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PLANT LEAF DISEASE DETECTION SYSTEM USING CONVOLUTIONAL NEUTRAL NETWORKS

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Abstract: Crop cultivation plays an essential role in the agricultural field. Presently, the loss of food is mainly due to infected crops, which reflexively reduces the production rate. In the field of agricultural information, the automatic identification and diagnosis of diseases in plants is highly desired. To identify the plant leaf diseases at an untimely phase is not yet explored. To improve the identification accuracy of detection Convolutional Neural Network is used. The main challenge is to reduce the usage of pesticides in the agricultural field and to increase the quality and quantity of the production rate. Our paper is used to explore leaf disease prediction at an untimely action. The main aim of this paper is to develop an appropriate and effective method for detection of the disease and its symptoms. A colour-based segmentation model is defined to segment the infected region and place it to its relevant classes. Experimental analyses were done on samples images in terms of time complexity and the area of the infected region. Plant diseases can be detected by image processing technique. Disease detection involves steps like image acquisition, image pre-processing, image segmentation, feature extraction and classification. Our project is used to detect the plant diseases. The detection is done without accessing the internet. It shows the accuracy of detection in percentage. This method will improve the accuracy of disease detection, and also effectively improve the model training and recognition efficiency.

Keywords: Leaf disease detection, Image processing, Image segmentation, machine learning, feature extraction.

I.INTRODUCTION

India is eminent for Agriculture that means most of the people are engaged in the agriculture industry. The agriculture industry acts as a significant role in the economic sectors. Most of the plants are infected by variant fungal and bacterial diseases. Due to the exponential inclination of population, the climatic conditions also cause plant disease.
The major challenges of sustainable development are to reduce the usage of pesticides, cost to save the environment and to increase the quality.
Precise, accurate and early diagnosis may reduce theusage of pesticides.

Data mining is termed as extracting the relevant information from a large pool of resources. Health monitoring and disease detection on plants is very critical for sustainable agriculture. The advent of data mining technologies has been adopted in the prediction of plant diseases. There are factors that affect the plants and are classified into two category:
(1) Diseases: The biotic factors that are either caused by the fungi, bacteria or algae.
(2) Disorder: The abiotic factors caused by the temperature, rainfall, nutrient deficiency, moisture.
Smartphones in particular offer very novel approaches to help identify diseases because of their computing power, high-resolution displays, and extensive built-in sets of accessories, such as advanced HD cameras. The combined factors of widespread smartphone penetration, HD cameras, and high-performance processors in mobile devices lead to a situation where disease diagnosis based on automated image recognition, if technically feasible, can be made available at an unprecedented scale. The conventional means of disease management involve farmers and the plant pathologists. The diagnosis and use of the pesticide are more often done in the fields. This process is time-consuming, challenging. With the Advancement of Computer Vision (CV), Machine Learning (ML), and Artificial Intelligence (AI) technologies, progress has been achieved in developing automated models empowering, accurate and timely identification of the plant leaves disease. Deep neural networks have recently been successfully applied in many diverse domains as examples of end-to-end learning. Neural networks provide a mapping between an input—such as an image of a diseased plant—to an output—such as a crop-disease pair. Nowadays, technology is widely used for plant disease prediction. The management of perennial leaves requires a close monitoring system especially for the diseases that affect production and post-harvest life. Deep Learning (DL) is a special class of ML algorithms which have multiple layers for transforming the raw data into information.

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II. RELATED WORK

The work in [1] have presented the number of studies for the Multilayer Convolution Neural Network for the Classification of Mango Leaves Infected by Anthracnose Disease.Therefore this work proposes a deep learning model named as MCNN for the classification of leaves infected by the Anthracnose disease presented by Uday Pratap Singh, Siddarth Singh Chouhan, Sukirty Jain, Sanjeev Jain.

In [2] has present various studies of Image based Plant Disease Detection in Pomegranate Plant for Bacterial Blight presented by Sharath D.M, Akhilesh, S. Arun Kumar, Rohan M.G, Prathap C. In [3] has present Identification of maize leaf diseases using improved deep convolutional neural networks presented by X. Zhang, Y. Qiao, F. Meng, C. Fan, M. Zhang. In [4] has present Dense semantic labeling of subdecimeter resolution images with convolutional neural networks presented by M. Volpi, D. Tuia.In[5] has present Cloud-based system for supervised classification of plant diseases using convolutional neural networks presented by L. Jain, M. A. H. Vardhan, M. L. Nishanth, S. S. Shylaja.

III. METHODOLOGY

Preprocessing and Training the model (CNN): The database is Preprocessed such as Image reshaping, resizing and conversion to an array form. Similar processing Is also done on the test image. A database consisting of about 32000 different plant species is obtained, out of which any image can be used as a test image for the software. The train database is used to train the model (CNN) so that it can identify the test image and the disease it has CNN has different layers that are Dense, Dropout, Activation, Flatten, Convolution2D, MaxPooling2D. After the model is trained successfully, the software can identify the disease if the plant species is contained in the database. After successful training and preprocessing, comparison of the test image and trained model takes place to predict the disease.

