ISSN:0975-9646

Tejal Deshpande et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 5 (3) , 2014, 4638-4645

Grading & Identification of Disease in Pomegranate Leaf and Fruit

Tejal Deshpande[1], Sharmila Sengupta[2], K.S.Raghuvanshi [3]

[1] *Assistant professor, Electronics & Telecommunication, Xavier Institute of Engg*
[2] *Assistant professor, Electronics & Telecommunication, Vivekanand Institute of Technology*
[1,2] *University of Mumbai, India*

[3] *Associate professor, Plant pathology, Mahatma Phule Krishi Vidyapeeth*
[3]*Mahatma Phule agriculture university ,Rahuri, Ahmednagar India*

Abstract - **Present paper is an attempt to automatically grade the disease on the Pomegranate plant leaves. This innovative technique would be a boon to many and would have a lot of advantages over the traditional method of grading. There has been a sea change in the mindset and the effort put down by the agricultural industry by adapting to the current trends & technologies. One such example is the use of Information and Communication Technology (ICT) in agriculture which eventually contributes to Precision Agriculture. Presently, plant pathologists follow a tedious technique that mainly relies on naked eye prediction and a disease scoring scale to grade the disease. Manual grading is not only time consuming but also does not give precise results. Hence the current paper proposes an image processing methodology to deal with one of the main issues of plant pathology i.e disease grading. The results are proved to be accurate and satisfactory in contrast to manual grading and hopefully take a strong leap forward in establishing itself in the market as one of the most efficient and effective process.**

The proposed system is also an efficient module that identifies the Bacterial Blight disease on pomegranate plant. At first, the captured images are processed for enhancement. Then image segmentation is carried out to get target regions (disease spots) on the leaves and fruits. Later, if the diseased spot on leaf is bordered by yellow margin then it is said that leaf is infected by bacterial blight otherwise not. Similarly when black spots are targeted on fruits, they are checked for whether a crack is passing through these spots. If cracks are passing through the spots then the disease identified would be Bacterial blight. Based on these two characteristics bacterial blight on pomegranate can be appropriately identified.

Keywords— **Percent Infection, Bacterial Blight, K-means clustering, Morphology, colour image segmentation, Precision agriculture.**

I. INTRODUCTION

Sole area that serves the food needs of the entire human race is the Agriculture sector. Research in agriculture is aimed towards increase of productivity and food quality at reduced expenditure and with increased profit [1]. In the past few years new trends have emerged in the agricultural sector. Due to the manifestation and developments in the fields of sensor networks, robotics, GPS technology, communication systems etc, precision agriculture started emerging [2]. Precision agriculture concentrates on providing the means for observing, assessing and controlling agricultural practices. It also takes into account the pre- and post-production aspects of agricultural enterprises. The objectives of precision agriculture are profit maximization, agricultural input rationalization and environmental damage reduction, by adjusting the agricultural practices to the site demands. The challenge of the precision approach is to equip the farmer with adequate and affordable information and control technology.

Plant disease is one of the crucial causes that reduces quantity and degrades quality of the agricultural products. Disease is impairment to the normal state of the plant that modifies or interrupts its vital functions such as photosynthesis, transpiration, pollination, fertilization, germination etc. The emergence of plant diseases has become more common now days, as factors such as climate and environmental conditions are more unsettled than ever [2]. Plant diseases are usually caused by fungi, bacteria and viruses. Also there are other diseases which are caused by adverse environmental conditions. There are numerous characteristics and behaviours of such plant diseases in which many of them are merely distinguishable. The ability of disease diagnosis in earlier stage is an important task. Hence an intelligent decision support system for Prevention and Control of plant diseases is needed. This system uses some high-tech and practical technology to appropriately detect and diagnose the plant diseases. Technological advancement is gradually finding its applications in the field of agriculture [3]. The information and communication technology (ICT) application is going to be implemented as a solution in improving the status of the agricultural sector [4]. The idea of integrating ICT with agriculture sector motivates the development of an automated system for pomegranate disease classification and its grading.

Pomegranate (Punica granatum), so called “fruit of paradise” is one of the major fruit crops of arid region. It is Popular in Eastern as well as Western parts of the world. The fruit is grown for its attractive, juicy, sweet-acidic and fully luscious grains called ‘Arils’ [6]. The fruits are mainly used for dessert purposes. In India it is cultivated over the area of about 63,000 ha, and its production is about 5 lakh tons/annum. Important varieties cultivated are Ganesh, Dholka, Seedless(Bedana), Bhagwa, Araktha.

