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Kissan Konnect – A Smart Farming App

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Abstract— Agriculture is the basic economic backbone of every country. India being the developing country has agriculture as its main occupation. Almost 50% of the population has agriculture as their main occupation. The idea is to develop an application that will be useful for farmers and reduce their dependencies. Farmers today follow traditional agriculture cultivation methods. Cultivating same crop repeatedly and that results in degradation of the soil quality. To solve such issues and more we have developed web application. The Application will recommend the best crop to be yielded according to the weather, soil type, rainfall, temperature, humidity and pH. Another important feature that has been implemented is the disease detection module. The proposed machine learning model will scan the images uploaded by the farmers and diagnose the disease. Some farmers do not own the modern tools due to the cost. The proposed solution for that problem is the "tool rental module". In this way the application is able to make significant contribution to the lives of the farmers and increase the crop cultivation

Keywords—Agriculture, Crop prediction, Plant disease detection, Soil, Image processing

INTRODUCTION

Around half of the population in India has agriculture as an occupation. Agriculture has a major role in the overall economic growth and development of our country. With consistent growth and population increase, recent studies indicate a need to increase food production to 70 to 90% by 2050. Thus, adopting a new age method in certain agricultural activities with the help of the latest technologies and softwares will prove to be very beneficial for the farmers and the consumers. Prior crop prediction algorithms came into action, the same task was performed on the basis of farmers' past experiences and intuitions for a particular location. The yield could be harmed by improper crop rotations and unplanned use of specific soil nutrients. Considering all these problems, we are planning to design our system which will act as a remedy and satisfy certain agricultural needs. This paper presents a system that will recommend the appropriate crop for a particular land, based on different parameters like weather, soil type, rainfall, temperature, humidity and pH. Hence by utilizing our system, farmers will be able to cultivate profitable crops which will actually yield in large numbers and prove beneficial over the long term too. Our system will intelligently recommend the crop that can be cultivated and would be the most profitable. Farmers use chemicals and pesticides to keep the insects at a bay. But when overused, it may damage the crop. Unknowingly the yield of the crop is affected. Leaves are one of the most sensitive parts of the plant from where we can first detect the symptoms of disease. It is necessary to begin monitoring the crops from a very early stage of their life cycle till the time they are ready to be harvested. Initially plants were observed and monitored to prevent diseases using traditional naked eye observation which is a time-intensive technique and requires very careful observation. Mostly, the symptoms of the diseases can be seen on the leaves, the stem or the fruits. Most of the time, leaves of the plant are considered for the detection of disease. Many times farmers do have enough and adequate knowledge about the crops and the diseases from which the crops are at risk. With new breeds of crop, new diseases are also being discovered. By using our system the farmers can effectively increase their yield and protect the crops from diseases without having to visit any expert.

A web application named Kissan Konnect-Smart Farming Solution was developed. The proposed system has various smart farming solutions which can be utilized from anywhere & anytime. The services include Crop prediction which will take input parameters like soil pH, rainfall, air humidity, air temperature and soil humidity of the land and using Random Forest Classifier. The ML model will help predict the best suitable crop to be cultivated considering all these aspects. Also, the web application offers a service that will assist farmers in detecting the disease that has affected the crop. The photographs that the farmer has submitted for diagnosis were used. The uploaded photos will be compared to the database, and the module will identify the disease using a machine learning model. Also, the website will offer a possible treatment for the identified illness. Plant Disease Recognition service [2] will use image processing for model construction and after taking the image input of the affected leaf it will accurately diagnose the disease. The proposed system also provides a service where farmers can rent tools from nearby farmers instead of buying them. This will help in reducing the cultivation cost. Reaching the tools will be simpler because they will be displayed depending on location. Email and phone numbers are available for contact. The news feed service will keep the farmers updated about new methods, technology, agriculture related. Farmers will benefit from the weather forecast function by being informed of both present and upcoming weather forecasts so they may be ready for upcoming circumstances. For this rest

APIs were used. The climate feature will fetch the information about the weather conditions of any particular city farmers will get to know the climate [3] just searching it . Weather APIs were used for the implementation.

