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Vision Based Classification of Different Diseases of Grape Leaves and their Severity

Mahantesh C. Elemmi, Shanta Kallur, Nitin Rameshi, Nikhil Aivalli, Prabhat Nayaki, Adarsh Naik
Department of CSE, K.L.E. Institute of Technology, Hubli, India
E-mail:mc_elemmi2004@rediffmail.com, shanta06kallur@gmail.com, nitin99ramesh@gmail.com, nikhilaivalli@gmail.com, prabnayak@gmail.com, adarshjnaik@gmail.com

Abstract

Grape leaf diseases are one of the most important reasons that lead to the destruction of grape fruits. The annual worldwide yield losses due to pests are estimated to be billions of dollars. Integrated pest management (IPM) is one of the most important components of crop production in most agricultural areas of the world, and the effectiveness of crop protection depends on accurate and timely diagnosis of phytosanitary problems. Detecting those diseases at early stages enable us to overcome and treat them appropriately. Here, we are classifying grape leaf images as healthy or diseased. The diseased leaf image is classified into various types along with their severity. This is carried out with the help of digital image processing which involves image analysis, visual examination and inspection of color

INTRODUCTION

India is a land of agriculture. Agriculture and Industries form the backbone of our economy as about 70% of our country's population basically derives its employment from these domains. Proper agricultural procedures accompanied with efficient use of industrial products decides the overall crop yield. Judicial application of resources and planned utilization of smart techniques leads to progress in agricultural production accounting to wide consumer acceptance.

Development in the agricultural sector is nether in comparison with the flow of development in electronic and automobile sector. Thus there is a vital need for the invention of some novel procedures so as to put the agricultural sector on pedal again. Evaluation of the agricultural produce on the basis of quality standards is necessary to meet the increasing market value. The error rate increases when the classification and grading is done through manual techniques. Classification is mainly based on prime factors such as texture, size, weight etc. If these quality measures are mapped into ***automated system*** by using suitable tool, then the work will be faster and error free.

Grape is one among the commercial crops that has high demand in market, and it contains few antioxidants which plays a key role in preventing cancer and other diseases.

The Government of India is supporting the grape industry of the country by:

- Encouraging and support the farmers for establishing the vineyards and installing drip irrigation systems by providing soft loans and subsidies.
- Providing research support to sustain the productivity of grapes under adverse situations.

  Promoting and supporting the export of fresh grapes by training the growers and providing soft loans and subsidies for pre-cooling and cold storage facilities

LITERATURE SURVEY

Literature survey is based on the previous research work that has been done. In providing understanding all research papers is actually not compactable in this

range of dissertation, so only the most inspiring paper is taken for the analysis.

[Ahmed Abd El-Wahed Rafea et. al., 2003] have said that leaf spots indicate crop diseases. In this, an integrated image processing system is developed to automate the inspection of these leaf batches and help to identify the disease type. The developed system consists of four stages; the first is the enhancement, which includes HSI transformation, histogram analysis, and intensity adjustment. The second stage is segmentation which includes adaptation of fuzzy c-mean algorithm parameters to fit the application in concern. Feature extraction is the third stage, which deals with three features, namely; color, size, and shape of the spots. The fourth stage is classification which comprises of a back propagation based neural network. The cucumber crop is considered and diseases, such as, powdery mildew, leaf miner, and downey mildew have been identified.

[Burks.T.F, et. al., 2002] have presented the use of computer vision and image processing techniques in the early detection and classification of diseased citrus leaves from normal citrus leaves. Algorithms based on image processing techniques for feature extraction and classifications are designed. Various classification procedures are implemented to test the classification accuracies. The classification approaches used are statistical classifier using the Mahalanobis minimum distance method, neural network based classifier using the back propagation algorithm and neural network based classifier using radial basis functions. Four different classes of citrus leaves, greasy spot, melanose, normal and scab are used for citrus leaf classification.

[Paul Boissard, et. al., 2008] have presented cognitive vision system that combines image processing, learning and knowledge-based techniques approach to early pest detection in greenhouse crops. A strategy based on advances in automatic interpretation of images applied to leaves of roses has been presented. Comparison with manual methods, the results have shown that automatic processing is reliable.

