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Predictor Analysis and Proliferation of Fertility and Production for Agriculturalists

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***Abstract*— The world of technical innovation and experiments have brought a new technological movement all over the world. Despite of it a major portion of the agribusiness community is far away from technical aspects that can make farming easy and efficient. About 60% of total agriculturalists in India are poor and can't afford heavy robotics to take advantage of the technology. Farmers are sometimes oblivious of the disease in the crop and the market prices of the products. This is why they are paid less than what the actual cost is. As a solution, a multilingual platform has been proposed which can be accessed by all people and from where the farmers can easily get to know the current price of their crops in the market. The system is fed with reliable data from the government and is built on the anaconda platform under the TensorFlow environment. The system helps in the prognosis of crop diseases and also furnishes the reason and cure for the disease. It is also helpful to get recommendations about the correct fertilizer as per the quality of soil and other considerations. The system will be very much helpful for poor farmers who can't afford pricey tools to enhance their crop production. Also, it will keep them aware of the current prices of the crop they are reaping and suggest which crop is suitable for which weather condition, which ultimately will be a boon for them.**

Keywords*— Agriculture, TensorFlow, Python, Anaconda, Disease Prediction, Fertilizer Prediction, Crop Recommendation

I. Introduction

Advancement in technology has ascertained to be a boon for various fields including agriculture. But, still, a major part of the farming community in India is either unaware of these technologies or they aren't able to afford them due to immense prices. Since a large part of the Indian population is dependent on agriculture, it is important to make them aware of these technologies and also to make them easily use these technologies. Two major factors that impact the productivity of a crop are soil and weather. With the help of experience, a farmer can anticipate the crop based on weather accurately but foreseeing the soil quality is very challenging. If one is not aware of the quality of soil, he can't achieve adequate crop production. So, it is very important to gain acquaintance with soil to get a good production. Also, it is necessary to choose a crop that can grow well in the weather condition of the area.

The enhancement in the field of machine learning has brought a revolution in overall surveillance and production. Every year news about suicides by the poor farmers is seen as they do not get the appropriate price of the hard work they do to produce the crop. After a survey, it is found that many of the farmers are unaware of the correct market price of the crop and hence, they are cheated by the middle-men in the market. To overcome these issues, a platform is required that could not only tell the current price but also predict the prices of the crop in the upcoming months. So that the farmers can also plan properly about which crop to grow. Also, it could recommend the farmers various ways to get better production.

II. Aim & Objective

The paper seeks to build and enforce an ML-based system that can foretell the diseases the plant is suffering from using images, recommend an appropriate fertilizer for boosting the soil quality, predict a suitable crop based on the location and weather conditions. The paper aims to build software that could predict the future prices of the crops and develop an incorporated software for a comprehensive analysis of the crops on the previous year's data of rainfall and wholesale price index (WPI). The objective of the paper is to make the farming community aware of technology advancements and make heavy technology available to them on an easy platform.

III. Literature Survey

The authors in the paper have used the notion of K Nearest Neighbor, to enforce the project. [1] The next algorithm which has been implemented is the Roulette selection methodology and the IGA population evolution concept. The instance is a supervised model and uses a labeled dataset to comprehend and render crop produce. The major advantage of the concept used is the clarity of the model and the ease of implementation while using KNN is also challenging to find the efficient and accurate value of k. The model is used to foreshadow optimal fertilizer for raising the nutrients of the soil. The paper helped