++++++++++++++++++++++++++++++++++++RELATED WORK

Madhuri,Arushi and Subba[1] proposed a system that aims to discover the best crop production model that can help decide the type of crop to grow based on climatic conditions and the presence of nutrients in the soil. Their paper compared several popular algorithms, including the KNN ,decision tree and the random forest classifier. The results show that random forest has the highest accuracy of the three. Entropy and Gini index were used to calculate the performance of the model. The results indicate that the effectiveness of the suggested machine learning algorithms is compared to the best accuracy with respect to precision, recall, and F1 score.

According to the authors of this paper[2], deep learning-based models are widely used to extract significant crop features for prediction, but they have the following shortcomings: they are unable to create a direct nonlinear or linear mapping between raw data and crop yield values, and the performance of those models is highly dependent on the quality of the extracted features. They proposed that combining the intelligence of reinforcement learning and deep learning, deep reinforcement learning builds a complete crop yield prediction framework that can map the raw data to the crop prediction values. The main goal to achieve favorable results is the integration of Deep Recurrent Q networks (DQN) with Recurrent Neural Networks(RNN). The suggested method gives the impression of implementing a more generalized yield prediction model. On observing the experimental values and results obtained for the paddy crop dataset, the deep reinforcement learning model is found to predict the data with better accuracy and precision of 93.7% over the other experimented algorithms.

The objective of this paper[3] is to use machine learning classification techniques to detect different plant diseases. The diseases can be recognized by examining the plant's leaves, stem, and roots. Leaf diseases can be detected using digital image analysis. For various kinds of crops, the authors performed studies using various classification techniques such as SVM ANN, KNN Fuzzy classifier, and CNN. The accuracy obtained using the SVM classifier on various plants ranged from 90 to 95%. The precision of the ANN classifier was around 93%. Fuzzy and KNN, on the other hand, could only reach 90% accuracy. To conclude the result shown that CNN classifier detects more number of diseases with high accuracy but SVM classifier is used by many authors for classification of diseases

The identification of plant diseases is essential for managing and producing crops. Although it requires a high level of experience and specialization, it can be effectively accomplished through optical observation of changes in plant leaves by scouting specialists. Artificial intelligence (AI)-based data analysis techniques used in novel technologies can increase the reliability of diagnoses and, as a result, be incorporated into tools for effective therapy. Methods that combine AI with picture feature analysis can help identify plant diseases even more successfully. The work done by the authors of this paper [4]is limited to vine leaves. They demonstrated an automatic way of crop disease identification by employing local binary patterns(LBP) for feature extraction and one class classification for classification.

A very high degree of generalization behavior on other crops was achieved when algorithms trained on vine leaves were tested on a range of crops. For all 46 of the plant conditions that were tested, the authors were able to obtain a 95% overall success rate.

The paper [5] focuses on supervised machine learning techniques such as Naive Bayes, decision trees, K Nearest Neighbour, Support Vector Machine and Random Forest for maize plant disease detection with the help of images of the plant. The authors compared the said classification techniques on basis of accuracy .

The accuracy of various algorithms were:

SVM - 77.56

NB 77.46

KNN 76.16

DT 74.35

RF 79.23

Random forest has been found to have the highest accuracy in detecting various maze leaf diseases. The proposed methodology was used to train the classification model using labelled image data.

Title of Paper	Abstract
Pantazi, Xanthoula Eirini, Dimitrios Moshou, and Alexandra A. Tamouridou. "Automated leaf disease detection in different crop species through image features analysis and One Class Classifiers." Computers and electronics in agriculture 156 (2019): 96-104.	This paper compares various algorithms for best crop prediction module like KNN,Decision Tree,Random Classifier.It was concluded that Random Forest has the best accuracy.

