PLANT LEAF DISEASE DETECTION USING IMAGE PROCESSING

V. Naveena Shree [$], R. Suwathi[$], T. Vinitha[$], Dr. V.T. Balamurugan*

[1,2,3]*Student & Bannari Amman Institute of Technology, Tamilnadu, India*
[4]*Professor, Dept. of Electronics and Instrumentation Engineering, Bannari Amman Institute of Technology, Tamilnadu, India*

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Abstract - *Agriculture plays an important role in Indian economy. The plant disease identification is the key for preventing the losses in the yield as well as agricultural product quantity. On the other hand, some factors like temperature, sunlight, soil moisture, pathogens and nutrition affect the growth of plants. Among those factors, pathogens are the major factor that leads to the destruction of the plant. To eradicate these pathogens, farmers use pesticides. Without identifying the type of pathogen, it is not advised to use any kind of pesticides. Image processing gives solution to overcome this problem. This paper involves K-means clustering algorithm to identify the disease of the plant. It also includes the comparison survey between K-means clustering and SVM algorithm. It gives an unmistakable view about the job of image processing in the recognition of plant infection. The diseases are detected by using the following processes; image acquisition, image pre-processing, image segmentation and feature extraction.*

***Key Words*: k means, SVM, leaf diseases,RGB images,HSI.**

1. INTRODUCTION

Indian economy is dependent of agriculture and its production. Therefore, in the agricultural field detection of disease in plants play an vital role. Almost all plants are affected mainly by fungal, bacterial or viral diseases. The climatic condition also plays an important role in affection of plants. To detect the plant disease at its initial stage, the technology used here is image processing and the main tool is MATLAB. The main aim is to increase the quality and reduce the usage of pesticides.

The existing method for detecting the disease in plant is simply an naked eye observation by experts. Since large team of experts and continuous monitoring of the plant is essential which costs much. Also farmers do not have proper facilities or even an idea, hence it is necessary to contact the experts. The plant disease not only affects the food scale but also the live hood of many small holding farmers whose income mainly depends only on agriculture field.In this conditions the proposed technique is addressed to be beneficial in monitoring the large field. Automatic detection technique will take less efforts, less time, and it is more accurate. This also supports machine vision to provide image based automatic process control, inspection and guidance. This mainly controls the plant disease. If the plant leaf disease is identified wrongly then it leads to huge loss of quality, time, money and production. Basically the disease in the plant are identified in stem, flower and leaves. The proposed method is done by observing the leaves for the identification of disease affected plants. The two main characteristics that are achieved in these methods are speed and accuracy.

2. LITERATURE SURVEY

[1] Savitha N. Ghaiwat , et. al., proposed that k- nearest-neighbour method seems to be the suitable method, simplest of all algorithms for detection and it also applicable for all types of small data set.But the drawback of this method is it fails to detect the optimal parameters for the non-trained data.

[2] Sanjay B. Dhaygude, et. al., proposed a method that involves mainly of four steps they are from input RGB image colour transformation structure. By detecting the pre computed threshold level, green pixels are removed and useful segments are masked. At last Classifier is used for the feature that are extracted to classify the diseases.

[3] Sabah Bashir, et. al., analysed the methodology of disease detection in leaf of malus domestica (Apple), an effective methods. They are k-means cluster algorithm texture and colour analysis to identify and detect various agricultural leaves.

[4] Kiran R. Gavhale, et. al., proposed a leaf disease detection. The important techniques used here are Back Propagation Neural Network(BPNN), K-nearest neighbour algorithm(KNN),Radial Basis Function(RBF) and Probabilistic Neural Network(PNN). Back Propagation Neural Network method is easy to implement as well as wide range of problems are applicable but it is a slow learning process. In Radial Basis Function, the training phase is faster as well as the hidden layer is easily interpreted but the execution process is very slow when the speed is considered as the factor.

[5] Y.Q. Xia, et. al., used a method of I ntelligent process to detect the disease in wheat plant. It captures the image of wheat and sends the respective data or image to the server. The server recognizes the data and computes the result.

