CHAPTER 1

INTRODUCTION

In India grape productivity is highest in the world and there is scope to raise it further. Grape export from India is about 53,910 tonnes valued at 48,505 that make a share of nearly 1.54% of total export of grapes in world. Near about 70% of population depends on agriculture. Grapes are an important fruit crop in India. Due to disease on grape plant there is loss of about 10-30 % of crop. Therefore there is a need to identify the diseases at the beginning and suggest solutions to the farmers so that maximum harms can be avoided so as to increase the yield. Farmers generally use naked eye observation to judge the diseases. But sometimes this may be an inaccurate way. Many times farmer needs to call the experts for detecting the diseases which is also time consuming in large farms [1]. The grape suffers from enormous loss due to the leaf diseases like: Powdery mildew, Downy mildew and anthracnose etc [2]. The disease on plant is on their leaves, fruits and on stem of plant. In an agriculture field, an early detection of leaf diseases is the major challenge. Using digital image processing techniques, number of applications has found in different fields such as industrial inspection, medical imaging, remote sensing, and agricultural processing etc.

India is eminent for Agriculture that means most of the people are engaged towards agriculture industry. The agriculture industry act as a significant role in the economic sectors. Most of the plants are infected by variant fungal and bacterial diseases. Due to the exponential inclination of population, the climatic conditions also cause the plant disease.

The major challenges of sustainable development is to reduce the usage of pesticides, cost to save the environment and to increase the quality. Precise, accurate and early diagnosis may reduce the usage of pesticides.

Data mining is termed as extracting the relevant information from large pool of resources. The advents of data mining technologies have been adopted in the prediction of plant diseases. Rice is one of the major crops cultivated in India.

Nowadays, technology is widely used for plant disease prediction. The management of perennial leaf requires close monitoring system especially for the diseases that affects production and post-harvest life.

The concept of image processing with data mining technologies assists us in following purposes:

1. Recognizing infected leaf.
2. Measure the affected area.
3. Finding the shape of the infected region.
4. Determine the infected region
5. And also influence the size and shape of the leaf.

The user is to select a particular diseased region in a leaf and the cropped image is sent for processing [4].This paper intends to study about the prediction of the plant diseases, at an untimely phase using k-mean clustering algorithm. Specifically, we concentrate on predicting the disease such as Alternaria alternate, Anthracnose, Cercospora, bacterial blight and leaf spot. It would be useful for identifying different diseases on crops [5].It provides various methods used to study crop diseases/traits using image processing and data mining. In addition, the infected area and affected percentage is also measured. Back Propagation concept is used for weight adjustment of training database [6].t disease detection.

Now days, a new concept of smart farming has been introduced where the field conditions are controlled and monitored using the self operating systems. The self recognition of the disease is based on the identification of the symptoms of disease. So that information about the disease occurrence could be quickly and accurately provided to the farmers, experts and researchers. This in turn reduces the monitoring of large field by human being. In disease recognition from image the key is to extract the characteristic feature of the diseased region. According to the disease the features may vary. The features that are extracted from the image are color, shape, texture etc. Sometimes for detection of the disease more features are extracted and these extracted features would increase the hardware as well as software cost. This further causes increase in the complexity and the computation time. Hence it is necessary to reduce the feature data.

The occurrence of the disease on the plant may result in significant loss in both quality as well as the quantity of agricultural product. This can produce the negative impact on the countries whose economies are primarily dependent on the agriculture. Hence the detection of the disease in the earlier stages is very important to avoid the loss in terms of quality, quantity and finance. Usually the methods that are adopted for monitoring and management of plant leaf

disease are manual. One such major approach is naked eye observation. But the requirement of this method is continuous monitoring of the field by a person having superior knowledge about the plants and its corresponding diseases. Moreover, appointing such a person would may prove costly.

Another approach is seeking advice from the expert which may add the cost. Also, the expert must be available in time otherwise it may results in loss. Diagnosis of disease on plant can also be done in laboratory testing. But this method requires satisfactory laboratory conditions along with professional knowledge. The pathogen detection methods can provide more accurate results. As the tests are carried out of field the cost may be high and could be time consuming.

This paper suggests a system which can provide more accurate results related to the identification and classification of disease. It tries to replace the need of the experts to certain extent. Here, the captured image is first preprocessed to resize it and then converted to HSI color space format by using segmentation. The features such as major axis, minor axis, eccentricity are extracted from the image. In the last step, these features are given to the classifier to classify the disease occurred on the leaf.

CHAPTER-2

LITERATURE SURVEY

In this section, various method of image processing for plant disease detection is discussed. The vegetation indices from hyper spectral data have been shown for indirect monitoring of plant diseases. But they cannot distinguish different diseases on crop. Wenjiang Huang et al developed the new spectral indices for identifying They consider three different pests (Powdery mildew, yellow rust and aphids) in winter wheat for their study. The most and the least relevant wavelengths for different diseases were extracted using RELIEF-F algorithm.

The classification accuracies of these new indices for healthy and infected leaves with powdery mildew, yellow rust and aphids were 86.5%, 85.2%, 91.6% and 93.5% respectively [1]. Enhanced images have high quality and clarity than the original image. Color images have primary colors red, green and blue. It is difficult to implement the applications using RGB because of their range i.e. 0 to 255. Hence they convert the RGB images into the grey images. Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images.

They used the MATLAB for the feature extraction and image recognition. In this paper pre-processing is done using the Fourier filtering, edge detection and morphological operations. Computer vision extends the image processing paradigm for object classification. Here digital camera is used for the image capturing and LABVIEW software tool to build the GUI. The segmentation of leaf image is important while extracting the feature from that image. Mrunalini R. Badnakhe, Prashant R. Deshmukh compare the Otsu threshold and the k-means clustering algorithm used for infected leaf analysis in [5]. They have concluded that the extracted values of the features are less for k-means clustering. The clarity of k-means clustering is more accurate than other method.

The RGB image is used for the identification of disease. After applying k-means clustering techniques, the green pixel is identified and then using Otsu's method, varying threshold value is obtained. For the feature extraction, color co-occurrence method is used. RGB image is converted into the 2015 International Conference on Computing Communication Control and Automation b HSI translation. For the texture statistics computation the SGDM matrix is generated and using GLCM function the feature is calculated [6].

The FPGA and DSP based system is developed by Chunxia Zhang, Xiuqing Wang and Xudong Li, for monitoring and control of plant diseases [7]. The FPGA is used to get the field plant image or video data for monitoring and diagnosis. The DSP TMS320DM642 is used to process and encode the video or image data. The nRF24L01 single chip 2.4 GHz radio transmitter is used for data transfer. It has two data compress and transmission method to meet user's different need and uses multi-channel wireless communication to lower the whole system cost.

Shantanu Phadikar and Jaya Sil use pattern recognition techniques for the identification of rice disease in [9]. This paper describes a software prototype for rice disease detection based on infected image of rice plant. They used HIS model for segmentation of the image after getting the interested region, then the boundary and spot detection is done to identify infected part of the leaf.

This paper presents a survey on methods that use digital image processing techniques to detect, quantify and classify plant diseases from digital images in the visible spectrum. Although disease symptoms can manifest in any part of the plant, only methods that explore visible symptoms in leaves and stems were considered. This was done for two main reasons: to limit the length of the paper and because methods dealing with roots, seeds and fruits have some peculiarities that would warrant a specific survey. The selected proposals are divided into three classes according to their objective: detection, severity quantification, and classification. Each of those classes, in turn are subdivided according to the main technical solution used in the algorithm. This paper is expected to be useful to researchers working both on vegetable pathology and pattern recognition, providing a comprehensive and accessible overview of this important field of research.

