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Crop and Fertilizer Recommendation System using Machine Learning

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Abstract—India being an agriculture country, its economy predominantly depends on agriculture yield growth and agroindustry products. Data Mining is an emerging research field in crop yield analysis. Yield prediction is a very important issue in agricultural. Any farmer is interested in knowing how much yield he is about to expect. Analyze the various related attributes like location, pH value from which alkalinity of the soil is determined. Along with it, percentage of nutrients like Nitrogen (N), Phosphorous (P), and Potassium (K) Location is used along with the use of third-party applications like APIs for weather and temperature, type of soil, nutrient value of the soil in that region, amount of rainfall in the region, soil composition can be determined. All these attributes of data will be analyzed, train the data with various suitable machine learning algorithms for creating a model. The system comes with a model to be precise and accurate in predicting crop yield and deliver the end user with proper recommendations about required fertilizer ratio based on atmospheric and soil parameters of the land which enhance to increase the crop yield and increase farmer revenue.

Key Words: ***Crop yield prediction, Support Vector Machine.***

1. INTRODUCTION

INDIA is a highly populated country and randomly change in the climatic conditions need to secure the world food resources. Framers face serious problems in drought conditions. Type of soil plays a major role in the crop yield. Suggesting the use of fertilizers may help the farmers to make the best decision for their cropping situation. The number of studies Information and Communication Technology (ICT) can be applied for prediction of crop yield. By the use of Data Mining, we can also predict the crop yield. By fully analyze the previous data we can suggest the farmer for a better crop for the better yield. For the better yield we need to consider soil type and soil fertility things and also one of the major factors rainfall and groundwater availability if it is dry land it is better to go for cash crops and if is wetland it is better to go for wheat and sugarcane. There are 15 agro-climatic regions in India these regions are divided on the bases of a type of the land. Each agro-climatic regions can grow some specific crops. Based on that we need to suggest the farmer that which crop is best among those crops which belong to those climatic regions. Achieving the maximum crop at minimum yield is the ultimate Aim of the project. Early detection of problems and management of those problems can help the farmers for better crop yield. Crop yield prediction is the important research which helps to secure food. For the better understanding of the crop yield, we need to study of the huge data with the help of machine learning algorithm so it will give the accurate yield for that crop and suggest the farmer for a better crop. Improving the quantity of the crop is the key goal of precision agriculture means obtaining a better understanding of the crop using the information technology methods. The main goal of precision agriculture is profitability and sustainability. From ancient times agriculture has become the backbone of our country. Nowadays climatic conditions vary very often. So, it is hard to grow crops by understanding weather conditions. We need to use some technology to find or understand the crop details and guide the farmers to grow crops accordingly and moreover fertilizer also one of the major factors to grow crops accordingly. If fertilizer is used more or less in the field the soil may lose it fertility and crop may not give the expected yield. So, fertilizer also becomes the major factor in it. mostly understanding the temperature conditions is much necessary for India because we can improve the Indian economy with the help of the crop prediction because it plays a major role in the Indian economy. Generally, machine learning algorithms will predict the most efficient output of the yield. Previously yield is predicted on the bases of the farmers prior experience but now weather conditions may change drastically so they cannot guess the yield. so, technology can help them to predict the yield of the crop weather to go for that crop or no. machine learning model will understand the pattern of the crop and yield based on the several conditions and predicts the yield of the area in which he is going to crop.

LITERATURE SURVEY

Ananthara,M.G.etal.(2013,February)proposed prediction model for datasets pertaining to agriculture which iscalledasCRYalgorithmforcropyieldusingbeehiveclusteringtechniques.Theyconsideredparametersnamelycroptype, soil type, soil pH value, humidity and crop sensitivity. Their analysis was mainly in paddy, rice and sugarcane yields in India.Their proposed algorithm was then compared with. C&R tree algorithm and it outperformed well with an accuracy of 90 percent

[2]. Awan, A. M. et al. (2006, April) built a new, smart framework focused on farm yield prediction clusteringkernelmethodologyandtheyconsideredparametersli keplantation, latitude, temperature and precipitation of rainfall in that latitude. They had experimented weighted k-means kernel method with spatial constraints for the analysis of oil palm fields

[3]. Chawla, I. et al. (2019, August) used fuzzy logic for crop yield prediction through statistical time series models. They considered parameters like rainfall and temperature for prediction.Their prediction was classification with levels 'good yield' , 'very good yield'

[4]. Chaudhari, A. N. et al.(2018,August)used three algorithms namely clusterin gk-means, A priori and Bayes algorithm, then they hybridized the algorithm for better efficiency of yield prediction and they considered parameters like Area, Rainfall, Soil type and also their system was able to tell which crop is suitable for cultivation based on the mentioned features

[5]. Gandge, Y.(2017, December) used many machine learning algorithms for different crops. They studied and analyzed which algorithm would be suitable for which crop. They have used K-means, Support vector Regression, Neural Networks, C4.5 Decision tree, Bee-Hive Clustering, etc. The factors implying were soil nutrients like N, K, P and soil ph.

