Detection of Plant Leaf Diseases using CNN

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Abstract - *Smart farming system is an innovative technology that helps improve the quality and quantity of agricultural production in the country. Plant leaf disease has been one of the major threats to food security since long ago because it reduces the crop yield and compromises its quality. diagnosis of accurate diseases has been a major challenge and the recent advances in computer vision made possible by deep learning has paved the way for camera-assisted disease diagnosis for plant leaf. It described the innovative solution that provides efficient disease detection and deep learning with convolutional neural networks (CNNs) has achieved great success in the classification of various plant leaf diseases. A variety of neuron-wise and layer-wise visualization methods were applied and trained using a CNN, with a publicly available plant disease given image dataset. So, it observed that neural networks can capture the colors and textures of lesions specific to respective diseases upon diagnosis, which can act like human decision-making.*

***Key Words*: Disease detection, Deep learning, Tensorflow.**

1. INTRODUCTION

Deep learning is a branch of machine learning which is completely based on artificial neural networks, deep learning is also a kind of mimic of human brain because the neural network can mimic the human brain. It's on hype nowadays because earlier we had lot of data and not enough processing power. A formal definition of deep learning is- neurons Deep learning is a particular kind of machine learning that achieves great power and flexibility by learning to represent the world as a nested hierarchy of concepts, with each concept defined in relation to simpler concepts, and more abstract representations computed in terms of less abstract ones. In human brain approximately there are 100 billion neurons, all together this is a picture of an individual neuron and each neuron is connected through thousands of their neighbours. The question here is how it recreates these neurons in a computer. So, it creates an artificial structure called an artificial neural net where we have nodes or neurons. It has some neurons for input value and some for output value and in between, there may be lots of neurons interconnected in the hidden layer.

2. LITERATURE SURVEY

A. Chowdhury, Dhruba K. Bhattacharyya, Jugal K. Kalita propose an Co-Expression Analysis of Gene Expression: A Survey of Best Practices. It presented an overview of best practices in the analysis of (differential) co-expression, coexpression networks, differential networking, and differential connectivity that can be discovered in microarrays and RNA-seq data, and shed some light on the analysis of scRNA-seq data as well.

XiaoyanGuo, MingZhang, Yongqiang Dai proposed Image of pant disease segmentation model based on pulse coupled neural Network with shuffle frog leap algorithm. A novel image segmentation model SFLA-PCNN for plant diseases based on hybrid frog-hopping algorithm is proposed. Using the weighted sum of cross entropy and image segmentation compactness as the fitness function of SFLA, the image of potato late blight disease is taken as a trial segmentation image to find the optimal configuration parameters of PCNN neural. Image segmentation is a key step in feature extraction and disease recognition of plant diseases images.

Chit Su Hlaing, SaiMaungMaungZaw proposed Plant Diseases Recognition for Smart Farming Using bModel-based Statistical Features. Ithas shown the advantages of GP distribution model for SIFT descriptor and successfully applied in plant disease classification. Furthermore, it proposed feature achieves a good tradeoff between performance and classification accuracy. Although it proposed feature can successfully model the SIFT feature and applied in plant diseases recognition, it need to try to improve our proposed feature by considering and cooperation with other image processing methods

3. EXISTING SYSTEM

Plants are considered as energy supply to mankind. Plant diseases can affect the agriculture which can be resulted in to huge loss on the crop yield. Therefore, leaf diseases detection plays a vital role in agricultural field. However, it requires large manpower, more processing time and extensive knowledge and skills about plant diseases. Hence, machine learning comes in play in the detection of diseases in plant leaves as it analyzes the data from various areas, and classifies it into one of the predefined set of classes. The features and properties like color, intensity and dimensions of the plant leaves are considered as a major fact for classification and the various types of plant diseases and different classification techniques in machine learning that are used for identifying diseases in different plants leaf.

