PLANT LEAF DISEASE DETECTION

Rushikesh Tharkar
Department of Information Technology
VPPCOE&VA, University of Mumbai
Vu4f2021007@pvppcoe.ac.in

Rahul Jadhav
Department of Information Technology
VPPCOE&VA, University of Mumbai
Vu4f2021044@pvppcoe.ac.in

Kaustubh Warke
Department of Information Technology
VPPCOE&VA, University of Mumbai
Vu4f2021054@pvppcoe.ac.in

Pratik Pathak
Department of Information Technology
VPPCOE&VA, University of Mumbai
Vu4f1920068@pvppcoe.ac.in

Abstract - Plant diseases affect the growth of their respective species, therefore their early identification is very important. Many Machine Learning (ML) models have been employed for the detection and classification of plant diseases but, after the advancements in a subset of ML, that is, Deep Learning (DL), this area of research appears to have great potential in terms of increased accuracy. Many developed/modified DL architectures are implemented along with several visualization techniques to detect and classify the symptoms of plant diseases. Moreover, several performance metrics are used for the evaluation of these architectures/techniques. This review provides a comprehensive explanation of DL models used to visualize various plant diseases. In addition, some research gaps are identified from which to obtain greater transparency for detecting diseases in plants, even before their symptoms appear clearly

Keywords: Plant leaf disease detection, leaf disease detection, convolutional neural network, deep learning

I. INTRODUCTION

Agriculture plays an important role in the development of the economy of a country. It provides lots of opportunities to innovate and apply the innovation.

When Plants or Crops get infected to a specific disease their quality of life begins to deteriorate and if the disease is not cured in early stage then the plant cannot survive anymore due to the increased rate of the disease in the plants.

Diseases are a major threat to the crops.Diseases destroy the crop and thus reduce the yield and also the quality of the crops thereby decreasing the profits. The use of technology in the area of agriculture will reduce manual labour and increase the accuracy by decreasing the amount of error. The systems developed earlier have just been able to detect diseases of leaves, this system will use image processing and classifiers which include CNN architecture available for image classification to detect the diseases.

Predictive models play a crucial role in plant disease management. Predicting the likelihood and timing of disease outbreaks based on historical data, weather conditions, and other environmental factors. The predictive models based on the training given to them can provide instant and immediate results in predicting plant diseases which can help plant owners or farmers who does farming in reducing the damage done to plants.

High Accuracy in Disease Identification: The foremost objective is to achieve a high level of accuracy in identifying plant diseases. CNNs are powerful in image recognition tasks and can be fine-tuned to accurately detect various types of diseases present on plant leaves. The goal is to ensure that the model correctly identifies and classifies diseases, minimizing false positives and false negatives.

Robustness and Generalization: The model's performance shouldn't be limited to the conditions under which it was trained. Robustness is crucial. The objective is to ensure that the model can generalize well to new, unseen data, regardless of factors like different lighting conditions, angles, or variations in plant types, leaf shapes, or diseases. This could involve strategies such as data augmentation, transfer learning, or diverse dataset collection.

II. LITERATURE REVIEW

1. Validation: The model's performance is evaluated on a separate validation dataset to tune hyperparameters and monitor overfitting.

2. Testing: The trained CNN is tested on a different set of images not seen during training to assess its generalization performance.

3. Deployment: Once the model performs well, it can be deployed in real-world scenarios. This can be on-site using cameras, drones, or smartphone apps to detect diseases in plant leaves.

4. CNN Model: A CNN architecture is designed for plant leaf disease detection. Common architectures include VGG, ResNet, Inception, or custom designs. The model is trained on the dataset to learn to classify images as healthy or diseased.

