Comprehensive Analysis of Apple Diseases Using Machine Learning: A Review

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Abstract - **In general, farming is the foundation of India and plays a significant part in the Indian economy by giving a specific level of a home-grown item to guarantee food security. Nowadays, food production and forecasting are declining due to unnatural climate change, which will disrupt farmers' economies by having poor harvests and helping farmers to become less accustomed to predicting future crops. Our research work is to distinguish the use of various AI and Machine Learning strategies to recognize crops sicknesses and give the avoidance to them. We can further improve an agriculture result by using Artificial intelligence/ML strategies applied successfully in developing regions. It is refined by applying AI Random Forest Algorithms like Support Vector Machine, Regression calculation, ANN on the cultivating data set. This research mainly focuses on the development of predictive models which can be used to predict the future of harvest diseases and mitigation to improve yields.**

Index Terms - **Predictive Analysis, Diseases Prediction, Machine Learning.**

I. INTRODUCTION

Agriculture is one of the most significant occupations rehearsed in India. It is a broad and highly competitive economy with an important role in global development. Himachal Pradesh is famous for its special apple orchards throughout India. India provides 65% of the world's total apple production. So, crop sicknesses can influence the two leaves and organic products which can be a deficiency of both quality and amount esteem. The most common disease in apples are as follows:

1. Apple Scab
2. Marssonina leaf blotch (premature leaf fall)
3. Black rot Canker
4. Powdery mildew
5. Apple Rusts
6. Apple mosaic and other virus diseases
7. Alternaria leaf spot /blight
8. Fire Blight

Apple scab: is an apple tree disease that mainly appears on the leaves of the apple tree and fruit. And the Affected leaves become bent or can have dark spots on the leaves, also can have round spots on the upper surface of the leaves.

Marssonina leaf blotch (pre-mature leaf fall): The sickness indications show up as dim green round indirect patches on the upper surface of the leaf and produce dim earthy colored spots on the leaves.
Black rot Canker: The underlying indications happen in the spring when the leaves are spreading out. They appear as nearly nothing, purple pieces on the upper surface of the leaves that form into indirect wounds 1/8 to 1/4 inch (3-6 mm) in width.

Powdery mildew: This Infection appears when the buds form into new leaves and can cause to decrease in the number of flowers and fruit.

Apple Rusts Diseases: The rust that impacts apple trees is typically called cedar-apple rust. Rust will usually appear as yellow-orange spots on the leaves, branches, and products of the apple tree.

Apple mosaic and other viral diseases: Apple trees are corrupted with apple mosaic contamination and pale to astonishing splendid spots on spring leaves as they expand.

Alternaria leaf Diseases and spots /blight: Leaf spots appear on the leaves in pre-summer and pre-summer. Right away, they are 1/8 to 1/4 inch in expansiveness, round, brown, and irregularly have a purple line.

Fire Blight Diseases: One of the more annihilating of the apple tree diseases, the fire curse is a bacterial infection that impacts all pieces of the tree and can incite the destruction of the entire tree. Manifestations of fire curse consolidate failing miserably back of branches, leaves, and blossoms, and deterred districts on the bark that will be stained.

So accepting new agricultural technologies are very important. Information and communications technology has been applied to the current cultivating practices to expand the quantity and quality of plants and yields. An enormous group of specialists and ranchers can recognize plant sicknesses dependent on the 2 indications on the leaves; in any case, this manual perception is tedious and exorbitant. Moreover, it is wasteful to ceaselessly screen every one of the plants on a huge field region. Therefore, by using automation strategies, the detection of Crop diseases is an important task. With the fast development in PC vision empowered by deep learning and image-based plant, disease detections have earned specific consideration.

Artificial Intelligence learns the algorithm calculation computations which are relied upon Supervised Machine Learning, Unsupervised Machine Learning, Reinforced Machine Learning and every one of their importance and compels.