Figure1 shows three varieties of pomegranate fruit.

a) Bhagwa (b) Ganesh (c) Araktha

Figure1- Varieties of pomegranate

Based on size and colour, pomegranate fruits are graded as follows:

Super size- in which fruits are free from spots and individual fruit weight is more than750grams.

King size –in which fruits are attractive and individual fruit weight is 500-700 grams.

Queen size- in which fruits are attractive, red and individual fruit weight is 400-500 grams.

Prince size- in which fruits are attractive, red and individual fruit weight is 300-400 grams.

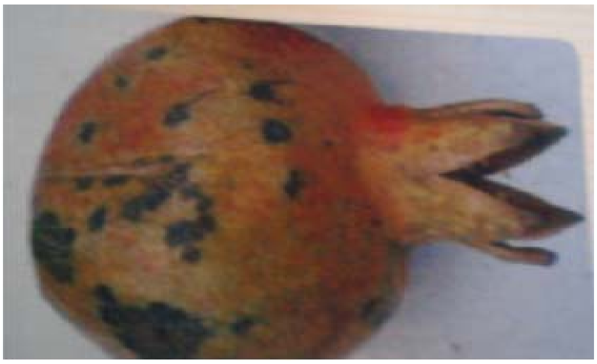
Unfortunately there are no organized marketing systems for pomegranate. Usually farmers dispose their produce to contractors who will later transport too far off markets. There is scope for exporting Indian pomegranates to Bangladesh, Bahrain, Canada, Germany, United Kingdom, Japan, Kuwait, Sri Lanka, Omen, Pakistan, Qatar, Saudi Arabia, Singapore, Switzerland, U.A.E. and U.S.A.

Diseases and insect pests are the major problems that threaten pomegranate cultivation. These require careful diagnosis and timely handling to protect the crops from heavy losses [6]. In pomegranate plant, diseases can be found in various parts such as fruit, stem and leaves. Major diseases that affect pomegranate fruit are bacterial blight (Xanthomonas axonopodis pv punicae), antracnose (Colletotrichum gloeosporoides) and wilt complex (ceratocystis fimbriata).

Image samples of these diseases are shown in Figure 2.

Wilt Complex

Anthracnose



Scab

Bacterial Blight on fruit

Bacterial Blight on leaf

Bacterial Blight on Stem

Figure2- Various diseases affecting pomegranate

Bacterial blight is the most severe disease of the pomegranate. The disease symptoms can be initially found on stem part which gradually pervades to leaves and then to fruits. On stem, the disease starts as brown to black spot around the nodes. In advance stages of nodal infection girdling and cracking of nodes lead to break down of branches. On leaves, the disease starts with small, irregular, water soaked spots that are 2 to 5 mm in size with necrotic centre of pin head size. Spots are translucent against light. Later, these spots turn light to dark brown and are surrounded by prominent yellow margin. Numerous spots may coalesce to form bigger patches. Severely infected leaves may drop off. On fruits brown to black spots appear on pericap with cracks passing through the spots. The disease spreads as the bacterium survives on the tree as well as in diseased fallen leaves. High temperature and high relative humidity favours the disease. The disease spreads to healthy plants through wind splashed rains and in new area through infected cuttings.

II. Manual Grading : Present Approach

Plants are bound to have diseases. The infected plants are diagnosed and treatment is suggested to cure the disease. To treat the disease chemical pesticides are used. Pesticides are substances or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. Chemicals are continually becoming a more intricate part of modern society. The rampant use of these chemicals, under the adage, "if little is good, a lot more will be better" has played havoc with human and also on agricultural products. Use of these toxic chemicals can only be minimised when the disease is identified accurately along with the stage in which the disease is observed.
Presently, the plant pathologists rely on disease scoring scale to grade the disease. This is shown in Table 1.