[Mohammed Hussien El-Helly et. al., 2004] have presented a novel approach for integrating image analysis techniques into diagnostic expert systems. The fungal disease for cucumber is given as a case study. The image of the defected plant is used as an input. The image analyzer component detects the abnormal symptom in the defected image then extracts their features and classifies these features to a specific class. These classes are stored in a dynamic database to be interpreted by the interpreter. The interpreter converts each record in the dynamic database into a disorder(s) name and sets this disorder name into working memory as a hypothesized disorder.

[Anand. H. Kulkarni1, Ashwin Patil R. K] have proposed a paper in which the work begins with capturing the images. Filtered and segmented using Gabor filter. Then, texture and color features are extracted from the result of segmentation and Artificial neural network (ANN) is then trained by choosing the feature values that could distinguish the healthy and diseased samples appropriately.

Motivation and Problem definition

From literature survey we found that, work on automation of grape fruit and its diseases and other leaf based diseases are carried out. There is need for automation of work related with the classification of grape diseases and also their severity using image processing techniques. Hence, the work **"Vision based classification of different diseases of grape leaves and their severity".**

PROPOSED METHODOLOGY AND OBJECTIVES

Proposed Methodology

Tree structure shown in Fig. 3.1 shows the work carried out in the proposed work.

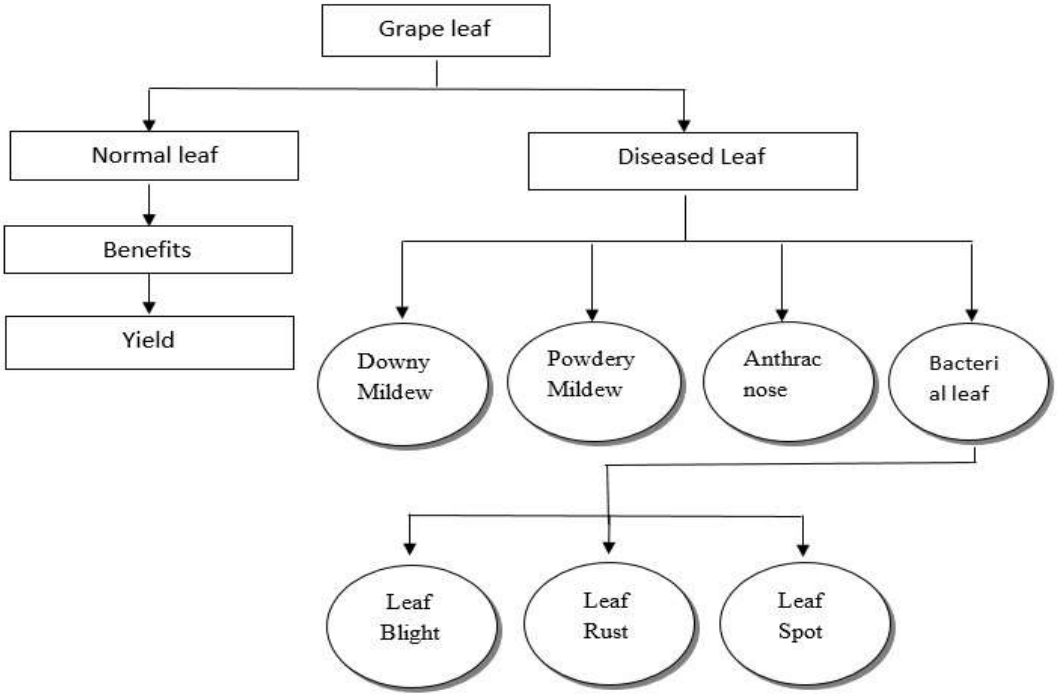

Fig. 3.1: *Tree structure showing the work to be carried out*

In the tree structure, first level is the grape leaf image classified into two types as normal or diseased. There is a distinct visual difference between healthy grape leaf images and diseased poisonous leaf images. The features determining this difference are colour, shape and shape. In the next level, diseased leaf is classified into three types as Downy Mildew, Powdery Mildew, Anthracnose and Bacterial leaf disease.

Objectives

- To identify the leaf images into normal and diseased.
- To identify diseased leaf image into different categories namely, Downy mildew, Powdery mildew, Anthracnose and Bacterial leaf.
- To identify the severity as pre-stage, later stage and severe stage.

3.1 Phases used in the Proposed system

The phases of the proposed work are as shown in Fig. 4.2. The phases are image acquisition, pre-processing, image segmentation, feature extraction and classification.