In an India 10% to 30 % of the total vegetable crop is destroyed yearly by diseases. chill production is decrease day by day due to disease. To achieve good accuracy and efficiency of disease detection and classification is challenging task. Traditional method of human eyes observation of plant is unpredictable for proper drug treatments. Using different techniques of Image processing leaf diseases will be identify and classify accurately. Continue observation of leaf is curtail and effective for exact disease identification. It goes toward proper drug treatment to crop which is help full for farmer. .Different image processing techniques are followed by distinguish researcher for leaf disease detection with help of Android application, client-server

architecture, sensor technology. Initially image acquisition using android mobile camera or web camera, image enhancement using histogram comparison conversion of RGB image ,image segmentation using clustering and classification using ANN are common steps for leaf disease detection. Focus on not only leaf disease identification but suggest proper pesticide when disease is arriving on crop.

A doubling in global food demand projected for the next 50 years poses huge challenges for the sustainability both of food production and of terrestrial and aquatic ecosystems and the services they provide to society.

Agriculturalists are the principal managers of global useable lands and will shape, perhaps irreversibly, the surface of the Earth in the coming decades. New incentives and policies for ensuring the sustainability of agriculture and ecosystem services will be crucial if we are to meet the demands of improving yields without compromising environmental integrity or public health.

Agricultural productivity is something on which economy highly depends. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. For instance a disease named little leaf disease is a hazardous disease found in pine trees in United States.

Detection of plant disease through some automatic technique is beneficial as it reduces a large work of monitoring in big farms of crops, and at very early stage itself it detects the symptoms of diseases i.e. when they appear on plant leaves.

This paper presents an algorithm for image segmentation technique which is used for automatic detection and classification of plant leaf diseases. It also covers survey on different diseases classification techniques that can be used for plant leaf disease detection. Image segmentation, which is an important aspect for disease detection in plant leaf disease, is done by using genetic algorithm.

CHAPTER 3

IMAGE PROCESSING TECHNIQUES

An image is the visual depiction of an object lit up by a radiation source and all Image formation has the following essentials, an object, a particle emission source (X-rays, visible light, electrons, etc.) And an image creation scheme [6]. Image processing is the technique of exploring and detection the varied pictures out there and providing the desired output within the type of pictures or different elaborate report [7].

3.1 Some Image Processing Algorithms

Algorithms for Image Processing Algorithms are the basis for computer Machine Vision and Image Analysis [8]. Employing a theoretical foundation – Image pure mathematics, powerful development tools such as Visual Fortran, Visual C++, Visual Java , Visual Basic and– high-level and efficient base computer, Vision Techniques have been developed by numerous research works. The analysis of the Elementary Image Processing and Machine Vision Algorithms ought to be divided in 5 major teams [9].

- Thinning and Skeletonization Algorithms
- Edge-Detection Techniques
- Digital Morphology
- Grey-Level Segmentation or Thresholding Methods
- Texture

3.2 Practices employed for analyzing the plants

There are basically two solutions:

1. Real time observation: In this method the field and crops are checked continually and an alarm is signaled as soon as an interest or a disease is sported in few of the plants [10].
2. Half-done Classification: When a sickness has to be known amidst many pathologies, it may be the simplest choice to perform the partial classification, in which the regions to be detected square measure being classified as per the explored symptoms and diseases, instead of applying a whole classification into any of the possible diseases.

Thresholding

This method tries to discriminate between the affected maize plants, which area unit already affected by the armyworms from the healthy crops victimization digital pictures. This model categorizes the algorithm into 2 methods: image process and image analysis. In the image processing stage, the image is transformed to a gray scale, threshold and filtered to remove art effects. In the image analysis stage, the whole image is split into 12 blocks. Blocks whose leaf space is less than five-hitter of the whole area unit are discarded. For each remaining blocks, the number of connected objects, representing the diseased and affected regions, is counted [7].

This method tries to discriminate a given sickness from different pathologies that have an effect on the rubber tree leaves. The algorithm will not need any reasonably segmentation techniques. Rather, principal component analysis is applied directly to the RGB values of the pixels of the low resolution (15X15 pixels) pictures of the leaves. Then, the first 2 principal elements square measure fed to the multilayer perceptron (MLP) neural network with one hidden layer, whose output reveals if the sample is infected by some disease of the interest that is familiar, or not [7].

3.3 Related Works

A lot of researchers have proposed and comes are with some conventional and non-conventional approaches in helping farmers to detect diseases as when their crops are affected. This paper takes a look at some of this work. As early as in the 90‟s an attempt was made by Hetzroni et al. (1994) cited by [1] using neural networks to monitor the health of plants. In their system, they tried to detect zinc, iron and nitrogen deficits by observing lettuce leaves. An analogue video camera was used in image capturing and then digitalized afterwards. The digital image is segmented into background and leaf in the first phase of their algorithm. The required feature (color and size) are extracted from RGB pictures of the image. These extracted parameters are fed finally into the analysis phase made of neural networks and statistical classifiers, which then determines the condition of the plant [1].

Sena et al. (2003) proposed a method of detecting diseases on leafs using a pre-set threshold value (h), which aims at differentiate among maize plants affected by fall armyworm from healthy employing digital images. Their proposed algorithm was divided

into two sections namely the image processing and image analyzing. At the processing stage the captured image is transformed to grey scale, filtered and tresholded to removed noise. The image is then divided into twelve block at the analysis stage of their algorithm and blocks with leafs less than 5% with respect to the total area V are thrown away. The number of connected objects (n) signifying the diseased areas is totaled for each remaining block. The plant is concluded to be disease infected if this number is above a set value (threshold), (thus if n > h) which, after experimental assessment, was set to 10 [11].

Al Bashish et al. (2010) proposed a method which attempts to detect 5 diverse plant diseases. The authors of this paper didn't lay down the types of plants used in their tests, and the images existed in situ. After a pre-processing stage to clean- up the image, a K-means crowding algorithm was applied to divide the image into 4 clusters. From their paper, at least one of the clusters must match to one of the diseases. Afterwards, a number of texture and color features are extracted from each by means of the supposed Color Co-Occurrence Technique, which runs with images in the HSI presentation. The features are then fed to a MLP Neural Network with ten (10) concealed layers, which implements the final identification and classification [12].

A mobile enhanced image processing approach for detecting plant leaf diseases was proposed. The research aimed at developing an image recognition system that can recognize crop diseases. The first stage of their methodology was to digitalize the uploaded leaf image by the system user via mobile phone to a remote server. A mathematics morphology is employed to segment these images, then shape, texture and color features of color image of disease spot on leaf is extracted, and finally a classification technique of associates functions was used to discriminate between the three types of diseases [13].

The research concluded that there are still numerous techniques that can be employed to better the detection and identification of diseases on plant leafs. Detecting the Plant Diseases and Issues by Image Processing Technique and Broadcasting was proposed by [7]. The proposal begins with, the image, then an analysis is carried out and eventually, the image is well understood and evaluated. This renders the required target of perceptive plants and their diseases. This forms the key factors of their paper. Their idea was to look at and determine the diseases that attacked the plants, with the help of sensors that use image process techniques to broadcast the captured image to the cloud. In turn, the image can then be viewed in any part of the world [7]. The research concluded that, their approach proves

to be an improvement compared to Boesse et al, in 2008 and Pagola et al in 2009.

Skaloudova in 2006 cited by [14] proposed another methodology plan that ascertains the injury caused in leaves by the spider bites and mites. Two stage Thresholding was the procedure used for this system. The 1st 1/2 the leaf in background was targeted within the first a part of the technique. The second part centers on the sorting of the healthy elements of the plants. The final estimation is provided the ratio of the quantity of pixels in injury areas and therefore the number of pixels of the healthy region. This approach was then matched with the outcomes of two unconventional ways and it was realized that the leaf damage index delivered extra advanced results than the opposite ways in contrast supported pigment and light [14].

Dhaygude & Kumbhar, (2013) proposed a texture statistics technique for plant leaf dieses detection, the developed processing theme consists of four main steps, first a color International Journal of Computer Applications (0975 – 8887) Volume 162 – No 2, March 2017 22 transformation structure for the input RGB image is created, his RGB is converted to HSI as a result of RGB is for color generation and his for color descriptor. Then green pixels area unit cloaked and removed mistreatment specific threshold worth, then the image is segmented and the helpful segments area unit extracted, finally the texture statistics is computed. From SGDM matrices. Finally the presence of diseases on the plant leaf is evaluated [15]. Their research concluded that there is a need to improve or to increase the recognition rate of classification process.

