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Plant Leaf Disease Detection & Classification using SNN

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Abstract : Nowadays, herb plants are importance to medical field and can give benefit to human. In this research, Phyllanthus Elegans Wall (Asin-Asin Gajah) is used to analyse and to classify whether it is healthy or unhealthy leaf. This plant was chosen because its function can cure breast cancer. Therefore, there is a need for alternative cure for patient of breast cancer rather than use the technology such as Chemotherapy, surgery or use of medicine from hospital. The purpose of this research to identify the quality of leaf and using technology in agriculture field. The process to analysis the leaf quality start from image acquisition, image processing, and classification. For image processing method, the most important for this part is the segmentation using HSV to input RGB image for the color transformation structure. The analysis of leaf disease image is applied based on colour and shape. Finally, the classification method use feed-forward Neural Network, which uses Back-propagation algorithm. The result shows comparison between Multi-layer Perceptron (MLP) and Radial Basis Function (RBF) and comparison between MLP and RBF shown in percentage of accuracy. MLP and RBF is algorithm for Neural Network. Conclusively, classifier of Neural Network shows better performance and more accuracy.

Keywords: Leaf disease, phyllanthus elegans wall, image processing

I. INTRODUCTION

In this research, the aim is to develop a technology in agriculture field, based on engineering technique. Nowadays, crops face many traits/diseases. Damage caused by the insect is one of the major trait/disease. Insecticides are not always proven to be efficient because insecticides may be toxic to some kind of birds. It also damages natural animal food chains. A common practice for plant scientists is to estimate the damage of plant (i.e. leaf, stem) based on percentage of the affected area of disease detected by naked eye on a big scale. It results in subjectivity and low throughput.

in several methods used to study plant diseases/traits using image processing. The

methods studied are for increasing throughput and reducing error arising from human experts in detecting the plant diseases. Detection of leaf disease using engineering technology and mathematically theory in Sequential Neural Network use for analyzes the result. Recently, SNN is widely used in agriculture image processing and it is one of the popular methods for classification problems as compared to most traditional classification approaches. At the end of this study, Neural Network will classify the sample data of leaf image based on healthy or unhealthy category.

Method used for this project is to get leaf image from herb plant. Method of extraction the image acquisition uses suitable image processing algorithms and then makes recognition and classification of healthy or unhealthy leaves using Sequential Neural Network. Image pattern of classification for this project is based on color and area of leaf. This project relates to the agriculture field based on engineering approaches. The title of this project is leaf disease classification using Sequential Neural Network. Method for this project is get leaf image from herb plant. Extract the image acquisition using suitable image processing algorithm. Then make recognition and classification of healthy or unhealthy leaves using Sequential Neural Network. Image pattern of classification for this project is based on color and area of leaf.

Human population steadily continues to grow, and along with it the need for food production increases. According to the UN projections [1], human population is expected to reach 9.7 billion in 2050, 2 billion more than today.

Considering that most of the population growth is to occur in the least developed countries (around 80% increase in the next 30 years), where the food scarcity is the main problem, it is easy to conclude that minimizing food loss in those countries is a primary concern.

It is estimated that the yield loss worldwide is between 20 and 40 percent [2], with many farms suffering a total loss. Traditional methods for detecting diseases require manual inspection of plants by experts. This process needs to be continuous, and can be very expensive in large farms, or even completely unavailable to many small farm holders living in rural areas. This is why many attempts to automate disease detection have been made in the last few decades.

One of the notable approaches is the use of hyper spectral imaging. Hyper spectral images are usually taken by satellites or airborne imaging devices and used for monitoring large areas. A downside of this approach is extremely high equipment cost, as well as high dimensionality and small number of samples which make them unsuitable for machine learning (ML) analysis.

Because of the recent breakthroughs in computer vision and the availability of cheap hardware, currently the most popular approach is the analysis of RGB images. The other motive for analysing RGB images is that with the current smartphone iniquitousness these solutions have potential to reach even the most rural areas. RGB images can be analysed by classical ML algorithms or the deep learning (DL) approach.

Classical methods rely on image pre-processing and the extraction of features which are then fed into one of the ML algorithms. Popular algorithm choices are Support Vector Machines (SVM), k-Nearest Neighbours (k-NN), Fully Connected Neural Networks (FCNN), Decision Trees, Random Forests etc. In the last few years, the researchers shifted almost exclusively to the DL methods for image classification tasks.

The reason is that they almost always outperform classical algorithms when given reasonably sized dataset, and can be implemented without the need for hand-engineered features. In this paper, we compare the DL approach with classical ML algorithms for the study case of plant disease classification.

