An Overview on Prediction of Plant Leaves Disease using Image Processing Techniques

Sridevi Sakhamuri¹ and Dr. Vijaya Sri Kompalli²

¹Research Scholar, Department of CSE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India-522502
²Associate Professor, Department of CSE, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh, India-522502

E-mail: sridevisakhamuri@kluniversity.in

Abstract. In the Indian Economy, agriculture plays a main role, therefore prior detection of plant diseases will aid in maximizing the productivity of the crops thereby adding to the economy’s augmentation. To predict the plant diseases, manual identification is used earlier but it requires vast manpower and wide knowledge about plants. Multi disease models and pest prediction can be automated using image processing techniques. This paper shows an overview of various image processing techniques to obtain and organize diseases in the plant. Developing contamination, supplement lack, dry season, and so on are the reasons in light of which plants are inclined to the various sicknesses. Illnesses can be found on the root, stem, branches, leaves, blossoms, and organic products. Diseases in plants are the main production and financial losses also decrease in agricultural product quality and quantity. To propose a proper solution for relating illness, recognizable proof, and arrangement of infections is significant. We reviewed a simple plat leaf disease detection system that would ease progressions in agriculture. The survey on various classification techniques presented in this paper for plant leaf diseases. An Automatic finding of plant diseases is significant to regularly find out the disease signs as soon as they emerge on the mounting phase.

1. Introduction

Developing countries like India about seventy percent of the populace depend on agriculture. The quantity and quality of the agricultural item are decreased because of plant malady. Plant infection is brought about by miniature living resembling growths and microorganisms. The lifecycle of a miniature living being can't anticipate some sickness don't have permeability during the beginning phase it just gives the idea that last stage. The expectation of plant infection by unaided eye is utilized by and by yet results are abstract and illness degree isn't correctly estimated. These days programmed identification of plant illness is a significant exploration theme and hence naturally recognizes the maladies from the indications that show up on the plant leaves [1].

Farmers have an extensive array of diversity to choose the right yields for their farming land. However, the farming of these crops for enough harvest and eminence production is mainly technological. It can be developed with the help of scientific support. The organization of recurrent crops needs correct governing particularly for the supervision of diseases that can concern yield drastically and later the post-harvest time. For some useful functions in agriculture, image processing is the best method. From the plant’s image, we can predict the diseases in a plant. Most of the initial symptoms in the plants are microscopic so it is difficult to diagnose by human visual potentials, also
this procedure is dull and time-consuming. Diagnosis of the plant disease through human monitoring needs regular monitoring of the leaves, plants stem by the expert. So, there is a need to design a technique that automatically predicts, categorizes, and significantly recognizes plant disease symptoms. A manifestation is a reality going with something and is seen as proof of its reality. The ailment is brought about by a microbe which is any operator causing malady. Ailment of the executives is a difficult undertaking. Generally, ailments are seen on the leaves or stems of the plant. The exact measurement of these outwardly watched maladies, bugs, attributes has not concentrated at this point as a result of the inconvenience of visual designs. In a large portion of the cases, maladies are seen on the leaves or stems of the plant. Accordingly acknowledgment of plants leaves and discovering the sicknesses, manifestations of the illness assault, plays a significant function the effective development of yields [2]. The crop classification was proposed by [1]. The crop classification is supposed to be one of the most important naïve method for the disease prediction [20-24].

Plant diseases are incredibly noteworthy, as that can unfavorably influence both the quality and amount of crops in horticulture creation. Plant ailment conclusion is extremely basic in the prior stage to fix and control them. By and large, the unaided eye strategy is utilized to distinguish the infections. In this technique, specialists are included who can identify the progressions in leaf shading. This technique includes bunches of endeavors, takes a long time, and not handy for the huge fields. Ordinarily, various specialists recognize a similar malady as the distinctive illness. This strategy is costly as it requires constant observing of specialists.

Contingent upon the applications, numerous frameworks have been proposed to illuminate or possibly to decrease the issues, by utilizing picture preparing, design acknowledgment, and some programmed grouping apparatuses. In the following area, this paper attempts to introduce those proposed frameworks in a significant manner [1].

2. Literature Review

[4] Proposed the fuzzy component choice approach - fluffy bends (FC) and surfaces (FS) – for cotton leaves infection picture highlight determination. This research is done in two stages. Firstly to consequently furthermore, rapidly disengage a little arrangement of critical highlights from a lot of unique highlights as indicated by their importance and to dispense with fake highlights they utilize FC. Also to segregate the highlights subject to the critical highlights use FS. This work is helpful for reasonable grouping requests which diminish the dimensionality of the highlight space. [9] has studied the Smart farming which predicts the diseases in crops studied the advanced crop field monitoring system in agriculture field through top notch sensors has proposed an efficient classification model for plant disease detection. [24] has proposed an automated leaf disease detection in corn species through image analysis.