Supervised learning is a method wherein we instructors prepare the machine utilizing information that is well marked. To comprehend Supervised Learning, how about we think about a similarity. As children, we as a whole required direction to tackle mathematical questions. Our educators assisted us with getting what expansion is, and how it is finished. Also, you can consider Supervised Learning a sort of Machine Learning that includes an aide.

Unsupervised Machine Learning model trained by using unstructured data and perform the actions by using the model on that information without any guidance. The model learns through the perceptions and tracks down or finds the structures in the information or the dataset.

So, Whenever we provide the given dataset to the model, it naturally identifies the examples and connections in the dataset by making the groups in it. And Whatever it can't do it add the names to the bunch, which are similar to it can't. As we can say this is a gathering of the 'apples' or 'mangoes', yet it will isolate every one of the 'apples' among s'mangoes'.

Reinforced Machine learning is a sort of AI technique where an intelligent agent (computer program) connects with the environment and figures out how to act inside that environment."

In the Semi-Supervised Machine Learning Algorithm, the algorithm develops a mathematical machine learning model from fragmented preparing information where a piece of the info model doesn't have names.

The main objective of this research work is to predict apple disease by using utilizing the low-level picture highlights of the leaves of an apple tree. The commitment of the work is to accomplish better prediction accuracy for apple leaf illness by utilizing just low-level surface or shape elements of apple leaf pictures.

II. LITERATURE REVIEW

In this section, some of the methods related to this work are discussed. These methods are explained as follows.

A. Prediction of Apple Leaf Diseases Using Multiclass Support Vector Machine.

In this paper the proposed system has five stages: dataset acquisition and portrayal, image preprocessing, picture segmentation, highlight extraction like color and surface, lastly exhibition of the preparation technique with a multiclass support vector machine classifier.
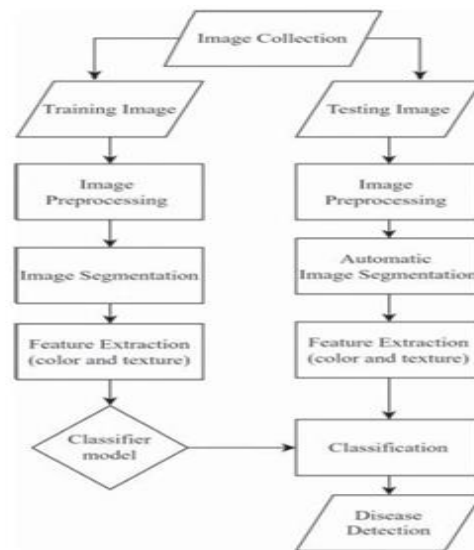

Fig.1 Whole process of the proposed system.

Dataset Used: In the given dataset, the disease leaves pictures and the healthy leaf images were 329 and 171 individually among 500 pictures. And some of them

were caught or captured in the research Lab and most of them were taken from the fields and every one of the pictures was gained from 8 distinct types of apple species. The model can perceive the following apple diseases.

1. Black Rot affected leaves.
2. Cedar Apple Rust affected leaves.
3. Healthy apple leaves

Algorithm Used: In this research, a multiclass Support Vector Machine model was constructed. The algorithm created a hyperplane. The multiclass Support Vector Machine model is a supervised machine learning model and we use its property to train our dataset. So, we can classify our test dataset for the impacted leaves and the healthy leaves also.

Output: In this research, this research paper proposed technique has accomplished 96% precision, which is highest among all of the referred to work.[1]

B.Deep Learning for Apple Diseases: Classification and Identification

This work is completed on the Detection of a profound learning model which is a strong Convolutional Neural Network (CNN) design for apple sickness characterization.

Dataset and Preparation: There are seven combinations of apple and eight kinds of diseases and vermin customarily found in the valley. For this survey, we have considered five for the most part found sicknesses viz. Scab, Alternaria, Apple Mosaic, Marssonina leaf smudge (MLB), and fine mold as it were. The majority of the data was accumulated from the apple ranches of Sher-e-Kashmir University of Agriculture Sciences likewise Technology, Kashmir (SKUAST-K) where they foster different assortments of natural products for instructive and research purposes.

