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Plant Disease Detection by Image Processing Algorithm- A Review

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Abstract - Our economy is extremely relying on agriculture production. One of the recent research topics is recognition, classification and detection of diseases from the leaf image of a plant. Plants are affected by various kinds of diseases, which causes great harm to the agricultural plant production. Today artificial intelligence and machine learning techniques is capable enough to detect and identify the plant disease. One of the biggest advantages of using AI and ML in agriculture is to reduce the hectic work of constant monitoring of crops field spread over hundreds of acres. Machine learning algorithms detect diseases in early stages as soon as they emerge on the plant surface. The aim of this research is to develop a software system that mechanically finds and classify diseases. The techniques like "image acquisition, pre-processing, segmentation, extraction and classification" are used in it. The leaves picture is captured to detect the plant disease. Thus, use of image processing techniques to detect and classify diseases in agricultural application is useful.

Keywords- Plant disease detection, segmentation, image processing, extraction, classification.

1.INTRODUCTION

Indian economy is highly dependent on agricultural productivity. Like any other living things several diseases can be found in plants too, that's why disease detection plays a vital role in plants. Various techniques have been proposed for disease detection at early stages, one of them is automatic detection technique.

As diseases of the plant are unavoidable, detecting them is crucial. In plants, not a single portion is immune from the diseases such as leaves, fruits, and even stems too. There are three stages involved in curing the plant: (i) Detection (ii) classification and lastly (iii) Treatment. These stages known as disease management. They are depending on each other, for example, treatment depend on classification, and classification rely on detection, we can't reach directly to the treatment phase by avoiding the first two stages. Diseases are classified based on coloured spots or the streaks which can be seen on leaves or stems.

There are many diseases that strike directly on the production and post-harvest life, the proposed framework can be used to identify those diseases in various plants. The automatic disease detection system requires close monitoring of plant's leaf. The notion of image processing helps us in below causes:

i) Recognizing infected leaf and stem.

ii) Measure the affected area.

iii) Finding the shape of infected region.

iv) Determining the colour of infected region.

v) And also influence the shape and size of the leaf.

Now the researcher has to choose specific diseased zone in a leaf and then cropped image is sent for further operations.

II. PROPOSED METHODOLOGY

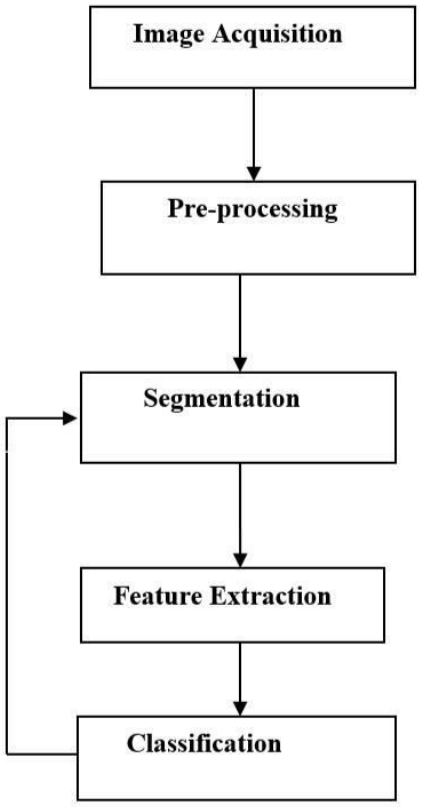

Fig: Process Flow Step

1. **Image Acquisition**: The initial process involves the collection of data from the public treasury. The image acquisition picks up the image as input for further treatment. It may include jpeg, gif, bmp images as input to our operation.

2. Image Pre-processing: Once the images are gained from the real field it may contain dust, spots and water splash as noise. The key goal of image pre-processing is to remove the noise in the image, and modify the pixels by improving the image quality for further processing. It comprises "shade correction, removing artifacts, image clipping, image smoothing, image enhancement formatting".

3. Image Segmentation: The third step is the "Image Segmentation". It involves splitting of an image into several pieces that have same features or having some analogous compatibility. The segmentation can be done using various approaches. like "bacteria forging method", "k-means clustering", "converting RGB image into HIS model", etc.

4. Feature Extraction: The feature extraction performs a significant duty in object recognition due to its prediction power in the infected zone. In our paper shape and feature oriented extraction is done. Shape oriented feature extraction like area, color, perimeter etc. Texture oriented includes contrast, homogeneity, correlation etc.

5. Classification: The plant leaf is classified on the basis of its morphological features. Different classification techniques like "Neural Network, Support vector machine, K- nearest neighbor, Genetic algorithm" etc. It has a wide application on agriculture field.

