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Deploy Cotton Plant Disease Prediction Application using CNN and Flask

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Abstract: The use of deep learning models to identify lesions on cotton leaves on the premise of images of the crop within the field is proposed in this article. Its cultivation in tropical regions has made it the target of a large spectrum of agricultural pests and diseases, and efficient economical solutions are needed. Moreover, the symptoms of the main pests and diseases cannot be differentiated within the initial stages, and also the correct identification of a lesion can be troublesome for the producer. To help resolve the problem, the present research provides a solution based on deep learning in the screening of cotton leaves that builds it attainable to watch the health of the cotton crop and make higher choices for its management. For this approach, Automatic classifier CNN will be used for classification based on learning with some training samples of that two categories. Finally the simulated result shows that used network classifier provides minimum error during training and better accuracy in classification.

Keywords: Plant disease, deep learning, CNN, Classification.

I. INTRODUCTION

This work presents cotton plant disease detection using image processing technique for automated vision system used at agricultural field. In agriculture research of automatic plant disease detection is crucial one in monitoring large fields of crops and therefore mechanically detects symptoms of disease as soon as they appear on plant leaves. It is terribly tough for a farmer to known varied disease in plants. The estimated annual crop losses due to plant disease at the worldwide is $60 Billions. The standard tools and techniques don't seem to be very useful since it takes innumerable time and manual work.

A plant disease could be physiological abnormality. Once a plant suffers from any disease or sickness it shows certain symptoms. Symptoms are the outwardchanges within the physical look of the eyes. Illustrations ofsymptoms are wilt leaf spots, rots, cankers and lots of additional. The main goal of this model is to detect the disease of a cotton plant and provide the cure of the disease. Here the CNNmodel is used to predict the plant is diseased or not based on spot on the leaves. The projected analysis applies the concept of ensemble learning, that is implemented through deep learning algorithm. Once the implementation is done then the result is compared to get the model that has the highest accuracy.

II. RELATED WORK

Before doing this work, we tend to scan and investigate to grasp some related paper work add order that we tend to do our work accurately. Throughout reviewing these papers it is clear that for malady detecting, classifying and measure different kinds of authentic model is introduced by researcher.For plant disease detection, classification and measure properly unnumerable innovative techniques are established by research worker and their work summary is basined during this section.

Esker published a conference paper for detection Stewarts disease on corn whose scientific name is Panto eastewartii subsp in 2006.They used 3 predictor model for establish the stewartia corn illness and these 3 model name are Stevens-boewe and lowa state.Among these 3 models stevens-boewe finds the Stewarts disorder leaf blight section.[1].

Umair Ayub published an international conference paper in Pakistan for finding crop disorder dealing with Data Mining,2018[2].

In this analysis they primarilly introduced losses which arefaced by Pakistani farmer and theses losses appear because of crops diseases that is occurred by the attack of insects. For analyzing the disorder properly they used many data processing model for example Neural Network, Supporting Vector Machine, Decision Tree and K Nearest Neighbors etc. James rethinks feature of Transgenic crops in 2002 and so the demand of maize over the world [3]. Here introduced that the corn approximate demand id 852 million at 2020. The financial losses is caused by the large amount of uses of pesticides in corn is given by the Craig Osteen within the Economic Threshold Ideas [4]. Ravi introduced a clear transparent thought of the origination of peach, its biological action and Morphology victimisation Medical Phytochemicals [5]. Here they in the main targeted on the utilization of peach fruits accordingto medicine and therefore the use of various betterment of human being.

Naeem establish and manages plant life fungal post-harvest pathogens of peach using morphological model [6]. In 2018 International conference on Design Innovations for 3Cs Compute communicate control(ICDI3C) published paper on "cotton plant disease detection using Machine learning". Emergence of correct techniques inside the sector of leaf-based image classification has shown spectacular results. This paper makes use of Random forest in characteristic between healthy and diseased leaf from the data sets created. This paper includes various phases of implementation particularly dataset creation, feature extraction, training the classifier and classification. The created datasets of unhealthy and healthy leaves are collectively trained using random forest to classify the diseased and healthy images. For extracting features of an image they used Histogram of an Oriented Gradient (HOG).Overall using machine learning to train the massive datasets offered in public is a transparent thought to detect the disease present in plants during a stupendous scale.[7]

Muhammad Hammad Saleem, Johan Potgieter and Khalid Mahmood Arif published their paper on 'Plant disease detection using deep learning". Plant diseases have an impact on the growth of their numerous species, so their early identification is extremely vital. Several Machine Learning (ML) models are used for the detection and classification of plant diseases however, when the advancements in a subset of ML, that is, Deep Learning (DL), this space of analysis seems to possess great potential in terms of increased accuracy. Several developed/modified DL architectures are implemented along with several visualization techniques to detect and classify the symptoms of plant diseases. Moreover, many performance metrics are used for the evaluation of these architectures/techniques. This review provides a comprehensive clarification of DL models used to visualize various plant diseases. Additionally, some research gaps are identified from which to obtain greater transparency for detecting diseases in plants, even before their symptoms seem clearly.[8]