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in study of KNN models and the working. The authors have differed that the improvement of yield production can be done through several machine learning techniques. [2] Tests are carried out on the agricultural dataset. Machine learning classifiers i.e. Random Forest, XGBoost, Logistic Regression, Linear Regression, and ANN are implemented to find the best classifier that gives reliable forecasts. These machine-learning algorithms are performed on Python 3.7 (Jupyter Notebook) using inbuilt libraries: Numpy, Pandas, Scikit-learn built on tensorflow backend. This paper explained in details about the advanced packages and algorithms which can be implemented. The author has used the wavelet analysis technique to smoothen the data before inaugurating the ARIMA model. [3] The layered details after the signal decomposition is steady for each layer after the signal decomposition, so the ARIMA model can be established directly. In the case of time series that are also uni-variate, the model is better than the simple ARIMA model. In accumulation, this study uses the model to predict the recompense price of soybean meal futures This paper have superseded the standard convolution with depth separable convolution, which reduces the parameter number and enumeration cost. [4] The implemented models were trained with an open dataset consisting of 14 different plant species, 38 different categorical disease classes, and healthy plant leaves. The implemented models performed disease-classification with accuracy rates of 98.42%, which stood greater than conventional handcrafted-feature-based techniques. This was useful for the understanding of the dataset and the feature handling. The authors stated that the automated detection of diseases in plants is required, as it eases the tedious work of scrutinizing large farms and it will detect the disease at an early stage of its circumstance to minimize further degradation of plants [5]. The model is an ensemble of pre-trained DenseNet121, EfficientNetB7, and EfficientNet Noisy Student aims to classify leaves of apple trees into one of the following categories: healthy, apple scab, apple cedar rust, and multiple diseases, using its images. Various Image Augmentation techniques are included to improve the dataset size, and subsequentially, the model's accuracy boosts. The proposed model can identify leaves with multiple diseases with 90% accuracy and overall 96.25% on the validation dataset is accomplished. The key outcome of this paper was the study of various image argumentation techniques. The paper used the feature selection of the KNN machine learning algorithm. [6] The ranking method is a basic technique of KNN which is useful for multilevel classification used to pick and categorize the salient attributes. The bagging technique is a pre-processing method used in this task which helps to augment the prediction accuracy of any frail classifier like KNN to predict the crop. All these preprocessing methods help to give much more precise results. But while using bagging can give an inner loss of the model. The study in this paper stimulates the premature diagnosis of plant ailments to prevent crop loss and the spread of diseases [7]. A deep learning model is trained here to classify the diverse plant diseases. CNN model is used due to its enormous success in image-based classification and it provides faster and better factual predictions than manual remark of the plant leaf. The CNN model and pre-trained models such as VGG, ResNet, and DenseNet models are trained using the dataset. Among them, the DenseNet model has attained the highest accuracy of 98.27% which is considerably high. The authors have examined the Naive Bayes method for urging food crop considering monthly rainfall, temperature, humidity, and price as attributes. [8] In this paper, NB is used as a classifier for calculating the probability. From a labeled excel dataset, NB makes the data evaluation and data validation. As an advantage of this project, NB is a highly recommended classifier for its performance with 84.6 percent accuracy. Secondly, Agriculturalists can get a good recommendation for food crops like paddy, corn, peanuts, etc. naïve Bayes is one of the famous classifier which can be implemented with ease, the paper gave its detailed information

The authors used yield forecast for a selected district that is often made by integrating Precipitation, Temperature, and other parameters like season and site. When all the factors are considered, Random Forest emerges because of the greatest classifier. [9] Random forest is the superior prediction algorithm in comparison to other technologies that are multiple rectilinear regression and decision trees. The dataset holds tons more variables, directing to more authentic predictions.

The authors have explained the use of time series in the forecasting of the observations that can be made with aid for a better commercial result. [10] As per the most delinquent notices of the government, Kerala is one of the biggest producers of arecanuts, the work helps the arecanuts farmers in managing their resources for more promising production of crops with utmost profit based on the prophecy of prices. Based on several prior works, statistical methods were dominating in foretelling the divergence of prices. But in this work, LSTM was found to be a more appropriate model for forewarning the prices.

IV. MATERIALS AND METHODS

The proposed work was separated into four modules liable for four operations namely *disease prediction, fertilizer prediction, crop recommendation, and future price prediction* for crops. Fig. 1 shows the complete synopsis of all the modules. The entire system can be translated to any language making it user-friendly. Different forms of data (both images as well as numbers) have been used to train the model.

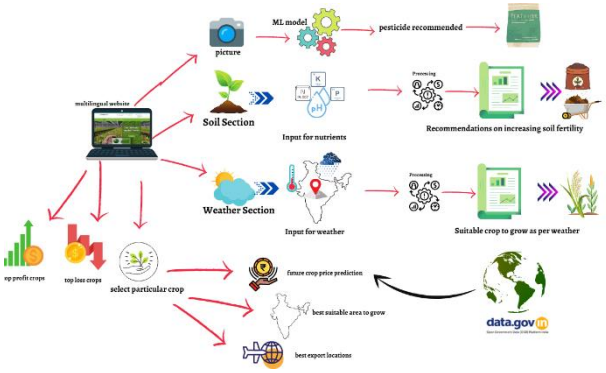

Fig.1: Architecture diagram

A. DISEASE PREDICTION MODULE

This module is a machine learning model which has been trained using leaf images of various crops infected with

different kinds of diseases. Fig 2 shows the implementation of the disease prediction model. The model is trained using the Conventional Neural Network (CNN) algorithm The user needs to upload the image of the infected plant, the module returns the name of the disease to the user. Additionally, it recommends the farmer about the cure of the disease and the reason for the disease. The farmer can keep precautions to avoid the disease in the future.

Fig. 2: Disease Prediction

B. FERTILIZER PREDICTION MODULE

This module deals with the processing of soil mineral values which is done using the Naive Bayes algorithm. Fig.3 represents the fertilizer prediction module of the system. After processing, the model will give the correct fertilizer to boost soil fertility as an output. Naive Bayes is a classification method used in machine learning. It is well known for its fast execution. The user has to provide the values of soil minerals such as Nitrogen (N), Phosphorous (P), and Potassium (K) along with the expected crop into the system and as an output, the mineral lagging in the soil along with steps to increase its percentage will be displayed. This includes natural methods as well as fertilizers.