This paper portrays Eigen highlight regularization and removal procedure by this recognition of three ailments that should be possible. This framework is having more precision, than that of the previous component recognition procedures. With this strategy about 90% of recognition of Red spot for example contagious sickness is identified.

[6] In this examination back-proliferation, neural organization with a self-sorting out element map together is used to perceive shades of the grape leaf. Additional MSOFM and GA sent for grape leaf sickness division and SVM for arrangement. At last filtration of coming about a portioned picture is finished by Gabor Wavelet and afterward, SVM is given to order the kinds of grape leaf sicknesses. This framework can characterize the grape leaf ailments into three modules: Scab illness, rust infection, what's more, no illness has proposed a prototype analysis of different data mining classification and clustering approaches. [8] proposed a classification based on Sub-feature selection of a digital image. [6][9] proposed the used Naïve Bayesian Algorithm for classification of Imbalanced Malaria Disease[10].
[3] Built-up a quick and precise technique for recognition and order of plant sicknesses. The projected calculation is tried on fundamental five infections on the plants; they are Early Scorch, Cottony form, Ashen Mold, Late burn, little whiteness. At first, the RGB picture is gained then a shading change structure for the gained RGB leaf picture is made. After that shading esteems in RGB changed over to the space determined in the shading change structure. [3] has proposed a machine learning approach to assess crop specific suitability for small/marginal scale croplands.

[2] Promoted a framework for the recognition and separation of sugar beet sicknesses in light of Support Vector Machines and otherworldly vegetation lists. They utilized Cercospora leaf spot, leaf rust, and fine mold infected leaves as study tests. The fundamental point was to recognize these illnesses before their manifestations got obvious. In this paper, nine otherworldly vegetation were utilized as highlights for a programmed order. The exploratory outcome shows that the segregation between sound sugar beet leaves and unhealthy leaves characterization precision up to 97%.

[1] Projected a computerized grouping framework dependent on the morphological changes brought about by earthy colored spots and the leaf shoot illnesses of the rice plants. To arrange the illnesses Spiral conveyance of the tone from the middle to the limit of the spot pictures has been utilized as a highlight by utilizing Bayes' and SVM Classifier. [11,12] surveyed the applications and performance of deep convolution neural network architecture for image segmentation.

3. Plant Leaf Diseases Investigation and its Symptoms

The main duty in improving the plant’s productivity is to recognize the right disease at a starting stage and take safety measures consequently. To increase the output of the system, we need to develop an intelligent decision supporting scheme. With the help of image processing techniques, the images of plant leaves and diseases can be detected. Three types of diseases attack the plants, namely Viral, bacterial and fungal diseases. The symptoms of each disease differ and it is shown in table 1[2].

Table 1. Leaf Bacterial Diseases

| Disease       | Affected Leaf | Symptoms                                                                 | Affected Plant            |
|---------------|---------------|--------------------------------------------------------------------------|---------------------------|
| Leaf Spot     | ![Leaf Spot](image) | • It looks like brownish.  
• Symptom is spots on foliage. | Shade plants and ornamentals                                           |
| Bacterial Blight | ![Bacterial Blight](image) | • The symptoms of this disease are like brown marks on the margins.  
• Commonly, at the early stage, the plants are affected with yellow color spots. | Jasmine, grape, beans, tomato |
| Fire blight   | ![Fire blight](image) | • The infected plant leaf change into brown or black color.  
• The leaves of the plant die but do not drop off. | Apple, rose family, and pears. |
Scabs
- It appears like suntan
- Potato, cucumber, tomato

Canker
- It increases a stem by attacking the foliage beyond it
- The plants come under the citrus family like lemon

Wilt
- The plant changes into yellow
- Tomato, watermelon, and cotton

Viral Diseases
The diseases caused by viral infections are the toughest to predict. It does not provide an early sign and caused by aphids, whiteflies are the common carriers of this viral disease. For instance, Mosaic virus, look for yellow spots on foliage. The affected leaves might be wrinkled, curled and development also reduced [3].

Bacterial Diseases
It is categorized by small fair green spots which quickly changed as water-soaked. It looks like dry dead spots.

Fungal Diseases
Late blight caused by fungal infesters, initially affects older leaves like water-soaked green spots. Later, these dark spots stronger, and then white fungal growth appears on the undersides [4,5].

3.1 Various Infections in Plant

While consolidating the work as per different diseases, we spotted on multiple parameters which is mentioned in the below table 2. The columns of the tables are disease type, culture, pathogen, and dataset gathered.