Percent Infection	Disease Grade
0 – 1	1
1-10	2
10-20	3
20-40	4
40-100	5

Table 1: Disease Scoring Scale for Leaves

From table 1, it is observed that the grade of the disease is assigned based on the percent-infection i.e., if the infection percent is about 5 then the grade is 2. The problem here is that even if the percent-infection is 2 or 9 the grade remains 2 only.
Presently, percent-infection is calculated based on grid paper analysis. This method is time consuming and burden of repetitive tasks. Since human intervention is involved, it is prone to errors also. Hence, now the time has come to overcome these problems. This can be achieved by inculcating machine vision into the agriculture to get the accurate grade of the disease. With this motto the present paper proposes an automatic and accurate disease grading system for plant leaves which can be of great use for the agronomists. For the experimentation purpose, pomegranate leaves are considered.

III. Methodology

Proposed method will grade and identify Bacterial Blight disease of pomegranate leaf and fruit.
The system architecture is presented in figure2.
The system is divided into the following steps: (1) Image acquisition (2) Image Pre-processing (3) Colour image segmentation (4) Calculating A_T and A_D (5) Disease grading

A. System Architecture

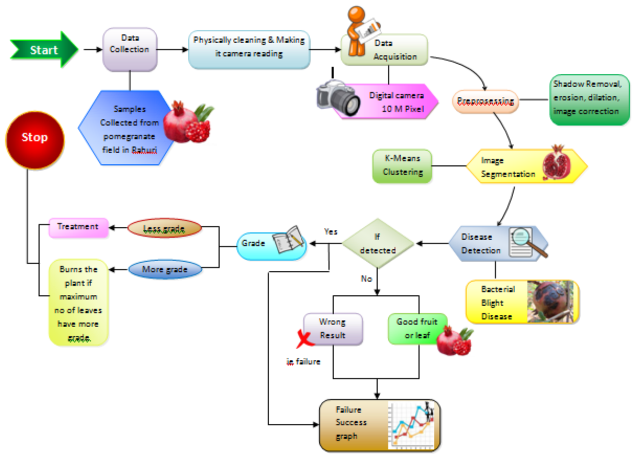


Figure2: System architecture

B. Image Acquisition

First stage of any vision system is the image acquisition stage. The digitization and storage of an image is referred as the image acquisition. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks required today. However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even with the aid of some form of image enhancement.
All the images are saved in the JPEG format. For the purpose of image acquisition, author has visited and captured images from several pomegranate farms in Rahuri, Ahmednagar district, Maharashtra, India.

C. Image Pre-Processing

Pre-processing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images[1]. Image pre-processing is the technique of enhancing data images prior to computational processing.
Image processing is a form of signal processing for which the input is an image, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image [1].
Pre-processing uses the techniques such as image resize, erosion, dilation, segmentation, cropping, etc.
Initially, captured images are resized to a fixed resolution so as to utilize the storage capacity or to reduce the computational burden in the later processing. Shadow may or not be there image acquisition. Shadow would disturb the segmentation and the feature extraction of disease spots. So it must be removed or weakened before any further image

analysis by applying shadow removal algorithms which makes use of morphology. In the present work, author has considered erosion, dilation operations for getting better results.

D. Image Segmentation

Image segmentation refers to the process of partitioning the digital image into its constituent regions or objects so as to change the representation of the image into something that is more meaningful and easier to analyze. The level to which the partitioning is carried depends on the problem being solved i.e. segmentation should stop when the objects of interest in an application have been isolated [5]. In the current work, the very purpose of segmentation is to identify regions in the image that are likely to qualify as diseased regions. There are various techniques for image segmentation. *K-means clustering* method has been used in the present work to carry out segmentation. K-Means Clustering is a method of cluster analysis which aims to partition *n* observations into *k* mutually exclusive clusters in which each observation belongs to the cluster with the nearest mean.
When the segmentation is completed, one of the clusters contains the diseased spots being extracted. This image is saved and considered for calculating A_D.

E. Calculating AT and AD

In image processing terminology area of a binary image is the total number of *on* pixels in the image[1]. Hence, the original resized image is converted to binary image such that the pixels corresponding to the leaf image are *on*. From this image total leaf area (A_T) is calculated. Similarly, the output image from color image segmentation, containing the disease spots, is used to calculate total disease area (A_D)[1].

F. Disease Grading

Once A_T and A_D are known, the percent-infection (PI) is calculated by applying the formula (1).
PI= (A_D / A_T) *100 . . . (1)
Grade of the disease has to be determined from PI.

Percent Infection	Disease Grade
0	0
0.1-5.999	1
6-15.999	2
16-25.999	3
26-35.999	4
36-45.999	5
46-55.999	6
56-65.999	7
66-75.999	8
76-100	9

Table2: Disease Scoring Scale for Leaves

Grading Process is shown in figure3.

