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Machine Learning Based Hybrid Ensemble Model Using Majority Voting Technique For Crop Prediction

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ABSTRACT:

Agricultural activities employ more than half of India's population. Machine learning algorithms are used in a variety of agricultural studies to predict the best crop. Machine learning is a branch of artificial intelligence that teaches machines to emulate human thought processes. Machine Learning algorithms are often applied to training data to predict outcomes such as crop production, ideal crop to plant, and so on. In this study, a Hybrid Machine Learning Ensemble model for crop prediction is proposed. For crop prediction, we used 22 distinct crops' data, including 7 features such as nitrogen (N), potassium(K), phosphorus(P), temperature, humidity, pH, and rainfall. We proposed a Hybrid Ensemble model with Majority Voting Technique for optimum crop prediction using given dataset. The proposed model is modelled using five different learning algorithms, including Support Vector Machine (SVM), K-Nearest Neighbors (KNN), Naive Bayes, Random Forest (RF), and Logistic Regression, and the prediction accuracy is assessed using the majority vote technique. The prediction accuracy of the hybrid ensemble model was compared to that of seven machine learning methods, including KNN, SVM, Nave Bayes, RF, Decision Tree, Gradient Boosting, and Extreme Gradient Boosting (XGB) classifiers. The results show that the proposed hybrid ensemble model outperformed than other algorithms in terms of accuracy.

Keywords: Machine Learning, KNN, SVM, Random Forest, XG Boost, Hybrid ensemble, Majority Voting,

1. Introduction

Agriculture plays a significant part in the economic growth of a nation like India since it provides rural residents with money and employment and acts as a main food source. As time passes, the importance of crop production continues to rise. It contributes around 20% of India's gross domestic product. Today's farmers cultivate crops using the expertise passed down from

previous generations. Farmers are unaware of the contemporary horticultural economy's interest due to the employment of obsolete practises. The farmers are negatively affected by this. The choosing of crops is an essential component of agricultural planning. When farmers get correct knowledge on the best crop for the season, their losses are decreased. Various elements, including weather-specific characteristics (e.g., precipitation, temperature, and humidity), soil parameters, and so on, impact the rate of crop production (e.g. soil moisture). The data sets for these attributes are collected and analysed. When constructing a prediction model, it is crucial to collect data from the appropriate source because it influences the model's accuracy.

The agricultural sector is one of India's most significant economic sectors. It is the economic sector that contains the greatest variety of businesses and plays an important part in the expansion of the country as a whole. More than 60% of the land in this nation is used for agricultural purposes, which allows the nation to sustain its population of over one billion people. For this reason, it is absolutely necessary to employ contemporary techniques in agricultural production. The nation's farmers will come out ahead as a consequence of this. The knowledge and experience of local farmers used to be the primary basis for crop prediction and yield prediction in the past. Because they are ignorant about the nutrients in the soil, such as nitrogen, phosphate, and potassium, they will only select the crop that was grown previously, in the neighbouring area, or that is currently more fashionable in the surrounding region for their own land. Crop rotation and the supply of insufficient nutrients to the soil are factors that contribute to decreased yield, pollution of the soil (in the form of soil acidity), and damage to the top layer of the soil when certain conditions are present. In light of all of these considerations, we decided to develop the system using machine learning so that it may be of use to farmers. The field of agriculture is undergoing a revolution brought on by machine learning (ML). In the field of agriculture, for example, machine learning is not a magic trick or a mystery; rather, it is a set of well-defined models that collect particular data and employ algorithms to achieve the results that are intended.

The field of machine learning (ML) is comprised of algorithms that make it possible for software applications to become increasingly accurate at predicting outcomes without the software being explicitly coded to do so. Developing algorithms that are able to take in data as input, utilise statistical analysis to establish an output, and update results when new data becomes available is at the heart of the primary assumption of machine learning. The classification and regression techniques of superwised machine learning are utilised in order to make forecasts regarding the characteristics of a given sample. Classification algorithms are typically utilised in order to make predictions based on categorical data. In order to make accurate predictions of real values, regression methods are utilised. For crop prediction, we utilised classification methods such as Naive Bayes, KNN, SVM, Decision Trees, Random Forest, Gradient Boosting, and XGB. These were some of the algorithms that we used.