As of late, image processing techniques are utilized in different fields such as automation, medical etc. Indeed, even the distinguishing proof of plant contamination utilizing customary strategy is supplanted by image processing. The image processing frameworks requires camera, PC and essential software. Steps associated with plant disease detection are image acquisition, pre-processing, segmentation, feature extraction and classification. Performing image enhancement, improves the quality of the picture just as the clearness. Basic primary colours red, green and blue combinations produce many varieties of colours. Hence, implementing image processing using RGB components is difficult and its range is very high. Changing over RGB picture into its proportionate grey image is accomplished for simpler implementation. Automated plant disease using image processing technique is beneficial for the farmers as it reduces large human labours and can help to detected by symptoms at early stage MATLAB software's tools are utilized for recognizing the disease of the plants. Image acquisition is performed using digital cameras. K-mean clustering algorithm used Euclidean distance metric method and clusters the image based on the specified number of groups [4][5]. Gray-Level Cooccurrence Matrix (GLCM) is one of the most popular methods for texture analysis. It creates an element based gray level matrix for the shading picture and measures the spatial separation between the pixels. GLCM represents the distance and angular spatial relationship of an image in a specific size. GLCM calculates how regularly the pixel with gray level power happens. Horizontally values are represented as „i" and vertically or diagonally values to adjacent pixels are labelled as „j".
Define the importance of detecting plant leaf diseases early.
Highlight the significance of automated detection methods.
Introduce the scope of the literature survey.

Review traditional methods used for plant leaf disease detection, such as visual inspection by experts and laboratory testing.
Discuss the limitations of traditional methods, such as time-consuming and subjective nature.
Explore the application of computer vision techniques for plant leaf disease detection.
Review image processing algorithms used for feature extraction and classification.

Discuss the advantages of computer vision techniques, such as speed and scalability.
Discuss the use of machine learning algorithms for plant leaf disease detection.
Review different types of machine learning algorithms employed, such as supervised, unsupervised, and deep learning.
Highlight the importance of datasets in training machine learning models.
Focus specifically on the application of deep learning techniques, particularly CNNs, for plant leaf disease detection.
Discuss the architecture of CNNs and their effectiveness in feature learning from images.
Review state-of-the-art CNN models used for plant leaf disease detection.
Identify challenges faced in plant leaf disease detection, such as dataset availability, model generalization, and robustness to environmental variations.
Discuss potential future directions for research, such as multi-modal approaches combining image analysis with other sensor data.
Summarize the key findings of the literature survey.
Highlight the significance of automated plant leaf disease detection methods.
Suggest areas for further research and development.
Data Collection: Gather a diverse dataset of plant images, including both diseased and healthy samples, from various sources.
Data Preprocessing: Clean and standardize the dataset, including image resizing, contrast adjustment, and quality enhancement to ensure consistency.
Feature Extraction: Implement feature extraction techniques to capture relevant information from the images, such as textures and shapes.
Model Development: Design and implement machine learning or deep learning models, often using techniques like convolutional neural networks (CNNs), to analyze the extracted features.
Training and Validation: Train the models using a portion of the dataset, validate their performance using a separate dataset, and fine-tune their parameters.
Testing and Evaluation: Evaluate the models' performance using a different, unseen dataset to assess their ability to accurately recognize plant diseases.
Interpretability and Transparency: Implement methods to provide explanations for the models' decisions, ensuring transparency in the recognition process.

[1] Revathi, P., Hemalatha, M. (2012 "Classification of cotton leaf spot diseases using image processing edge detection techniques".169-173.10.1109/ INCOSET.2012.6513900J. Clerk Maxwell, A Treatiseon Electricity and Magnetism, 3rd ed., vol.2. Oxford: Clarendon, 1892, pp.68– 73.

[2] Arivazhagan, S., Newlin S., Ananthi, S., Vishnu V (2013) "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features", Agric Eng. Int CIGR, 15, pp.211-217

[3] Gavhale, K., R., and Gawande, U. (2014) "An overview of the research of plant leaves disease detection using image processing, IOSRJ, Comut.Eng, pp.10-16.

[4] Singh, V., Misra, A. (2015) "Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm in Computer Engineering and Applications (ICACEA).

[5] Arti.N.R, Bhavesh, T., Vatsal, S., (2013), "Image processing Techniques for Detection of Leaf Disease", International Journal of Advanced Research in Computer Science and Software Engineering, vol 3, no.11.

