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Advanced Plant Leaf Diseaseprediction Using Artificial Neural Networks

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ABSTRACT: In the field of agriculture, Smart farming system is an innovative technology that helps to improve standards and amount of agriculture production in the country. Plant disease are crucial issue in the field of agriculture and its symptoms are not much as explicit as us humans would show off. The plants needed to be attended and monitored right from the beginning and prevent any means of getting affected by disease. Plant leaves disease has been one in all the foremost threat to food security, since way back as a result of it reduces the crop yield and compromises quality. Diagnosis of accurate disease has been a major challenge and recent advance in computer vision, may possible by deep learning has as made up the manner for camera assisted disease diagnosis for plant leaf. It describes the innovative solution that provides efficient disease detection and deep learning with artificial neural network (ANN), where ANN is an interconnected group of nodes called neurons. A variety of neurons and layer wise methods were applied and trained using ANN. So, it is observed that the artificial neural network can capture the colour, shape and texture of the specific leaf disease upon diagnosis, which can make decision like humans.

KEYWORDS: ANN, Disease Prediction, Deep learning, Tensor flow.

I. INTRODUCTION

Deep learning is a subclass of machine learning, also a subclass of artificial intelligence that has networks capable of learning apart from the disorder data. Deep learning algorithms are multi-layered structure known as deep neural networks, which enable us to perform many tasks like clustering, classification or regression[1]. Artificial intelligence mentions the techniques that enables the computer to imitate human behaviour, that is whenevernew information is received the brain tries to compare it with known information. Same approach is involved in deep neural networks.Deep learning Artificial intelligence does not need human supervision[2]. Artificial neural networks have distinctive capabilities that allow deep learning models to solve tasks that machine learning models can never solve. In ANN, neurons are visual representation of numerical values and the connection between artificial neurons are said to be axon in human brain. The set of numerical values differs for every task and dataset. After training these values allows the neural network to do classification. While training, these values are adjusted, some neurons become more connected and some neurons become less connected and some neurons are interconnected in the hidden layer.Wehave designedto predict the plant leaf diseases using Artificial Neural networks with deep learning techniques[3]. Input Dataset is given and it is stored in the database. Now the image processing technique is used to process the given input image[4]. Data augmentation process is carried on to increase more datasets for getting more accurate results[5]. During image segmentation the required features are extracted. Also the noises are removed. The features are extracted by splitting the augmented image parts by colour, shape and texture[6]. Now the datasets are trained. This training is taking place using Artificial Neural Networks[7]. After training the prediction of the disease classes and the preventions measures for the plant leaf is obtained.

II. LITERATURE SURVEY

Varsha and A K Mishra proposed "Detection of unhealthy region of plant leaves using image processing and genetic algorithm". Indian economy highly depends on agriculture. In agriculture field, having disease in plants are quite common so this is the reason for disease detection to play major role. The product quality, quantity

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and productivity depend upon the maintaining and monitoring of the plants. Automatic detection and classification of plant leaf diseases uses image segmentation technique, which is an important view carried on by genetic algorithm.

Md. Arifur Rahman; Md. Mukitul Islam proposed "Improved segmentation approach for plant disease detection". Smart agriculture plays an important role in economic growth and food security. But crop disease cause danger in achieving this goal. This methodology helps to provide a perfect solution for classification of diseases. It mainly depends on implementation of improved segmentation using a collaboration of threshold and morphological operations for classification.

MelikeSardogan and AdemTuncer proposed "Plant leaf disease detection and classification based on CNN with LVQ algorithm". For an efficient crop yield early detection of diseases is important. Tomato leaf disease detection and classification is done here by Convolution Neural Network for automatic feature extraction and classification and Learning Vector Quantization feds the output feature vector for training the network. This method recognizes tomato leaf diseases effectively.