2. Literature Survey

Crop Recommendation System with Machine Learning[1] emphasizes the limits of current yield prediction techniques and their practical applications. On the provided datasets, different

machine learning methods, including Random Forest, ANN, SVM, MLR, and KNN, were implemented and evaluated for yield to accuracy. The accuracy of each algorithm is compared against one another. The acquired results indicate that Random Forest Regression is the most accurate conventional algorithm employed on the available datasets, with a 95% accuracy.Using machine learning, Priyadharshini A, Swapneel Chakraborty, Aayush Kumar, and Omen [2] proposed an Intelligent Crop Recommendation System. Five distinct algorithms were employed to recommend crops for the soil series beneath the surface. SVM, Bagged Tree, Adaboost, Naive Bayes, and ANN are their names. The suggested method assists farmers in selecting the optimal crop by providing information that regular farmers do not keep track of, hence decreasing crop failure risks and boosting crop yield.

Agro Consultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms was proposed by Zeel Doshi, Subhash Nadkarni, Rashi Agrawal, and Prof. Neepa[3]. Before selecting the most suited crop to the user, it considers environmental data and soil characteristics . This model would get information from another recommendation system called Rainfall Predictor, which would anticipate the monthly precipitation for the user's district during the next twelve months. Regularized Greedy Forest is utilised by authors to select an acceptable crop sequence at a given time stamp. demonstrates the use of numerous algorithms[11,12], including ANN, KNN, and Regularized Greedy Forest, to select a crop based on the production rate forecast, which is influenced by multiple parameters.S.Bangaru Kamatchi and R.Parvathi[4] suggested Enhancing Crop Production Using Weather Forecast Recommender Systems. ANN are being implemented in weather prediction studies. In order to increase the success rate of the recommender system, the regularisation of ANN is incorporated into the Hybrid approach via CBR.

Machine Learning Approaches for Crop Prediction was proposed by Nischitha K, Dhanush Vishwakarma, Mahendra N, Ashwini, and Manjuraju M.R[5]. The system will suggest the crop that will do best on a certain piece of land. Based on things like rainfall, temperature, humidity, and pH, as well as what's in the soil. The system gets the information it needs from the farmers or from sensors, like Temperature, Humidity, and pH. This data is used by machine learning predictive [15] algorithms like SVM and Decision tree to find patterns in the data and then process it based on the conditions that were given. Girish L. talks about how a machine learning method is used to predict crop yield and rain fall. Rahul Katarya talks about the different ways that machine learning is used to boost crop yield. To avoid these kinds of losses, we've made a farmer-friendly system with a graphical user interface (GUI) that can predict which crop will do best.Rohit Kumar Rajak, Ankit Pawar, Mitalee Pendke, Pooja Shinde, Suresh Rathod, and Avinash Devare[6] employed machine learning to optimise crop productivity. This research proposes a strategy for variable control on open, small farms utilising precision agriculture (PA)[7] at the individual farmer and crop level. SVM, Random Forest, Bagging, and Bayes were used to predict agricultural yield. Bagging delivers the most accurate yield projection among those offered.

deepak.g, deepika.j, dharshini.m, and dr.b.vanathi [8] built a system for guiding farmers using historical data. In this study, the Guassian Mixture Model-clustering and KNN and XGBoost approaches were utilised to cluster and classify the data. So the machine can match

each clustered data set's condition and give the right solution.Crop Recommendation System using Machine Learning Algorithms was proposed byG. Chauhan and A. Chaudhary[9] and presents the utilisation of machine learning approaches like Random Forest and Decision Tree to predict which crop is best for which soil type based on the data sets.

