Detection of Disease in Plant Leaf using Image Segmentation

Nandini Kakran
Department of CSE
IIMT, University, Meerut

Pratik Singh
Department of CSE
IIMT, University, Meerut

K. P. Jayant, PhD
Department of CSE
IIMT, University, Meerut

ABSTRACT
Disease have a worse effect on crop plants and directly or indirectly impact the agriculture production and market access. Farmers experience difficulties as crop effected and also having difficulties in change from one disease control policy to another. Plant disease diagnosis is a science as well as technology. Disease reduces both the quality and quantity of agriculture production as well as causes the economic losses. Now a days, plant disease detection has received increasing attention. In most of the cases, diseases are seen on leaf or stem part of the plant. In this paper, we will define the types of disease with their symptoms and how the image segmentation technique is used in detection of leaf disease.

Keywords
Leaf disease, symptoms of disease, image segmentation

1. INTRODUCTION
India is an agriculture country. About 70% of the population depends on crop production. Agriculture pay an important in country economy. Agriculture techniques like irrigation, crop rotation, different types of pesticides or fertilizers were developed long ago in 19th century [1].

Plant exist at both the places where live as well as without us. In plants, the disease defined as the disturbance in normal physiological function of plants. In production of crops identification of disease, identification of infected part, or percentage of pests plays important role [2].

Plant disease negatively influence the country economy that are primarily depends on agriculture. Monitoring task of crop, plays important role in detection of disease [3]. The disease on leaf or stem or on other part of plant have different types with different symptoms. There are different types of disease like bacterial disease, viral disease, fungal disease etc. These require careful and timely detection of type of disease and timely handling to protect the plant. The process of detection of disease require judgement as well as use of scientific methods. Farmers are concerned as their huge amount of cost is involved in these activities. In early ages, no automatic detection and classification of these disease based on their symptoms and causes are very useful to farmers [4].

The paper is divided into different sections as first section define the literature review of plant disease, next section analyses the disease and type of disease with their symptoms, after that we define the image segmentation technique in detection of leaf disease and conclude the paper.

2. LITRATURE REVIEW
The paper "Detecting Leaf Spots in Cucumber Crop using Fuzzy Clustering Algorithm" present the segmentation technique for identifying leaf spots using fuzzy clustering algorithm (FCM). This technique has the detection of spots using the window selection [5].

The paper by Anand H. Kulkarni, present the methodology of disease detection and accurately use of image processing system. The paper present how Artificial Neural Network and Gabor filter is used in detection of pest [1].

The paper "Detection and classification of leaf disease using K-means based segmentation and neural- network based classification" present the image processing system for disease detection and composed it in four main phases. The first phase creates RGB leaf image. In third phase, we calculate the texture features passed through pre-trained neural network [6].

The paper by S. Arivazhagan detect and classify the unhealthy region using texture features. The paper tests the ten spices of plants namely banana, jackfruit, mango, lemon, potato, sapota, tomato using support vector machine [8].

The paper by Amiya Halder and Nilavra Pathak titled, "An Evolutionary Dynamic Clustering Based Colour Image Segmentation" present that each pixel in color images have three components that are RED, GREEN, BLUE and these components are more complex than gray scale images which have single intensity value for pixels. RGB segmentation can be used in medical imaging, mining and mineral imaging, bioinformatics, and material sciences [9].

The paper titled" A Parallel Genetic Algorithm for Cell Image Segmentation", have attempted to overcome the slow convergence of the traditional genetic algorithm and have proposed "a parallel genetic algorithm for cell image segmentation under severe noise". The segmentation results of noisy human thyroid and small intestine cell images demonstrate that their method is very successful in segmenting images of elliptically shaped cells [10].

3. ANALYSIS OF PLANT DISEASE AND THEIR SYMPTOMS

3.1 Disease in plants
It can occur on leaf, stem or any other part of the plant. The detection of disease in early stage is important task. Farmers need to have continuous monitoring which might be expensive. The farmers basically need fast and less expensive methodology that automatically detect the disease from symptoms that are on plant leaf. In most of the cases, symptoms of the disease in plants are seen on the stem, fruit and leaves. In the present work, symptoms of plant leaf have been considered for the detection of disease. In plants leaf, brown and yellow spots are common symptoms for general diseases. Early and late scorch, viral, bacterial and other fungal diseases are also generally found in plants.

3.2 Symptoms of plant disease

3.2.1 Viral Disease

Viral diseases are most difficult to diagnose. Viral disease does not show telltale signs so that they can easily observed and often confused with nutrient deficiencies. Some common virus are leafhoppers, whiteflies, aphids and cucumber beetle insects etc. with the carrier of disease mosaic virus, look for yellow or green stripes.

Fig 1; Mosaic virus

3.2.2 Bacterial Disease

Bacterial diseases are spread out by rain, wind, birds or insects. The disease having symptoms on the leaf with tiny pole green spots on foliage, sometimes with yellow halo.

Fig 2; Bacterial Leaf Spots

3.2.3 Fungal disease symptoms

The fungal leaf diseases are late blight caused by fungus phytophthora infesters. This disease appears on older leaves like water soaked, grey green spots, in its early stages. When it gets matures, the spots get darken and white fungal growth form on the undersides [10].