III. ANN PRINCIPAL

There are four principal objects in Artificial Neural Network (ANN):

i.LAYERS: A layer is where all the studying takes place. There are an infinite number of neurons inside a layer. A neural network is altered by densely connected layers that is fully connected layers. All the given inputs are linked to the output. This network takes a vector of input and a scalar that consists of labels. Here the binary classification is with two classes: 0 and 1. The input is taken by the network and passes it to all the nodes and the assess signal with an activation function. There are 3 layers:

Input layer: This layer gets the input value for the hidden layer.

Hidden layer: This layer receives input values. The neuron is broken down into the input part and activation function. Here the right path is the inputs sum which passes through the activation function.

Output layer: Here prediction is done by the value that is computed from the hidden layer. For classification and regression, it is equal to the number of class and only one value is predicted.

ii.FEATURE AND LABEL:

Feature: This depicts the input data to the network.

Label: This depicts the output from the network.

iii.LOSS FUNCTION:

This is a foremost metric to estimate the performance of the optimizer. This metric will be minimized during training. Depending on the type of dealing problem quantity will be selected. For binary classification and regression, binary cross entropy loss function and the mean square error is used respectively.

iv.OPTIMIZER:

This model's performance is measured by Loss function. In order to decrease the loss the optimizer helps to improve the weights of the network. Common optimizer used in ANN is Stochastic Gradient Descent. Some of the conventional optimizers are: Momentum Optimization, Nesterov Accelerated gradient, AdaGrad, Adam Optimization.

IV. SYSTEM OVERVIEW

Plants produces basic food and plays a vital role for all living organisms. Plant disease has a major impact on economy and causing a depletion in profit for crop producers. Hence detecting infection in plant leaf is necessary.We planned to design the module so an individual with no information regarding programming, also can be ready to use and get the knowledge regarding the plant disease. Sample images are collected and that are comprised of different plant diseases like Tomato, Pepper and Potato. Various images is collected for each disease that was classified into images and input images. The image of the infected part is pre-processed so that it does not have noise, distortion and other image anomalies. Then the features of the image that is the colour, shape and texture are extracted as a concise vector. All the different image snippet obtained are undergone through neural network. Along with a up to date dataset. Those results with the help of classifiers can determine what disease the plant has been infected with and provides the prevention method. The observation data obtained is also added into the dataset.

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4.1 SYSTEM ARCHITECTURE

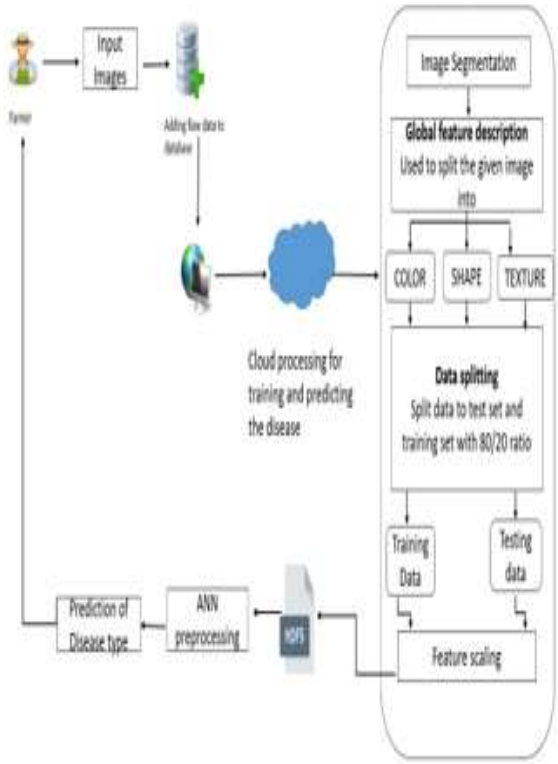

FIGURE 1: SYSTEM ARCHITECTURE

As shown in the above figure 1 the farmer is uploading the diseased plant leaf image as the input. And the raw data of the infectedleaf image is added to the database. The module is trained repeatedly by image segmentation. If a input image is given to the module its features get compared with the features that are already trained in the database.Thenthe scaled feature is given by the Hierarchical data format. And now the ANN pre-processing is done and the disease is predicted.