4. PROPOSED SYSTEM

We planned to design the module so that a person with no knowledge about programming can also be able to use and get the information about the plants disease. It proposed system to predicting leaf diseases. It explains about the experimental analysis of our methodology. Samples of 38 images are collected that are comprised of different plant diseases like Tomato, Grape, Apple and Healthy Leaves. Different number of images is collected for each disease that was classified into database images and input images. The primary attributes of the image are based upon the shape and texture oriented features.

5. SYSTEM ARCHITECTURE

5.1 ARCHITECTURE DIAGRAM

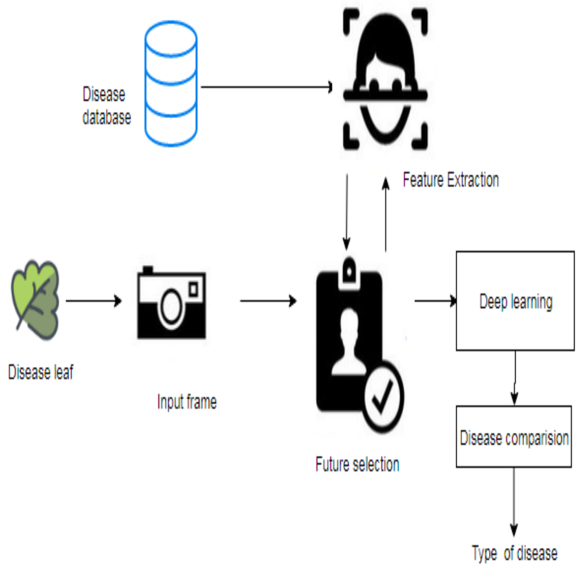

Fig 1: Architecture diagram

As shown in figure 1 there is a database which consist of all the different plant leaf diseases which we have taken into account. The module is trained repetitively to attain the maximum accuracy. If a new image is given to the module it's features get compared with the features that are already trained in the database. It then provides the appropriate result.

5.2 USE CASE DIAGRAM

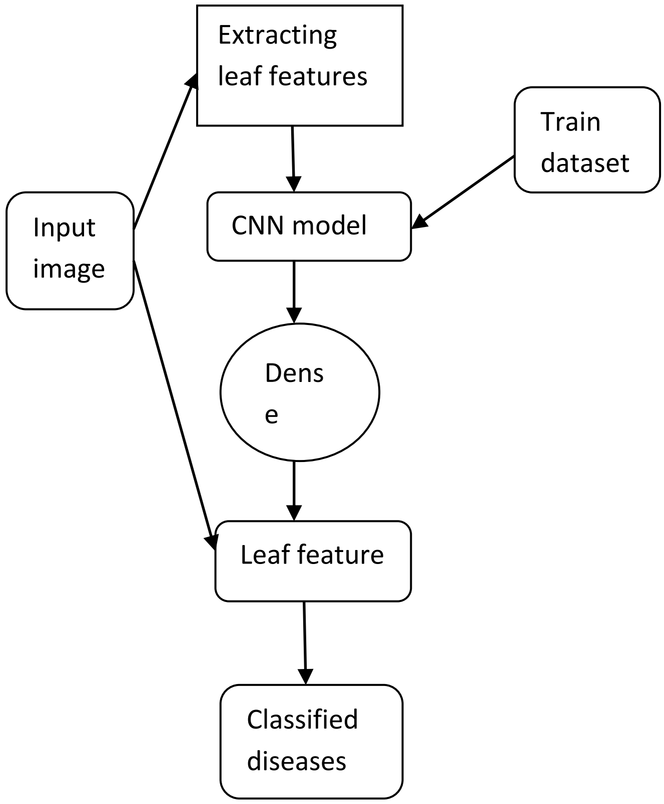

fig 2: UML use case diagram

As shown in figure 2. When we give a new input image first the module extracts the leaf features. Then it goes through the CNN model. It then compares the features with already trained dataset. Then it goes through dense CNN and the leaf features are extracted separately. Then the module will predict whether the plant leaf is affected by any disease or not. It shows the output from one of the 38 classes which are predetermined and trained. Then the output will be in a textual format.