Anguraj.Ka, Thiyaneswaran.Bb, Megashree.Gc, PreethaShri.J.Gd, Navya.Se, and Jayanthi. J f [10] proposed Crop Recommendations for Soil Analysis Using Machine Learning[13,14]. This can be accomplished with the aid of machine learning algorithms, which have been demonstrated to be an excellent way for forecasting the most suited crop. IoT sensors capture soil characteristics such as soil moisture, temperature, humidity, and pH, and send them to a graphical user interface (GUI). The training dataset is submitted to the machine learning model to generate the crop suggestion prediction model. The test data are sent to the model once it has been generated with minimal error and maximum precision. The inputs are fed into the model that is developed. The programme then forecasts and advises the crops to be seeded with a 96.89% degree of accuracy.

3.Methodology

In this research work we were collected data for crop prediction, which consist of soil characteristics such as N (Nitrogen), P(Phosphorous) , K(Potassium) and ph and environmental characteristics such as temperature, humidity, and rainfall.The distributions of these features are shown in figure.1. The target variable contains 22 different crops.

After accumulating datasets from several sources. The dataset must be preprocessed prior to model training. The data preparation can be performed in multiple steps, beginning with reading the obtained dataset and continuing with the application of data transformation techniques to normalise the data for improved precision. Then, specify the model's objective. Using the sklearn library, the dataset will be divided into training and test sets following data transformation. Precision agriculture is currently popular. It aids farmers in making informed decisions on their farming plan. Here, I provide a dataset that enables users to construct a prediction model that recommends the best ideal crops to cultivate on a certain farm based on a variety of factors.

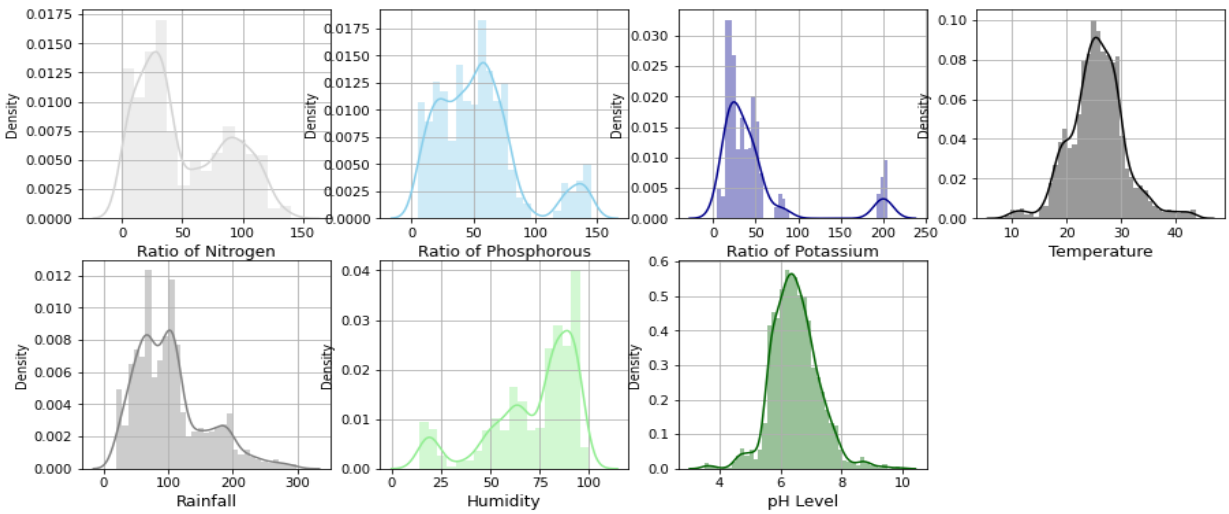

Fig.1: Distribution of data for Agriculture Conditions

When it comes to machine learning approaches, ensemble learning has a long history of outperforming other methods. Among the difficulties addressed by these applications include classification and regression. Well-known ensemble models that use a group of weak learners to build an ensemble include the random forest model and the gradient boosting model. All of the learners are put together to display their collective strength in these models, which are homogeneous.In this research, a heterogeneous group of learners is proposed to construct a hybrid ensemble learning model. To solve a categorization challenge, diverse machine learning algorithm types are joined together. The performance of individual learning models will be presented, followed by the performance of our hybrid ensemble model.