[6] K. Padmavathi et. al., proppsed a comparative study that gives the RGB and gray scale image of the plant leaves. The colour becomes the most important feature while detecting the infected areas in the plants. The reason for transforming

the images into grey scale is that only the few information should be provided for each and every pixel.

[7] Sachin D. Khirade et. al., Identification of the plant diseases is the key to stopping the losses in the yield and quantity of the rural product. Disease detection entails the steps like picture acquisition, photograph pre-processing, photograph segmentation, function extraction and classification. This paper discussed the strategies used for the detection of plant sicknesses using their leaves snap shots.

[8] P.Revathi et. al., This proposed paintings is primarily based on Image Edge detection Segmentation strategies in which, the captured pics are processed for enrichment first. Later, image functions together with boundary, shape, colour and texture are extracted for the disease spots to understand illnesses and manipulate the pest advice.

[9] Mr. Pramod S. Landge,et. al., In this advocate and experimentally compare a software program answer for automatic detection and category of plant diseases via Image Processing. This paper addresses this hassle with the goal of developing photo processing algorithms that could understand issues in crops from pics, based totally on coloration and texture.

[10] Heeb Al Bashish et. al., In this paper an picture-processing-primarily based technique is proposed and used for leaf and stem disorder detection. In step one of the proposed approach, the photographs at hand are segmented the usage of the K-Means method, within the 2nd step the segmented pictures are handed via a pre-educated neural network.

3. PROPOSED WORK

3.1 K-MEANS CLUSTERING ALGORITHM

K-Means clustering shown in the figure 1 is a simple unsupervised learning algorithm that is used to solve clustering problem. K-Means clustering is used for clustering analysis especially in data mining and statistics.

The first step in K-Means clustering is loading the input image then convert the RGB image into L*a*b colour space. RGB images are the combination of primary colours that is red ,blue and green. RGB image feature pixel is a counting technique which is extensively applied to agricultural science.

The L*a*b consists of ,'L*'- Radiance layer, 'a*'- chromaticity layer(indicating the colour falling along the red green axis),'b*'- chromaticity layer(indicating the colour falling along the blue yellow axis)

Euclidean distance between two objects is defined as,

Dis(a,b) = √ ∑(x-y)^2

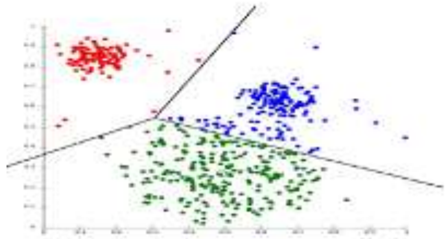


Fig -1: K-Means clustering algorithm

Based on the feature of the leaf this algorithm is used to cluster or divide the leaf into K number of groups. The K value should be selected by the user. The number of groups are clustered is defined as the value K. The nearest centroid is assigned to every pixel.

K means clustering shown in the figure 2 is a better choice to place them as much as possible away from each other. Each point belongs to the given data set and associate it in the closest centre. When no point is pending initial step is completed and then first group age is done. In this stage it is necessary to recalculate K-new centroids which results from the previous process. Loop has been generated. K centroids changes their location according to the input image. Finally clustering is done and the algorithm aims in minimising an objective function.

Fig -2: Clustering of leaves

3.2 RGB TO HSI CONVERSION

The steps that are to be followed are, The input RGB image is read. Then it is represented as the range[0 1].Then find HSI components.

$$\theta = \cos^{-1}[\frac{1}{2(R-G)} + (R-G)/(R-G)^2 + (R-B)(G-B)^{1/2}$$

HUE: H=θ $if\ B \leq G$

H=360-θ $if\ B > G$

SATURATION: S=1-3/(R+G+B)

INTENSITY: I=1/3(R+G+B)

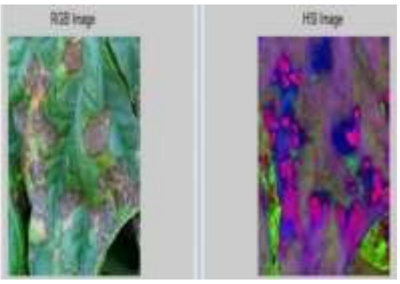
e 

Fig -3: RGB to HSI conversion

RGB image is read using 'imread' function. The RGB component will be in the range of (0 to 255). Then it is represented as [0 1] by dividing the image by 255.Theta value should be found. If the value of B is less than or equal to G then the value of H is θ. If the value of B is greater than G then the value of H is 360-θ.