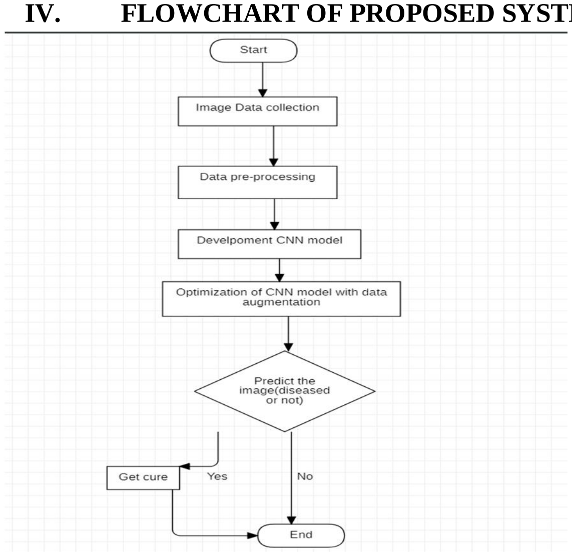
Agricultural productivity depends heavily on the economy. This can be often one of the explanations why plant disease detection plays a significant role in agriculture. As plant disease is sort of natural and if we don't care the plants properly in this area, it has serious effects on plants and affects the standard, amount or productivity of the respective products. Detection of plant disease using some automatic technique is helpful as a result of it reduces a large monitoring work in large crop farms and detects the symptoms of diseases at a very early stage, i.e. after they seem on plant leaves. In this paper we can get idea of different methodologies to detect plant leaf and fruit diseases using neural network.[9].

They principallly characterize the fungous by morphological model and verified motive of postharvest rot of peach. Throughout this work main focus was on the detection of plant diseases and provides acceptable cure instantly. During this work they used image processing and authentic technologies like CNNso that the illiterate farmer will get immediate result with high accuracy.

III. PROPOSED SYSTEM

We planned to design the module so that a someone with no knowledge about programming can also to use and get information about the plants disease. It proposed system to predicting leaf diseases It explains about the experimental analysis of our methodology.

IV. FLOWCHART OF PROPOSED SYSTEM



V. DATASET AND FEATURES

For this project we have got downloaded dataset from Kaggle. In this dataset there are three folders like train, test and validation folder. In this dataset there four category like diseased cotton leaf, diseased cotton plant, fresh cotton leaf, fresh cotton plant. There are a total 3110 images of diseased and healthy plants. The training set includes 2700 images of disease and healthy plants. The validation set includes 410 images of disease and healthy plants.

All the images were segmented to get rid of the background. Additionally, all the images were resized to possess a dimension of width of 74 pixels and height of 74 pixels. Then this was recurrent for images that were segmented. The primary attributes of the image are based upon the shape and texture oriented features.

VI. CNN MODEL STEPS

1) *Conv2D:* It is the layer that used to convolve the image into multiple images.
2) *Activation Function:* Activation function decide whether a neuron should be activated or not. Thus it bounds the value of the net input.
3) *MaxPooling2D:* It is the layer that used to max pool the value from the given size matrix and same is used for the next 2 layers.
4) *Flatten:* It is used to flatten the size of the image obtained once convoluting it.
5) *Dense:* It is used to make this a fully connected model and is the hidden layer.
6) *Dropout:* It is used to avoid over fitting on the dataset and dense is that the output layer contains only one neuron which decide to which category image is belonging.
7) *Image Data Generator:* It is that rescales the image, applies shear in some range, zooms the image and will horizontal flipping with the image. This Image Data Generator includes all doable orientation of the image.
8) *Training_datagen:* This is the augmentation configuration we are using for training. It generates more images using the parameters of Image data generator
9) *Epochs:* It is the number of times model will be trained in forward and backward pass.
10) *Validation Process:* validation_data is used to feed the validation/test data into the model. validation_steps defines the number of validation/test samples.

```
#Building cnn model
cnn_model = keras.models.Sequential([
                                    keras.layers.Conv2D(filters=32, kernel_size=3, input_shape=[150, 150, 3]),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=64, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=128, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),
                                    keras.layers.Conv2D(filters=256, kernel_size=3),
                                    keras.layers.MaxPooling2D(pool_size=(2,2)),

                                    keras.layers.Dropout(0.5),
                                    keras.layers.Flatten(), # neural network beulding
                                    keras.layers.Dense(units=128, activation='relu'), # input layers
                                    keras.layers.Dropout(0.1),
                                    keras.layers.Dense(units=256, activation='relu'),
                                    keras.layers.Dropout(0.25),
                                    keras.layers.Dense(units=4, activation='softmax') # output layer
])
```