3.1 Hybrid Ensemble Model using Majority Voting

A hybrid ensemble learning model is constructed by including the five different types of machine learning models as learners. Logistic Regression Model, Decision Tree, Random Forest, KNN, and the Naive Bayes are the models that can be used to crop prediction. Figure 2 depicts the proposed model architecture.

The architecture of the proposed Hybrid Ensemble Model using Majority Voting which is built using 5 different algorithms. Firstly, the collected dataset consists of Soil and Environment Characteristics. Data preprocessing is done on the given dataset to transform the raw data into useful and understandable data. This particular step makes datasets more complete and efficient for data analysis. Then the dataset is split into Training data and Testing data. Train data is then further fed to different algorithms or we can say machine learning models to train them to predict the output. So after the models are trained, we were applied majority voting technique then their performance is measured using Testing data.

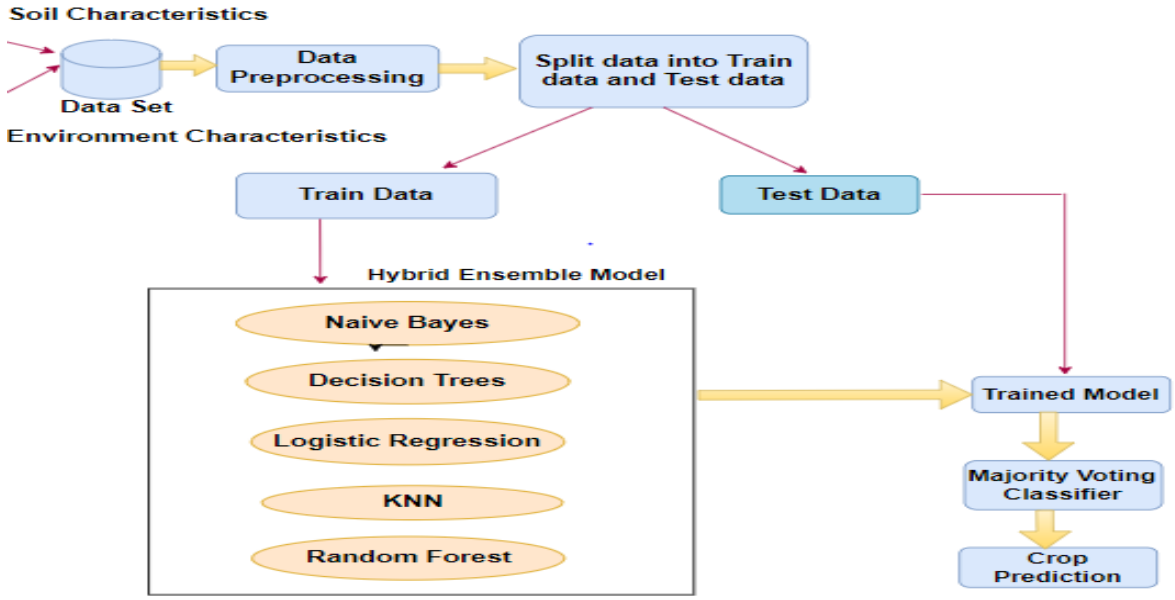

Fig.2: System Architecture

3.2 Majority voting

Voting ensembles are a class of machine learning models that incorporate predictions from a large number of other models. Improved models can outperform any one model in an ensemble using this method. An ensemble voting system combines predictions from multiple models. To classify or regression, use it This is accomplished by averaging the forecasts from each model, which is accomplished by regression. A total of predictions are collected for each label, and categorization will be assigned to the label with the most votes. It is possible to think of voting ensembles as a form of meta-model. Every trained machine learning model can be utilised in an ensemble with its meta-model without the model even knowing it's in the ensemble.