II. LITEARTURE SURVEY

[2] Savary, Serge, et al. (2019) This study highlights the global impact of pathogens and pests on major food crops like wheat, rice, maize, potato, and soybean. Through expert-based assessments, the authors estimate significant yield losses—up to 40% in some crops—especially in food-insecure regions. The work emphasizes the need for robust crop health management and reinforces the importance of timely disease detection systems to enhance food security. This contextualizes the urgency for intelligent disease detection technologies in agriculture.

[3] Mohanty, Sharada P., et al. (2016) Mohanty et al. propose a deep learning-based method for plant disease detection using a large dataset of over 54,000 leaf images. Their convolutional neural network (CNN) achieves 99.35% accuracy in identifying 26 plant diseases across 14 species. This research demonstrates the high potential of AI-driven image classification in agriculture, paving the way for scalable mobile applications that help farmers in remote areas detect diseases early.

[4] Fujita, E., et al. (2018) Fujita and colleagues present a practical automated plant disease diagnosis system trained on field images of cucumber leaves. Their system, built using 9,000 original images, classifies diseases with an average accuracy of 93.6%. It also visualizes key diagnostic features, making the model interpretable. This research addresses the common limitation of lab-controlled datasets by focusing on real-world field imagery, enhancing the model's reliability in actual agricultural settings.

[5] Haralick, Robert M., et al. (1973)
This foundational paper introduces a set of textural features for image classification, based on gray-tone spatial dependencies. Haralick's features became widely adopted in computer vision for analyzing images in agriculture, medicine, and remote sensing. Their use in distinguishing patterns and textures is crucial for detecting disease symptoms on plant leaves, such as spot, mildew, or mosaic patterns.

[6] Cortes, Corinna, and Vladimir Vapnik (1995)
Cortes and Vapnik introduced the Support Vector Machine (SVM), a powerful supervised learning algorithm that classifies data by finding the optimal hyperplane. This technique has been effectively applied in plant disease classification tasks, especially when using limited and labeled datasets. Its strong generalization capabilities make it a go-to baseline method in many agricultural image classification projects.

[7] Cunningham, Padraig, and Sarah Jane Delany (2007)
This paper explores the K-Nearest Neighbors (KNN) algorithm, a simple yet effective classification method used in many early plant disease detection systems. KNN works by comparing new data with stored examples. Though easy to implement and often accurate with large datasets, its computational cost can be high. The paper discusses practical insights, such as choosing the right value of "K," which is crucial for balancing accuracy and performance.

[8] Szegedy, Christian, et al. (2015)
Szegedy et al. present GoogLeNet, a deep convolutional neural network that introduced the Inception architecture. With a depth of 22 layers, GoogLeNet achieved state-of-the-art performance on the ImageNet dataset with significantly fewer parameters. Its multi-scale feature extraction and efficiency make it a valuable architecture for real-time plant disease detection tasks, especially when deployed on mobile or embedded platforms.

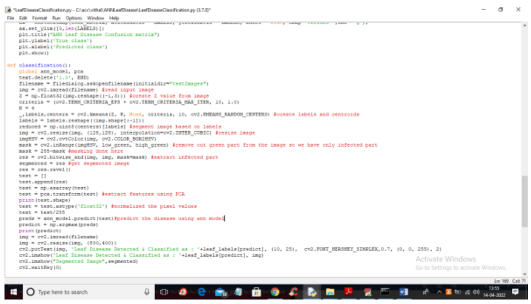
III. PROPOSED METHOD

In this project we are using SNN algorithm to detect and classify leaf diseases and to train this algorithm we have used 'PlantVillage' dataset which contains 25 different types of leaf diseases including health leaf.

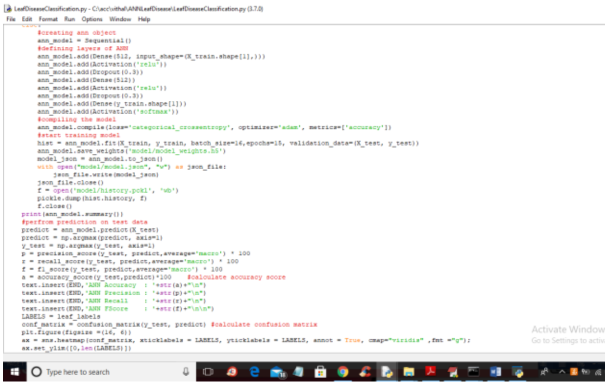
To implement this project we have designed following modules

1) Upload Leaf Disease Dataset: using this module we will upload leaf dataset to application
2) Image Preprocessing: using this module we will read all images and then resize images to equal size and then normalize all pixel values
3) Segmentation & Features Extraction: using this module we will apply KMEANS algorithm to segment infected part of the leaf and then apply PCA features extraction algorithm to extract important features from all images
4) Train SNN Algorithm: Extracted features will be input to SNN algorithm to trained a model and this model can be applied on test images to detect and classify diseases
5) Disease Classification: using this module we will upload test images and then apply SNN model to detect disease from that image