Fig.1:CNN model creation using Keras

```
# compile cnn model
cnn_model.compile(optimizer = Adam(learning_rate=0.0001), loss='sparse_categorical_crossentropy', metrics=['accuracy'])
```

Fig.2:Compiling the CNN model

We used categorical cross-entropy as loss and adam optimizer. In the Model, we are using ReLU as activation but for the last layer, we have to use Softmax activation.

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```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 148, 148, 32)      896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (None, 74, 74, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (None, 72, 72, 64)        18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 36, 36, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 34, 34, 128)       73856
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (None, 17, 17, 128)       0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 15, 15, 256)       295168
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 7, 7, 256)         0
_________________________________________________________________
dropout (Dropout)            (None, 7, 7, 256)         0
_________________________________________________________________
flatten (Flatten)            (None, 12544)             0
_________________________________________________________________
dense (Dense)                (None, 128)               1605760
_________________________________________________________________
dropout_1 (Dropout)          (None, 128)               0
_________________________________________________________________
dense_1 (Dense)              (None, 256)               33024
_________________________________________________________________
dropout_2 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_2 (Dense)              (None, 4)                 1028
=================================================================
Total params: 2,028,228
Trainable params: 2,028,228
Non-trainable params: 0
```

Fig.3:Model summary

VII. METHODOLOGY

Basically, at first we tend to resize each image into 150 x 150. After that this image feed into the Convolutional Neural Network. First conv layer we apply 32 filter size or output channels. Which means 32 different filters apply to the images and try to find features and after that using 32 features, we have tendency to produce a features map that has channels 32. Therefore from 32 x 150 x 150 it will become 32 x 148 x 148.

Afterward we are applying ReLU activation function to remove non linearity. After that this image we feed to the max pool layer which takes only the most relevant features only so that we get the output image in shape 32 x 74 x 74. After that, we feed this image to the next convolutional layer and its process is the same as mentioned above.