5.3 DATA FLOW DIAGRAM LEVEL 0

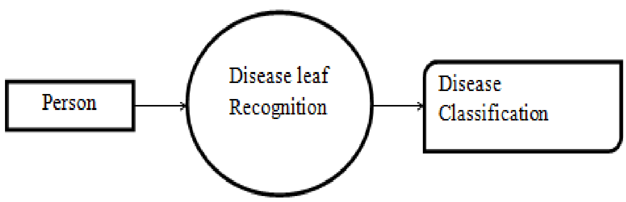

Fig 3: Data flow diagram level 0

As shown in figure 3, at level 0, the person recognizes the plant leaves disease and able to classify it.

5.4 DATA FLOW DIAGRAM LEVEL 1

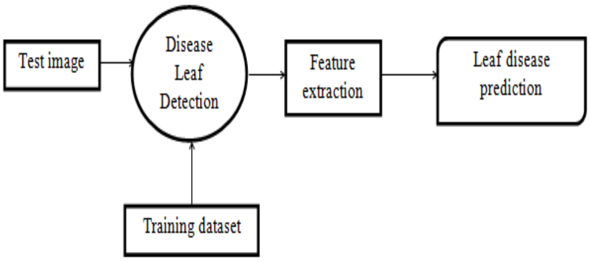

Fig 4: Data flow diagram level 1

As shown in figure 4, at level 1,a test image is given and it is tested with using the trained dataset. The features are extracted and gets compared. Then we can able to predict the leaf disease.

5.5 DATA FLOW DIAGRAM LEVEL 2

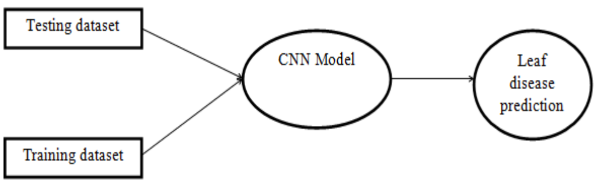

Fig 5: Data flow diagram level 2

As shown in figure 5, at level2, The testing and training dataset are used in CNN model to predict the leaf disease

5.6 DATA FLOW DIAGRAM LEVEL 3

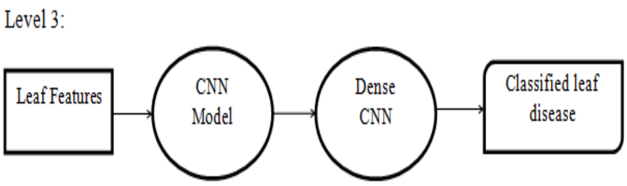

Fig 6: Data flow diagram level 3

As shown in figure 6, at level 3, The last level comprises of both CNN and dense CNN model. It is used to gain more accuracy

5.7 CLASS DIAGRAM

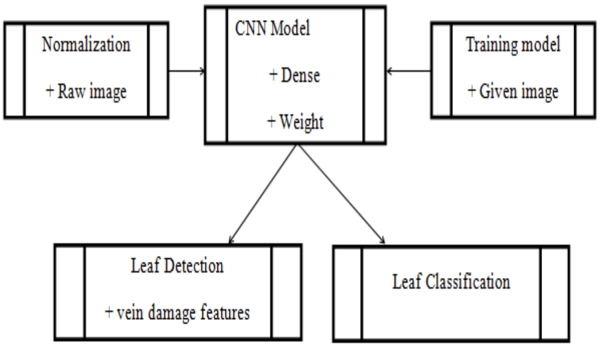

Fig 7: Class diagram

As shown in figure 7, the normalization class comprises of raw image and it is feeded to the CNN model which comprises of dense and weight .The CNN model classifies and detects by using the training model. The training model class comprises of the image dataset. Leaf detection gets use of the features.