[6]. Armstrong, L. J. et al.(2016, July) used ANNs for the prediction of rice yield in the districts of Maharashtra, India. They considered climatic factors namely (considering range) temperature, precipitation and reference cropevapo transpiration. The records were collected from Indian Government repository from 1998 to2002 [7]. Tripathy, A. K. et al. (2016, July) were same authors who used support vector machines to predict the rice crop yield with same features as the previous paper mentioned

[8].Petkar,O. (2016, July) were also the same authors who applied for SV Mandneural networks for rice cropyield prediction proposed a new decision system which is an interface to give the input and get the output

[9].Chakrabarty,A.etal.(2018,December)nalyzed crop prediction in the country of Bangladesh where they majorly cultivate three kinds of rice, Jute, Wheat, and Potato. Their research used a deep neural network where the data had around 46 parameters into their consideration. Few of them were soil composition, type of fertilizer ,type of soil and its structure ,soil consistency, reaction and texture

10].Jintrawet, A. et al. (2008, May) used SVR model for crops like rice to predict the yield where the model was divided into three steps- predicting the soil nitrogen weight followed by prediction of rice stem weight and rice grain weight respectively. Their factors were solar radiation, temperature and precipitation along with those three steps

[11].Miniappan,N.etal.(2014,August)usedartificialneuralnetworkinmodelling multi-layer perceptron model with 20 hidden layers for prediction wheat yield which considered factors likes unlight, rain, frost and temperature

[12]. Manjula, A et al.built crop selection and to predict the yield which considered various indexes like vegetation, temperature and normalized difference vegetation as factors. They distinguished between climate factors and agronomic factors and other disturbances caused in the prediction for better understanding

[13]TamilNadu, India.They have considered actors like soil, temperature, sunshine, rainfall, fertilizer, paddy, and type of pest used and other factors like pollution and season

[14]. Verma, A. et al. (2015, December) used classification techniques like NaïveBayes,K N algorithm for crop prediction on soil datasets which constituted nutrients of soil like zinc, copper, manganese, pH, iron, Sulphur, Phosphorous, Potassium, nitrogen, and Organic Carbon

[15].Kalbande,D.R.et al. (2018) used support vector regression, multi polynomial regression and random forest regression for prediction of cornyield and evaluated the models using metrics like errors namely MAE,RMSE and R-square values

[16].Rahman,R.M.etal. (2015, June) used mainly clustering techniques for cropyield prediction. The paper explained the analysis of majorcrops in Bangladesh and divided the variables into environmental and biotic variables.The algorithms applied were line arregression, ANN,and KNN approach for classification

[17]. Hegde, M. et al. (2015, June) used multiple linear regression and neuro fuzzy systems for predicting cropyield by taking biomass, soil water, radiation and rainfall as input parameters for the research and their majorly concentrated crop was wheat

[18]. Sujatha, R., & Isakki, P.(2016, January) used classification techniques like ANN, j48,Naïve Bayes, Random Forest and Support vector Machines. They have also included both climatic parameters and soil parameters as features in their modelling

[19]. Ramalatha, M.et al. (2018, October) used a hybrid approach of combining K-means clustering and classification based on modified KNN approach.The data was collected from TamilNadu, India where the majorly concentrated crops were rice, maize, Ragi, Sugarcane, and Tapioca

[20].Singh,C.D.etal.(2014,January)developedanapplicationtoadvisecropswhichworkson selected districts of Madhya Pradesh, India. The user would give input cloud cover, rainfall, temperature, observed yield in the past and the system would predict the yield and Depending on the trigger values set, the crop will be labeled and obtain the results.