At last, we tend to flatten the final max pool layer output and feed to the next linear layer that is additionally referred as a fully connected layer, and finally, as a final layer, we tend to predict 4 categories or classes. Therefore as a model output we tend to get tensor 1x4 size. And from that tensor, we tend to take an index of the maximum value in the tensor. That particular index is our main prediction.

VIII. RESULTS

This experiment was able to score 98.46 accuracy in the training phase under 500 epochs where the batch size is 61.

After the creating CNN model we have to deploy our model . To deploy our model into web application we use python framework Flask to connect CNN model with html , css file . For using model into flask we have to save our model .

After saving a model create web application using html,css and then connect with Flask . So, here are some output prediction below.

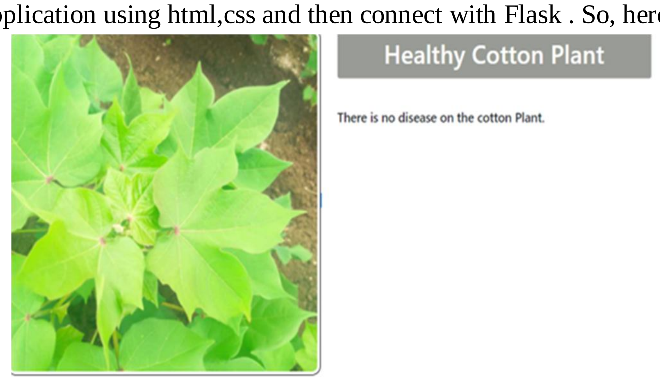

Fig.4:Output prediction(Healthy cotton plant)

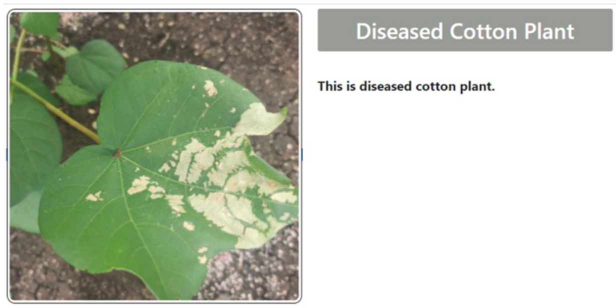

Fig.5:Output prediction(Diseased cotton plant)

IX. CONCLUSION

It targeted how image from given dataset (trained dataset) in field and past data set used predict the pattern of plant diseases exploitation CNN model. This brings a number of the subsequent insights concerning plant leaf disease prediction. As most types of plant leaves will be covered under this method, farmer might get to understand about the leaf which may never have been cultivated and lists out all possible plant leaves.

It helps the farmer in decision making of which crop to cultivate. Also, this method takes into consideration the past production of data which is able to facilitate the farmer get insight into the demand and therefore the cost of various plants in market.

Agricultural department needs to modify the detecting the yield crops from eligibility method (real time).To modify this method by show the prediction lead to web application or desktop application. It can be the huge success for Artificial Intelligence domain.

Future analysis can embrace an evaluation of the capability of the algorithm rule to diagnose and detect the cause of the lesion (what pest or disease). Moreover, the planned algorithm are going to be enforced with the utilization of a software which can be utilized throughout actual field visits to facilitate the creation of maps of the extent of infestation by pests and diseases.

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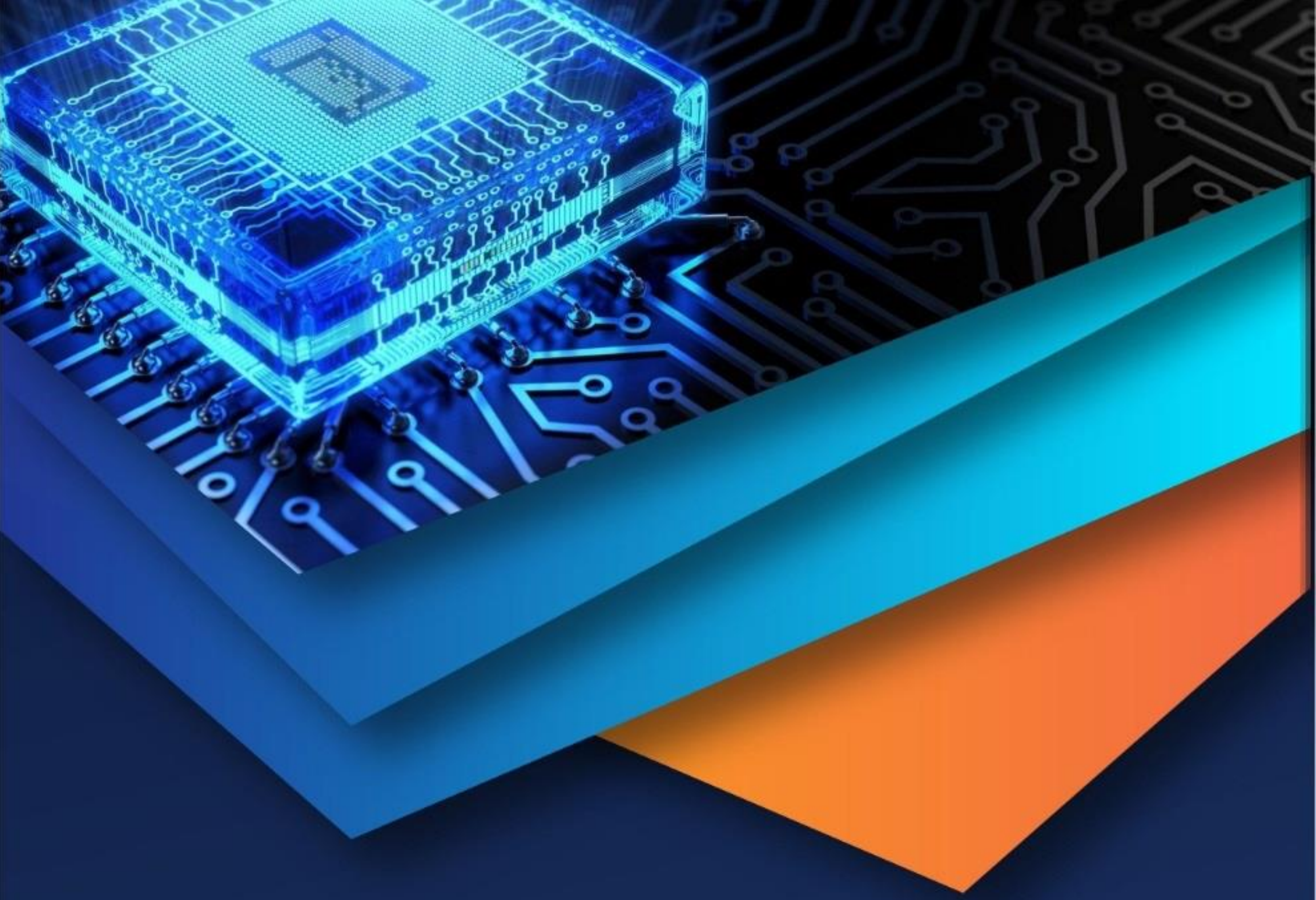

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