We assembled around 8400 pictures of polluted and sound leaves. The organized dataset was then separated into a preparation set and approval set including 70% and 30% of all our information individually

Model Training and algorithm used: In this exploration, one of the profound learning procedures called Convolutional Neural Network (CNN) is a brain network engineering with different secret layers, which uses close by affiliations known as neighborhood open field and weight-sharing for better execution and viability.

Conclusion: In this survey, we at first organized a dataset of sound and tainted apple leaves which were assembled from various estates arranged in the Kashmir valley. And afterward, they arranged a profound learning model for the programmed recognizable proof and characterization of apple infection because of the arranged dataset. The results got by the proposed approach are great with an exactness of around 97%. [2]

C.Image Features Based Intelligent Apple Disease Prediction System: Machine Learning Based Apple Disease Prediction System

In this research, an apple infection conclusion framework is created to anticipate the apple scab and leaf/spot scourge ailments. In this, the low-level and shape-based highlights are used for the progression of the apple sickness forecast framework.

Dataset Used: The different pictures of apple leaf sickness have been accumulated from the different locales of Kashmir. These photos are used to set up the proposed brain network one of the Images shown in Figure 2 depicts (a) Apple scab and (b) Alternaria leaf spot/revile.
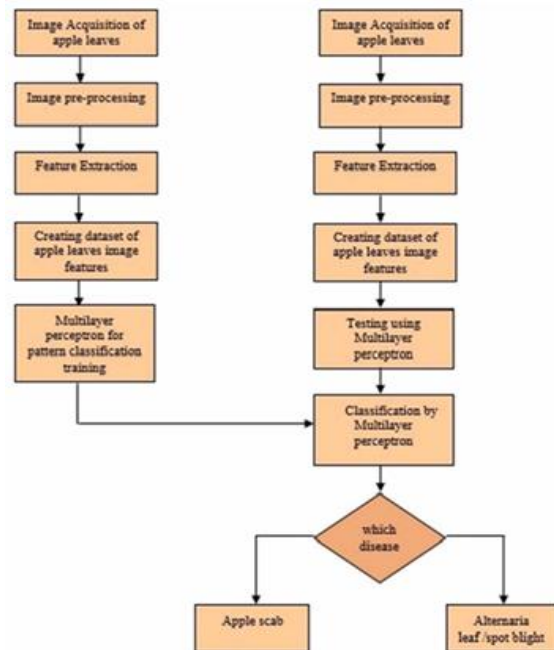

Fig.2

The algorithm used for Proposed System: The model for the proposed structure is prepared by using a multi-facet perceptron (MLP) design classifier and eleven apple leaves picture highlights. Slope plummet back-

engendering calculation is used for building the framework to complete the example grouping.

Outcomes: The proposed framework is tried utilizing a few irregular examples and displays excellent diagnosis accuracy of 99.1%. The responsiveness of the proposed prediction model is 98.1% and particularity of ~99.9%. [3]

D. Predicting Yield of The Crop Using Machine Learning Algorithm

This research focuses on predicting the yield of the harvest because of the current data by using the Random Forest calculation. The estimate will serve to the farmer to predict the yield of the reap before creating onto the agriculture field.

Dataset Used: All the datasets utilized in the exploration were obtained from the straightforwardly open records of the Indian Government. This was obtained for the years 1997 to 2013 for various seasons like Kharif and Rabi of rice creation. From the huge beginning dataset, just a set number of significant elements which the highest impact on agricultural yield was chosen for the current exploration.

Algorithm and Parameters Used: To foresee the harvest yield later on precisely the Random Forest calculation, a for the most part solid and renowned regulated AI calculation is utilized.