III. LITERATURE REVIEW

In recent years, numerous techniques and methods of "image processing" and "pattern recognition" came into existence to discover the diseases intervening in plant leaf, roots, stems etc. As soon as disease emerges on the leaf it should be spotted, identified and relevant actions should be taken to avoid damage. Researchers have taken different methods of identification and detection of diseases accurately.

One such method is "Minimum Distance Classifier" (MDC) and "K- Nearest Neighbour" (K- NN). A four proposed rice disease detection technique- rice blast, rice bacterial blight, rice brown spot and rice sheath rot[1].Researchers achieved over 89.23% classification and accuracy of 30% of 115 sample images. But it requires two features namely color and shape of disease.

Another system uses "thresholding" and "Back- Propagation Network" (BNN). The input of the system is the picture of grape leaf on which thresholding is performed to hide the green pixels. This system achieve the infected portion by using K- mean clustering techniques. Then ANN is used for classification [2]. Other method is Principal Component Analysis known as PCA. Researchers used PCA to decrease the dimensions of data and to improve the speed of neural network.

J. Keerthi et.al [3] proposed "Tomato Leaf Disease Prediction", they used Support Vector Machine or SVM classifier technique. Exact identification of the malady is done and then it is transferred to the disease recognizable proof, image are handled utilizing histogram adjustment, separating, shading change and division, then the images are taken in order utilizing SVM classifier.

Detection of Mulberry leaf diseases can be done by using Deep Learning Technique[4]. Disease classification using RCNN and R- FCN method. Data is collected by taking pictures and then image is pre- processed using image annotation and augmentation. Image analysis is done using multiple extractor.

Sugarcane leaf disease detection by Evy Kamilah Ratnasari, R.V Hari Ginardi, Ratih Kartika Dewi, Mistika Mentari[5], they proposed the system recognizing the fungi caused disease symptoms that appears on leaf as spots. The disease severity can be estimated by calculating the quotient of infected area and leaf area. A simple triangle thresholding method is used. By using L*a*b color space we get segmented spot by thresholding a* component and use different classification method to detect the exact type of diseases. Accuracy of 80% and 5.73 error severity estimated at an average.

Table 1: Tabular list of reviewed paper, their methodology and future work is presented below:

Paper	Methodology	Future work
[1] Detection of rice disease using Minimum Distance Classifier and K- Nearest Neighbour	Minimum distance classifier (MDC) and K- Nearest Neighbour (K- NN)	Naïve Bayes classifier to improve the faster density and efficiency
[2] Detection of grape leaf by using thresholding	Back propagation network (BNN), PCA, Thresholding	LTSRG algorithm for segmentation is proposed.
[3] Tomato Leaf disease detection by SVM classifier	SVM classifier, histogram adjustment.	Grey-level co-occurrence matrix (GLCM) for texture analysis of image.
[4] Mulberry leaf disease detection by Deep learning.	Disease classification by RCNN and R-FCN	Use of deep learning algorithm across various platforms by CNN
[5] Sugarcane plant detection by thresholding.	Using L*a*b colour space component. Accuracy of 80% and 5.73 error severity.	Pre-processing the image so that lesion can be detected easily.

IV. RELATED WORK

Monia Jhuria[6] proposed "fruit disease detection" relying on image processing. The aim of the research work is to analyse and discover the disease on fruits. Experiments were performed on fruits like Guava, apple, grapes and mangoes. Image transformation from RGB to HSV was performed on in order to extract the infected part of fruit. Back propagation was used for weight adjustment and the grading of fruit was done on the basis of disease spreading.

Johannes A, Picon A, Alvarez-Gila A[7] investigated the three wheat diseases Rust, septoria and tan- spot. Under different stages and natural conditions by using mobile devices. Segmentation was done by using the Simple Iterative Clustering Algorithm followed by the mask refinement by Chan- Vese algorithm based on colour

saturation methods. Their proposed system revealed excellent results by sensing premature infection. Moreover, some reports indicate that role of "colour constancy normalization" enhance the overall precision about 5%.

Es-Saady et al.[8] suggested a system on the basis of consecutive amalgamation of two SVM classifiers to identify three diseases known as "early blight", "late blight" and "powdery mildew", and three pest conditions called "leaf miners", "Thrips" and "Tuta Absoluta", by using a dataset of 284 images. The author reported that his system improved the recognition accuracy to 87.80% compared to other system that were proposed on ANN and SVM classifiers.

A research on "leaf rot disease detection" was held on betel vine leaves [9]. The dataset was formed by getting 12 infected leaves from the field and scanning was executed on them with a flatbed scanner.
Further, Otsu segmentation was also performed to separate infected tissue. Intensity of infection was taken into consideration by calculating the area of the infected chunks with respect to the size of the leaf. A performance of 100% precision and 83.33% recall was reported in this research.