Fig 3; Downy Mildew

4. DISEASE DETECTION USING IMAGE SEGMENTATION

To cut down the large monitoring work in farms of crops, symptoms at initial stage is taken care of. Naked eye observation by experts is the most prominent and existing method of plant disease identification and detection. But this method is convenient only when farms are smaller in size. As for the larger farms this method is quite cumbersome. A big team of experts and their continuous monitoring is needed for doing so which results in high cost in terms of both time and labor [12].

In most of the developing nations the farmers lack the knowledge about the plant diseases and methods to prevent them or deal with them. They are not able to contact the experts in time for their advice and if they do so it is again time consuming and expensive process. For such situations, crop monitoring in large farms, propounded technique is profitable. On the basis of symptoms, automatic detection of the diseases is easier and cheaper as identification is done simply by checking the symptoms on the leaves of plant. This also supports machine vision to provide image based automatic process control, inspection, and robot guidance [13].

Image segmentation is a process wherein different parts of an image are either grouped together or separated based on certain attributes. There are many approaches prevailing now days for image segmentation. They include thresholding methods from the simple to advanced segmentation for the color image. Those parts which generally humans can easily identify and can be viewed as individual objects, corresponding to these methods. As variety of methods have been developed for image segmentation, therefore for computers recognizing objects intelligently have no meaning. Segmentation process is based upon on the various features available in the image. This information might be boundaries, color or segment of an image [14] [15].

Image Segmentation is performed using these techniques-

4.1 Edge Detection Technique

Image Segmentation by using Edge Detection technique determine the presence of edge or line in an image [16].

"To define the edge, the boundary pixels that connect two separate regions with changing image amplitude attributes such as different constant luminance and tri-stimulus values in an image are considered" [17].

Edge Detection means the boundary between two homogeneous regions. The technique is used to find background of the image and outlines of an object within an image. The technique refers to the process of identifying and locating sharp discontinuities in an image [18].

Edge Detection is done in following ways;

4.1.1 Filtering

Noise, which is "random variations in intensity values", is of following types:

i Salt & pepper noise,

ii Impulse noise and

iii Gaussian noise

Salt and pepper noise contain random occurrences of both black and white intensity values. However, there is a trade-off between edge strength and noise reduction. More filtering to reduce noise will results in the loss of edge strength [19] [20].

4.1.2 Enhancement

Edge detection is facilitated by "determine changes in intensity in the neighborhood of a point". "Enhancement emphasizes pixels where there is a significant change in local intensity values and is usually performed by computing the gradient magnitude" [19].

4.1.3 Detection

"Many points in an image have a nonzero value for the gradient, and not all of these points are edges for a particular application. Therefore, some method should be used to determine which points are edge points. Frequently, thresholding provides the criterion used for detection" [19].

4.2 Thresholding Techniques

When grey levels of pixels of objects are quite different from those of background, then objects can be easily separated from the background using thresholding techniques. Thresholding technique converts the gray scale image into a binary image of which "one state will indicate the foreground objects, while the other state will indicate the background. Depending on the application, the foreground of the image can be represented by gray-level 0, that is, black as for text, and the background by the highest luminance for document paper that is 255 in 8-bit images, or conversely the foreground by white and the background by black" [21].

Mehmet Sezgin et al [21] have done an extensive survey over "Image Thresholding Techniques". Besides image segmentation these techniques are also used in applications such as, "Document image analysis, Map processing, Scene processing, Inspection of materials for quality, Cell images, Knowledge representation, Non-destructive testing, Ultrasonic, eddy current and thermal images, X-ray computed tomography and Endoscopic images etc."

The thresholding techniques can be divided in to following six categories [21]:

1. Histogram shape-based methods,
2. Clustering-based methods,
3. Entropy-based methods,
4. Object attribute-based methods,
5. Spatial methods,
6. Local methods

4.3 Clustering

A set of objects when grouped into classes of similar objects based on some similarity measure, forms a cluster. The data objects within a cluster are similar to each other while dissimilar to those in another cluster. "By clustering, one can identify dense and sparse regions and therefore, discover overall distribution patterns and interesting correlations among data attributes". Cluster analysis serves as a pre-processing step for other algorithms, such as classification, which would then operate on detected clusters. Hierarchical agglomerative clustering techniques start with as many clusters as there are unique values. Then pairs of clusters are successively merged till the optimal number of clusters is reached, depending on the termination condition. Termination condition is to be chosen carefully; else the hierarchical agglomerative clustering technique will ultimately yield one cluster containing all the values [22].

5. CONCLUSION

In this paper, we summarized the effect of plant leaf disease on agriculture production and on country economy. The paper defines the type of disease i.e. bacterial disease, fungal disease, and viral disease with their symptoms. The technique named Image Segmentation is defined. How this technique is used to detect the disease on leaf. The review paper defines the different techniques of image segmentation like Edge Detection technique, Thresholding technique and Clustering technique. The review show that the disease detection technique keeps the good potential to detect the disease on plant leaf and therefore there is a scope of improvement in existing research.

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