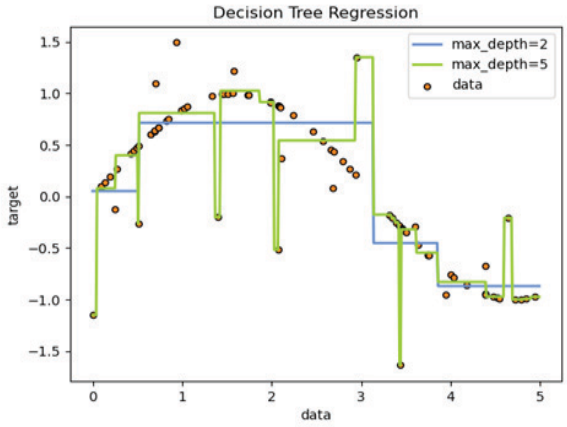

Fig. 3. Decision Tree Regression

The default value for the parameter controlling the size of the tree is max_depth to decrease memory utilization and complexity.

The performance of decision tree regression is estimated by three metrics - Mean Absolute Error, Mean Square Error and R^2 score.

IV. IMPLEMENTATION

The dataset which is used is obtained from the official site of the government of India.

We trained the model on KNN, Naive Bayers, Decision Tree Regression algorithms and found that the Decision Tree Regression algorithm reduced the overfitting problem. It also improved accuracy significantly.

We performed testing and training on our dataset. The model was trained and thus the results obtained were noted.

Then, compared the expected result with the initial data set. Later, we used the test samples to estimate the accuracy of the model. We predicted the accuracy of the model with different algorithms. Out of the 3 algorithms used, we concluded that the Decision Tree Regression gave the best results and hence used the same to train our model.

In Weather Forecast, using the openweathermap API, we are forecasting the weather by taking the city name as an input from the user.

For Crop Recommendation, the user has to give input parameters such as Date of Cultivation and Location. Using the self-made dataset of Maharashtra state and applying linear regression, crop recommendation model which will display most suitable and least suitable crops.

For Fertilizer Recommendation, we are taking crop name and disease present on the crop as an input and by using the dataset we are displaying the appropriate recommended fertilizer.

To see nearby Agri-Shop, we initialized google API and using location and recommended fertilizer, location of nearby shops is displayed.

For Chat, we initialized socket and established a connection between client and server.

V. RESULTS

Utilizing this framework, we ought to get the same accuracy indeed when an information autonomous framework is utilized.

For testing purposes, we have calculated the mean absolute error, Coefficient of determination R^2 and Variance score of both training and testing dataset. Along with that we have calculated accuracy for the test dataset.

For Paddy:

R^2 of the Test Set: ~0.9999

R^2 of the Train Set: 1.0

Mean absolute error test set: 1.64

Test Variance score: 0.98

Mean absolute error Training Set: 4.72

Training Variance score: 0.70

Test Set Accuracy ~ 0.9773

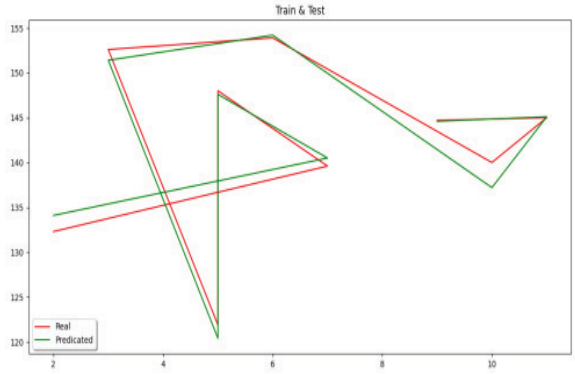

Fig. 4. Real Values versus Predicted Values

In this graph, the Real values are plotted with “Red” colour and the Predicted values are plotted with “Green” colour.

In Figure 4, output shows a little deviation from the real values. We have achieved an accuracy of ~97% after training the model.

Fig. 5. Prediction Errors

Figure 5 visualizes the prediction errors.

We get the weather forecast of 5 days with 3 hours of interval showing temperature, maximum temperature, minimum temperature, humidity, weather group and weather description

Farmers get the recommendation for the best suited crop and least suited crop for the entered location.

The farmer gets the recommended fertilizer on the disease name provided by the farmer on the crop.

Once the farmer sees the fertilizer, he can easily shop the fertilizer and some required seeds using the shopping portal created.

Farmers can communicate with each other easily by selecting the chat option. Group chat is also made available.

To make the website multilingual, we have used google translation to translate the website in 20+ languages.

VI. CONCLUSION

This project is undertaken using machine learning and evaluates the performance by using KNN, Naive Bayes, and Decision Tree algorithms. In our proposed model among all the three algorithm Decision Tree gives the better yield prediction as compared to other algorithms

As most extreme sorts of harvests will be secured under this system, farmers may become more acquainted with the yield which may never have been developed. The work exhibited the expected utilization of machine learning methods in foreseeing the harvest cost dependent on the given attributes. The created web application is easy to understand and the testing accuracy is over 90%.

VII. FUTURE SCOPE

This system can be enhanced by building a model with an increase in the number of crops. This paper aims at recommending crops in Maharashtra. We can extend our research by including region wise dataset. Organic fruits and vegetables can also be taken into consideration to increase the scope of the project.

Lastly, include category-wise AgriVideos. Farmers will be able to choose the category in which section they want to browse and watch videos related to that category.

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