D. Elavarasan and P. M. D. Vincent, "Crop Yield Prediction Using Deep Reinforcement Learning Model for Sustainable Agrarian Applications," in IEEE Access, vol. 8, pp. 86886-86901, 2020	The paper researched about combining the deep learning and reinforcement learning techniques to form deep reinforcement learning model.The proposed model was able to achieve accuracy of 93.7%.
U, S., Nagaveni, V., & Raghavendra, B. K. (2019). A Review on Machine Learning Classification Techniques for Plant Disease Detection. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS).	The authors compared various machine learning techniques like SVM ANN, KNN Fuzzy classifier, and CNN.On further work,it was concluded that CNN classifier detects more number of diseases with high accuracy but SVM classifier is used by many authors for classification of diseases.
Pantazi, Xanthoula Eirini, Dimitrios Moshou, and Alexandra A. Tamouridou. "Automated leaf disease detection in different crop species through image features analysis and One Class Classifiers." Computers and electronics in agriculture 156 (2019): 96-104. Panigrahi, Kshyanaprava Panda, et al. "Maize leaf disease detection and classification using machine learning algorithms." *Progress in Computing, Analytics and Networking: Proceedings of ICCAN 2019*. Springer Singapore, 2020.	.The work done by the authors of this paper is limited to vine leaves.They demonstrated an automatic way of crop disease identification by employing local binary patterns(LBP) for feature extraction and one class classification for classification.Overall,95% accuracy was obtained. The paper focuses on supervised machine learning techniques such as Naive Bayes, decision trees, K Nearest Neighbour, Support Vector Machine and Random Forest for maize plant disease detection with the help of images of the plant. The authors compared the said classification techniques on basis of accuracy. Again, it was found out that random forest has the best accuracy.

As per the authors [6],in India, less than 30% of farmland is mechanised. This is due to the fact that 75% of farmers have less than one hectare of land. This limited land ownership prevents families from purchasing agricultural equipment solely for their own use. Farmers lease machinery from people who lend money for their equipment. Farmers face a number of challenges when renting farm equipment, including limited access for borrowers, no appointments, high prices, and untrustworthy transportation. Farmers' yields are reduced as a result of these difficulties. Tractors and harvesters are extremely expensive for small and medium-sized farmers. They must therefore obtain rental services from other machinery owners. Manik rakhra Randeep Singh Tarun Kumar and Mohammed Shahbaz have conducted survey of about 562 farmers. It is found out that most of the farmers lie under the burden of Debt because they are unable to buy new machinery. They made an information system name Smart Tillage which can accommodate the farm equipment sharing and renting considering seasonal fluctuations, market demand and pricing as per the crop cycles.

PROPOSED SYSTEM

A. Architecture

Referring to the architecture in figure 1. The user launches the application and must first register himself/herself and create an account. After logging in, the various features are displayed. To use features such as crop production, the user must enter the PH value of the soil, humidity, rainfall, and temperature. For plant disease recognition, the user must upload images, preferably of the plant's leaves. The climate service can be used to find out the temperature and weather in different parts of the country. The most recent news can be read using a news feed. When needed, the expert assistance feature will provide assistance. Finally, the user may log out of his\her account.

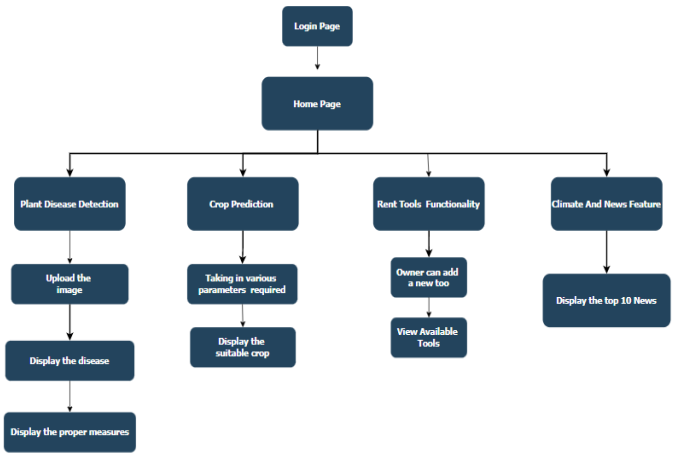

Fig. 1 System Block Diagram

B. Methodology Used :

The system has a total of 6 submodules -Crop prediction, Plant disease detection, tool renting, Weather forecast, fetching top 10 NEWS headlines and providing contacts of agencies that can help out farmers in time of need.