CHAPTER 4

Basics of Image Processing

The neuropeptide oxytocin has these days been seemed to improve eye gaze and feeling pervasiveness in sound people. Here, we archive a randomized twofold outwardly impeded, counterfeit treatment regulated primer that investigated the neural and social eventual outcomes of an unmarried bit of intranasal oxytocin on inclination unmistakable quality in individuals with Asperser issue (AS), a clinical situation portrayed through incapacitated eye gaze and facial inclination reputation. Using supportive alluring resonation imaging, we reviewed paying little respect to whether oxytocin may configuration feeling reputation from facial zones of the thought versus the mouth region and alter neighborhood activity as a main priority areas related to confront thought in each adult with AS, and a neurotypical control affiliation.

Intranasal the leading group of the neuropeptide oxytocin wandered forward execution in a facial inclination affirmation assignment in people with AS. This changed into associated with revived left amygdale reactivity as a result of facial lifts and extended redirection in the neural system related with social insight. Our assurances brief that the amygdale, all things considered with for all intents and purposes related cortical regions intervene the fine effect of oxytocin on social mental working in AS.

The neuropeptide oxytocin has these days been seemed to decorate eye gaze and feeling pervasiveness in solid people. Here, we record a randomized twofold outwardly hindered, counterfeit treatment regulated starter that reviewed the neural and social delayed consequences of an unmarried bit of intranasal oxytocin on inclination popularity in individuals with Asperser issue (AS), a clinical condition portrayed through handicapped eye gaze and facial inclination reputation.

Using profitable appealing resonation imaging, we examined paying little respect to whether oxytocin may decorate feeling reputation from facial regions of the thought versus the mouth area and parity neighborhood activity at the top of the priority list regions related to confront thought in each adult with AS, and a neurotypical control affiliation.

4.1 Digital image processing

Advanced photo preparing is utilizing PC calculations to perform picture handling on virtual photos. As a subcategory or circumstance of virtual sign preparing, advanced photograph handling has numerous endowments over simple photo handling. It lets in an a lot more extensive sort of calculations to be accomplished to the info insights and might maintain a strategic distance from inconveniences comprising of the build up of commotion and flag bending all through preparing. Since pix are characterized over measurements (more then likely increasingly) virtual photo preparing can be displayed inside the type of Multidimensional Systems.

A large number of the techniques of advanced photo handling, or virtual picture preparing as it consistently moved toward becoming alluded to as, have been predominant in the Sixties at the Jet Propulsion Laboratory, Massachusetts Institute of Technology, Bell Laboratories, University of Maryland, and a couple of exceptional examinations offices, with programming to satellite television for pc symbolism, line picture necessities transformation, clinical imaging, videophone, character ubiquity, and photo upgrade. The benefit of handling transformed into genuinely exorbitant, notwithstanding, with the registering contraption of that innovation. That changed inside the 1970s, while virtual photo preparing multiplied as economical PC frameworks and devoted equipment have come to be accessible. Pictures at that point is most likely prepared progressively, for a couple of committed inconveniences alongside TV necessities change.

As general-intention PC frameworks have develop as speedier, they began to assume control over the capacity of submitted equipment for all anyway the most specific and pc-broad activities. With the short PC frameworks and sign processors accessible during the 2000s, virtual picture preparing has end up the most not unordinary state of picture handling and by and large, is utilized in light of the fact that it isn't in every case best the most adaptable methodology, anyway also the most modest. Advanced picture handling innovation for restorative projects progress toward becoming enlisted into the Space Foundation Space Technology Hall of Fame in 1994. Computerized photo handling licenses the use of burdens additional perplexing calculations for photo preparing, and along these lines, can offer each more noteworthy best in class generally speaking execution at simple obligations, and the usage of techniques which

might be never again conceivable by the use of simple methods. In exact, advanced picture preparing is the best practical period for

• Classification

• Feature extraction

• Pattern notoriety

• Projection

• Pixelization

• Linear separating

• Principal added substances examination

• Independent issue assessment

• Hidden Markov styles

• Anisotropic dispersion

• Partial differential conditions

• Self-sorting out maps

• Neural systems

• Wavelets

4.1.1 Feature Extraction

Feature Extraction does not mean topographical capacities seen on the picture but instead "factual" characteristics of picture actualities like individual groups or total of band esteems that convey data with respect to precise variation inside the scene. In this way in multispectral measurements it helps in depicting the need components of the photograph. It additionally diminishes the scope of phantom groups that should be investigated. After the trademark extraction is finished the investigator can works of art with the ideal channels or groups, anyway

in turn the individual transmission capacities are more grounded for data. At long last, any such pre-handling will build the rate and diminishes the expense of examination.

4.2 Theory of Digital Image Processing

An picture is represented technically as two dimensional characteristic f(x, y) which represents the depth of selected pixel and here f denotes the intensity and x, y terms is termed as sparsity of pixel or weight of the pixel which offers the exact place of pixel in an virtual image. Literally the virtual image is likewise termed as “a picture is not an photo without any item in it”.

Fig4.1 Digital image

4.2.1 Representation of Digital image

By and large a virtual picture is spoken to in pixels which can be considered as moment components of a picture or also named as pictures. A pixel is a blend of eight bits made out of both greatest exceptional bits and just as least huge bits. Here an intriguing point is that the greatest enormous bits (MSB's) have the resistive conduct and least huge bits (LSB's) have the acknowledgment conduct. At whatever point a photograph is in danger of commotion or some other variation in brilliance, assessment, choice at that point it's heading off to its effect specifically on least broad bits because of its engaging quality conduct.

The individual bits are spoken to are appears as confirmed in the decide 3.2. These bits in a pixel are sorted out inside the falling conduct in which each of the eight bits force is approved in greatest monstrous bits all things considered. Computerized picture powers are predicated upon the course of action of these bits appropriately which will imagine in a correct way to human visual gadget (HVS).

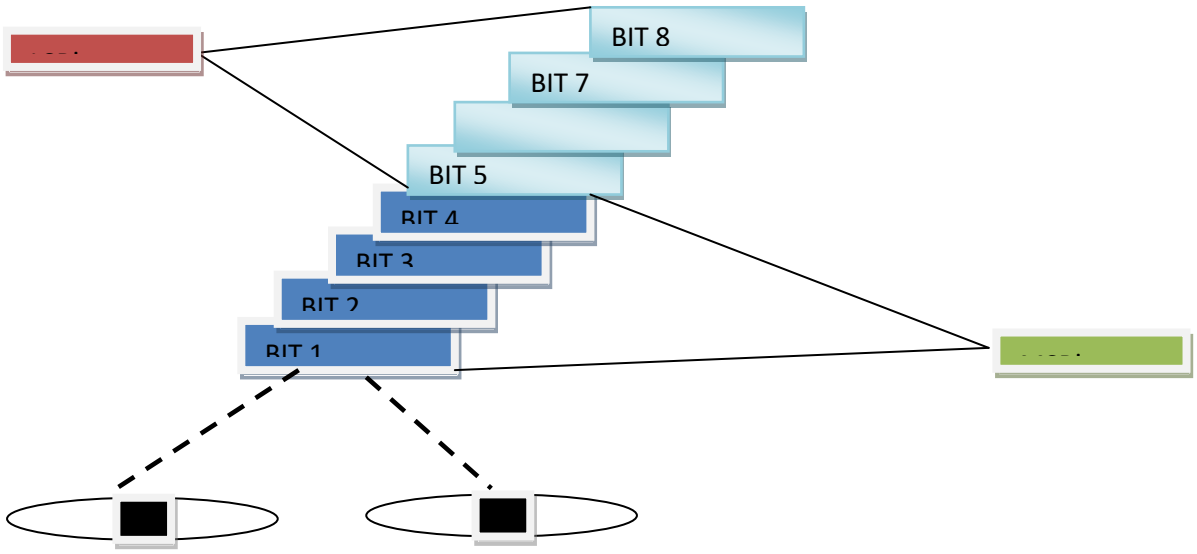


Fig 4.2 Cascading approach of bits in an pixel

In the recognize 3.2, the falling method of bits as for greatest significant bits and least across the board bits are demonstrated and how all the particular eight bits force is mixed to shape the last profundity esteem in the absolute last most extensive piece and the way the last power falls on human obvious gadget to make the surface of item in a virtual photo and actually it's miles named as human impression of virtual photo. These bits are consistently present while the least detail envisioned with the guide of the human noticeable gadget is the pixel and with the aim to shape the pixel we have to make full scale of the 8 individual bits expense to imagine the digitalized substance material in a splendid methodology. These bits play a fundamental trademark in security related applications close by watermarking, steganography and a lot of others.