4. Results and Discussion

Open-source software library Scikit-learn (Sklearn) was used to construct learning models. In this work proposed Hybrid Ensemble model was compared with Naive Byaes, KNN, Random Forest, Decision Tree, SVM and XGBoost Classifiers. All of these models were constructed in Python in the most efficient manner feasible in order to provide fair comparisons. Their performance was compared using the exact identical software and hardware..

A supervised learning technique such as Naive Bayes algorithm is employed for the purpose of solving classification issues. This algorithm is based on Bayes theorem. The classification of the test data set can be quickly and easily predicted. Additionally, it does very well in the area of multi class prediction. Training accuracy of the model which is built using naïve bayes algorithm is 99.5%.Test accuracy of the model which is built using naïve bayes algorithm is 99.3%.Model accuracy with K-Fold Validation is 99.3750%.

Training accuracy for Naïve Bayes is higher than the KNN model and SVM models.And it is lessthan Gradient Boosting, Extreme Gradient Boosting, Random Forest, Decision Tree models,it’s training accuracy is same as Hybrid ensembles models.Testing accuracy for Naïve Bayes is higher than KNN, SVM models,It’s Training accuracy is lessthan Gradient boosting, Extreme Gradient Boosting, Random Forest, Hybrid Ensembles models, it’s Training accuracy is same as Decision tree model.Model Accuracy with K-Fold Validation for Naïve Bayes is higher than KNN, Gradient Boosting, Extreme Gradient Boosting, Decision tree, SVM models, It’s accuracy is less than Random Forest, Hybrid Ensembles model.

KNN is based on Supervised Learning technique.Predicting or classifying a new unknown variable requires knowing how many of its nearest neighbours are known. KNN determines the shortest paths to the unknown data by calculating the distances between each location in the neighbourhood and the unknown data. The term "distance-based algorithm" has become common because of this.Training accuracy of the model which is built using KNN algorithm is 98.7%.Test accuracy of the model which is built using KNN algorithm is 98%.Model accuracy with K-Fold Validation is 98.0114%

Training accuracy for KNN model is higher than the SVM model. And it is less than Naïve Bayes, Gradient Boosting, Extreme Gradient Boosting, Random Forest, Decision Tree

models, Hybrid ensembles models.Testing accuracy for KNN model is less than all the models in this document i.e., Naïve Bayes, Gradient Boosting, Extreme Gradient Boosting, Random Forest, Decision Tree models, Hybrid ensembles, SVM models.Model Accuracy with K-Fold Validation for KNN is least compared to all other models- Naïve Bayes, Gradient Boosting, Extreme Gradient Boosting, Random Forest, Decision Tree models, Hybrid ensembles, SVM models.

An ensemble technique known as Gradient Boosting is often used. By lowering mistakes, each Gradient Boosting predictor strives to improve on its predecessor. Rather, Gradient Boosting employs a novel approach: instead of fitting a predictor to the data, it instead fits a new predictor to the residual errors of the preceding predictor. This is an intriguing concept. The Gradient Boosting technique used to construct the model has a training accuracy of 100%. The model's test accuracy is 99.5%. Using K-Fold Validation, the model's accuracy is 98.75%.

Training accuracy for Gradient Boosting model is the highest among all other models and it is same as Extreme Gradient Boosting, Random Forest models.Testing accuracy for Gradient Boosting model is less thanthe Hybrid Ensemble model. More than the Naïve Bayes, KNN, Decision Tree, SVM models.It's accuracy is same as Extreme Gradient Boosting, Random Forest.Model Accuracy with K-Fold Validation for Gradient Boosting is higher than KNN, Decision Tree models,it's accuracy is less than Naïve bayes, Extreme Gradient Boosting, Random Forest, Hybrid ensembles models.It's accuracy is same as SVM model.