V. SYSTEM IMPLEMENTATION

5.1 DATASET INPUT MODULE

This is the primary module of the system which gets the input datasets. These inputs dataset is for training. This is where the training and the test dataset is input for training. This is fed to the next module. This module acts as the Graphical User Interface where the user can navigate and upload the image and behaves as a feeder to the project. Accurate Datasets are needed in each stages of object recognition research that is from the training of images to evaluation of recognition algorithm. These images in datasets are gathered into different classes. These classes indicate plant diseases which could be found from leaves. One more class is added in dataset which consist images of healthy leaves only for distinguishing healthy leaves from diseased ones. Another class with background images in the dataset is favourable to get accurate classification of diseases. Therefore, deep learning is used to differentiate the leaves from surroundings.

5.2 DATA AUGMENTATION

This module is the prerequisite to the training module. This is the second module of the system where the previous module fetches the input. Here the data is augmented in such a way that the model find it easy for parsing. And the features required are extracted and the noises are also removed. The data is properly pre-processed before the various image segmentations and other processes are done. To obtain feature extractioninput image is pre-processed in order to gain consistency. Procedure of image pre-processing involves cropping of images by making the square around the leaves, to highlight the region of plant leaf. Images in dataset are resized to reduce the training time which is computed automatically. The augmentation process is to increase the dataset and introduce slight distortion to the images which reduces over fitting in training stage. Here image rotations process is applied on the different axis by

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various degrees this improves flexibility and also gives accurate result.

5.3 MODEL TRAINING USING ANN

This is the third module of the system used for training and testing the accuracy of the model. The training dataset is fed as pre-annotated images to the model, feeding as input a huge dataset. These annotated image parts are analyzed and taken for model training. Greater the dataset supplied the greater is the accuracy of the model. After training of the model it is used in the classifier module. For classification of disease the datasets are trained after augmentation. Measuring the performance of ANN is splitting the datasets into the training set and the test set and then training a deep neural network under training set and using test set for prediction. Different tests is performed with input images when trained with images from database. Cross validation technique is used for the evaluation of prediction model. The test results are obtained for both complete dataset and each class separately.

5.4 CLASS PREDICTION AND ALERT MODULE

This is the output module of the system used to classify the data based on the various dataset and determine what class they belong to and also shows the prevention method for the class type. The features are compared with trained datasets, the it goes through the hidden network of ANN. Then this module will predict whether the leaf is affected by disease or not. The classification is done by importing the model and using it to classify the type of disease the plant is affected with. This is done by analyzing the plant image and depending on the output prevention method is suggested. The result is predicted by training with the whole databasecontaining both original and augmented images. The output is predicted from the classes which are fixed and trained.

5.5. DISEASE CLASS

```
['Pepper__bell___Bacterial_spot',
'Pepper__bell___healthy',
'Potato___Early_blight',
'Potato___Late_blight',
'Potato___healthy',
'Tomato_Bacterial_spot',
'Tomato_Early_blight',
'Tomato_Late_blight',
'Tomato_Leaf_Mold',
'Tomato_Septoria_leaf_spot',
'Tomato_Spider_mites_Two_spotted_spider_mite',
'Tomato__Target_Spot',
'Tomato__Tomato_YellowLeaf__Curl_Virus',
'Tomato__Tomato_mosaic_virus',
'Tomato_healthy']
```

FIGURE 2 CLASSESS OF PLANT LEAF DISEASES

The above figure 2 denotes the classes we have taken into the modules. It can be seen that there is pepper bell, potato and tomato. Also,there is a healthy class for all thementioned plant leaves. The module predicts the output from the class.