6. CLASS

```
{'Apple___Apple_scab': 0,
 'Apple___Black_rot': 1,
 'Apple___Cedar_apple_rust': 2,
 'Apple___healthy': 3,
 'Blueberry___healthy': 4,
 'Cherry_(including_sour)___Powdery_mildew': 5,
 'Cherry_(including_sour)___healthy': 6,
 'Corn_(maize)___Cercospora_leaf_spot Gray_leaf_spot': 7,
 'Corn_(maize)___Common_rust_': 8,
 'Corn_(maize)___Northern_Leaf_Blight': 9,
 'Corn_(maize)___healthy': 10,
 'Grape___Black_rot': 11,
 'Grape___Esca_(Black_Measles)': 12,
 'Grape___Leaf_blight_(Isariopsis_Leaf_Spot)': 13,
 'Grape___healthy': 14,
 'Orange___Haunglongbing_(Citrus_greening)': 15,
 'Peach___Bacterial_spot': 16,
 'Peach___healthy': 17,
 'Pepper,_bell___Bacterial_spot': 18,
 'Pepper,_bell___healthy': 19,
 'Potato___Early_blight': 20,
 'Potato___Late_blight': 21,
 'Potato___healthy': 22,
 'Raspberry___healthy': 23,
 'Soybean___healthy': 24,
 'Squash___Powdery_mildew': 25,
 'Strawberry___Leaf_scorch': 26,
 'Strawberry___healthy': 27,
 'Tomato___Bacterial_spot': 28,
 'Tomato___Early_blight': 29,
 'Tomato___Late_blight': 30,
 'Tomato___Leaf_Mold': 31,
 'Tomato___Septoria_leaf_spot': 32,
 'Tomato___Spider_mites Two-spotted_spider_mite': 33,
 'Tomato___Target_Spot': 34,
 'Tomato___Tomato_Yellow_Leaf_Curl_Virus': 35,
 'Tomato___Tomato_mosaic_virus': 36,
 'Tomato___healthy': 37}
```

Fig 8: Classes of plant leaf diseases

As shown in figure 8, these are the 38 classes we are taken into the modules. It can be seen that there is apple, blueberry, cherry, grape, orange, peach, pepper bell, potato, raspberry, soybean, squash, strawberry, tomato, corn. You can also see that there is a healthy class for all the above mentioned plant leaves. The module predicts the output from the classes.

7 CNN MODEL STEPS

Conv2D: It is the layer to convolve the image into multiple images activation is the activation function.

MaxPooling2D: It is used to max pool the value from the given size matrix and same is used for the next 2 layers.

Flatten: It is used to flatten the dimensions of the image obtained after convolving it. Dense: It is used to make this a fully connected model and is the hidden layer. Dropout: It is used to avoid over fitting on the dataset and dense is the output layer contains only one neuron which decide to which category image belongs.

Image Data Generator: It is that rescales the image, applies shear in some range, zooms the image and does horizontal flipping with the image. This Image Data Generator includes all possible orientation of the image.

Training Process: Train_datagen. Flow_from_directory is the function that is used to prepare data from the train_dataset directory Target_size specifies the target size of the image. test_datagen. flow_from_directory is used to prepare test data for the model and all is similar as above. fit_generator is used to fit the data into the model made above, other factors used are steps_per_epochs tells us about the number of times the model will execute for the training data.

Epochs: It tells us the number of times model will be trained in forward and backward pass.

Validation process: validation_data is used to feed the validation/test data into the model. validation_steps denotes the number of validation/test samples.

7.1 TRAINING AND TESTING MODEL

The dataset is preprocessed such as Image reshaping, resizing and conversion to an array form. Similar processing is also done on the test image. A dataset consisting of about 38 different plant leaf diseases is obtained, out of which any image can be used as a test image for the software.