3.3 SUPPORT VECTOR MACHINE

In machine learning, SVM or Support Vector Networks shown in the figure 4 are supervised learning model which areassociated with learning algorithms. The ana\lysed data used for classification and anaysis. SVM models are the representation of the examples as points in space, mapped so that these examples of the different categories are divided by a clear gap that is as wide as possible. SVM can efficiently perform a non linear classification by using the algorithm called Kernel Trick in addition to performing the linear classification. A good separation is possible by using hyperplane which has the longest distance to the closest trained data point of any class by lowering the generalisation error of the classifier. SVM allows to classify data which are linearly separable for non-linear classification, Kernel Trick can also be used. In comparison with newer algorithms like neural networks, they may have two advantages: better performance with limited number of samples and higher speed with good efficiency. This algorithm is very suitable for text classification problems. It is most commonly and to access a dataset of tagged samples.

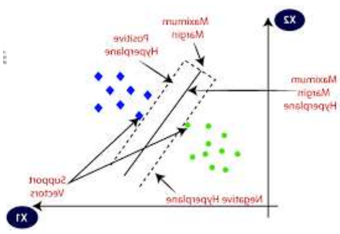


Fig -4: Support Vector Machine

SVM is a maximum linear classifier with a maximum range which achieves maximum separation by using hyperplane to classify, it might end up closer to set of dataset compared to others. The concepts of maximum margin classifier or hyperplane is an apparent solution.

3.4 IMAGE PROCESSING TECHNIQUES

3.4.1 IMAGE ACQUISITION

Leaf is captured through high resolution camera. Image will be in the form of RGB(Red, Green, Blue) form. Colour Conversion Structure for the RGB image is created. Colour Space Conversion for the colour variation is applied to the image like HIS observation model. To improve the precision of the disease detection and classification process, device dependent colour space is required. The procedure includes obtaining pictures from any equipment sources or from any database. This is the initial phase in the process of image processing. The obtained image is in RGB format.

3.4.2 IMAGE PREPROCESSING

Image pre-processing is to remove noise in the image. Different types of filters are used to remove noise. Cropping of the leaf image is to get the interested image region. Image smoothening is done by using smoothening filter. Image enhancement is applied for increasing the contrast. Apply device independent colour space transformation, that converts the colour value in the image to colour space specified in the colour transformation structure. RGB values will be altered as brightness and contrast. The main motive to use image pre-processing is to improve the image data. It is used to supress unwanted distortions. Pixel brightness transformation is used to improve the contrast of the image.

3.4.3 IMAGE SEGMENTATION

Image segmentation is the process of dividing an image into multiple parts. The main aim of segmentation is to simplify the image into a form that is much easier to analyse. K-means clustering algorithm is used to partition the image into various parts having similar or unique features. Division of image into diverse part of the same skin tone. Simply the representation of the image, which is more meaningful as well as it is easier to analyse. K means clustering is more suitable than other clustering techniques. It is commonly used for image compression or object recognition.

3.4.4 FEATURE EXTRACTION

Input image is enhanced to protect information of the protenious pixels before coloured from the background. It is used to reduce effects of illumination and distinguish between diseased and non-diseased leaf colour, resulting colour pixels are clustered to acquire group of colours in the image. Feature extraction is based on specified threshold value, that is computed for corresponding pixel value. The intensity will be less than the pre computed threshold value, when pixel value of RGB is set to zero. Feature extraction gives more accurate disease classification and significant to reduce the processing.Contrast: The measure of intensity is returned between the pixel and neighbour over the whole image.

$$Contrast = \sum_{i,j=0}^{N-1} C(i,j)(i,j)^2$$

Energy: It gives the sum of squared elements. The energy of the contrast image is 1.

$$Energy = \sum_{i,j=0}^{N-1} C(i,j)^2$$

Homogeneity: It gives the value of closeness that is measured. Homogeneity for diagonal segment is 1.