What is the need for handling a computerized photo?

Computerized photo preparing plays a recognized capacity numerous product situated fields as armed force, biometric, mechanical technology, hereditary qualities, radar photograph handling, satellite television for pc television for PC photo preparing and therapeutic picture handling, etc. At whatever point a photo will in general interchange its conduct from the ordinary shape to curious shape then it proposes that the variety in the splendor, demonstrate in the appraisal levels, form inside the determination, etc and in each other situation it can will in general exchange the conduct because of ecological aggravations named as Gaussian clamor and fellow committed errors alongside applying the inaccurate calculation, hand jitter and specifically logical issue is a product in which the preparing plays out a critical capacity to comprehend the influenced individual condition by means of the use of the particular wellbeing expert yet this take region after we've the records in a correct way on the off chance that handling isn't performed, at that point such huge numbers of clinical related projects are comes up short.

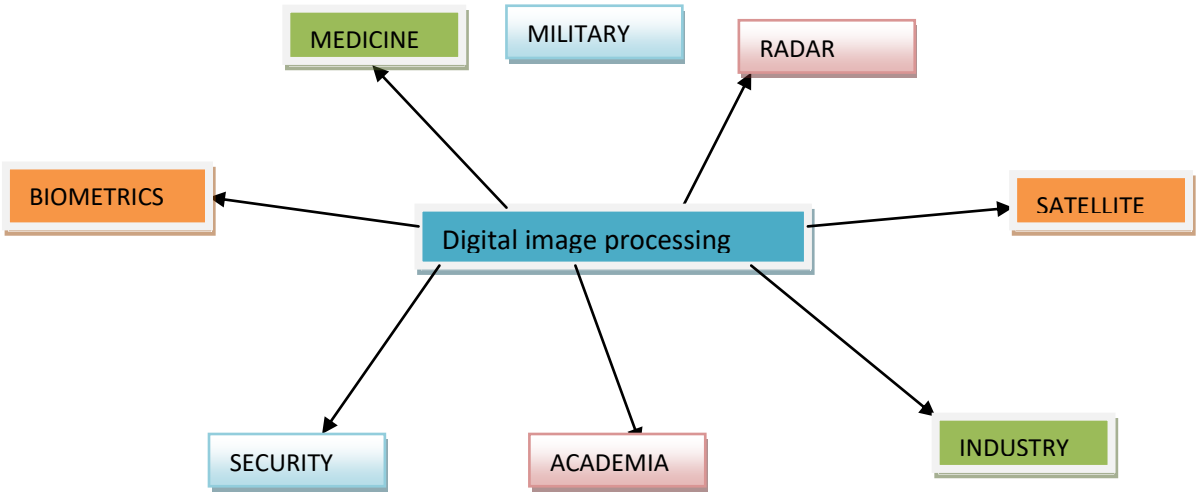


Fig 4.3 Digital image processing applications

Computerized photo might be spoken to in two unique strategies, in first methodology in which you likely can see the substance material of photo like thing anyway we can't see the pixels and its qualities and it is known as the advanced photograph. In second methodology we can see the pixels and its records anyway we cannot see the substance material like item in it and it's far known as in light of the fact that the histogram. Histogram specialized calls in light of the fact that the graphical delineation of the moment pixels estimations of the photo this is pixels. The

significant increase of the virtual photograph histogram is that through survey the insights of histogram it is easy to get clear estimation of the tonal estimation of the separate virtual picture

Fig 4.4 Digital image

In Histogram Equalization (HE) method on the way to equalize the all the background pixel intensities we appoint the normalization approach. But even as assessing the electricity intake the use of the Histogram Equalization (HE) method is mainly suffering from the pixel intensities in choice to ancient past moderate intensities. So an extra nice energy consumption version is executed primarily based on the Histogram Equalization (HE) term and index term.

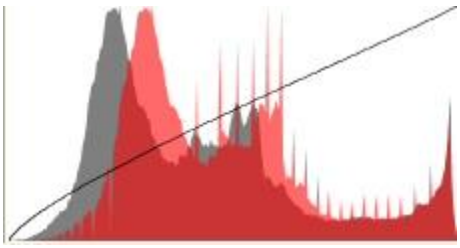


Fig 4.5 Histogram of Respective digital image

Picture reclamation

Picture Restoration is the methodology of getting the certified photograph from the corrupted photo given the data of the debasing components. Advanced photo recuperation is a subject of building that reviews procedures used to get higher specific scene from the debased photographs and perceptions. Methods utilized for picture reclamation are arranged nearer to demonstrating the debasements, regularly obscure and commotion and using various channels to accomplish an estimation of the genuine scene [16]. There are a determination of thought processes that would reason debasement of an image and picture recovery is one of the key fields in present day Digital Image Processing because of its vast area of uses. Regularly taking region debasements comprise of obscuring, movement and clamor [3][14].

Obscuring might be incited even as thing in the photograph is outside the digicam's profundity of subject at some point throughout the presentation, while movement obscure can be expedited while a thing activities in respect to the computerized advanced camera at some phase in an introduction. A thing notoriety device must pick appropriate apparatuses and methods for the stairs noted previously. Numerous components should be thought about in the craving of fitting procedures for a chose programming program. The huge issues that ought to be considered in planning an article fame framework are:

1. Object or model example: How need to things be spoken to inside the model database? What are the fundamental traits or capacities of devices that must be caught in those models? For certain contraptions, geometric portrayals can be accessible and may moreover be green, while for some other eminence one may must depend on popular or reasonable capacities. The representation of a thing need to catch every single relevant measurement with none redundancies and must assemble this insights in a shape that lets in clean access through method for superb added substances of the thing notoriety gadget.
2. Feature extraction: Which highlights must be distinguished, and the way would they be able to be recognized dependably? Most capacities can be processed in two dimensional images however they're identified with 3-dimensional patterns of devices. Because of the character of the picture arrangement process, some capacities are smooth to figure

dependably while others are exceptionally extreme. Highlight identification issues have been referenced in masses of sections on this book.

3. Feature-show coordinating: How can abilities in pix be coordinated to styles in the database? In greatest item ubiquity commitments, there are numerous abilities and various contraptions. A comprehensive coordinating methodology will cure the acknowledgment bother anyway might be too steady to ever be valuable. Viability of capacities and generally execution of an indistinguishable methodology should be mulled over in building up a coordinating methodology.
4. Hypotheses development: How can a lot of more then likely articles dependent on the element coordinating be settled on, and the way can chances be relegated to each feasible thing? The theory arrangement step is essentially a heuristic to decrease the span of the mission place. This progression utilizes know-how of the product program region to allocate a couple of type of danger or self observation confirmation to explicit things inside the area. This degree mirrors the danger of the nearness of devices based absolutely at the recognized highlights.
5. Object check: How can protest models be utilized to choose the most no doubt object from the arrangement of conceivably gadgets in a given picture? The nearness of each conceivably thing can be built up through utilizing their designs. One should inspect each possible theory to affirm the nearness of the article or overlook it. In the event that the models are geometric, it is anything but difficult to absolutely insist questions the utilization of camera place and other scene parameters. In unmistakable occasions, it cannot be conceivable to check a hypothesis. Depending at the unpredictability of the inconvenience, one or additional modules in Figure 15.1 may moreover develop as trifling. For instance, design acknowledgment based totally thing prevalence frameworks don’t utilize any trademark rendition coordinating or objects confirmation; they immediately allocate potential outcomes to devices and pick the article with the absolute top notch chance.