1. Plant Disease Detection module:

The plant disease identification module made use of the extensive dataset which included tomato, potato, pepper bell, and other plant leaves. Using Keras, disease detection of leaf pictures were found. Keras is a Python-written deep learning API that runs on top of a machine learning platform. We utilized the sequential API to build a model. At first, we set some default settings for parameters like epoch, image size, image width, and image height.The processing phase involved converting images into array. We used open CV to read the images, and the Keras preprocessing function called Img to Array to transform images into arrays. Label binarizer was used to transform multi-class leaf disease labels to binary labels, and the numpy library in Python was used to change the image's data type to float. After that, the data was divided into testing and training sections. In order to strengthen the model and reduce overhead memory usage, we have real-time picture augmentation while also training our model. A stochastic gradient descent method called Adam optimization was used for optimizing the results of our model. The test accuracy we were able to achieve was 95.94%.

2. Crop Prediction Module:

The data set used is made up of various soil attributes, such as the NPK values of the soil, temperature, humidity, soil pH, rainfall, etc. The crops that can be grown will be intelligently recommended by the algorithm. It consists of a variety of cultivable crops. The data set was divided into training and testing set. Data from the training set make up 80%, while data from the testing set make up 20%. The decision tree classifier, random forest classifier, naive bayes algorithm, SVM, and logistic regression were among the many classification techniques we used. The algorithm with the highest accuracy was Randomforest(95%), according to our calculations. As a result, it should be used to predict crops.

3. Rent tools Functionality :

Farming requires the use of numerous tools and equipment. Not all farmers have the necessary equipment. We know that the economic conditions of Indian agriculture industry workers are not always stable, so we built a feature into our system to account for this. This feature is available in three languages: English, Marathi, and Hindi, and it allows farmers to rent tools from other farmers rather than buy them, allowing them to save and earn money while also making communication easier because a preferred language can be selected. Farmers can provide tools that they are not currently using by renting them to other farmers who may require them. Along with the rent, the contact information for the farmers is made available. This will assist the agricultural community to earn more.

4. Climate and News Feature:

When growing any given crop, the weather is a significant factor. So, the farmer must be aware of the weather in the region where he or she farms. The online application also includes a built-in feature for weather forecasts. Any farmer can use the tool to learn about the climate and the weather forecast, which will help him plan his next agricultural activities. We used the Rest API to do this. To ensure that farmers are informed of all recent developments in the farming industry, we also introduced a feature that lists the top 10 news.