The parameters that are used for the current review:

1. Rainfall (mm): The aggregate sum of precipitation for.
2. Kharif and Rabi period of every time of each area.
3. Most extreme Temperature (degree Celsius): Crop creation will have an effect due to.
4. Crop Production (Tons): The harvest developed region in Hectares and creation in tons for Kharif also Rabi seasons for every y year in each chosen locale of Tamilnadu state was considered for the.
5. Perception: Perception data for every y year.

Conclusion: The results show that we can accomplish a precise harvest yield expectation utilizing the Random Forest calculation. It is appropriate for massive crop yield prediction and this makes the ranchers take the best choice such that the agricultural sector will be developed by innovative ideas.[4]

E. Disease Detection in Apple Leaves Using Deep Convolutional Neural Network

The proposed model accomplished a decent exhibition on various measurements and can be deployed in the farming area to distinguish plant health accurately and timely.

Dataset Used: The dataset used in this exploration directly available dataset, which is a subset of the dataset made by the Plant Pathology and Plant-Microbe Biology Section of Cornell University.

The first dataset contains 3651 high-grade pictures of apple leaves with various foliar sicknesses. The dataset used in this assessment contains 3642 pictures of apple leaves relatively among four classes - cedar apple rust, various contaminations, strong leaves, and apple scab. Out of the 3642 pictures, 5% of the plants have various diseases, i.e., having two scabs and rust. The other three classes-solid, cedar apple rust, and apple scab are equivalent in extent.

Algorithm and Workflow of model: In this research, the three state-of-the-art deep learning models - Convolutional Neural Networks (CNN), DenseNet121, EfficientNetB7, and Efficient Net Noisy Student is used to automate the prediction of the apple disease.
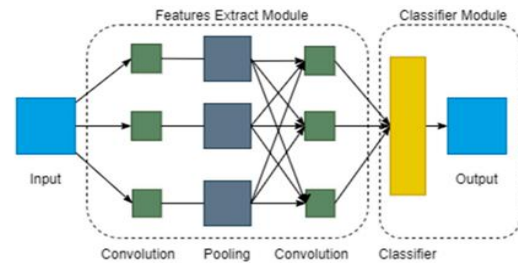
Workflow:

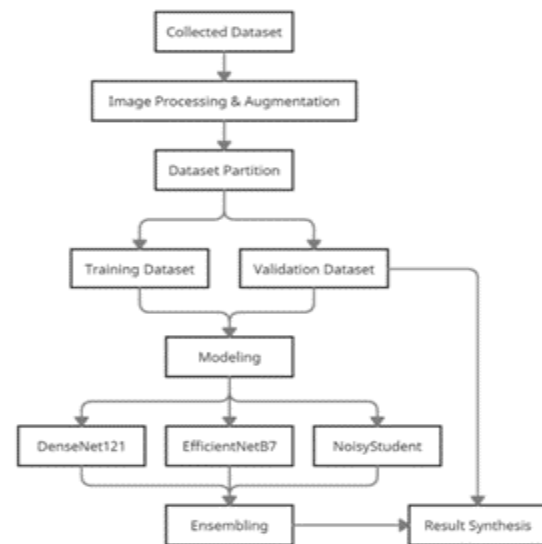Fig.3 Modules of Convolutional Neural Networks (CNN)

Fig.4 Workflow for the proposed model.
Output: The proposed model is a gathering of pre-prepared DenseNet121, EfficientNetB7, and EfficientNet NoisyStudent, which expects to group leaves of apple trees into one of the going arrangements: strong, apple scab, apple cedar rust, and different diseases, by using its photos. The proposed model achieves an accuracy of 96.25% on the approval dataset. The proposed model can distinguish leaves with various sicknesses with 90% exactness.[5]

F. Plant disease classification using deep learning
The proposed system is faster and more careful than the customary strategy for a manual impression of each plant leaf. Conveying such a model into a flexible application can help farmers with perceiving different plant infections utilizing portable cameras and making fundamental moves to stay away from sickness spread. Dataset Used: The information for this review is accumulated from the Plant town dataset. In this review, the grape plant leaf pictures are taken, containing 4,062 pictures with four classes. The classes are solid, dark decay, Esca (Black Measles), and Leaf curse (Isariopsis Leaf Spot). The dataset involves 423 sound leaves, 1,180 dark decay impacted leaves, 1,383 esca impacted leaves, and 1,076 Leaf curse impacted pictures. To play out the tests, the dataset is parted into preparing and approval set in the proportion of 80:20. The preparation set contains 3,258 pictures, and the approval set contains 812 images.