CHAPTER 5
METHODOLOGY

In disease acknowledgment from an image, the strategic is to extract the characteristic feature of the unhealthy region. According to the disease the choices may vary. The features extracted from the image are Colour, texture etc.

5.1 The Proposed Approach

The block diagram shown in Figure 1 depicts the basic technique of the recommended vision-based detection algorithm in this research. Firstly, the images of various plants leaves are going to obtain using a digital camera. The next stage of the proposed algorithm is to apply the image-processing techniques on the acquired images to extract useful features for onwards analysis

5.1.1 The step-by-step process of the proposed system

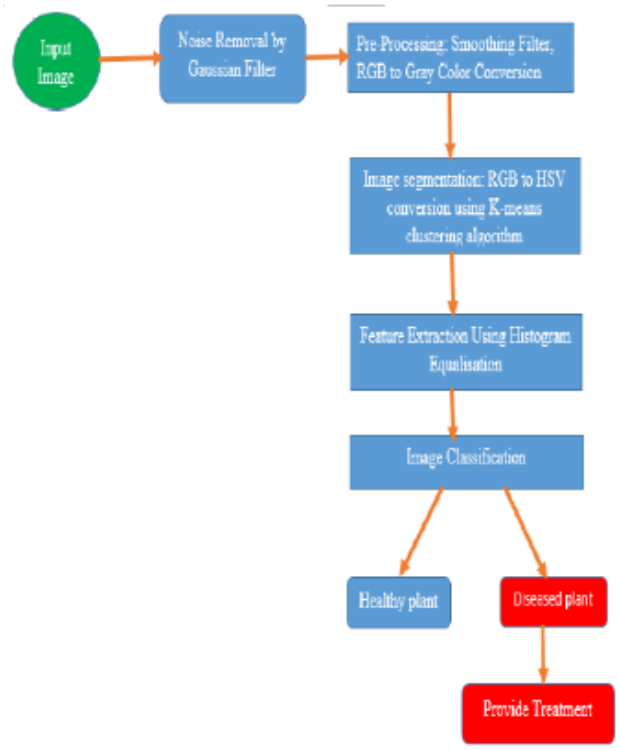


Figure 2 Block Diagram of Plant Leaf Disease Detection

5.1.2 Image Acquisition

The images of the plant leaf are captured through the camera in a controlled background and are stored in the JPEG format. Infected leaf is located horizontal on a black background. The leaf is zoomed on so as to make sure that the picture taken contains only the leaf and black background. This image is in RGB (Red, Green and Blue) form. Color transformation structure for the RGB leaf image is created, and then, a device-independent color space transformation for the color transformation structure is applied.

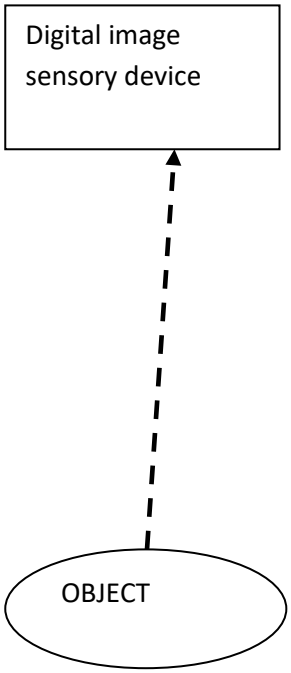


Fig 5.1.2 Digital image Acquisition process

5.1.3 Image Pre-Processing

To remove noise in image or other object removal, different pre-processing techniques are considered. Image clipping thus cropping of the leaf image to get the interested image region. Image smoothing is done using the smoothing filter. Image enhancement is carried out for increasing the contrast. The RGB images are converted into the grey images using color conversion formula as shown in equation (1).

$f(x) = 0.299*R+0.587*G+0.114*B$--------(1)

Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant diseased leaf images. The cumulative distribution function is used to distribute intensity values.

5.1.4 Gaussian Filter

The Gaussian smoothing operator is a 2-D convolution operator that is used to smoothened images and remove detail (higher frequencies) and noise. However, it is similar to the mean filter, but it uses a different kernel that represents the shape of a Gaussian (`bell-shaped') hump. The general representation of Gaussian filter is shown below.

5.1.5 Image segmentation

Segmentation means partitioning of image into various parts of same features or having some similarity. The segmentation can be done using various methods like Otsu method, k-means clustering, Boundary and spot detection algorithm, converting RGB image into HIS or HSV model. The RGB image is converted into the HSV model for segmenting using boundary detection and spot detection algorithm. Boundary ejection and spot detection helps to find the infected part of the leaf. For boundary detection the connectivity of pixels is considered and boundary detection algorithm is applied.

5.1.6 k-means clustering

K-means clustering is a method of vector quantization, originally from signal processing, that is popular for cluster analysis in data mining. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells.

The problem is computationally difficult (NP-hard); however, efficient heuristic algorithms converge quickly to a local optimum. These are usually similar to the expectation-maximization algorithm for mixtures of Gaussian distributions via an iterative refinement approach employed by both k-means and Gaussian mixture modeling. They both use cluster centers to model the data; however, k-means clustering tends to find clusters of comparable

spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes.

The algorithm has a loose relationship to the k-nearest neighbor classifier, a popular machine learning technique for classification that is often confused with k-means due to the name. Applying the 1-nearest neighbor classifier to the cluster centers obtained by k-means classifies new data into the existing clusters. This is known as nearest centroid classifier or Rocchio algorithm.

5.2 Feature Extraction

The feature extraction is used to extract the information that can be used to find out the significance of the given sample. The main types of features are shape, color and texture, which are mostly used in image processing technique.

For Downy Mildew color features and for Powdery Mildew texture features are need to be used. Hence in this system color and texture features both are extracted to get better accuracy.

Following steps are used to calculate the color features for a given image [8]

1. First conversion of RGB image into HSV color spaces is done.
2. An image is subdivided into 3X3 blocks uniformly.
3. The mean color (H/S/V) for each of the nine blocks is calculated by using following formula.

$$x' = \frac{1}{N} x_i$$

Eqn 5.1

Where xi is the pixel intensity and N is the total number of pixels. Here mean is considered as one of the feature.

For each block the variance is calculated by using below formula.

$$\text{Variance} = \frac{1}{N} \sum_{i=1}^{N} (x_i - x')^2$$

Eqn 5.2

The computed variance has the ability of measuring the variability.

5) The skewness for each block of (H/S/V) is calculated.

$$\text{Skewness} = \frac{\frac{1}{N}\sum_{i=1}^{N}(x_i - x')^3}{\left(\frac{1}{N}\sum_{i=1}^{N}(x_i - x')^2\right)^{\frac{3}{2}}}$$

Eqn 5.3

The skewness is used to judge the image surface. Each block will have 3+3+3=9 color features. The 9 texture features-contrast, uniformity, maximum probability, homogeneity, diagonal variance, difference variance, entropy, inverse difference, and nine color features are used.