In below screen showing code for KMEANS segmentation



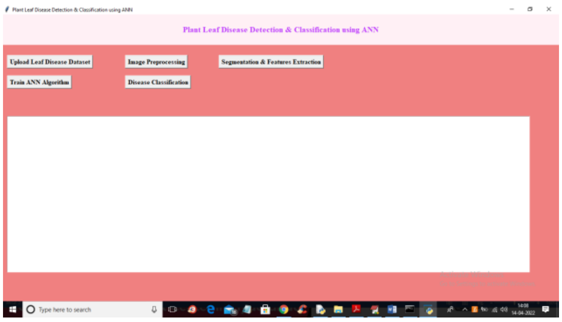
In above screen read red colour comments to know about segmentation and in below screen we have created SNN Model



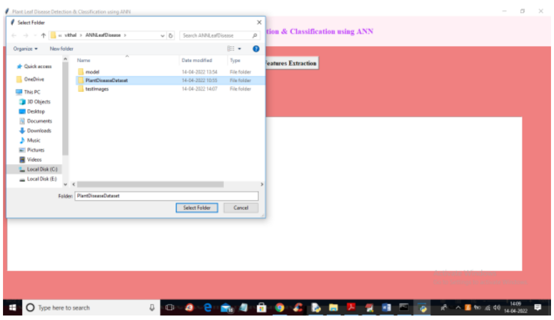
In above screen read red colour comments to know about SNN model

IV. RESULTS

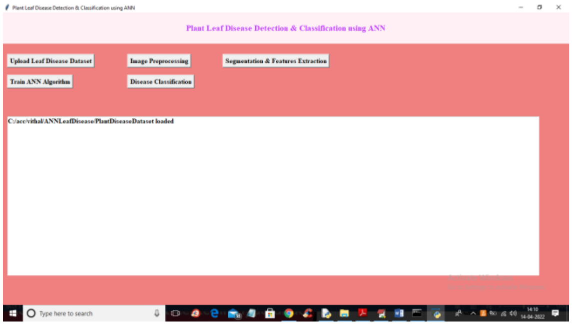
To run project double click on 'run.bat' file to get below output



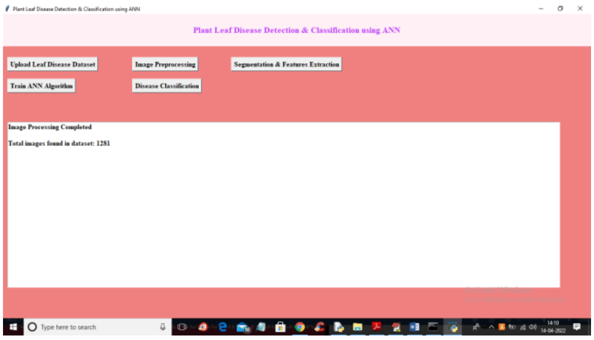
In above screen click on "upload Leaf Disease Dataset' button to upload dataset and get below output



In above screen selecting and uploading 'Plant Disease' dataset folder and then click on 'Select Folder' button to upload dataset and to get below output



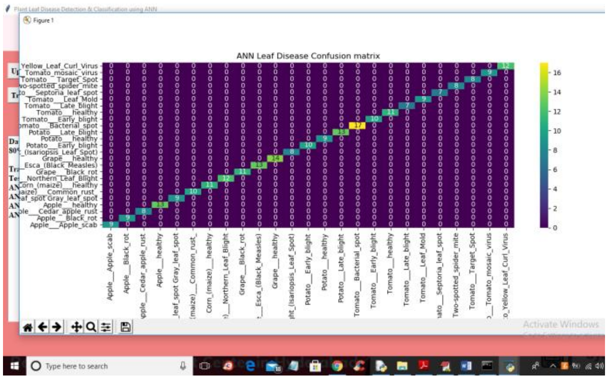
In above screen dataset loaded and now click on 'Image Processing' button to normalize image and get below output



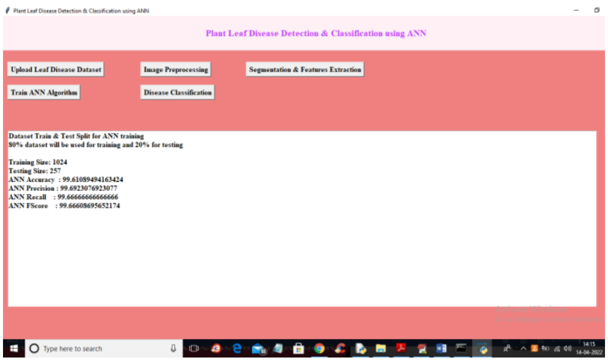
In above screen all 1281 images from dataset are normalized and now click on 'Segmentation & Features Extraction' to segment images and then extract features and then will get below output