Fig. 3: Fertilizer Prediction

C. CROP RECOMMENDATION MODULE

This module of the system deals with data concerning weather conditions like average rainfall. Fig.4 depicts the crop recommendation module for the system. This is done using the notion of data abstraction. To perform the processing of these data, K Nearest Neighbor (KNN) algorithm was used to give the best crop corresponding to the weather conditions. KNN is a supervised algorithm that can predict data using feature similarity. Here, the user has to select a place where he wants to do farming and provide mineral values like N, P, and K along with the average rainfall of that area. This will be the input for the system. After processing all the information, the best suitable crop related to that location and weather condition will be recommended as the output.

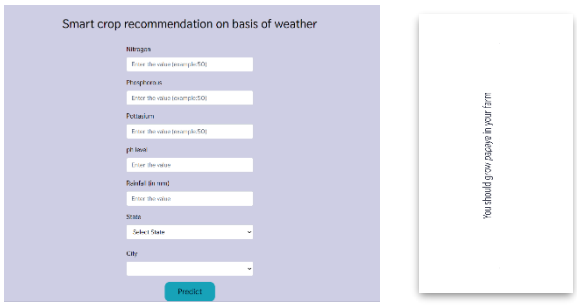

Fig. 4: Crop Recommendation module

D. FUTURE PRICE PREDICTION MODULE

This module has been introduced to make the user aware of the current market price of crops in the market. The data used has been taken from a government website data.gov.in. In this module, the user has to select a particular crop, and all the details like current price, export locations, and its lowest, as well as highest price in that year, will be displayed. Also, in the interface of selecting the crop, the list of crops with the highest price is displayed as *Top gainers* and the crops with the least price are displayed as *Top losers.* Fig.5 represents the home page of the price prediction module of the system. It shows the data in form of charts and graphs which makes the visualization easy and convenient. In Fig. 6 the graph shows the future market price which is generated by trends in the previous year's data of the particular crop. Also, the options of general data of the crop help the user to know about the export, import, and other essential information of the crop in detail.

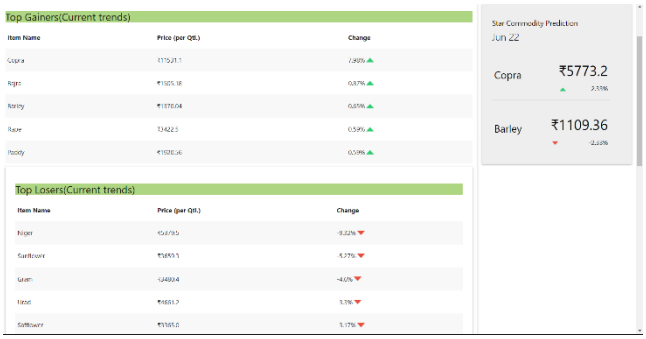

Fig. 5: Future Price Prediction module homepage

Fig. 6: Price visualization

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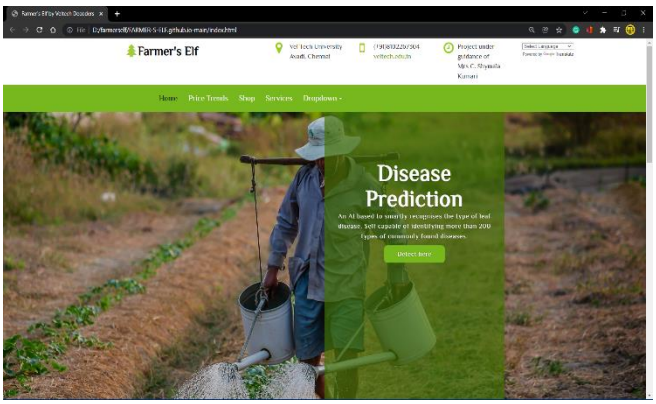
E. WEBSITE OVERVIEW

The website is built using HTML, CSS, and JS. Google Translate API has been used to make the website multilingual. The website consists of various tabs namely price trends, shop, and services which refer to the related modules. Fig.7 shows the interface of the website. Using the translate button at the top right corner, the website can be translated into any language of the world.



V. COMPARATIVE STUDY

Table 1: Accuracy comparison of various algorithms used for recommendation.

S.No	***Algorithms***	***Accuracy***
1	Decision Tree	90.0%
2	Naive Bayes	99.0%
3	SVM	97.6%
4	Logistic Regression	95.2%
5	**Random Forest**	**99.3%**
6	XGBoost	99.1%

The recommendation model was trained using various classifier which has been depicted in table 1. Based on the dataset chosen for the purpose of classification. The models gave various accuracy. Among which *Random Forest* was chosen for the best accuracy of 99.3%.

VI. CONCLUSION AND FUTURE WORKS

The ultimate focus of this paper was to make the farming community aware of the advancing technologies in agriculture. Being unaware of technology and not using it is okay but being aware of something beneficial and not using it due to huge prices is very unfair. So, to remove this gap between farmers and technology, the system has been proposed as a solution where people can know more about agricultural tips. The whole project is completely based on ML algorithms which have been proved to be efficient. In completion, it can be concluded that this paper is a great step for rural upliftment. In the future, the system can be combined with drone technology to perform pesticide spraying only at the target plant. This project can add up with UAV technology to continuously monitor our field and crop remotely.

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