KeepItGreen – Plant Leaf Disease Detection App

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Abstract - Plant diseases cause high productivity and economic losses as well as declining both the quality and quantity of agricultural products. Now a days the detection of plant diseases has received growing attention in monitoring the vast field of plants. Farmers face great difficulties in shifting disease control policy to another. Specialist eye examination is the most commonly used method for detection and diagnosing plant diseases. In this paper we review the need for a simple plant leaf diagnostic program that will facilitate agricultural development. Early information on plant health and disease detection can help control disease by using proper management strategies. This process will improve crop production. It covers a few steps namely image detection, pre-image processing, feature extraction and neural network-based classification.

***Key Words*:** Restaurant Chatbot, Artificial Intelligence, Machine Learning, Conversational system, Neural Network, Restaurant Reservations.

I. INTRODUCTION

India is an agricultural country where most people depend on agriculture. Agricultural research aims to increase productivity and food quality at reduced costs, with additional benefits. The agricultural production system is the result of complex interactions between soil, seeds, and agricultural chemicals. Vegetables and fruits are the most important agricultural products. For the most important products, product quality control is mandatory. Numerous studies indicate that the quality of agricultural products can be reduced due to plant diseases. Diseases are damage to the normal state of a plant that alters or disrupts its vital functions such as photosynthesis, transpiration, pollen, fertilization, germination etc. These diseases are caused by viruses, fungi, bacteria and viruses, and due to their poor environmental conditions. Therefore, the diagnosis of early stage plant disease is an important task. Farmers need professional monitoring that can be very costly and time consuming. Therefore, finding a quick, inexpensive and accurate way to diagnose autoimmune diseases from plant leaves is very important. This enables machine vision which is to provide automatic image-based testing, process control and robot guidance. The purpose of this paper is to focus on diagnosing plant leaf disease based on leaf formation.

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II. BACKGROUND

Disease Detecton in plant's leaf has always been vital subject since the beginning of human life. There has been a lot of changes in the methods of detection of leaf disease over the centuries . Previously it was done by just looking at the leaf by naked eyes by some experts [1] , but this method has always not been very convenient and not very easily approachable to everyone. Thus , Implementing appropriate techniques to identify healthy leaves is very important for us. It helps to control crop losses and increase productivity.

Some of the Existing Systems to Determine Diseases in Plants Leaf :

In [2], the authors identified diseases by images of tomato leaves. They use slightly different geometric features and histograms in different parts of the disease and SVM sections with different key constructs. S. Kaur et al. [3] identified three different soybean diseases using different color and texture features. [4] P Babu et al. Identify plant leaves and diseases using feedforward

neural networks and backpropagation. S. S. Chouhan et al. [5] used a radial base function neural network (BRBFNN) to identify leaf and fungal infections. on plants. In the process, a local algorithm is used to extract features from the leaves based on source points with similar properties. The effectiveness of bacterial fogging is used to speed up the network and increase the accuracy of sections. Mohanty et al. [6] identified 26 different plant diseases using AlexNet and GoogleNet CNN architectures. Ferentinos et al identified 58 different plant diseases that achieved high levels of classification accuracy using various CNN architectures. In the approach, they also tested the CNN architecture with real-time images. Sladoevich and others.[7] built a DL architecture to detect 13 different plant diseases. They trained the CNN using the Caffe DL platform. Camilaris et al. [8] have continued to explore various DL approaches and their shortcomings in agriculture. In [9], the authors proposed a nine-step CNN model for detecting plant diseases. For experimentation purposes, they used the PlantVillage dataset and data augmentation techniques, so they can increase the data size, and analyzed performance. The authors reported better accuracy in comparison with traditional machine learning based approach. Pretrained AlexNet and GoogleNet were used in [10] to detect 3 different soybean diseases from healthy leaf images with modified hyperparameters such as minibatch size, max epoch, and bias learning rate. There are six different pretrained network(AlexNet, VGG16, VGG19, GoogLeNet, ResNet101 and DenseNet201) used by KR Aravind et al. [8] to identify 10 different diseases in plants, and they achieved the highest accuracy rate of 97.3% using GoogleNet. A pretrained VGG16 as the feature extractor and multiclass SVM were used to classify different eggplant diseases. Different color spaces (RGB, HSV, YCbCr, and grayscale) were used to evaluate performance; using RGB images, the highest classification accuracy of 99.4% was achieved. In [12], the authors classified maizeleaf diseases from healthy leaves using deepforest techniques. In their approach, they varied the deepforest hyperparameters regarding number of trees, forests, and grains, and compared their results with those of traditional machine learning models such as SVM, RF, LR, and KNN. Lee et al. compared different deeplearning architectures in the identification of plant diseases [12]. To improve the accuracy of the model, Ghazi et al. used a transfer learning based approach on pretrained deep learning models.