$$Homogeneity = \sum_{i,j=0}^{N-1} \frac{C(i,j)}{1 + (i-j)^2}$$

Correlation: It gives the measure of pixel how it is correlated to the neighbour of the whole image. The value is 1 or -1 for perfect positive or negative image.

$$Correlation = \sum_{k=i,j=0}^{N-1} (i * j) * C(i,j) - (\mu x - \mu y)/\sigma x * \sigma y$$

3.5 BLOCK DIAGRAM OF THE PROPOSED SYSTEM

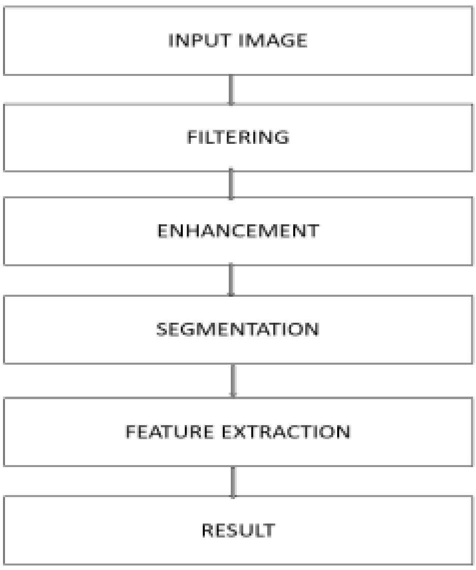


Fig -5: Block diagram of proposed system

Input image is initially detected through web camera or digital camera. It is then processed for filtering, where the noises are removed. The filtered image is enhanced where the image is brightened and increasing the contrast of image. The brightened image is segmented for better and accurate results. The process of segmentation of the input images increases the efficiency of the result. The diseases are clearly identified through segmentation process. The required features are extracted from the input image and compared to the trained data. Required or interested data are analysed and diseases are detected by comparing with RGB pixels of the images. Thus the diseases is detected and the results are displayed according to the input image.

4. RESULT AND DISCUSSION

The input image is captured using the web camera then the image forms an different clusters, the clusters that are infected is selected. Then the green pixels are marked that is based on the threshold value which is set already. As well as the pixels on the boundary of the leaf is removed. Then RGB image is converted into HSI model. The feature values are extracted for this particular type of disease. Similarly, the values can also be obtained for other types of diseases. After these features are analysed, they are compared and finally indicated as whether it is healthy or infected. In next phase it uses the K-means clustering and SVM algorithm for the effective classification of diseases. This process is tested for different types of diseases and found that accurate result is obtained. This algorithm gives highest accuracy when compared to other algorithms.

Number of leaf pixels affected=

Total percent of affected area in the leaf

Total number of pixels

The challenges that are obtained is optimization and the effect of noise in the background. But the proposed system gives the effective as well as accurate result when compared with other techniques with less computational work.

Fig -6: Input image

In figure 6, the diseased leaf of tomato plant is captured using the web camera and then the diseased area are marked in respective clusters. The features are extracted and finally the result is displayed with respective disease name. The result of sample leaf in clustering on Septoria Leafspot of tomato plant is shown in the figure 7.

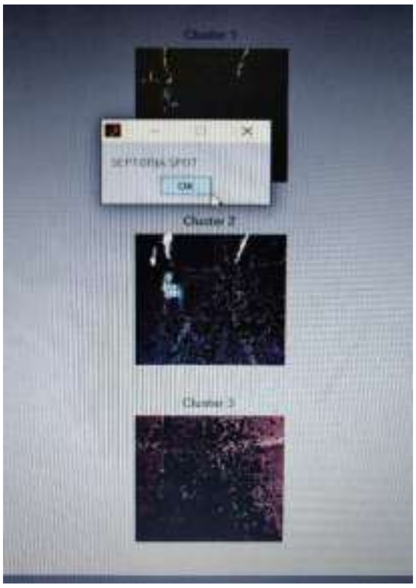


Fig -7: Diseased leaf

When the healthy leaf of tomato plant is captured using the web camera and the image is converted to the respective form. The features are extracted and finally the result is displayed as healthy image.