TABLE 5.1 MATHEMATICAL FORMULAS FOR TEXTURE FEATURES

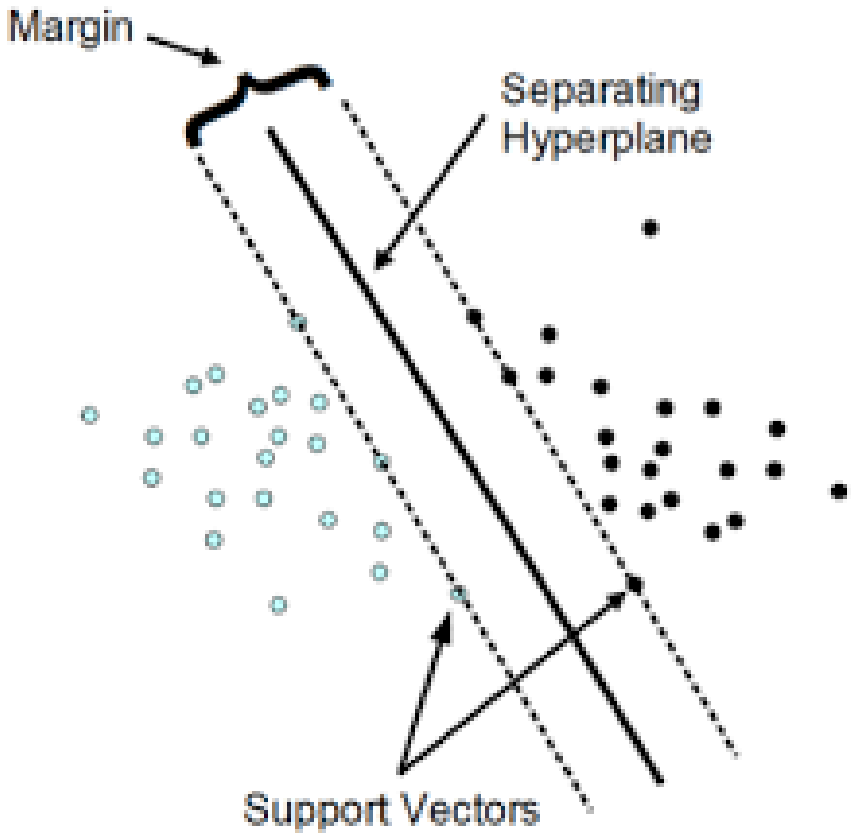
We first need to combine the texture and color (9+9=18) features for classification, before we use SVM to train the classifier.

No.	Feature	Formula
1	Contrast	$\Sigma_i \Sigma_j \lvert i-j\rvert^2 p(i, j, d, \theta)$
2	Uniformity (Energy)	$\Sigma_i \Sigma_j p(i, j, d, \theta)^2$
3	Maximum probability	$\text{Max}_{ij}\, p(i, j, d, \theta)$
4	Homogeneity	$\Sigma_i \Sigma_j p(i, j, d, \theta)/(1 + \lvert i-j\rvert)$
5	Inverse difference moment of order 2	$\Sigma_i \Sigma_j 1/(1 + (i-j)^2)\, p(i, j, d, \theta)$
6	Difference variation	Variance of $\Sigma_i \Sigma_j \lvert i-j\rvert\, p(i, j, d, \theta)$
7	Diagonal variance	Variance of $p(i, j, d, \theta)$
8	Entropy	$\Sigma_i \Sigma_j p(i, j, d, \theta) \log (p(i, j, d, \theta))$
9	Correlation	$\sum_{i,j} \frac{(i-\mu_i)(j-\mu_j)p(i,j)}{\sigma_i \sigma_j}$

5.3 Classification:

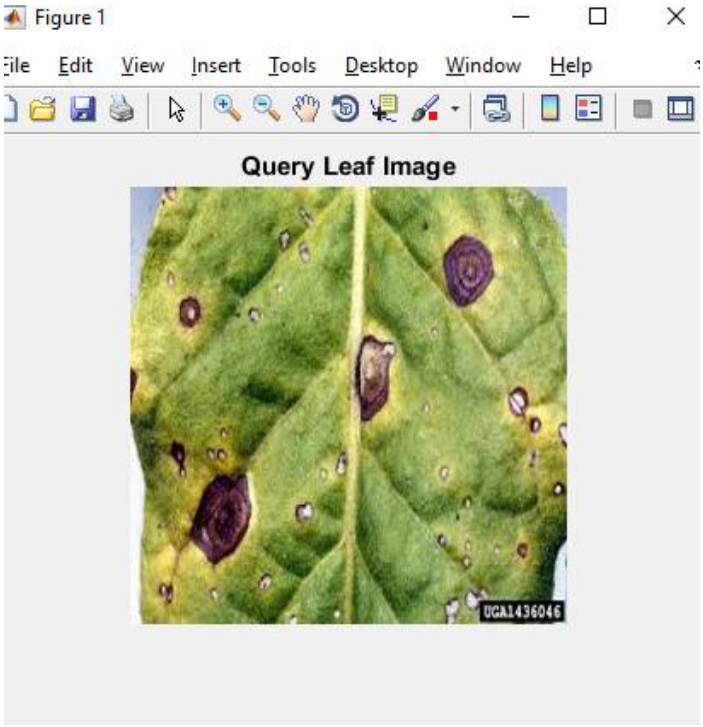
The classification technique is used to detect the type of leaf disease. Classification deals with associating a given input pattern with one of the distinct class. In the given system a Linear Support Vector Machine (LSVM) is used for classification of leaf disease.

SVM is a binary classifier which uses a hyper plane called the decision boundary between two classes. This hyper plane tries to divide, one class containing the target training vector which is labelled as +1, and the other class containing the training vectors which is labelled as −1. Using these labeled training vectors, SVM optimizer finds a hyper plane that will then maximizes the margin of separation among the two classes as shown in Fig.