XGBoost is an ensemble machine learning technique that use a gradient boosting decision tree structure. XGBOOST is a Gradient Boosting concept implementation that uses a more regularised model formalisation to control overfitting. The XGBoost model was given a 100% training accuracy with a test precision accuracy of 99.5%.Model accuracy with K-Fold Validation is 99.2045%

Training accuracy for XGBoostmodel is the highest among all other models and it is same as Gradient Boosting, Random Forest models.Testing accuracy for XGBOOST model is less than the Hybrid Ensemble model. More than the Naïve Bayes, KNN, Decision Tree, SVM models. It's accuracy is same as Gradient Boosting, Random Forest models.Model Accuracy with K-Fold Validation for XGBOOST is higher than KNN, Gradient boosting, Decision Tree, SVM models, it's accuracy is less than Naïve bayes, Random Forest, Hybrid ensembles models.

As an ensemble learning method, Random Forests can be used to classify and predict. There are many independent decision trees in this system, but they work together as a unit. Our model's prediction is based on the class predictions made by each individual tree in the random forest.Training accuracy of the model which is built using Random Forest is 99.7% and Test accuracy is 99.5%.Model accuracy with K-Fold Validation is 99.4318%

Training accuracy for Random Forest model is the higher than Naïve Bayes, KNN, SVM, Hybrid Ensemble models. It's accuracy is less than Gradient Boosting, Extreme Gradient

Boosting, Decision tree models.Testing accuracy for Random Forest model is less than the Hybrid Ensemble model. More than the Naïve Bayes, KNN, Decision Tree, SVM models. It's accuracy is same as Gradient Boosting, Random Forest models.Model Accuracy with K-Fold Validation for Random Forest model is higher than Naïve bayes, KNN, Gradient boosting, Extreme Gradient Boosting, Decision Tree, SVM models, it's accuracy is less than, Hybrid ensembles models.

Decision Tree is supervised learning system. It solves regression and classification problems. Decision Node and Leaf Node are nodes in a decision tree. Leaves are decision results, while Decision nodes make multi-branch decisions. Visualize all possibilities for addressing an issue or making a decision. Training accuracy is 100% and test accuracy is 99.3% using a Decision Tree. Using K-Fold Validation model accuracy is 98.3523 %.

Training accuracy for Decision tree model is the less than Naïve Bayes, KNN, SVM, Random Forest, Hybrid Ensemble models. It's accuracy is same as Gradient Boosting, Extreme Gradient Boosting, models.Testing accuracy for Decision treemodel is less than the Gradient boosting, Extreme GradientBoosting, Random Forest, Hybrid Ensemble model. More than the KNN, SVM models. It's accuracy is same as Naïve bayesmodels.Model Accuracy with K-Fold Validation for Decision tree model is higher than KNN model,it's accuracy is less than all other models- Naïve Bayes, Gradient Boosting, Extreme Gradient Boosting, Random Forest, Hybrid ensembles, SVM models.

SVM classifies data points by finding an N-dimensional hyperplane. Features determine hyperplane size. For example two input features yield a straight hyperplane. Model training accuarcy is 98.5% and testing accuracy is 97.7%. Model accuracy is 98.75% using K-Fold Validation.

Training accuracy for SVM models less than all other models.Testing accuracy for SVM model is less than all other models..Model Accuracy with K-Fold Validation for SVM model is higher than Decision tree,KNN model, it's accuracy is less than Naïve Bayes, Extreme Gradient Boosting, Random Forest, Hybrid ensembles model but same as Gradient Boosting Model.

4.1 HYBRID ENSEMBLE

Training accuracy of the Hybrid Ensembles is 99.5%.Test accuracy of the Hybrid Ensemble is 99.7%.Model accuracy with K-Fold Validation is 99.4652%.Training accuracy for Hybrid Ensemble model is higher than KNN, SVM, Random Forest models. It's accuracy is same as Naïve bayes model, its accuracy is less than Gradient Boosting, Extreme Gradient Boosting, Decision tree models.Testing accuracy for Hybrid Ensemble model is higher than all other models.Model Accuracy with K-Fold Validation for Hybrid Ensemble model is higher than all other models as shown in table 1.

The Hybrid ensemble model train accuracy, test accuracy and k fold validation accuracy compared with various other machine learning algorithms then the fig.3 shows that the proposed model was given best values.