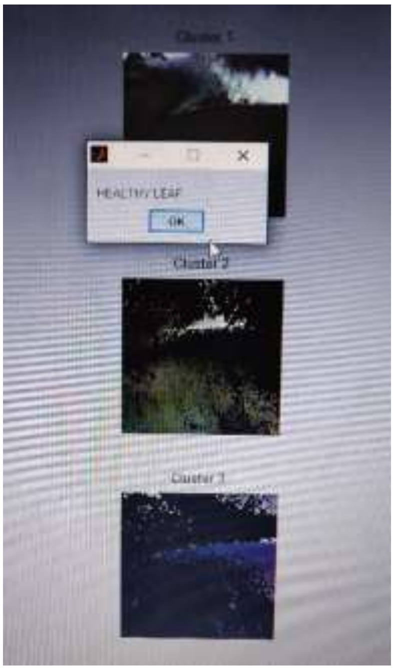


Fig -8: Healthy leaf

5. CONCLUSION

The precise recognition and grouping of the plant infections are vital for the effective development of plants and this is possible by utilizing image processing. This paper examines different procedures to section the infected part of the plant. It also talked about some feature extraction and grouping procedures to separate the tainted leaf and the characterization of plant ailments. The utilization of techniques for order of sickness in plants could be done. From these strategies, we can precisely recognize and arrange different plant ailments utilizing image processing procedures. In future we have planned to increase the efficiency and accuracy of the disease detection by using other algorithms. Also, in future the large number of diseases could be identified by this algorithm.

REFERENCES

[1] R. Pydipati, T. F. Burks, and W. S. Lee, **"Identification of citrus disease using color texture features and discriminant analysis,"** Computers and Electronics in Agriculture, vol. 52,no. 1-2, pp.49-59, 2006.

[2] A. Meunkaewjinda, P. Kumsawat, K. Attakitmongcol,A. Srikaew, **"Grape leaf disease detection from color imagery using intelligent system"**, Proceedings of ECTI_CON,2008.

[3] Y.Geng, study on **"Crop Disease Diagnosis Based on Image Recognition"** University of science and technology of China, Anhui, China, 2009.

[4] Chunxia Zhang, Xiuqing Wang, Xudong Li, **"Design of Monitoring and Control Plant Disease System Based on DSP &FPGA"**, Second International Conference on Networks Security Wireless Communications and Trusted Computing,2010.

[5] Sabah Bashir, Navdeep Sharma**"Remote area plant disease detection using image processing"** IOSR J Electron CommunEng,2012.

[6] Mrunalini R. Badnakhe, Prashant R. Deshmukh, **"Infected Leaf Analysis and Comparison by Otsu Threshold and k-Means Clustering"**, International Journal of Advanced Research in Computer Science and Software Engineering, vol. 2, no. 3, March 2012.

[7] Sanjay B. Dhaygude, Nitin P. Kumbhar**"Agricultural plant leaf disease detection using image processing"** Int J Adv Res Electr Electron InstrumEng,2013.

[8] Savitha N. Ghaiwat, Parul Arora **"Detection and classification of plant leaf diseases using image processing techniques"** Int J Recent Adv EngTechnol, 2014.

[9] Wenjiang Huang, Qingsong Guan, Juhua Luo, Jingcheng Zhang, Linsheng Huang, Dongyan Zhang, **"New Optimized Spectral Indices for Identifying and Monitoring Winter Wheat Diseases"**, IEEE journal of selected topics in applied earth observation and remote sensing, IEEE vol. 7, no. 6, June 2014.

[10] Y.Q. Xia, Y.Li and C. Li, **"Intelligent Diagnose System of Wheat Diseases Based on Android Phone,"** J. of Infor. and Compu. Sci. 2015.

[11] K. Padmavathi and K. Thangadurai, **"Implemetation of RGB and Gray scale images in plant leaves disease detection-comparative study,"** Indian J. of Sci. and Tech. 2016.

[12] Radha, Suja, **"Leaf Disease Detection using Image Processing"**, Journal of Chemical and Pharmaceutical sciences, March 2017.