CHAPTER 6

RESULTS AND DISCUSSION



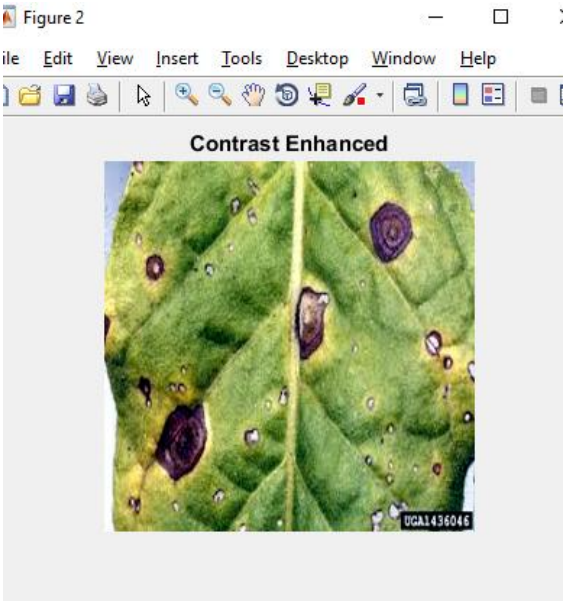


Figure 2
ile Edit View Insert Tools Desktop Window Help
Contrast Enhanced

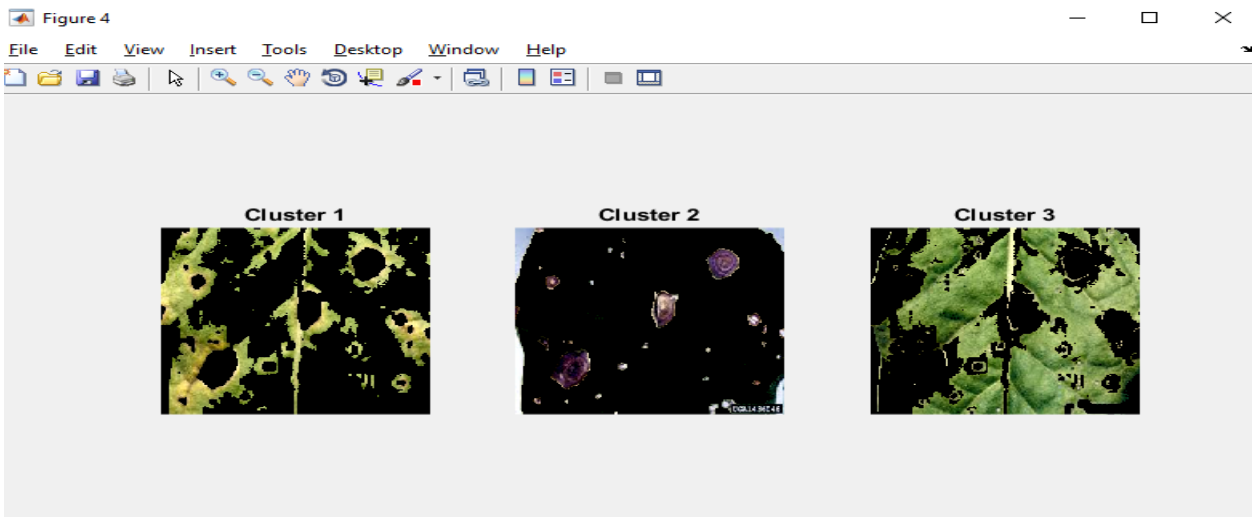
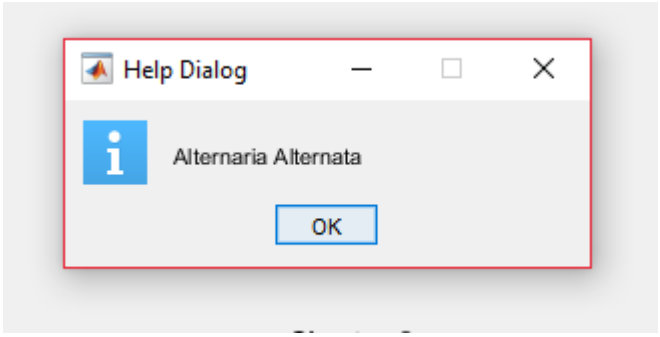
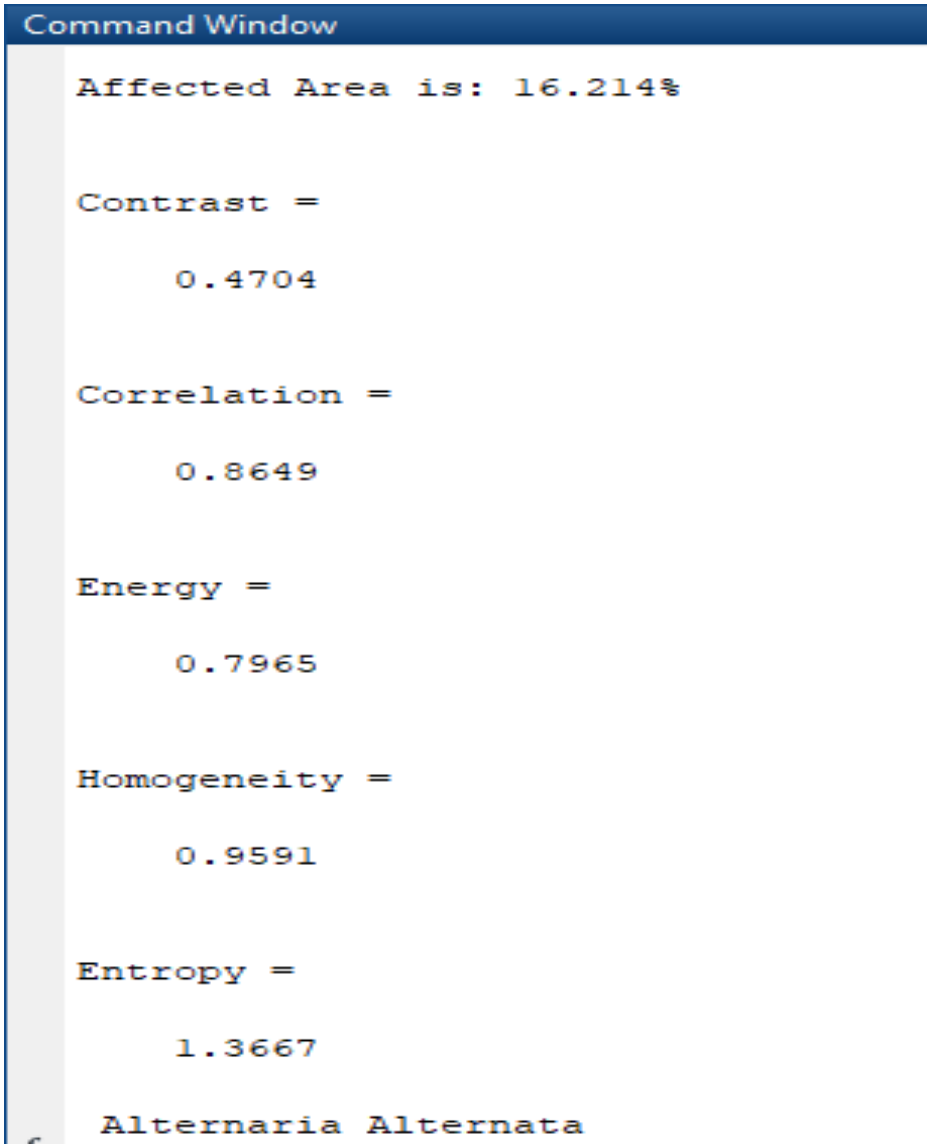
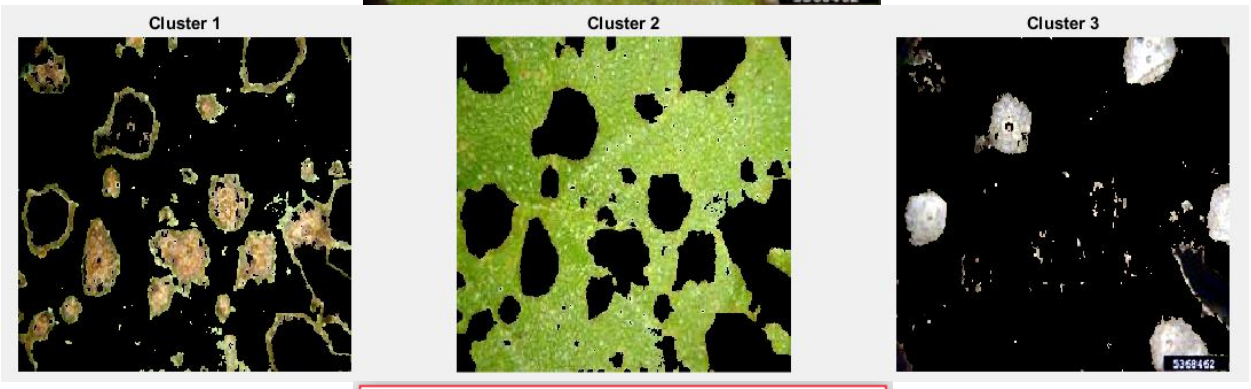
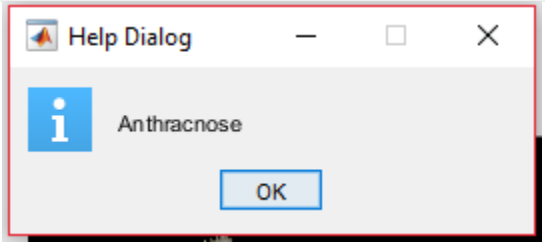


Figure 4
File Edit View Insert Tools Desktop Window Help
Cluster 1
Cluster 2
Cluster 3


Help Dialog
Alternaria Alternata
OK

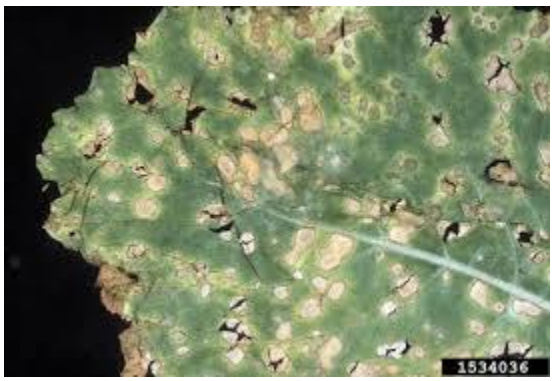

Command Window
Affected Area is: 16.214%
Contrast =
0.4704
Correlation =
0.8649
Energy =
0.7965
Homogeneity =
0.9591
Entropy =
1.3667
Alternaria Alternata