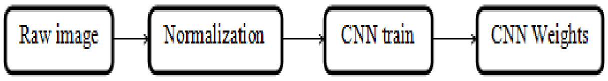

Fig 9: Training model

The train dataset 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, and MaxPooling2D. After the model is trained successfully, the software can identify the disease if the plant species is contained in the dataset. After successful training and preprocessing, comparison of the test image and trained model takes place to predict the disease

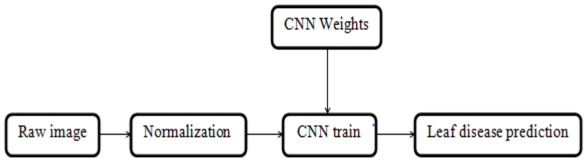

Fig 10: Testing model

7. RESULTS

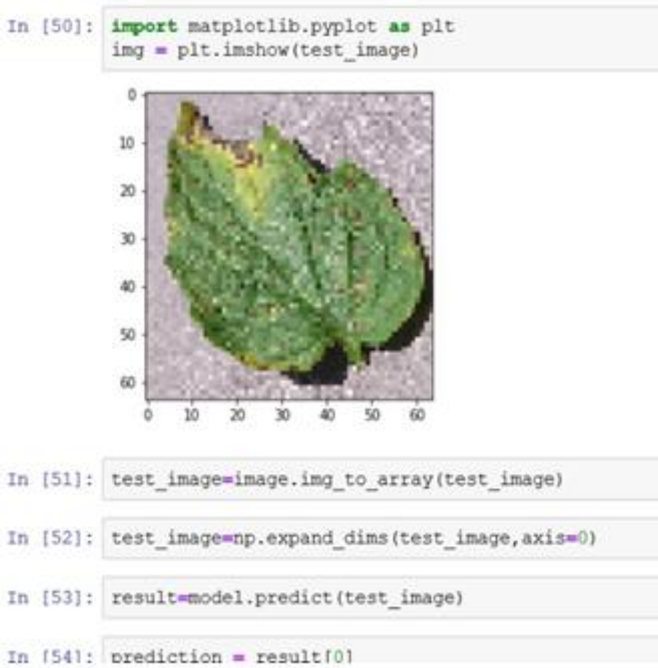

Fig 10: Test image

As shown in figure 10, if we give a new image to the model to predict its outcome. The model predicts any one of the classes from the 38 class mentioned before. Here the test image we have given is tomato leaf with septoria leaf spot

```
    print("Tomato_Leaf_Mold")
elif output['Tomato___Septoria_leaf_spot']==1.0:
    print("Tomato_Septoria_leaf_spot")
elif output['Tomato___Spider_mites Two-spotted_spider_mite']==1.0:
    print("Tomato_Spider_mites_Two-spotted_spider_mite")
elif output['Tomato___Target_Spot']==1.0:
    print("Tomato_Target_Spot")
elif output['Tomato___Tomato_Yellow_Leaf_Curl_Virus']==1.0:
    print("Tomato_Tomato_Yellow_Leaf_Curl_Virus")
elif output['Tomato___Tomato_mosaic_virus']==1.0:
    print('Tomato_Tomato_mosaic_virus')
elif output['Tomato___healthy']==1.0:
    print("Tomato_healthy")

Tomato_Septoria_leaf_spot
```

Fig 12: Output prediction

The output is tomato_septoria_leaf_spot.

8. CONCLUSION

It focused how image from given dataset (trained dataset) in field and past data set used predict the pattern of plant diseases using CNN model. This brings some of the following insights about plant leaf disease prediction. As maximum types of plant leaves will be covered under this system, farmer may get to know 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 system takes into consideration the past production of data which will help the farmer get insight into the demand and the cost of various plants in market.

9. FUTURE ENHANCEMENT

Agricultural department wants to automate the detecting the yield crops from eligibility process (real time).To automate this process by show the prediction result in web application or desktop application. To optimize the work to implement in Artificial Intelligence environment.

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