Table 1: Models Accuracy in %

Model	Training Accuracy	Test Accuracy	Model Accuracy with K-Fold Validation
Naive Bayes	99.5	99.3	99.3750
K Nearest Neighbors	98.7	98	98.0114
Gradient Boosting	100	99.5	98.75
Extreme Gradient Boosting	100	99.5	99.2045
Random Forest	99.7	99.5	99.4318
Decision Tree	100	99.3	98.3523
Support Vector Machine	98.5	97.7	98.75
Hybrid Ensembles	**99.5**	**99.7**	**99.4652**

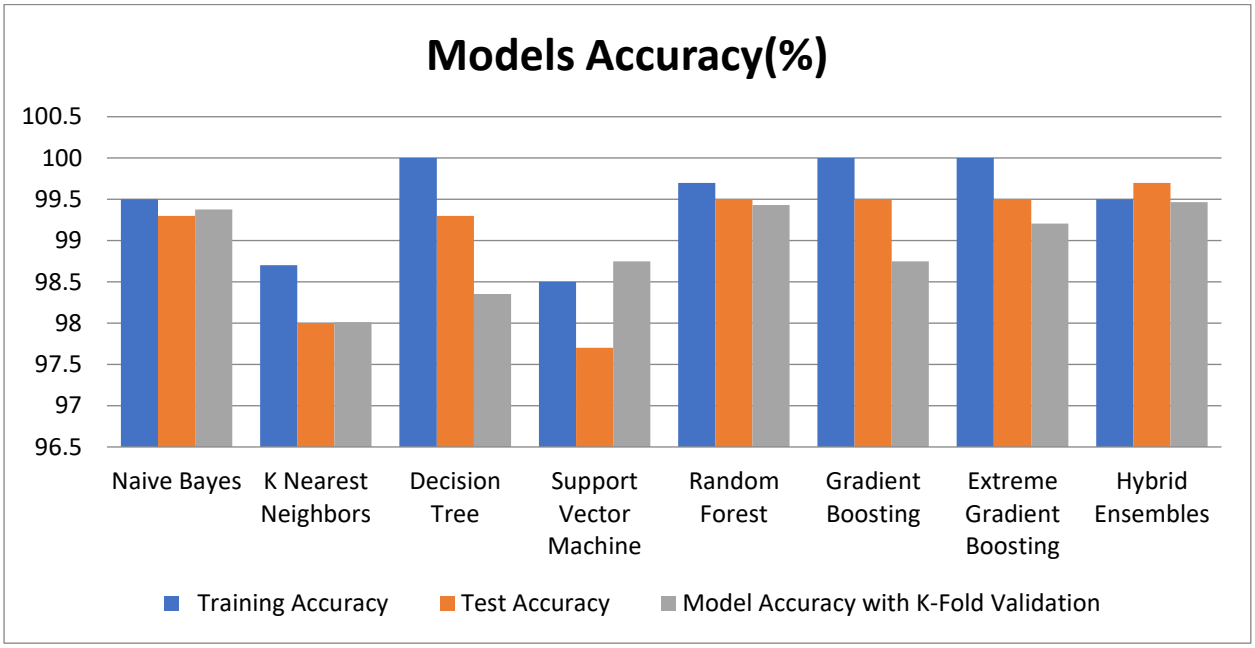

Fig.3: Algorithms accuracy

5. CONCLUSION

In this work Machine learning hybrid ensemble model was proposed for crop prediction.In Hybrid ensemble model 5 different algorithms such naïve bayes, Random Forest, Decision Tree, Logistic Regression and KNN algorithms were used to achieve best results. The proposed model accuracy was compared with 7 different machine algorithms and the results shows that the proposed model was given more accuracy

6. REFERENCES

1. s. m. pande, p. k. ramesh, a. anmol, b. r. aishwarya, k. rohilla and k. shaurya, "Crop Recommender System Using Machine Learning Approach," 2021 5th International

Conference on Computing Methodologies and Communication (ICCMC), 2021, pp. 1066-1071, doi: 10.1109/ICCMC51019.2021.9418351.