1.DATASET

Initial step for any image processing-based project is acquiring a proper database which is valid. A database repository has been used, plant Village dataset repository having leaves of multiple plants. Data available here is not labeled. So the first task is to clean and label the database. The dataset is collected from Plant Village which has a collection of 54305 images. These images categorized among two classes namely multiple plants leave images with the disease, and without the disease. Based on the category these images are labeled to their respective classes. The database is accessed from crowd AI which is a plant disease classification challenge. After selection of images, we should have deep knowledge about the different leaves and the disease they have. After detail study, labeling is done by segregating the images and with different diseases.

2.IMAGE ACQUISITION

First step in image acquisition is to capture the leaves using a mobile phone or digital camera. These stored images of the leaves from the database are loaded by specifying the path. Figure 2 shows the images of the samples of plant leaves**.**

a b c

3.IMAGE PRE-PROCESSING

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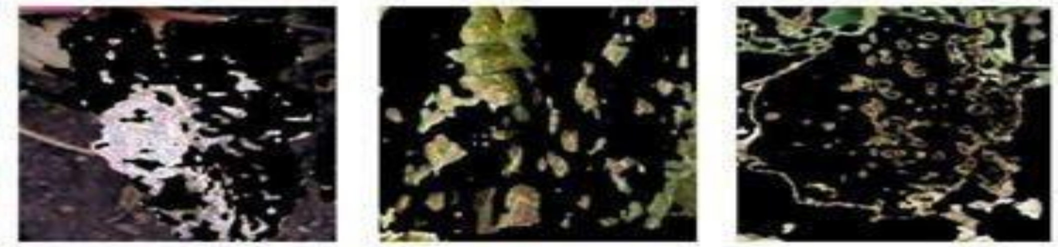
At first, the training and testing images were preprocessed for contrast enhancement and resizing them to a 224×224 pixels and 32×32 dots per inch. Pre-processing improves the quality of the image by removing unsought distortions. Clipping the images based on the region of interest (ROI), image smoothing and contrast enhancement are done here. Figure 3 shows the images after performing image enhancement.

Enhanced Images after Pre-processing

4.IMAGE SEGMENTATION

After the original images are preprocessed, additional versions are created by rotating the images 90°, 180°, and 270°; by mirroring each rotated image; by cutting the center of the image by the same size. Image segmentation is the method of dividing an image into different sub images. Here we use K-mean segmentation technique which uses hue estimation method for dividing and clustering the image. Since the green color of the leaves is normal, we do not consider them. We select the cluster image showing the infected area for feature extraction. Figure 4, below shows the segmented images of the leaves.



Segmented Images of the Infected Leaves

5. K-MEANS CLUSTERING

K-means clustering algorithm, the data vectors are grouped into clusters based on the closeness of the pixels by the Euclidean distance measurement. Centroids of the clusters are initialized randomly and their dimensions are equal to data vectors.

Sample No.	Disease Classified	Affected Area (Percentage)
1	Anthracnose	49.88
2	Anthracnose	53.12
3	Anthracnose	66.37
4	Cercospora Leaf Spot	30.56
5	Cercospora Leaf Spot	43.25
6	Cercospora Leaf Spot	21.89
7	Bacterial Blight	30.51
8	Bacterial Blight	15.68
9	Bacterial Blight	88.76

Classification of Disease and Affected Area

GENERAL EXPLANATION

1. The input test image is acquired and preprocessed in the next stage and then it is converted into array form for comparison.
2. The selected database is properly segregated and preprocessed and then renamed into proper folders.
3. The model is properly trained using CNN and then classification takes place.
4. The comparison of the test image and the trained model take place followed by the display of the result.

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5. If there is a defect or disease in the plant the software displays the disease along with the remedy.