S. S. Sannakki and V. S. Rajpurohit, proposed a "Classification of Pomegranate Diseases Based on Back Propagation Neural Network" which mainly works on the method of Segment the defected area and color and texture are used as the features. Here they used neural network classifier for the classification. The main advantage is it Converts to L*a*b to extract chromaticity layers of the image and Categorisation is found to be 97.30% accurate. The main disadvantage is that it is used only for the limited crops. P. R. Rothe and R. V. Kshirsagar introduced a" Cotton Leaf Disease Identification using Pattern Recognition Techniques" which Uses snake segmentation, here Hu's moments are used as distinctive attribute. Active contour model used to limit the vitality inside the infection spot, BPNN classifier tackles the numerous class problems. The average classification is found to be 85.52%. [3] Aakanksha Rastogi, Ritika Arora and Shanu Sharma," Leaf Disease Detection and Grading using Computer Vision Technology &Fuzzy Logic". K-means clustering used to segment the defected area; GLCM is used for the extraction of texture features, Fuzzy logic is used for disease grading. They used artificial neural network (ANN) as a classifier which mainly helps to check the severity of the diseased leaf.

Godliver Owomugisha, John A. Quinn, Ernest Mwebaze and James Lwasa, proposed" Automated Vision-Based Diagnosis of Banana Bacterial Wilt Disease and Black Sigatoka Disease "Color histograms are extracted and transformed from RGB to HSV, RGB to L*a*b.Peak components are used to create max tree, five shape attributes are used and area under the curve analysis is used for classification. They used nearest neighbors, Decision tree, random forest, extremely randomized tree, Naïve bayes and SV classifier. In seven classifiers extremely, randomized trees yield a very high score, provide real time information provide flexibility to the application.

S. S. Sannakki and V. S. Rajpurohit [4] suggested a Backpropagation Neural Network based mostly classifier (BPNN) for sleuthing the malady in Pomegranate leaf. Features have been designated as color and texture. BPNN detects and classifies the diseases with a precision of around ninety seven.30 %. Dr. K. Thangadurai and K. Padmavathi [5] recommended pc vision image improvement for leaf malady identification. It includes color conversion and Histogram deed. Histogram deed will increase the image clarity. RGB to Grayscale conversion is used to retain the luminance data instead of Hue and Saturation data. For encoding of linear intensity values, Gamma expansions are used. Cumulative Gaussian distribution operate distributes the intensity worth of the image. Histogram deed provides the higher quality image in Grayscale. [6] proposed an SVM-based Multiple Classifier System (MCS)[25] for wheat leaf diseases. It uses a stacked generalization structure to join the classification choices obtained from 3 sorts of support vector machines (SVM) based mostly classifiers. The features like color, texture and shape options area unit used as coaching sets for classifiers. Firstly, features area unit classified mistreatment a classifier in low-level of MCS to corresponding mid-level classes, which will part notice the symptom of crop diseases in line with the information of plant pathology. Then the mid-level features area unit generated from these mid-categories generated from low-level classifiers.

III. PROPOSED METHODOLOGY

Fig. 2 displays the Convolutional Neural Network (CNN) is a type of deep learning algorithm specifically designed for image processing and recognition tasks. Compared to alternative classification models, CNNs require less preprocessing as they can automatically learn hierarchical feature representations from raw input images. They excel at assigning importance to various objects and features within the images through convolutional layers, which apply filters to detect local patterns