5.6 PREVENTION MEASURE CLASS

The below figure 3 shows the prevention measure classes we have taken into the modules. These are the prevention methods for the infected leaves of Potato, Pepper bell and Tomato. The

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module predicts the prevention measure from the class

```
['Select__resistant__varieties',
 'Keep__bell__peppers__well_watered',
 'Avoid__overhead__irrigation', 'Use__certified__potato_seeds',
 'Inspect__potatoes__soft_spots__sprouts__mold__shovel__and__pest_damage',
 'Using__pathogen_free_seed',
 'Use__of__Fungicides_with_protectant_and_curative_properties',
 'Purchase__healthy_seeds',
 'Seed__treatment__with__hot_water',
 'Apply__Fungicides__containing__maneb_and_mancozeb',
 'Spray__tomato__plants__with__horticultural_oil'
 'Use_of_combination__product__of__mancozeb_and_fumoxate',
 'Imidacloprid__should_be_sprayed__on_the__entire_plant_and_below_the_leaves',
 'Staking_and_pruning_to_increase__air_circulation',
 'Water_at_Ground_Level']
```

FIGURE 3 PREVENTION MEASURE CLASS FOR PLANT LEAF DISEASE DETECTION

VI. RESULT

The below figure shows that if a input image is given to the model, after comparing the image with the training data it predicts outcome. The model predicts any one of the classes from the mentioned classes. Here the test image given is Potato Leaf. The model predicts the class as Potato_Early_blight and the prevention for the above class is Avoiding overhead irrigation.

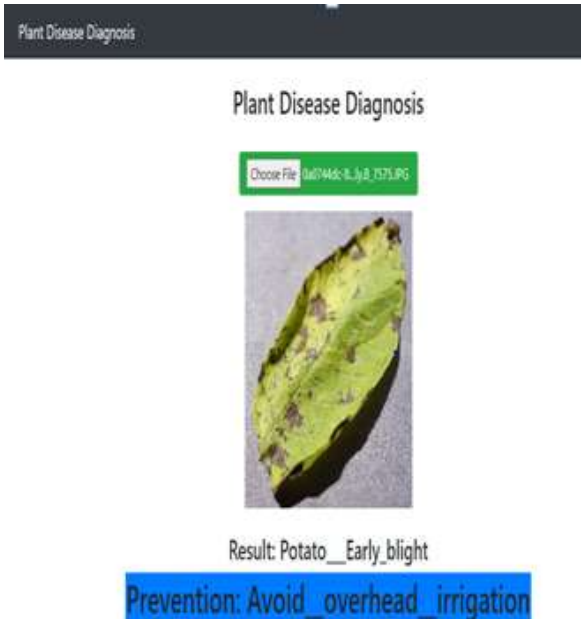

FIGURE 4: OUTPUT PREDICTION

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VII. CONCLUSION

This model focused on how image from the trained dataset and past dataset used to predict the pattern of Plant leaf Disease Detection using ANN model. This brings some of the following insights about plant leaf disease prediction. ANN can be used to give high accuracy in detection and classification of diseases compared to other algorithms. The model trained as a result can classify a number of diseases by ANN to give high accuracy unlike other algorithms as high up to 90%. This process of plant disease detection can be very much useful of a resource for multiple segments of the market where it can be deployed and made use of. If this technique is implemented correctly in scalable places, it has the effect of higher crop yield and maximize the development and economic activity in short time frame.

VIII. FUTURE ENHANCEMENT

In Agriculture this model can be developed for classification of disease for all type of crops and also giving tips to prevent them. Further the root cause for the diseases can also be provided and the amount of pesticides can be mentioned which will be used to increase the crop yield. To alternate this process by showing the prediction result in mobile applicationand work can be optimized using AI environment. The technology consists of deep learning and image processing technique which can be equipped for further future development on any charges and methods which can be used for large scale implementation with even more accuracy and stability.

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