METHODOLOGY

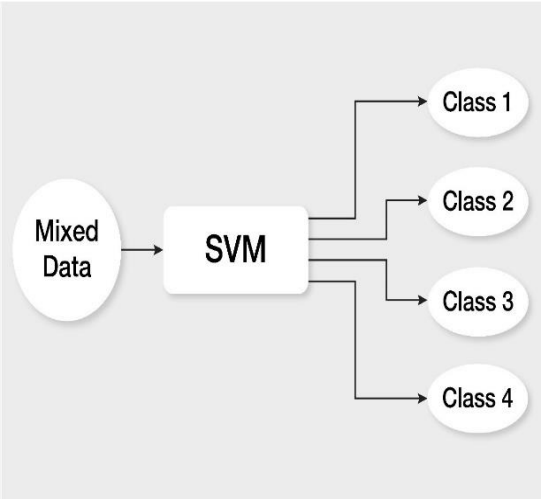

Fig.2.Processchartoftheresearchproject

A. *Pre-processing*

For the given data set, there are few values missing in the data set, the missing values could lead to false prediction results. The missing values are removed using the python. It is also important to remove the replicated data from the data set to fetch the accurate results. Normalization is used to scale the data to a specific range.

B. *Support Vector Machine:*

The Support Vector Machine is one of the supervised machine learning algorithm mainly used in classification and regression problems. We plot each data item as a point in n-dimensional space with the value of each feature being the value of a particular coordinate.

Step1:the total training set is again divided into two different sets.(train and holdout)

Step2:train thes elected base models with first part (train).

Step-3:Test them with these cond part.(holdout)

Step-4: Now,the prediction test results are used to measure the accuracy.

To separate the two classes of data points, there are many possible hyperplanes that could be chosen. Our objective is to find a plane that has the maximum margin, that is the maximum distance between data points of both classes. Maximizing the margin distance provides some reinforcement so that future data points can be classified with more confidence.

Hyperplanes are decision boundaries that help classify the data points. Data points falling on either side of the hyperplane can be attributed to different classes. Also, the dimension of the hyperplane depends upon the number of features. If the number of input features is 2, then the hyperplane is just a line. If the number of input features is 3, then the hyperplane becomes a two-dimensional plane. It becomes difficult to imagine when the number of features exceeds 3.

Support vectors are data points that are closer to the hyperplane and influence the position and orientation of the hyperplane. Using these support vectors, we maximize the margin of the classifier. Deleting the support vectors will change the position of the hyperplane. These are the points that help us build our SVM.fig.3.

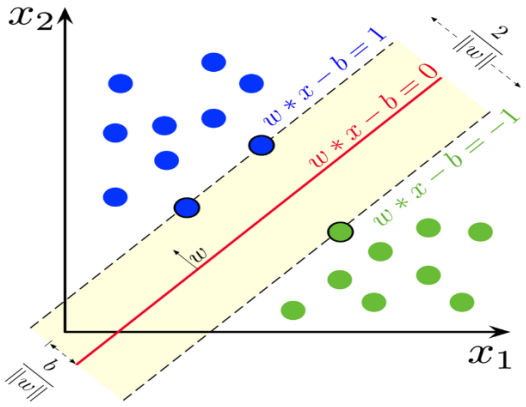

Fig.3.Support Vector Machine

C. *Output:*

The Support Vector Machine Used in this project gives the accuracy over 90.01%, Besides the accuracy of the SVM is (mean accuracy=0.950; mean AUC=0.934; mean F1 score=0.903)The user or the farmer can enter the following details over the web application to get the prediction as depicted below in the fig 4

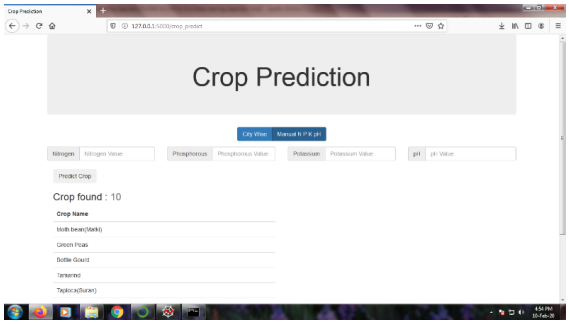

Fig.4.InterfaceofWebApp

CONCLUSION AND FUTUREWORK

The core strategy of this project is to predict the crop based on the soil nutrient content and the location where the crop is growing. This system will help he farmers to choose the right crop for their land and to give the suitable amount of fertilizer to produce the maximum yield. The Support Vector Machine algorithm helps to predict the crop the precisely based on the pre-processed crop data. This system will also help the new comers to choose the crop which will grow in their area and produce them a good profit. A decent amount of profit will attract more people towards the agriculture. Also, the crop growth is based on the climate conditions in the particular area and the seasonal monsoons happens now are unpredictable, hence it is easy for the farmers when the prediction result is also based on the climatic conditions. Live weather prediction will also help the users to predict the crop water needs and also it will help the farmers to decrease the crop damage due to the rain or drought.

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