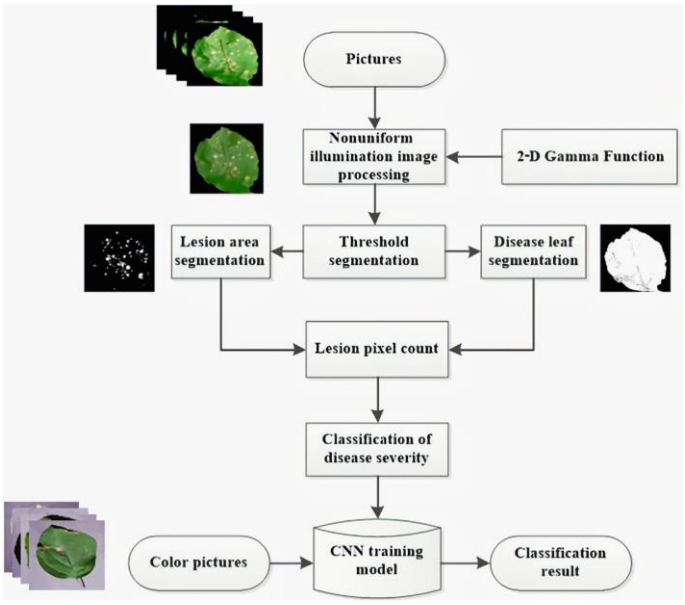

Fig. 2. Working of Plant leaf disease system

Initially, the digital images are acquired from the circumstances using a digital mobile camera. Then imageprocessing techniques are applied to the acquired images to extract RGB Pixel counting features that are necessary for further analysis. After that, some analytical perceptive techniques are used to classify the images according to the specific problem at hand. In this work farmers can take decision immediately at the time. They want to get the best solution to diseases and pest recommendation is 3 languages Tamil, English, Hindi, Production can be improved, the yield loss can be reduced, they minimum cost of ultimate system very useful to farmers and we can increase the economic of the country. Main farmers life protects and reduces their burden.

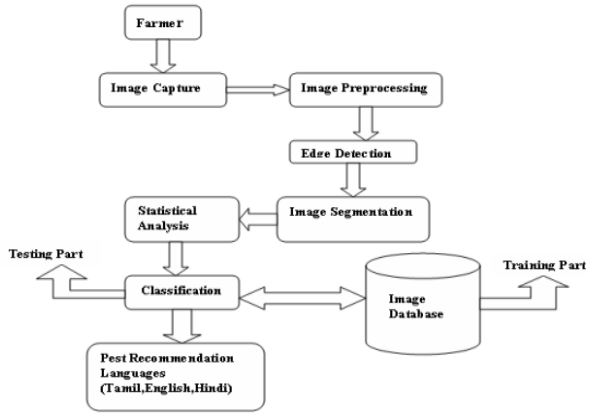

Fig. 3. Plant Leaf Diseases Identification System Architecture

Users acquire images of the leaves from the field using sensors and pass it to the computer system which analyze the input images using the homogenous edge detection algorithms and diseases wise the pixels call function logic used for diseases wise detect the affected parts of the leaves to recognize the diseases and then result (recognition of the diseases and pest recommended) is given as output to the farmers in three languages.

I. RGB image acquisition

II. Create the color transformation structure

III. Convert the color values in RGB to the space specified in the color transformation structure.

IV. Apply Color Filtering

V. Masking green-pixels

VI. Remove the masked cells inside the boundaries of the infected clusters

VII. Calling the pixel Ranging function to calculate the RGB features (each and every disease)

VIII. Texture Statistics Computation

IX. Configuring Disease Reorganization and Pest Recommendation .

IV. CONCLUSION

Today, the technology is used in every aspect of life. Farmers are facing difficulties in manually identifying the diseases in plants. Also, expert advice is not available easily to the farmers. It is beneficiary to have an automated mechanism to identify the plant diseases. The proposed method used machine -learning techniques to detect the leaf diseases in plants the plants related sector will grow more effectively and efficiently due to availability of such type of automated systems to detect plant diseases.

V. FUTURE WORK

In neural network it's difficult to understand structure of algorithm and to determine optimal parameters when training data is not linearly separable.
Artificial Neural Network and Fuzzy Logic with other soft computing technique can be used to classify the crop diseases.
Disease spot area can be computed for assessment of loss in agriculture crop. Disease can be classified by calculating dimensions of disease spot.

REFERENCES

[1] Revathi, P., Hemalatha, M. (2012 "Classification of cotton leaf spot diseases using image processing edge detection techniques".169-173.10.1109/ INCOSET.2012.6513900J. Clerk Maxwell, A Treatiseon Electricity and Magnetism, 3rd ed., vol.2. Oxford: Clarendon, 1892, pp.68– 73.

[2] Arivazhagan, S., Newlin S., Ananthi, S., Vishnu V (2013) "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features", Agric Eng. Int CIGR, 15, pp.211-217

[3] Gavhale, K., R., and Gawande, U. (2014) "An overview of the research of plant leaves disease detection using image processing, IOSRJ, Comut.Eng, pp.10-16.

[4] Singh, V., Misra, A. (2015) "Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm in Computer Engineering and Applications (ICACEA).

[5] Arti.N.R, Bhavesh, T., Vatsal, S., (2013), "Image processing Techniques for Detection of Leaf Disease", International Journal of Advanced Research in Computer Science and Software Engineering, vol 3, no.11.