G. Disease Detection

Image Pre-processing is carried out on the acquired image. Shadow removal and image correction algorithm are used in this stage. For removing shadow morphology fundamentals such as erosion and dilation are used. In image post processing the interested part is extracted by using K-Means clustering and its features are analyzed. If the leaf containing brown to black spot is bordered by yellow margin, denotes that the leaf is infected by Bacterial Blight. For fruits first the black spots are identified and if there is a crack passing through that black spot it signifies that the fruit is infected by Bacterial Blight. Cracks are found using canny edge detector.
Once the disease is identified, grading is done so that appropriate treatment advisory can be provided by seeking the help from agricultural experts so that the disease can be prevented from further spreading.
Disease detection process is shown in figure4.

IV. DESIGN

A. Flowchart for Grading

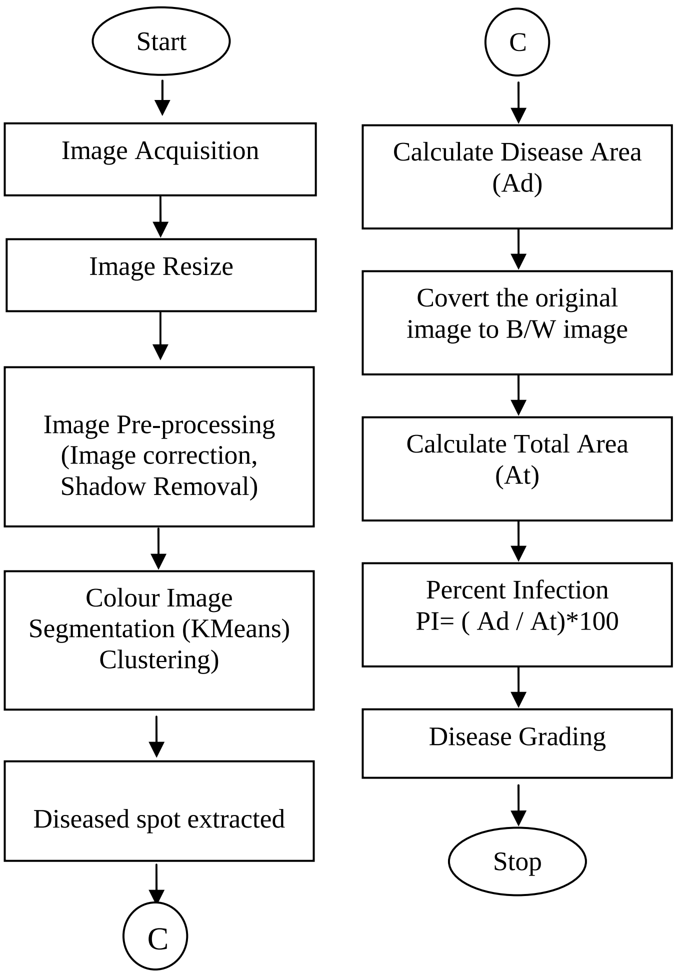


Figure3: Grading Process

B. Disease Detection Process