Oevola et al. [16] used PCNN (Simple Convolutional Neural Network) and DRNN (Deep Residual Network) to identify five different cassava plant diseases and found that DRNN differed by 9.25% over PCNN. . Ramachran et al. [4] used transfer learning to identify three diseases and two pest types in cassava plants. The authors then extended the task of identifying cassava plant diseases using a smartphone-based CNN model, achieving an accuracy of 80.6% [44]. A deep architecture CNN based on NASNet was used to detect leaf diseases of plants in [8] and achieved an accuracy of 93.82%. Diseases of rice and maize were described by Chen et al.[2] by the INCVGGN method. In the approach, they replaced the last VGG19 convolutional layer with two initial layers and one global average pooling layer. Shallow CNN (SCNN) used by Yangri et al. [12] in the identification of diseases of corn, apples and grapes. First, CNN features were extracted and classified using SVM and RF classifier. Seti et al. [1] extracted features using various deep learning models and classified them using an SVM classifier. Best performance accuracy was achieved using ResNet50 with SVM. The VGG16, ResNet and DenseNet models were used by Yafeng Zhao et al. [16] Identify plant diseases in the Plant Village dataset.

III. PROPOSED APPROACH

A. System Proposal

To detect the disease in plant's leaves we are using Convolution Neural Networks (CNNs) here CNN is simply an advanced version of ANN that gives better result on images. Because images contains repeating patterns of particular thing (any image). Two important functions of CNN are convolution and pooling. Convolution is used to detect edges of patterns in an image and pooling is used to reduce the size of an image. CNN architectures that were applied on a problem are following: (a) Simple CNN. (b) VGG. (c) InceptionV3.

B. System implementation

Android Studio and JAVA were utilized to execute the framework. The execution in the Android Studio. This is the execution screen in the Android Studio.