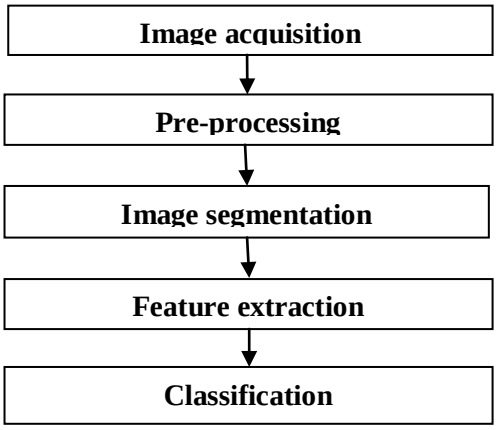

Fig. 3.1: *Phases used in the proposed work*

Image Acquisition

In the first step, the images of normal and diseased leaves are acquired using a digital camera with high resolution for better quality. The images are acquired by visiting fields periodically. During image acquisition, the images are captured with different distances and light intensity. The table gives the different types of diseased and normal grape leaves collected during phase of image acquisition.

Table 2: *Number of images collected for each grape disease*

S.NO	Variety Name	Total Images Collected
1	Anthracnose	75
2	Bacterial leaf	72
3	Downy Mildew	68
4	Powdery Mildew	81

The samples of the collected data are shown in Fig 3.2.1

Fig. 3.2.1(a): *Images of normal grape leaves*

Fig. 3.2.1(b): *Images of Downy mildew diseased leaf images*

Fig. 3.2.1(c): *Images of Powdery Mildew diseased leaves*

Fig. 3.2.1(d): *Images of Anthracnose diseased leaves*

Fig. 3.2.1(e): *Images of Bacterial leaves*

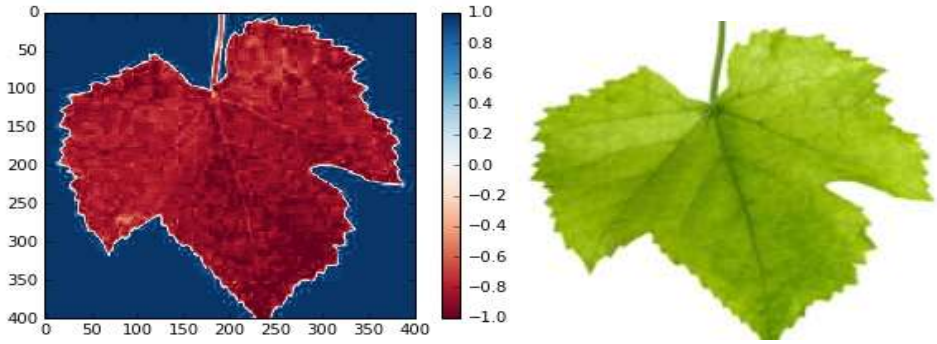

Fig. 3.2.2: *The image before and after colour space conversion and resizing*

Pre-processing

Pre-processing mainly deals with improving the image data by suppressing the undesired distortions and some important features of the image are enhanced which is useful for processing and analysis task. It mainly comprises of image enhancement and colour space conversion.

Colour space conversion: Translating and representing a colour from one basis to another is called as colour space conversion.

Image Enhancement

Image enhancement is required to improve the quality of affected images to highlight important disease features and to make the image more suitable for identifying the symptoms. The symptoms need to be clear during identification and classification. Image features need to be very distinct in case of diseases. This task involves development of methodology for

enhancing those features that make identification of diseases accurate.

Image Segmentation

During disease identification, we need to work in the affected areas which become the regions of interest. The region of interest is identified. Different segmentation techniques and their performances in our work will be taken up. There are various techniques for image segmentation discussed below.

Region based: technique involves grouping of pixels which are related to an object, usually a closed area is chosen for segmentation. We won't find any kind of gaps in this type of segmentation due to the missing edge pixels.

Edge based: In this technique edges are detected to find the discontinuities in the images, boundary of the image is mainly identified for segmentation.

Feature extraction

Diseases are characterized in many ways. Some changes are observed in color of leaves, some develop spots on leaves, some check the growth and the like. These characteristics become features in our proposed work. Shape, texture are used as features to identify the diseased leaf.