Algorithm and Proposed Methodology: The working model purposes convolutional brain organizations and move figuring out how to order plant leaf sicknesses. CNN is a sort of profound learning brain organization and has extraordinary achievements in a picture-based grouping. The proposed structure is speedier and more exact than the customary strategy for a manual impression of each plant leaf.

In this survey, a convolutional brain organization and notable pre-prepared models like VGG, ResNet, and DenseNet are ready to use the plant dataset. CNN model used contains sets of convolution and pooling layers. The convolution layers perform channels on the information picture and concentrate the elements.
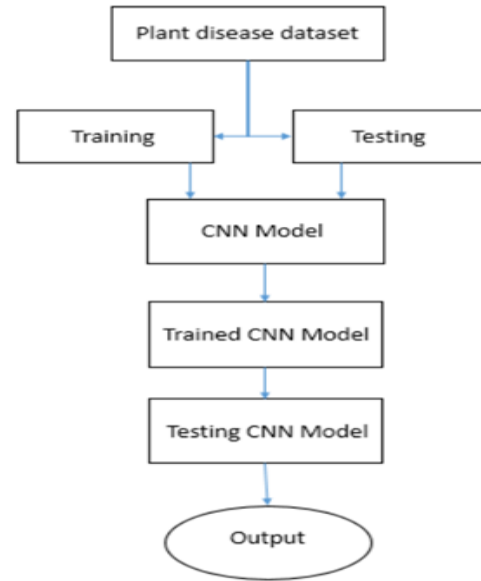

Fig.5 the classification diagram of the system
Conclusion: This review works with the early diagnosis of plant infections to forestall crop misfortune and the spread of infections. The CNN model is utilized to foresee different plant sicknesses precisely. The model's trying is finished utilizing a performance assessment measurements, for example, accuracy, precision, and review. The DenseNet model can achieve the highest accuracy of 98.27%.[6]

G. Crop Prediction using Machine Learning Approaches
In this research, The Proposed framework will forecast the most appropriate yield for specific land dependent on soil substance and climate parameters like Temperature, Humidity, soil PH, and Rainfall.
Dataset Used: Information assortment is the best strategy for a get-together and estimating the data from different resources like govt destinations, VC Form Mandya, APMC locales. This dataset ought to contain the accompanying ascribes like i)Soil PH ii) Temperature iii) Humidity iv) Rainfall v) Crop data vi) NPK regards, those limits will consider for crop and the yearly precipitation expectation, they gather earlier year's precipitation information.
Machine Learning Algorithm for Prediction: - In this, the supervised machine learning algorithm is used as it has to have subcategories as classification and regression.
In this, the classification algorithm is most suitable for the crop diseases prediction system.

- Rainfall prediction: -SVM algorithm.
- Crop prediction: - Decision tree algorithm.

Conclusion: By using the Machine learning algorithm the model purposes the best reasonable yield for specific land dependent on content and climate boundaries. Furthermore, the framework gives data with regards to the necessary substance and amount of composts, required for seeds cultivation. Thus by using the prediction model ranchers can cultivate a new variety of crops, which may increment overall revenue.[7]

H. Classification of Custard Apple Leaves Using Deep Convolutional Networks

The proposed work is an accurate expecting approach for gathering the custard apple leaves in light of profound convolutional brain organizations. The picture dataset for custard apple leaves was made and changed general CNN engineering was utilized to arrange the leaves.