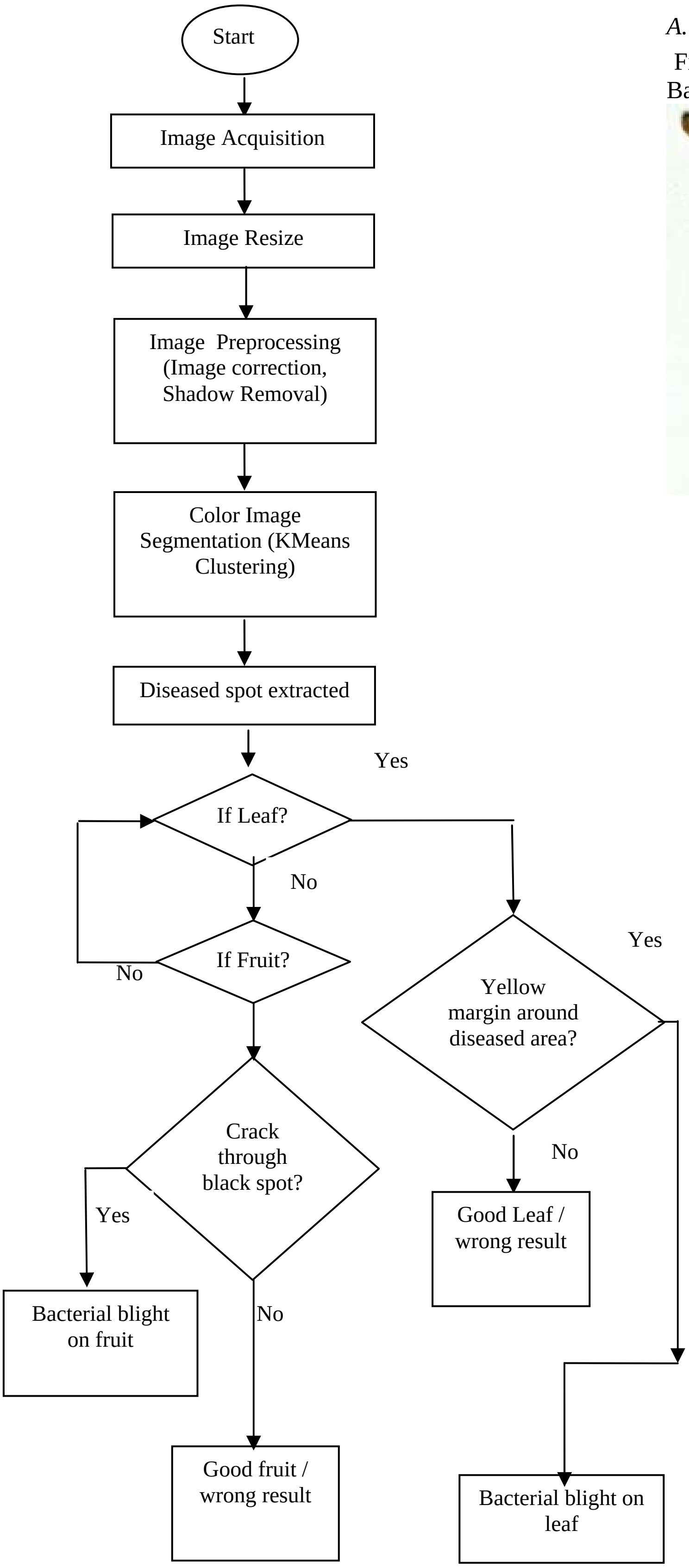


Figure4: Disease detection Process

V. RESULTS

A. Image Acquisition

Figure 5 shows the images of pomegranate leaf diseased by Bacterial Blight.

Sample 1

Sample 2

Sample 3

Figure5: samples of Leaf Diseased by Bacterial Blight

B. Image Pre-processing

Resize

The image is resized to a resolution of [250 300].

Morphology

Operations like erosion and dilation are used. Shadow removal algorithms are applied to the images wherever necessary.

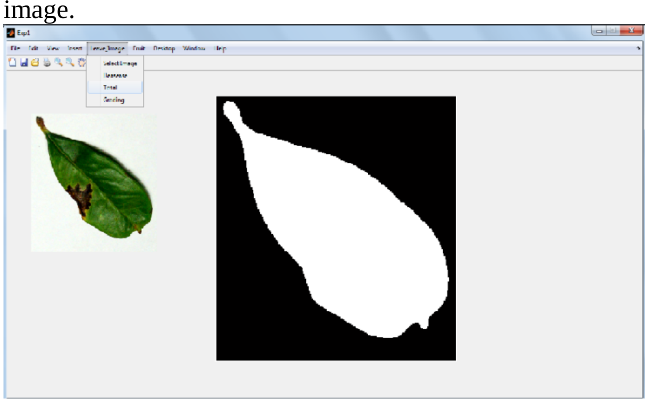
C. Colour image segmentation

K-means segmentation algorithm requires users to select the value 'k'. The correct choice of k is often ambiguous. Increasing k will always reduce the amount of error in the resulting clustering, to the extreme case of zero error if each data point is considered its own cluster (i.e., when k equals the number of data points, n). Intuitively then, the optimal choice of k will strike a balance between maximum compression of the data using a single cluster, and maximum accuracy by assigning each data point to its own cluster.