FLOW CHART

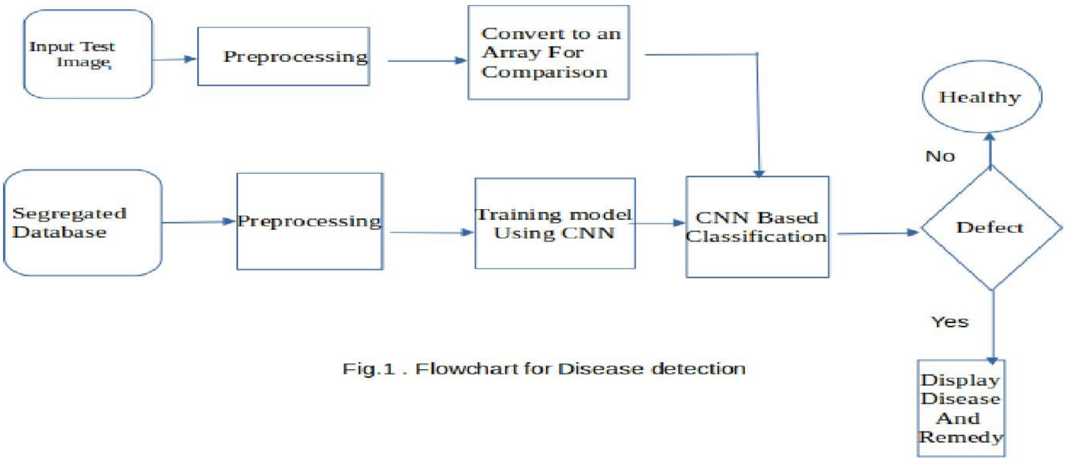

Fig.1 . Flowchart for Disease detection

TRAINING AND TESTING

Initially, the entire dataset is divided into two parts, the training and the testing dataset. This is done by randomly splitting the dataset into training sets comprising about 75% of the images and the testing set constitutes about 25% of the images. This distribution is used in the neural network applications. For the training of the CNN 40728 images are used and remaining 13577 images are used for testing the performance of the model. Training this CNN is the practice of running training examples (images) through the model from the input to the output simultaneously making a prediction and figuring out the results or errors. If the prediction is wrong then this is back propagated in reverse order. The proposed model does not include the object segmentation process.

The proposed system is based on a classification model that is then trained for the detection and classification of plant leaves. This model includes three cases
(i) to find and classify the given image (ii) the image is a non-diseased plant leaf and (iii) the image is a diseased plant leaf. The training images were taken from each of the class labels C_0, C_1, C_2, respectively maintaining the ratio of 75% images. All the other remaining 25% images were untouched during the complete process. Each image from the normalized training dataset is given as an input to the Convolution Neural network model to extract the features. This model is trained to predict the class label for every training image. The results of proposed model focus mainly on:
1. Primary task is to classify the given images. Then, the secondary task is to identify the given leaf is a non-diseased leaf, and third is to identify and classify that the leaf is a diseased leaf or not.
2. Measuring the accuracy for both the training process and the testing process of the proposed model.

The accuracy of the proposed method was computed to be 88%. Images taken in real condition majorly suffers from various problem
1. Variation in Temperature
2. Light density on leaf
3. Presence of multiple objects
4. Overlapping of other leaves

Handling these issues can improve the performance of the model. Figure 4 shows validation of trained datasets.

```
EPOCHS=5 #@param {type:"integer"}
history = model.fit_generator(
    train_generator,
    steps_per_epoch=train_generator.samples//train_generator.batch_size,
    epochs=EPOCHS,
    validation_data=validation_generator,
validation_steps=validation_generator.samples//validation_generator.batch_size)
```

for i in
range(total_iter,total_iter+FLAGS.training_steps

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```
): print("\nRunning trainng step: " + str(i)) image_batch, label_batch = ds.get_next_batch(images,
'training', BATCH_SIZE, i, IMAGE_SIZE) feed_dict_train = {label_placeholder: label_batch,
image_placeholder:image
_batch} start = int(round(time.time() * 1000)) session.run(optimizer, feed_dict=feed_dict_train) end =
int(round(time.time() * 1000)) print("\n\tRuntime: "+str(end - start)+"ms") saver.save(session,
FLAGS.output_dir+"model")

image_batch, label_batch = ds.get_next_batch(images, 'validation', BATCH_SIZE, i, IMAGE_SIZE)
feed_dict_validate = {label_placeholder: label_batch,
image_placeholder:image_batch}

loss = session.run(cost, feed_dict=feed_dict_validate) print("\tLoss: " + str(loss))

image_batch, label_batch = ds.get_next_batch(images, 'testing', BATCH_SIZE, i, IMAGE_SIZE)
feed_dict_test = {image_placeholder: image_batch, label_placeholder:
np.zeros(num_classes)} training_accuracy = session.run(accuracy,
feed_dict=feed_dict_train) validation_accuracy = session.run(accuracy,
feed_dict=feed_dict_validate)
print("\tTraining accuracy: {0:>6.1%} Validation accuracy:
{1:>6.1%}".format(training_accuracy, validation_accuracy))
```

IV. CONCLUSION

The proposed system was developed taking in mind the benefits of the farmers and agricultural sector. Computer vision with machine learning methodologies has performed in solving a number of plant leaves disease problems including pattern recognition, classification, object extraction etc. In this project, we propose an innovative model for the classification of plant leaves infected from the disease. The developed system can detect disease in plants and also provide the remedy that can be taken against the disease. By proper knowledge of the disease, the remedy can be taken for improving the health of the plant.

V. FUTURE WORK

The proposed system is based on python and gives an accuracy of around 88%. The presented model is also computationally efficient and simple. The accuracy and the speed can be increased by use of Goggles GPU for processing. The system can be installed on Drones so that aerial surveillance of crop fields can be done. Improvised models of this system can be done by building a Web/Internet of Things (IoT) enabled real-time disease monitoring system.

REFERENCES

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