Dataset Used: The pictures are made by taking photographs of custard apple leaves physically. At least 150 photographs of both solid and unhealthy leaves are taken. From that point onward, the dataset is made by using the taken pictures.

Testing and Training Algorithm used for modeling: In testing, the photos are again parted into sound and undesirable leaves. For example, if 200 pictures of solid and sicknesses leaves are taken. Then, at that point, pictures are parted in the 80% i.e 160 pictures are used in preparing, and 20% of pictures for example 40 pictures ought to be added to the testing organizer and approval envelope. The preparation dataset is used for giving a contribution to the model. While the preparation set is given, the model gains the highlights from the photos. Given learnings, the model will anticipate the photos which are given in the approval dataset.
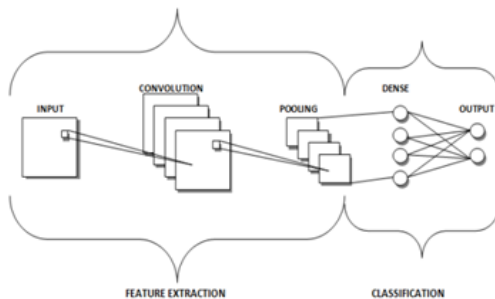
Fig. 6. The CNN architecture

Conclusion: After the gathering of the forecast model, the model is prepared and approved for a cluster size of 128. While doing accordingly, accuracy and not set in stone via preparing and approval. The preparation exactness of 98.5% is accomplished and the approval precision of 92.50% is in the like manner achieved with the overall CNN design.[8]

I. Optimizing Random Forest to Detect Disease in Apple Leaf

This paper focuses on how the agriculture industry can consolidate tuning of Random Forest classifier to effectively recognize infection in Apple leaf.

Dataset Used: The dataset from Plant Village was utilized to train the Random Forest classifier. It is around 1000 sets of apple leaf images that are used to train the model. The following parameters are used to train the random forest classifier:

- Estimators (number of trees)
- Leaf size
- Random State

Algorithm Used: In this research, a supervised learning method i.e Random Forest algorithm is used. Random forest is a decision tree-based supervised learning. Random Forest can be utilized for both Classification and Regression.

Conclusion: In this research paper the image segmentation of Apple leaf is done by using the thresholding method. The evolution of different parameters of Random Forest is to determine the best accuracy. From the perceptions made, it can be concluded that tuning the Estimators hyper boundaries to a worth of 100 improves the accuracy by 7.5%.[9]

J.Early-Stage Apple Leaf Disease Prediction Using Deep Learning

In this research, the framework distinguishes different apple leaf illnesses in a beginning phase that will caution the farmer and close by research establishments to take proper action to control it.

Dataset Used: The dataset contains 1821 pictures of apple leaves which have regular leaves, scab, rust, and other illness-contaminated leaves. It contains 4 classes: solid (516 pictures), numerous illnesses (91 pictures), rust (622 pictures), and scab (592 pictures).

Algorithm Used: The proposed technique depends on Mask-RCNN (Regional Convolutional Neural Network). Veil RCNN is an extension of faster

RCNN. RCNN is a thing acknowledgment calculation that is likewise utilized for picture division and covering.

Conclusion: The proposed model accomplished 90% assurance to recognize to identify every illness class. The outcomes exhibit that our proposed model performs well with high accuracy and can recognize apple leaf sickness in a beginning phase in a proficient way.[10]

III.CONCLUSIONS

This review paper gives information about Machine Learning and different machine learning algorithms that are used for crop disease predictions. The above-listed papers describe the different Machine Learning techniques for Precision in the field of agriculture.

In this way, the system model suggests that the 'prediction of apple diseases using Machine learning algorithms' can be implemented efficiently. Machine learning algorithms give more precise and accurate predictions. The proposed work can also be extended to act as a guide for farmers like, which one of the fertilizers should be used to overcome the disease problem and which crop is beneficial to sow in these weather conditions.

ACKNOWLEDGMENT

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