Fig. 3: User interface of the proposal system

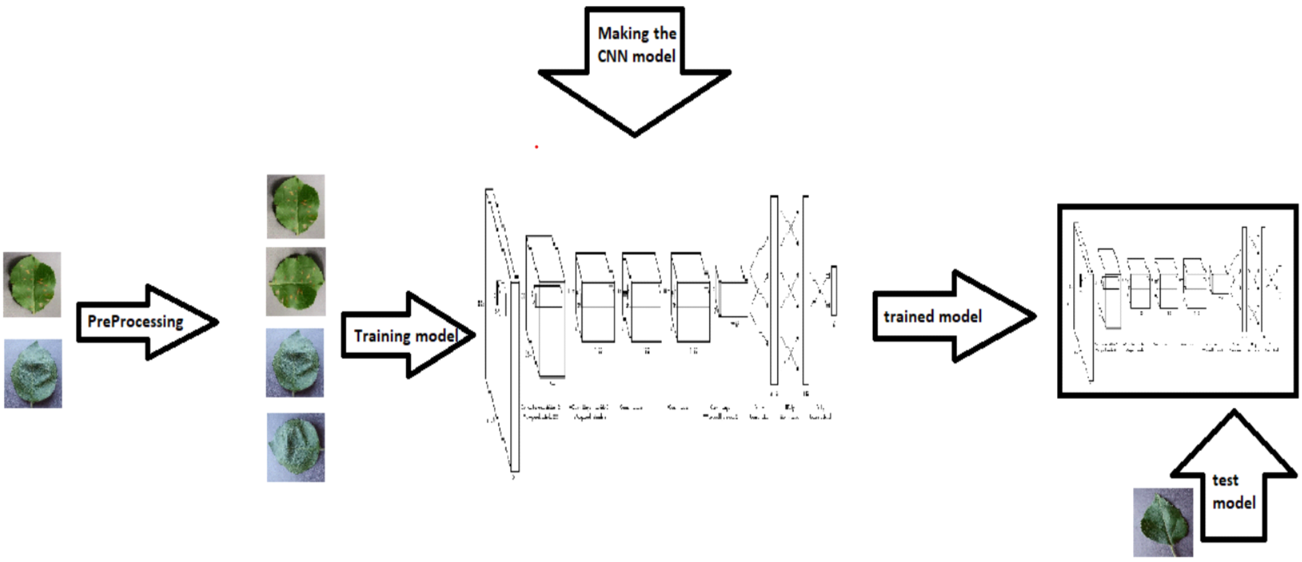


Fig. 4: Workflow

Fig 4 Training of these models are done using Jupyter notebook and Keras API of Tensor flow. Keras is tensor flow's high level API for building and training deep learning models.

IV.METHODOLOGY

The following methodology will be followed to achieve the objective defined for proposed research work:

Deep learning is a powerful form of machine learning that has diminished traditional Machine learning head engineering feature. It does not require any domain technology right now either all praise goes to deep learning. The Deep learning models consists of artificial neural network (ANN) and recurrent neural network (RNN) Models. Neural networks made by mathematical models replicate their own neurons Synapses that bind them to normal brain function. Neural conduction network one of the most common Tensor flow. Provides all related libraries artificial neural network. With the help of Tensor flow one can perform the functions of separation in text and images.

- **Convolution Neural Network (CNN)**

Convolution Neural Networks (CNN) are used to detect the disease in plant's leaves. CNN is an upgrade of simple ANN that gives better output on images. Images contains repeating patterns of particular thing that are used to classify and differentiate between the classes of images. Two important functions or layers are convolution and pooling which are used in CNN models. Convolution layers is used to detect edges of patterns in an image and pooling layer is used to reduce the size of an image. CNN architecture that is applied on a

Problem is **VGG 19**.

- **Dataset used**

Dataset is used to in our VGG 19 Model is Plant Village dataset. This dataset is recreated using offline augmentation from the original dataset.

This dataset consists of about 87K RGB images of healthy and diseased crop leaves which is categorized into 38 different classes. It is freely available on kaggle. The total dataset is divided into 80/20 ratio of training and validation set preserving the directory structure. A new directory containing 33 test images is created later for prediction purpose.

Description of these classes and dataset is given in following Table- I (a) and (b).

Class	Plant Name	Healthy or Diseased	Disease Name	Images (Number)
C_0	Apple	Diseased	Apple_scab	2016
C_1	Apple	Diseased	Black_rot	1987
C_2	Apple	Diseased	Cedar_apple_rust	1760
C_3	Apple	Healthy	-	2008
C_4	Blueberry	Diseased	-	1816
C_5	Cherry_(including_sour)	Diseased	Powdery_mildew	1683
C_6	Cherry_(including_sour)	Healthy	-	1826
C_7	Corn_(maize)	Diseased	Cercospora_leaf_spotGray_leaf_spot	1642
C_8	Corn_(maize)	Diseased	Common_rust	1907
C_9	Corn_(maize)	Diseased	Northern_Leaf_Blight	1908
C_10	Corn_(maize)	Healthy	-	1859
C_11	Grape	Diseased	Black_rot	1888
C_12	Grape	Diseased	Esca_(Black_Measles)	1920
C_13	Grape	Diseased	Leaf_blight (Isariopsis_Leaf_Spot)	1722
C_14	Grape	Healthy	-	1692
C_15	Orange	Diseased	Haunglongbing (Citrus_greening)	2010
C_16	Peach	Diseased	Bacterial_spot	1838
C_17	Peach	Healthy	-	1728
C_18	Pepper_bell	Diseased	Bacterial_spot	1913
C_19	Pepper_bell	Healthy	-	1988
C_20	Potato	Diseased	Early_blight	1939
C_21	Potato	Diseased	Late_blight	1939
C_22	Potato	Healthy	-	1824
C_23	Raspberry	Healthy	-	1781
C_24	Soybean	Healthy	-	2022
C_25	Squash	Diseased	Powdery_mildew	1736
C_26	Strawberry	Diseased	Leaf_scorch	1774
C_27	Strawberry	Healthy	-	1824
C_28	Tomato	Diseased	Bacterial_spot	1702