RESULTS

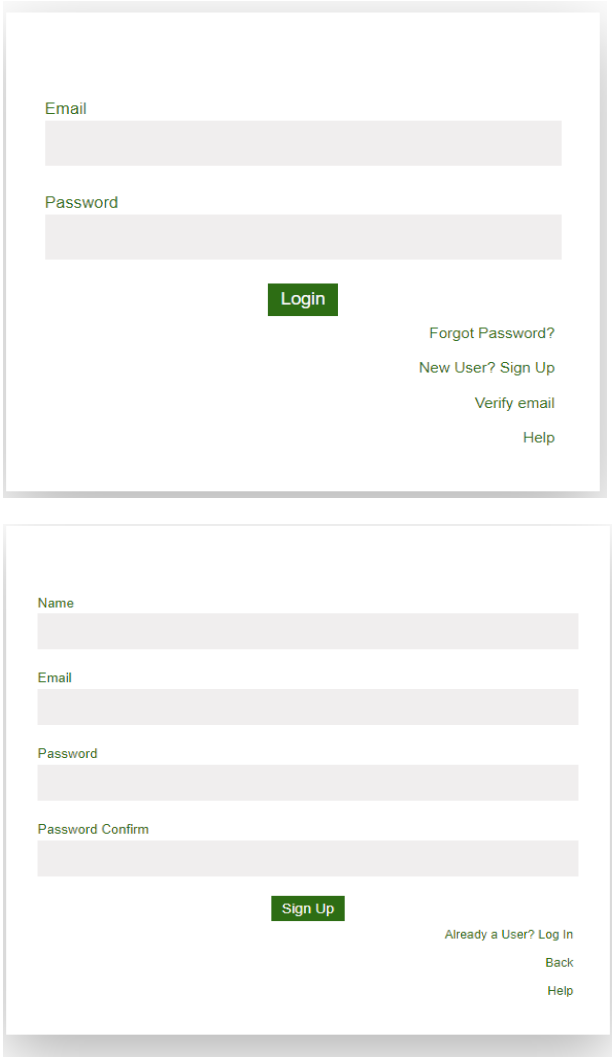

Fig 1. Login Page And Signup Page

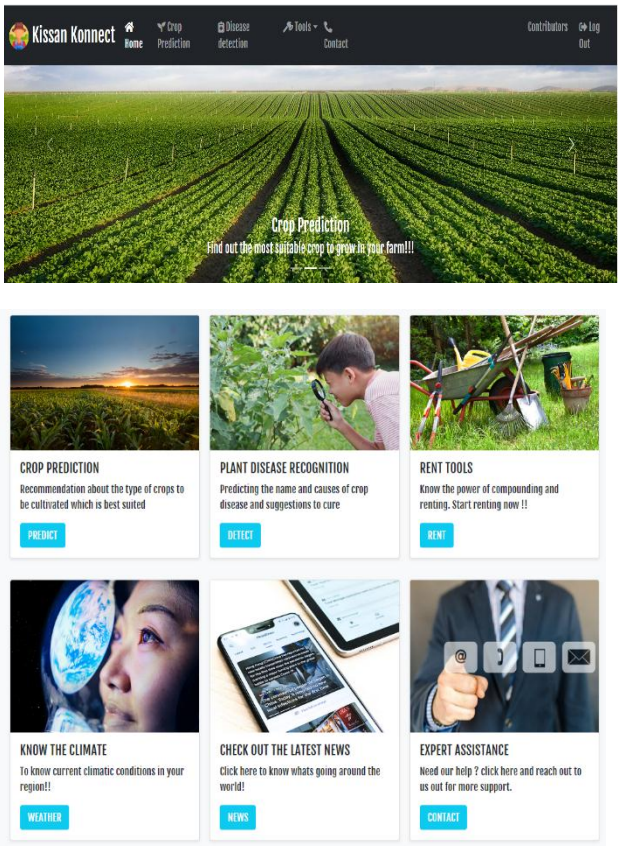

Fig 2. Home Page

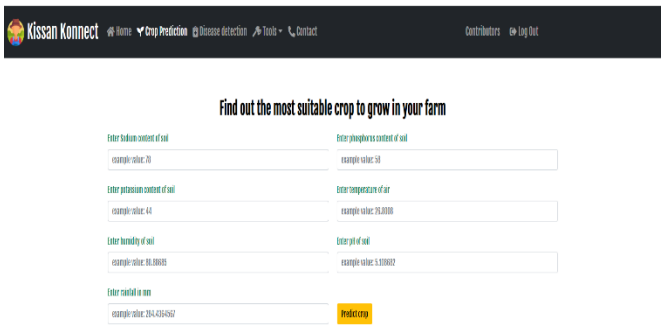

Fig 3. Crop Prediction

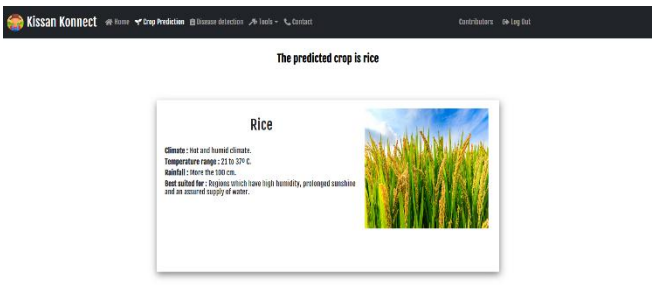

Fig 4. Crop prediction result

Fig 5. Plant Disease Detection

Fig 6. Detected Disease

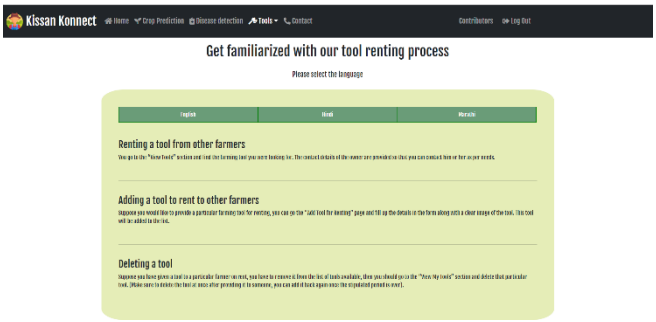

Fig 7. Renting Tools Home Page

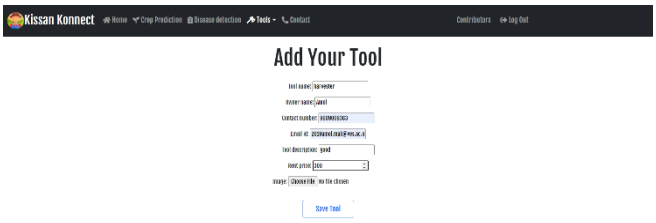

Fig 8. Add Tool Screen

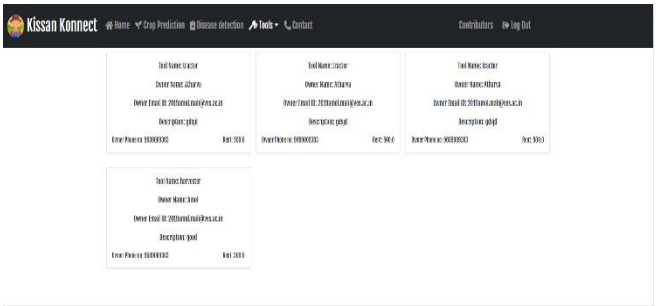

Fig 9. All Available Tools

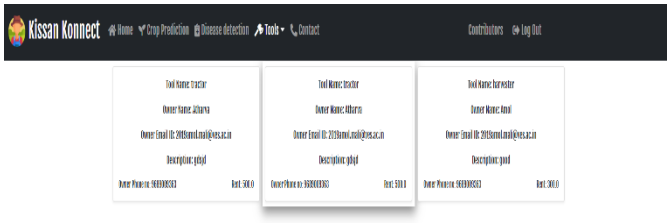

Fig 10. Users Added Tools

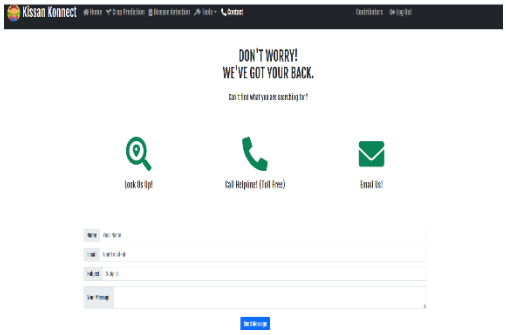

Fig 11. Helpline Page

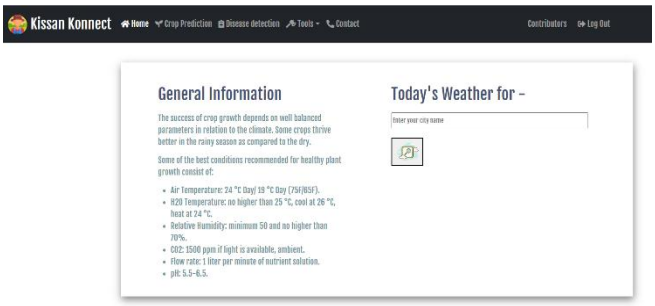

Fig 12. Climate Page

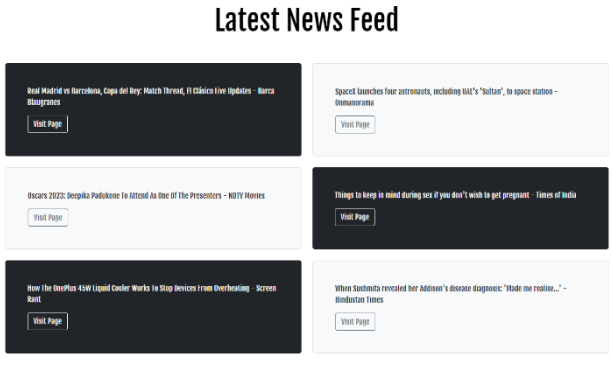

Fig 13. Current News Page

PERFORMANCE EVALUATION

Fig 14. Training and Validation Accuracy

Fig 15. Training and validation loss

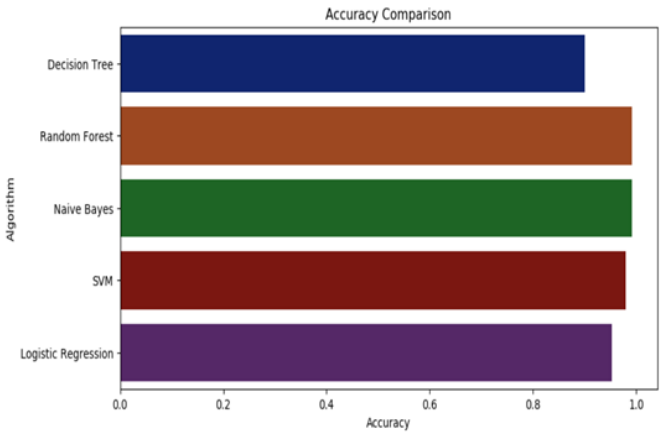

Fig 16. Accuracy comparison