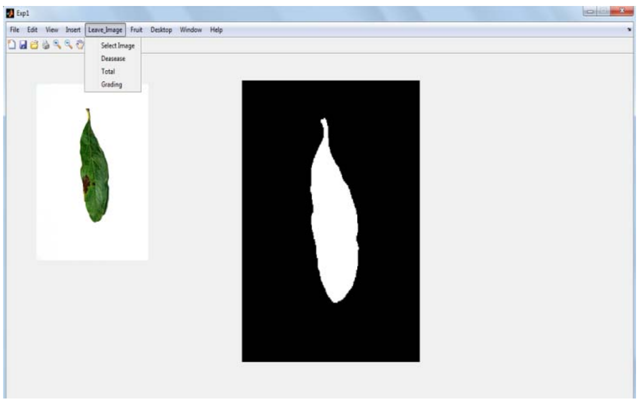
After some trial and error method, for the current work, value of K is chosen as 2.

D. Calculating A_T and A_D

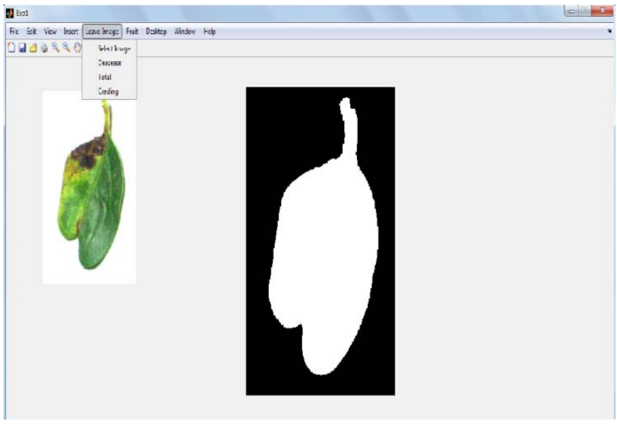
Figure6 shows the binary images of the original resized image.



Sample1



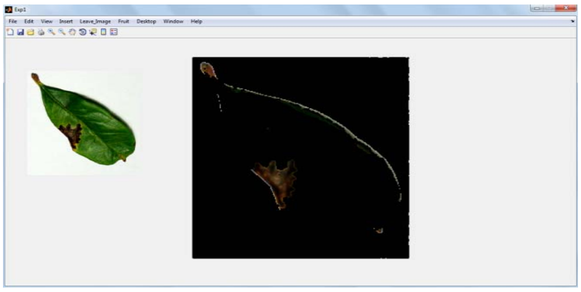
Sample 2



Sample 3

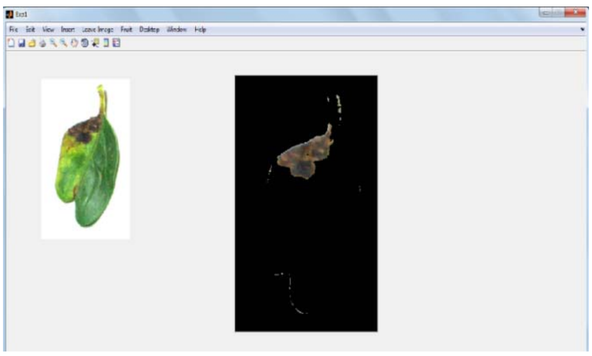
Figure6: Black and white images of the different query image

Figure7 shows the images of the diseased portion.