V.TYPES OF DISEASE

1. Diseases found in root of Plant: The disease that infect the roots of plants are root infected disease. And it occur basically in plants such as Chickpea(dry root rot, Ascochyta blight), Rice (Leaf blast, brown spot, leaf blight), Wheat (leaf rust, stripe rust) etc.

Fig1. Sclerotinia blight

Fig2. Root Rot

2. Disease found in Stem: Stems of the plants are infected by insects, pests and caterpillars. Caterpillars feed within the stem of growing plant and may cause enough damage at the growing points of the plant stems. This results in brown holes, sheath smut, red stip. Plants like apple (black stipe, brown spot), sugarcane (sheath smut, red stipe), pigeon pea (root rot), tomatoes (pith necrosis) etc.

Fig3. Brown scale spot

Fig4. Mealybugs infected stem

Fig5. Pith necrosis on tomatoes

3. Disease found on Leaves: Identification of infected disease is very important. Leaf disease are caused by pathogens brutally affecting the

yield of crop. Leaf diseases can be identified on the basis of its symptoms such as brown spot, sheath rot, brown bumps, leaf blast. These diseases are caused by the bacteria and organisms such as magnaporte oryzae and fungi. To diagnose these diseases different types of algorithms and techniques are used like BFO- DNN, Jaya Algorithm, K- means clustering, Neural network etc. Some other diseases like Powderly mildew and Downey mildew [10] are leaf infected disease most frequently found in wheat, barley and other cereal crops.

K- Means is very effective and simple technique for detection of infected area. This algorithm is basically applied for separating foreground and background images to identify infected leaves in plant. Some of the common leaf diseases are potato (leaf blight, early blight), wheat (leaf rust), rice (leaf blast, brown spot, leaf blight) etc.

Fig6: leaf blast

Fig7: Brown spot

Fig8: Brown Bumps

Leaf Image	Disease name	Cause / Symptoms	Effect	Suitable Climatic conditions
	Common rust (*Phragmidium* spp.)	Puccinia sorghi / White, slightly raised spots on the undersides of leaves and on the stems. After sometime, these spots become covered with reddish-orange spore masses. Later, leaf pustules may turn yellow-green and eventually black	Most commonly found on corn leafs causes leaf drop	Cool temperature
	Late Blight	*Phytophthora infestans* / Late blight first appears on the lower, older leaves as water-soaked, gray-green spots	Leaf, fruits and stems get of tomato and potato plants are effected Leaf spots darken and a white fungal growth forms on the undersides. Eventually the entire plant will become infected. Crops can be severely damaged	Wet, humid conditions
	Cedar apple rust	*Gymnosporangium juniperi-virginianae* / Generally appears to be bright orange-yellow spots	Primarily effects apples and crabapples. The leaves that are heavily infected leaves may drop prematurely	Wet weather (Early Spring season)
	Leaf curl	*Taphrina deformans* / Reddish areas on developing leaves. These areas become thick and puckered causing leaves to curl and distort	Observed on peaches, almonds, apricots and nectarines plants. Severe, leaf curl can substantially reduce fruit production	Cool wet weather (Spring season)
	Leaf spot	Parasitic fungi / Infected plants have brown or black water-soaked spots on the foliage, sometimes with a yellow halo, usually uniform in size	Found on an ornamental or shades trees. As spots become more numerous, entire leaves may yellow, wither and drop	Moisture and warm temperatures
	Early blight	*Alternaria solani* and *Alternaria to matophila* / On the lower, older leaves as small brown spots with concentric rings that form a "bull's eye" pattern	Leaf, fruits and stems get of tomato and potato plants are affected. Leaf surface causing it to turn yellow, wither and die	Wet, humid conditions

Fig9: Classification of Plant Disease Types

VI. CONCLUSION

We discussed study of various diseases that occur on different plant type. Different techniques and methods were adopted for disease detection and algorithm used for image segmentation technique. Rice, tomato, grapes, mulberry and sugarcane, betel vine, wheat, chickpea etc. are some of the species on which survey was done and algorithms and methods were tested. The main stress was on leaf diseases because most of the diseases are found to be infecting the leaves of plants itself.

Thus, with various image processing techniques like Ostu's method, K- means clustering, feature extraction and classification optimum result were obtained which also showed efficiency of algorithm. This is also useful to identify diseases at an early stage. However, to

improve in future efficiency, density and recognition rate in classification process ANN, Bayes, Fuzzy Logic, Hybrid algorithm, Neural network, Bacteria Forging Algorithm can also be used.

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