As per figure after training the model with different classification algorithms like Decision tree classifier, Random forest classifier, Naive bayes, SVM and logistic regression, the accuracies are 90%, 99.09%, 99.05%, 97.95% and 95.22% respectively which shows Random Forest classifier gives the best accuracy for the prediction of the most favorable crop based on N, P, K values of soil and temperature, humidity, soil pH, and rainfall.

CONCLUSION

There were various study publications that covered subjects including detecting plant diseases, predicting crops, and renting equipment. In our proposed system, we have combined all three components into one project while raising the accuracy of each module individually. Farmers can access all of the services thanks to the web application.

The Keras library was used for the plant disease detection module. The model's outputs were enhanced using the Adam optimization stochastic gradient descent approach. 95.94% test accuracy was obtained. Random forest classification was used to predict crops based on a variety of characteristics, and accuracy of 95% was attained. NPK levels, temperature, humidity, rainfall, and pH were all taken into account. Any farmer can list their tools for rental in the feature for renting tools. Farmers in need who cannot afford to purchase costly equipment can rent one of the many tools on hand. The web application portal also has a tool that displays the local weather forecast and current conditions. The top 10 news stories at any particular time will be displayed by a news feature that was also implemented. Agriculture industry makes a significant contribution to the Indian economy, so the system should be quicker, safer, and more comfortable for all types of users. This paper strongly believes that our innovation and technology in this field will be a significant contribution in this sector.

FUTURE SCOPE

A mobile-friendly application with enhanced functions can be created in the future. The use of a payment method can be added for tool rental services. The various tools can be filtered based on the location. Significant improvement can be done by including even more plants for disease prediction.

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