In above screen I am displaying sample segmented image where green part removed out and taking only infected part and now close above image to get below output

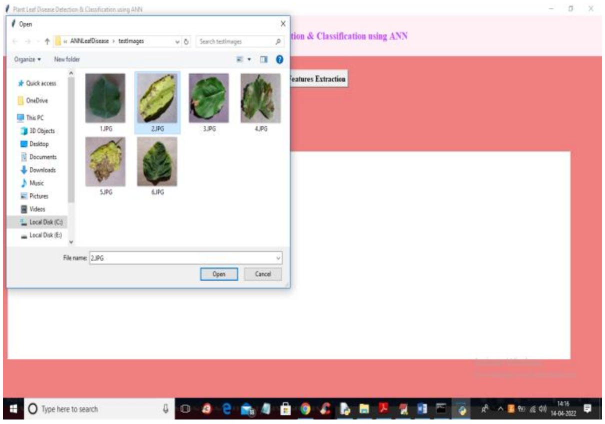
In above screen each image contains 12288 features and after PCA we got 1200 extracted features and now click on 'Train SNN Algorithm' button to train SNN with images and get below output



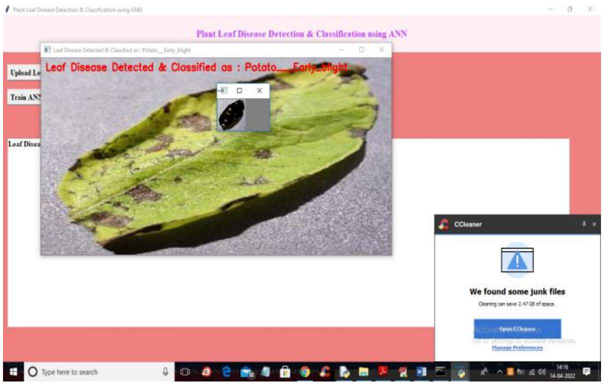
After training will get above confusion matrix graph on test data and in above graph x-axis represent Predicted Classes and y-axis represents TRUE classes and we can predicted is accurate as it matching with the True class box and now close above graph to get below output



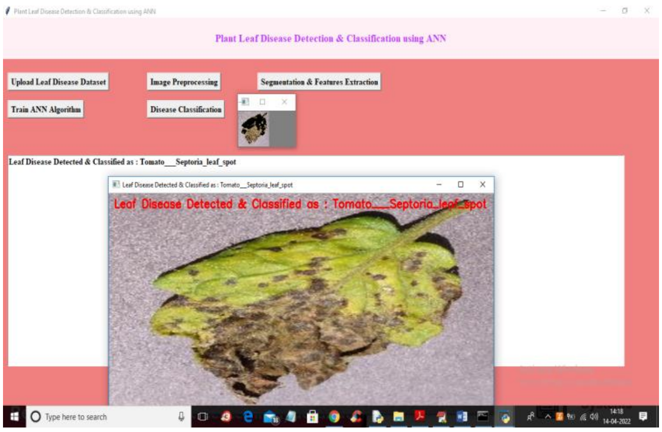
In above screen displaying total images used for training and how many images are used for testing and we got 99% accuracy with SNN and now click on 'Disease Classification' button to upload test images like below screen



In above screen selecting and uploading 2.JPG file and then click on 'Open' button to get below output



In above screen leaf disease predicted as 'Potato early blight' and we can see segmented image also and now test other image



In above screen leaf disease detected as 'Tomato Septoria leaf spot' and similarly you can upload and test other images and with each we can see segmented small image also

V. CONCLUSION

Leaf disease classification using Sequential Neural Network has been successfully analyzed using image processing method and classified using Neural Network to get the performance of the data. The image processing method has been applied to 100 samples of leaf and the data based on color and area of unhealthy analysed. The objective to capture and analysis data from leaf images for classify healthy or unhealthy of the leaves of medicine plants was achieved using image processing method. From image processing method, algorithm of adjusted contrast, segmentation and features extraction is used to extract image and to get data. The three of the method are included in image processing method. The experiment results have been done using Sequential Neural Network. Multi-layer feed forward Neural Network which are multi-layer perceptron and radial basis function RBF are the structures of the network used to class healthy or unhealthy of leaves. In the final experiment, the result shows that the RBF network performs better than MLP network.

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