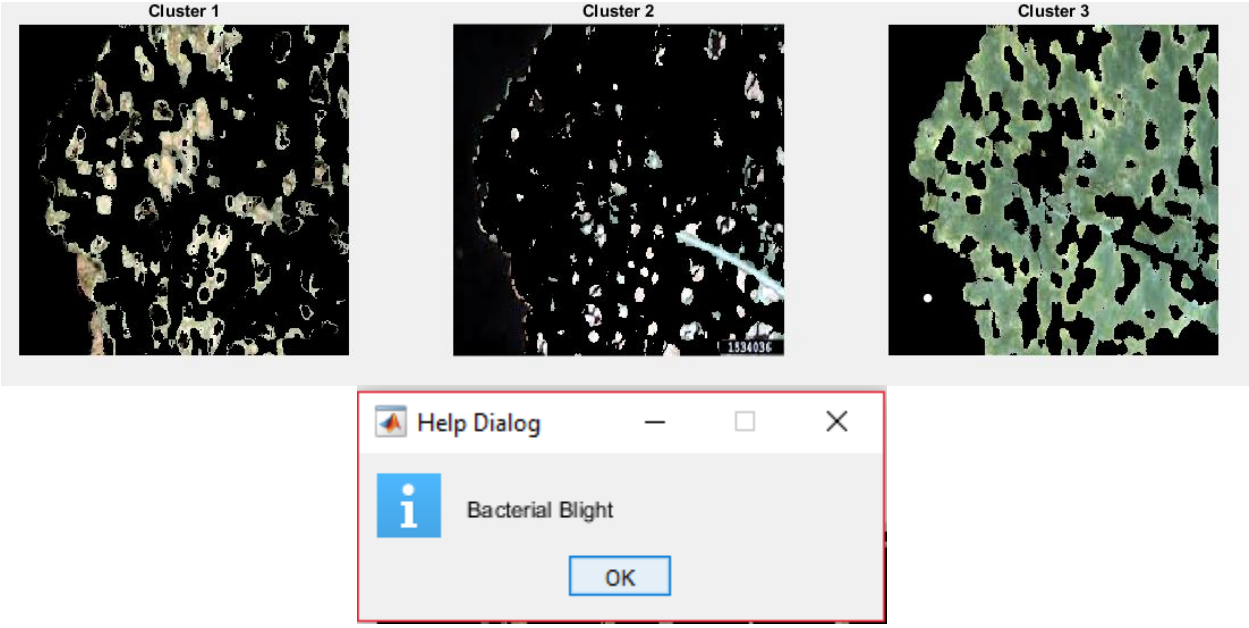

Cluster 1
Cluster 2
Cluster 3

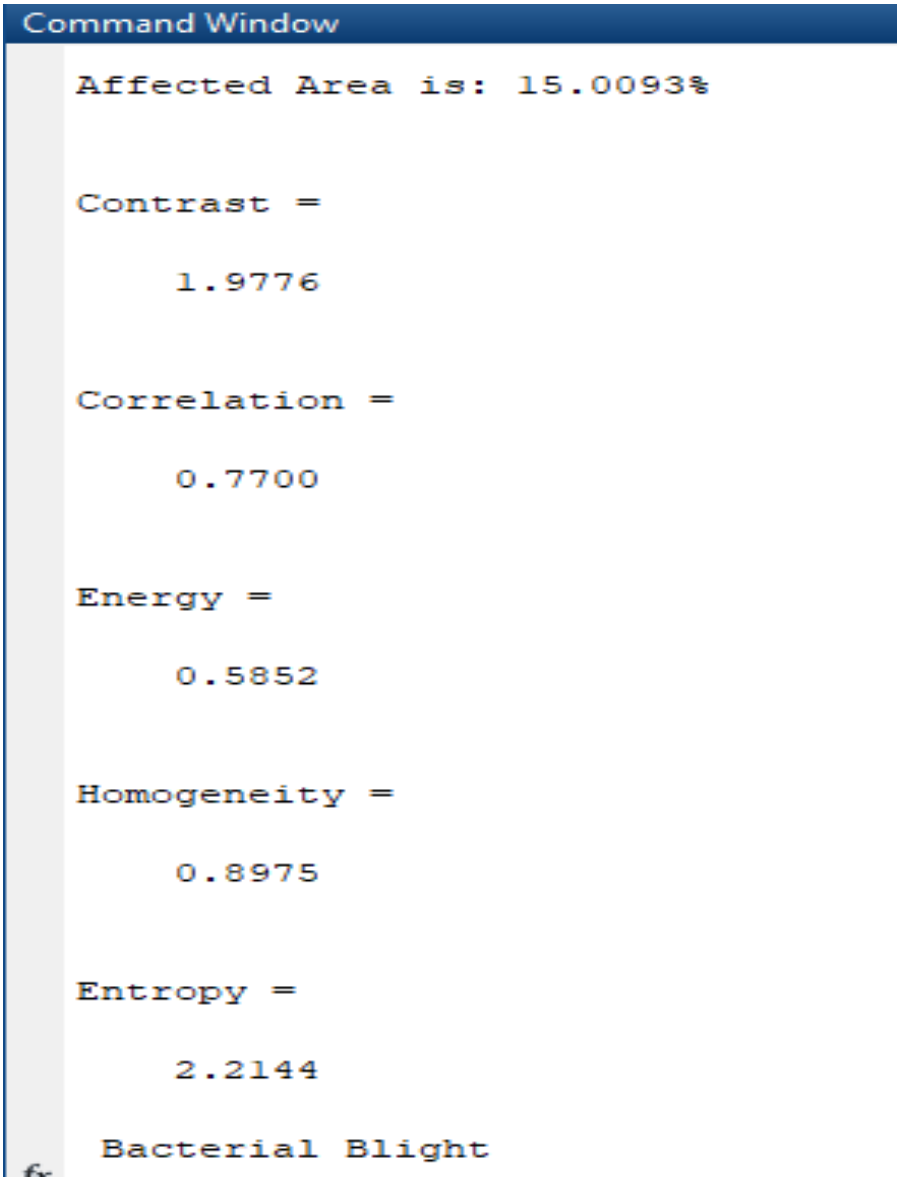

Help Dialog
Anthracnose
OK

Command Window

```
Affected Area is: 16.1374%


Contrast =

    1.1523


Correlation =

    0.8077


Energy =

    0.5889


Homogeneity =

    0.9109


Entropy =

    2.2825

Anthracnose
```




Cluster 1
Cluster 2
Cluster 3
Help Dialog
Bacterial Blight
OK



6.1 Discussion of Results

The system was tested with image of 256 x 256 pixels. The total samples were 3 from different grape plant . The system was simulated in MATLAB. The system detected the leaf, processed, segmented and displayed the Area Fraction of Disease (AFD) to be 24.79%. The white colors in the healthy and diseased images represent the portions of the leaf that are healthy and diseased respectively. Gaussian filter was included in the system, and simulation was ran for the same image.

It is observed in figure 4 that, smoothened hue, saturation and value images are obtained and the AFD also reduced to 22.36%. This clearly shows that the original image

contains some levels of unwanted signals in the form of higher frequencies and noise. Figure 5 and 6 contains different plant leaves. The area fraction of disease is 18.3% and 78.37% respectively. The area fraction of disease determines the amount of pesticides to be applied. The higher the AFD the higher the pesticides to be applied.

6.2 Summary of Findings

MATLAB code for facial recognition was modified and implemented for the plant disease detection system. The system performed better when the Gaussian filter was introduced. This clearly depicts that an image contains some degree of noise which needs to be filtered for successful image processing technique design. The image background has impact on the system performance. When any other ground apart from black was used, there was significant effect on the AFD. Hence black background was appropriate for accurate results.

CHAPTER 7
CONCLUSION

The accurately detection and classification of the plant disease is very important for the successful cultivation of crop and this can be done using image processing. This project discussed the image processing technique for diseased plant leaf detection. Extraction of features of an infected leaf and the classification of plant diseases can accurately identify and classify various plant diseases and provide the farmer an idea about extend of damage for suitable treatment using image processing techniques. The overall achieved accuracy of the proposed system is higher than 90.96% in line with the experimental results compared with [2].

CHAPTER 8

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