Different features of images are extracted and the image database is generated. The feature values of different types of leaf diseases are shown in Table 3, Table 4, Table 5, Table 6 and Table 7. The textural features ans morphological features are extracted and are given in tables.

Table 3: *Feature values for Anthracnose leaf disease*

Image No	Image Name	Average mean Intensity	Average Area	Average Perimeter	Average eccentricity	Average Equivalent Diameter
1	1.jpg	4.948919471	0.83990617	2634	795.7272727	27.6254114
2	12.jpg	4.402053586	0.719671219	1867	575.2727273	20.83156449
3	13.jpg	1.273088919	0.6437732	143865	9999.4375	49.20461513
4	2.jpg	1.273088919	0.6437732	143865	9999.4375	49.20461513
5	21.jpg	3.452936741	0.876858903	1925	607	21.88575891

Table 4: *Feature values for Downey Midew leaf disease*

No	Image Name	Average mean intensity	Average Area	Average Perimeter	Average eccentricity	Average Equivalent diameter
1	2.jpg	1.983973593	0.469043578	20	12.5	3.951633334
2	dsc02466.jpg	3.39184461	0.40112692	5784	241.137931	8.292029265
3	dsc02467.jpg	4.298855264	0.310725585	40	15.16666667	4.18492486
4	dsc02468.jpg	1.664915754	0.446593541	35	14.5	4.173627665
5	dsc02469.jpg	3.432656964	0.425649504	40	17.55555556	4.566767325

Table 5: *Feature values for normal leaf*

Image No	Image Name	Average mean Intensity	Average Area	Average Perimeter	Average eccentricity	Average Equivalent Diameter
1	31.jpg	1.730593261	0.282473902	18	10.3030303	3.59893402
2	32.jpg	1.718404862	0.469378939	26	11.81818182	3.819971665
3	40.jpg	1.805442348	0.388241079	18	11.33333333	3.773681972
4	41.jpg	1.724661472	0.141324068	15	9.888888889	3.533379496
5	49.jpg	1.56644527	0.288613729	21	11.04	3.703375327

Table 6: *Feature values for bacterial leaf disease*

Image No	Image Name	Average mean Intensity	Average Area	Average Perimeter	Average eccentricity	Average Equivalent Diameter
1	100.jpg	3.131912775	0.575508179	134741	1028.831169	10.17239922
2	101.jpg	5.542672856	0.641493206	2436	103.3139535	8.892475874
3	102.jpg	5.184282187	0.623475252	2112	87.91666667	8.257231306
4	103.jpg	4.974901842	0.630554949	99853	1542.671233	13.19652282
5	104.jpg	3.641862946	0.599558157	120125	1204.836066	10.93463306

Table 7: *Feature values for Powdery Mildew leaf disease*

Image No	Image Name	Average mean intensity	Average Area	Average Perimeter	Average eccentricity	Average Equivalent Diameter
1	1.jpg	1.803719	0.608249043	2821	139.0701754	8.040976436
2	10.jpg	2.078229089	0.65200421	134884	1026.131579	9.851980303
3	11.png	4.699943761	0.559342927	99	50.25	7.366145569
4	12.jpg	4.481936053	0.647437437	322	74.26666667	7.815552286
5	13.jpg	0.698185162	0.764927395	107719	846.1511628	10.79132816

CLASSIFICATION

In the proposed system, we have used SVM classifier to classify the various types of diseased images. It mainly includes two phases namely training and testing phase.

Training Phase: In training phase the images are been loaded and trained. Trained image values are been stored in data file.

1.Steps to Learn the images are

- Load the image of a grape.
- Pre-process and segment the image
- Extract features from the segmented image and learn using SVM
- After executing svm_python_learn the values will be stored in datafile Excel sheet.
- Repeat the same for all images.
-

Testing Phase: In testing phase, the images are been loaded and trained. The values generated will be compared to the stored values of the images.

2. Steps to test image

- Load the image of a grape.
- Pre-process and segment the image
- Extract features from the segmented image.
- The feature values are compared to the values stored in data file.
- Classify the image into specific category.

CONCLUSION

Due to the high initial cost of establishment of vineyards and high recurring cost of production the area under grape cultivation is not expanding. The proposed work mainly identifies symptoms of various diseases and helps to take action against them in the early stages. Thus, the proposed system gives solution to the farmers problem by saving their crop from deadliest diseases.

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