Sample1

Sample 2



Sample 3

Figure 7: Diseased portion of the different query image

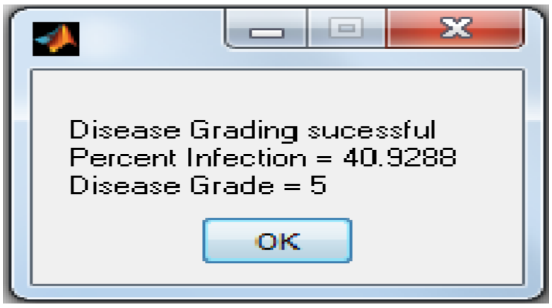
E. Disease grading

From (1), Percent-infection is given by

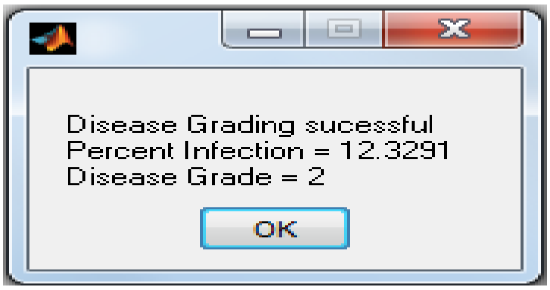
PI= (AD / AT) *100

= (72990/ 178334) * 100

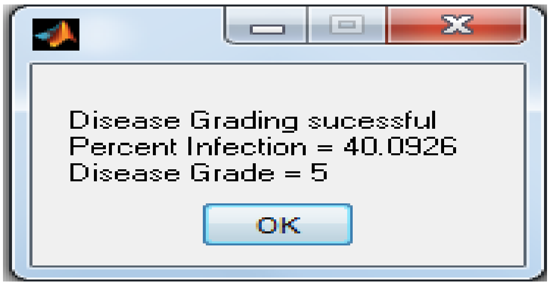
= 40.9288 %



Sample 1



Sample 2



Sample 3

Figure8: Grading Results of different Query images

A System is developed for disease grading by referring to the disease scoring scale in Table1 to grade the disease. Figure8 shows the result of grading for different images From the result, it can be observed that the accurate values of percent-infection and disease grade are obtained with which a proper treatment advisory can be given thereby eliminating the above mentioned problems. Also chemical spray frequency can be minimised thereby reducing chemical residue in plant parts i.e. food or fodder parts.

F. Disease Detection Results:

Edge Detection algorithms have been used along with black spot detection algorithm.