2. P. A, S. Chakraborty, A. Kumar and O. R. Pooniwala, "Intelligent Crop Recommendation System using Machine Learning," 2021 5th International Conference on Computing Methodologies and Communication (ICCMC), 2021, pp. 843-848, doi: 10.1109/ICCMC51019.2021.9418375.
3. Z. Doshi, S. Nadkarni, R. Agrawal and N. Shah, "AgroConsultant: Intelligent Crop Recommendation System Using Machine Learning Algorithms," 2018 Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018, pp. 1-6, doi: 10.1109/ICCUBEA.2018.8697349.
4. S. Bangaru Kamatchi, R. Parvathi,Improvement of Crop Production Using Recommender System by weather Forecasts, Procedia Computer Science,Volume 165,2019,Pages 724-732,ISSN 1877-0509,https://doi.org/10.1016/j.procs.2020.01.023
5. Mahendra N , Dhanush Vishwakarma , Nischitha K , Ashwini, Manjuraju M. R, 2020, Crop Prediction using Machine Learning Approaches, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 09, Issue 08 (August 2020),
6. Rohit Kumar Rajak, Ankit Pawar, Mitalee Pendke , Pooja Shinde, Suresh Rathod, Avinash Devare,2017,Crop Recommendation System to Maximize Crop Yield using Machine Learning Technique,International Research Journal of Engineering and Technology (IRJET),Volume 04 Issue 12, Dec-2017,e-ISSN: 2395-0056
7. Chlingaryan, A., Sukkarieh, S., Whelan, B., 2018. Machine learning approaches for crop yield prediction and nitrogen status estimation in precision agriculture: a review. Comput. Electron. Agric. 151, 61–69. https://doi.org/10.1016/j.compag.2018.05.012.
8. deepak.g, deepika.j, dharshini.m, dr.b.vanathi,crop yield prediction based on ensemble model using historical data Vol-7 Issue-2 2021,IJARIIE-ISSN(O)-2395-4396
9. G. Chauhan and A. Chaudhary, "Crop Recommendation System using Machine Learning Algorithms," 2021 10th International Conference on System Modeling& Advancement in Research Trends (SMART), 2021, pp. 109-112, doi: 10.1109/SMART52563.2021.9676210
10. Raj, Angu & Balashanmugam, Dr.Thiyaneswaran & Jayanthi, J & Yoganathan, N & Srinivasan, P.. (2021). Crop Recommendation on Analyzing Soil Using Machine Learning. Turkish Journal of Computer and Mathematics Education (TURCOMAT). 12. 1784-1791.
11. Crane-Droesch, A., 2018. Machine learning methods for crop yield prediction and climate change impact assessment in agriculture. Environ. Res. Lett. 13 (11), 114003. https://doi.org/10.1088/1748-9326/aae159.
12. Filippi, P., Jones, E.J., Wimalathunge, N.S., Somarathna, P.D.S.N., Pozza, L.E., Ugbaje, S.U., Bishop, T.F.A., 2019b. An approach to forecast grain crop yield using multilayered, multi-farm data sets and machine learning. Precis. Agric. https://doi.org/10. 1007/s11119-018-09628-4.
13. Gonzalez-Sanchez, A., Frausto-Solis, J., Ojeda-Bustamante, W., 2014. Predictive ability of machine learning methods for massive crop yield prediction. Spanish J. Agric. Res. 12 (2), 313–328. https://doi.org/10.5424/sjar/2014122-4439

14. Shah, A., Dubey, A., Hemnani, V., Gala, D., Kalbande, D.R., 2018. Smart Farming System: Crop Yield Prediction Using Regression Techniques. Springer, Singapore, pp. 49–56. https://doi.org/10.1007/978-981-10-8339-6_6.

15. Shekoofa, A., Emam, Y., Shekoufa, N., Ebrahimi, M., Ebrahimie, E., 2014. Determining the most important physiological and agronomic traits contributing to maize grain yield through machine learning algorithms: a new avenue in intelligent agriculture. PLoS ONE 9 (5), e97288. https://doi.org/10.1371/journal.pone.0097288.

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