**Table 2. Overview of Plant disease identification, finding and classification of techniques**

| Technique           | Disease                  | Pathogen | Culture | Colour space | Dataset   |
|---------------------|--------------------------|----------|---------|--------------|-----------|
| Fuzzy logic [3]     | Leaf spot                | Bacteria | Cucumber| HSI          | 129 images|
| Deep learning [4]   | Northern leaf blight     | Fungus   | Banana  | RGB          | 1834 images|
| Method                                         | Objects                                      | Disease                          | Plant      | Spectral bands | Sample size       |
|-----------------------------------------------|----------------------------------------------|-----------------------------------|------------|----------------|-------------------|
| Neural network [1]                            | Wildfire, weather fleck and brown spot       | Tobacco                          | HSV        |                | 40 of brown spot, 30 of angular leaf spot, 50 of wildfire, 40 for CMV |
| Multiple kernel SVM [2]                       | Leaf nitrogen concentration                  | Virus                            | Wheat      | Four spectral bands | 339 samples       |
| Fusion of super pixel expectation maximization and PHOG descriptors [3] | Downy mildew, scab diseases                  | Bacteria and fungus              | Cucumber   | L*a*b          | 300 affected leaf images with 60 pictures per class |

It is worth to mention that were capable to separate cucumber leaves effectively, and also the spot infection on a leaf from the compound environment in an efficient way by enhanced fuzzy c-means technique. [2] Invented a convolution neural networks-based technique to obtain and predict the northern leaf blight illness in plants using field-based imaging apparatus. By using this technique, data limitation and high noise in the plants grown are handled effectively.

This method is introduced to predict and manage different tobacco diseases. To predict the disease location data, the Otsu technique was used, for extracting the diseased place GrabCut method was used, and the grey-level co-occurrence matrix was utilized to acquire color.

Multiple kernel support vector [8] algorithm was used for the obtaining level of leaf nitrogen absorption in the wheat plant. [7] Projected a method to predict and categorize illness in cucumber leaves. The authors utilized a sparse image categorization for the prediction of diseases.
Figure 1. Various Diseases in Plants

As mentioned in figure 1, there are several behaviours a plant might be infected by virus or diseases. Depending on the effect of diseases on plants, we provide various techniques. The results mostly focused on bacterial, fungal, and viral over numerous years.

4. Disease Prediction Techniques
In various image processing techniques for plant leaf disease prediction consist of the following detection steps. Based on these steps, plant diseases are identified [9].

Figure 2. Disease Detection Steps
4.1 Leaf Disease Detection based on SVM Classifier
In this method, initially, the affected area is established using segmentation by K-means clustering and the color and texture types are taken out. At the end classification approach is utilized to the leaf disease type.

Image Acquisition:
In this process, model pictures are gathered to train the system. The sample images are taken using digital cameras and considered for system training and testing. The captured pictures may be different forms and dimensions.

Pre-processing:
For developing the superiority of the image, image preprocessing is done. Removal of background noise and suppress the pixel values are found in this step. It also enhances the quality of the images.

Figure 3. (a) Real Image (b) Adjusted Image

Image Segmentation
Concerning particular features, the specified image is separated into homogenous areas in image segmentation. In this K-means clustering is utilized for segmenting a picture into three sets as exposed in figure 4. The clusters have a affected element of the leaf. Before clustering ‘a’ part is extracted from L*a*b space [4].

Process of K-means algorithm
• Separate the dataset into k number of clusters and allocate the data points to each cluster.
• Then find out the Euclidean distance from each data point to all cluster.

Euclidean distance = \( \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \) (1)

Figure 4. K-means clustering Segmentation

The surface and color features of the entire pictures are extracted.

Feature Extraction:
It is an important part to extract the data that can be utilized to obtain the implication of the specified model. Here the shape and textural trait extraction is found. The subsequent procedures are utilized to find out the color features of an image.

Result:
The final result section, provides an 88.8% accuracy result. Accuracy is calculated by using,

\[
\text{Accuracy} (\%) = \frac{\text{Correctly identified images}}{\text{Total number of test images}} \times 100
\]

Table 3. Classification Outcomes of SVM

| Dataset          | Samples | Classified data | Accuracy (%) |
|------------------|---------|-----------------|--------------|
| Downy            | 15      | 14              | 93.3%        |
| Powderly         | 12      | 10              | 83.3%        |
| Combined dataset | 27      | 24              | 88.8%        |

4.2 SVM, ANN, Fuzzy Classification Methods:
In this technique, paddy leaf disease prediction is done. In image acquisition, RGB color picture of paddy leaf is collected using a digital camera with 768*1024 pixel size for clear vision.

To get high accuracy of images, the RGB pictures are changed into grayscale pictures.

In image segmentation, the noises and unnecessary spots are detected and removed using the K-means algorithm. The binary picture with noise is adapted into noise-free image which detects the leaf disease.

Here, image classification features like artificial neural network (ANN), fuzzy classification, SVM are used. Based on spot color, paddy leaf color, lesion type, boundary leaf, fuzzy logic is used to predict the
disease in paddy field. 94.70% accuracy final result is achieved using this technique [5].