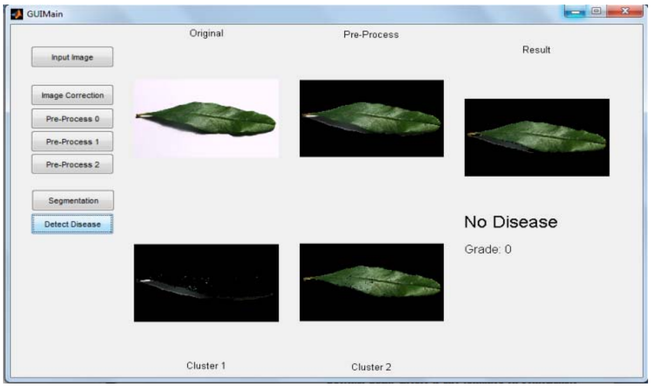


Figure9: Leaf Disease Detection for un-diseased leaf image

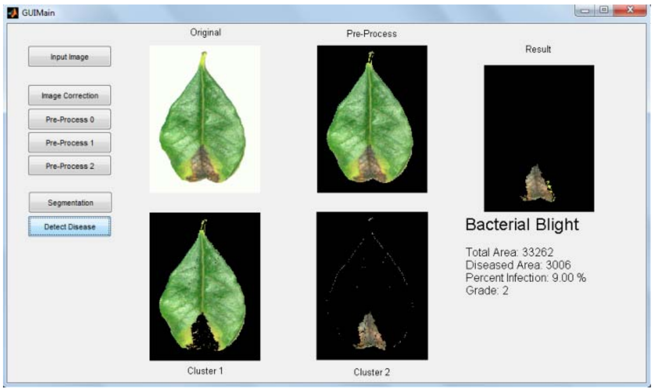


Figure10: Leaf Disease Detection for diseased leaf image

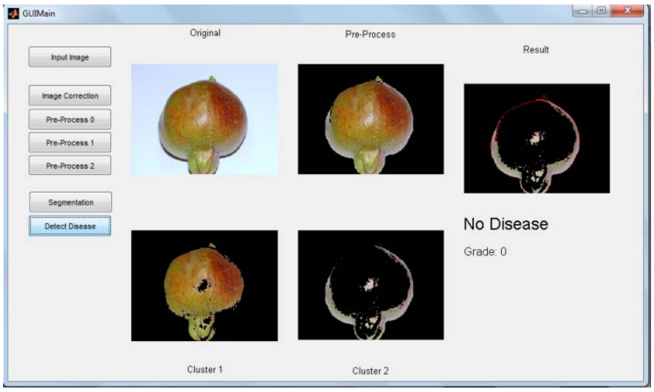


Figure11: fruit disease identification for un-diseased fruit image

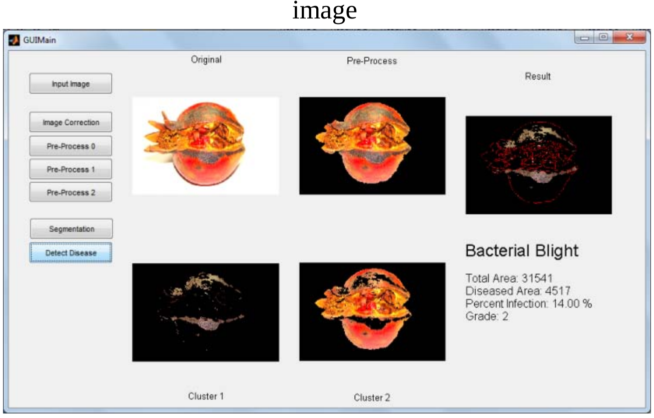


Figure12: fruit disease identification for diseased fruit image

VI. CONCLUSIONS

The main motive of this paper is to improve the efficiency and productivity through a robust system which can overcome the shortcomings of the manual process. Looking at the current scenario an approach to automatically grade the disease on plant leaves is very much essential. As discussed in the earlier sections Grading System built by Machine Vision is very useful for grading the disease. The disadvantages faced through the manual grading would be overcomed once this system is adopted and will help the pathologists in terms of complexity and time. Through research and experiments it has been observed that the results found are precise, accurate and acceptable. Also it is observed that the bigger the bacterial blight spots, higher grade is obtained

Bacterial Blight disease is also identified on pomegranate leaf and fruit. Once the disease is identified proper treatment advisory can be given to prevent further loss.

ACKNOWLEDGMENT

We thank Mahatma Phule Krishi Vidyapeeth (agriculture college) Rahuri, Ahmednagar district, Maharashtra India for providing their support and giving directions to the proposed work.

REFERENCES

[1] Sanjeev S Sannakki1, Vijay S Rajpurohit, V B Nargund, ArunKumar R, Prema S Yallur , "Leaf Disease Grading by MachineVision and Fuzzy Logic", Int. J. Comp. Tech. Appl., Vol 2 (5),1709-1716, 2011.

[2] Camargo, A. and Smith, J. S. (2009)." An image-processing based algorithm to automatically identify plant disease visual symptoms", Biosystems Engineering, 102(1) pp. 9-21

[3] Narendra V.G., Hareesh K.S. (2010). Prospects of Computer Vision Automated "Grading and Sorting Systems in Agricultural and Food Products for Quality Evaluation", International Journal of Computer Applications, 2, 1.

[4] Nur Badariah Ahmad Mustafa, Syed Khaleel Ahmed, Zaipatimah Ali, Wong Bing Yit, Aidil Azwin Zainul Abidin, Zainul Abidin Md Sharrif, "Agricultural Produce Sorting and Grading using Support Vector Machines and Fuzzy Logic", 2009 IEEE International Conference on Signal and Image Processing Applications

[5] Rafael C.Gonzalez & Richard E.Woods, "Digital Image Processing", Second edition, 2005.

[6] Üsmail Kavdir,Daniel E. Guyer, "Apple Grading Using Fuzzy Logic", Turk J Agric (2003), 375-382 © T.BÜTAK

[7] Meunkaewjinda, Kumsawat, At-takitmongcol, k.; and Srikaew, A. "Grape leaf disease detection from color imagery using hybrid intelligent system". ElectricalEngineering/Electronics, Computer, Telecommunications and Information Technology, 2008. ECTI-CON 2008. 5th International Conference on v.1, pp.513–516, 14-17 May, 2008.

[8] Mahendran R, Jayashree GC, Alagusundaram K, "Application of Computer Vision Technique on Sorting and Grading of Fruits and Vegetables", Food Process Technol S1-001. ISSN:2157-7110 JFPT, an open access journal.

[9] Tian Youw, Li Tianlai, Niu Yan (2008) Congress on Signal and image processing,978-0-7695-3119-9/08 $25.00 © 2008 IEEE DOI 10.1109/CISP.2008.29

[10] Nur Badariah Ahmad Mustafa, Nurashikin Ahmad Fuad, Syed Khaleel Ahmed, Aidil Azwin, Zainul Abidin, Zaipatimah Ali, Wong Bing Yit, and Zainul Abidin Md Sharrif (2008) 978-1-4244- 2328-6/08 © IEEE.

[11] Qing Yao, Zexin Guan, Yingfeng Zhou Jian Tang, Yang Hu, Baojun Yang (2009) International conference on Engineering Computation.