Class	Plant Name	Healthy or Diseased	Disease Name	Images (Number)
C_29	Tomato	Diseased	Early_blight	1920
C_30	Tomato	Diseased	Late_blight	1851
C_31	Tomato	Diseased	Leaf_Mold	1882
C_32	Tomato	Diseased	Septoria_leaf_spot	1745
C_33	Tomato	Diseased	Spider_mites Two-spotted_spider_mite	1741
C_34	Tomato	Diseased	Target_Spot	1827
C_35	Tomato	Diseased	Tomato_Yellow_Leaf_Curl_Virus	1961
C_36	Tomato	Diseased	Tomato_mosaic_virus	1790
C_37	Tomato	Healthy	-	1926
Total				**70295**

Table – I (a) and (b)

- **Model Description**

First some Preprocessing is done on dataset in order to achieve better accuracy. Then images size are reduced for the model to takes it as input. After that a CNN model will be created with multiple pooling and convolution layers and a dense layer used for prediction of data. Number of Convolution layers with 3x3 filter and MaxPooling2D layers with 2x2 filter are used in model. Batch Normalization is also used in this model. Batch normalization is used to scale data on particular scales. At last model is trained on Plant Village dataset.

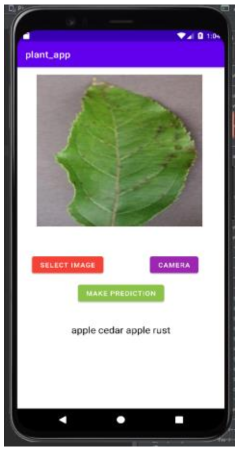
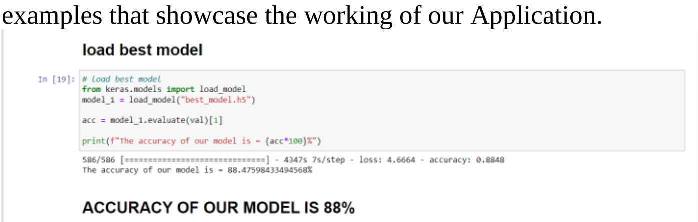


Fig.6: Apple leaf is suffering from Cedar-apple rust disease

V. RESULTS

Our application is successful in detecting the disease and reverting with correct disease and here are some of the examples that showcase the working of our Application.



load best model

```
In [19]: # load best model
from keras.models import load_model
model_1 = load_model("best_model.h5")

acc = model_1.evaluate(val)[1]

print(f"The accuracy of our model is = {acc*100}%")

586/586 [==============================] - 4347s 7s/step - loss: 4.6664 - accuracy: 0.8848
The accuracy of our model is = 88.47598433494568%
```

ACCURACY OF OUR MODEL IS 88%

Fig.6: We attained an accuracy of 88%

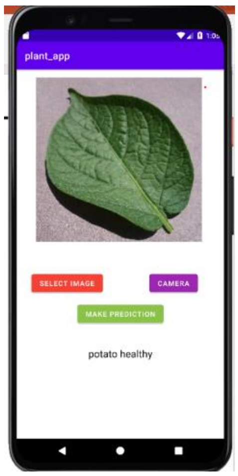


Fig.7: Potato leaf is healthy

VI. CONCLUSION AND FUTURE WORK :

Advantage of using image processing method is that the leaf diseases can be identified at its early stage. With very less computational efforts the optimum results were obtained, which also shows the efficiency of proposed algorithm in recognition and classification of the leaf diseases. Another advantage of using this method is that the plant diseases can be identified at early stage or the initial stage. To improve recognition rate in classification process Artificial Neural Network, Bayes classifier, Fuzzy Logic and hybrid algorithms can also be used.

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