4.3 SVM Method:
In this technique, image preprocessing is done by using three steps. Resize image, enhance an image, and noise removal. To do classification, the image size in the database must fit with the input image size. Thus, it is essential to set the input picture size to a selected dimension. In the enhance image section, adjust image contrast by changing intensity values. A variety of sorts of noises present in the uploaded image which create a thresholding issue. So it is necessary to eliminate the noises from the picture [2].

**Hue based image segmentation:** To identify only the affected portion of the image, here hue based segmentation is used.

**Thresholding:** To separate an image into foreground and background, image thresholding is used. It is used to get better output.

![Original Image](a) ![Threshold Image](b)

**Figure 7.** (a) Original Image (b) Threshold Image

**Image Classification:**
The accuracy if 86% result is achieved through this method. For classifying the disease, SVM (support vector machine) is used. It is a set of associated learning techniques used for classification and regression. SVM increases the marginal distance between classes. The affected part is segmented from the training picture after being preprocessed and the features are extracted.

4.4 Improved K-means Clustering Technique
[3] This technique includes several steps that consist of image acquisition, image pre-processing with color enhancement by scaling (SF-CES), and k-means clustering image segmentation approach, Gray level co-occurrence matrix (GLCM), and last SVM classification. The 95% accuracy is achieved through SVM with the polynomial kernel. It is suitable for identifying diseases in citrus [4].

For feature extraction, color co-occurrence method (CCM) is utilized. It is based on five forms of ailments: Early singe, cottony and ashy mold, late singe, and small whiteness.

![Yellow Rust](a) ![Septoria](b)

**Figure 8.** (a) yellow rust and (b) septoria

This system uses yellow rust and septoria plant diseases. It is based on SVM classification and super pixel-based features. The framework is tested with a set of 60 best and 120 harmful wheat crop pictures.
with 3264x2448 dimensions. This approach established that the SVM classifier works better than ANN in finding the accuracy of yellow rust and septoria with 95% and 70% accordingly.

5. Conclusion

Some type of problems can be recognized with human visual at early points while a little take some time to predict. In this survey paper, various image processing techniques for predicting multiple plant diseases are scheduled and explained. In plant pathology, image processing techniques play a main role. Multiple segmentation techniques and feature extraction methods were explained to enhance prediction and accuracy. Researchers can increase a new hybrid technique using various image processing techniques to develop system performance. All the efficient techniques are useful for analyses the strong and diseased plants leaves. The overview proposes a survey on various disease classification methods that can be utilized for automatic plant leaf disease identification.

References

[1] Bhimanpallewar, Ratnmala, and M. R. Narasinagrao. "A machine learning approach to assess crop specific suitability for small/marginal scale croplands." International Journal of Applied Engineering Research 12.23 (2017): 13966-13973.
[2] Reddy, ANNAPAREDDY VN, Ch Phani Krishna, and Guntur Vaddeswaram. "A survey on applications and performance of deep convolution neural network architecture for image segmentation." International Journal of Pure and Applied Mathematics 118.19 (2018): 43-60.
[3] Vishnu, Bhanawase Vishal, and Chalasani Srinivas. "Metaheuristic Algorithms Based Crop Classification." 2018 3rd International Conference on Communication and Electronics Systems (ICCES). IEEE, 2018.
[4] Kolli S., Sreedevi M. (2018),'Prototype analysis of different data mining classification and clustering approaches',ARPN Journal of Engineering and Applied Sciences,13 (9),PP. 3129-3135.
[5] Balram G., Kiran Kumar K.(2018),'Smart farming: Disease detection in crops',International Journal of Engineering and Technology(UAE),7(2),PP. 33– 36.
[6] Narayana B.V.V.S., Ravi K.S., Ramesh N.V.K.(2018),'A review on advanced crop field monitoring system in agriculture field through top notch sensors' Journal of Advanced Research in Dynamical and Control Systems,10(6 Special Issue),PP. 1572– 1578
[7] Kalavala S.S., Sakhamuri S., Prasad B.B.V.S.V. (2019), ‘An efficient classification model for plant disease detection’, International Journal of Innovative Technology and Exploring Engineering, 8(7), PP.126-129.
[8] Lakshmi Praneetha, Vidyullatha P,"Automated leaf disease detection in corn species through image analysis", International Journal of Advanced Trends in Computer Science and Engineering, Vol. 8, No. 6, pp. 2893-2899, 2019.
[9] Bhuwan, Hemanta Kumar, and MD Sirajul Huque. "Sub-feature selection based classification." 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI). IEEE, 2018.
[10] Sajana, T., and M. R. Narasingarao. "Classification of Imbalanced Malaria Disease Using Naïve Bayesian Algorithm." International Journal of Engineering & Technology 7.2.7 (2018): 786-790.