Automatic Detection of Plant Diseases using image processing techniques based on SVM classifier and controller is used to pesticide the diseased plant

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Abstract- *The agricultural land mass is more than just being a feeding sourcing in today's world. Indian economy is highly dependent of agricultural productivity. Therefore in field of agriculture, detection of disease in plants plays an important role. 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. 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 image processing techniques and also controller used to fertilize the diseased plant automatically .*

Keywords- image processing, camera, SVM classifier, image segmentation, automatic detection

I. INTRODUCTION

In imaging science, image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, 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. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Images are also processed as three-dimensional signals with the third-dimension being time or the z-axis.Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging. Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which machine /computer /software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans).In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization(of often large-scale complex scientific /experimental data). Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance.

II. LITRETURE REVIEW

Sanjeev S Sannakki, Vijay S Rajpurohit, V B Nargund, Pallavi Kulkarni Diagnosis and classification of Grape leaf Disease using Neural Networks,IEEE,2013

Plant diseases cause significant damage and economic losses in crops. Subsequently, reduction in plant diseases by early diagnosis results in substantial improvement in quality of the product. Erroneous diagnosis of disease and its severity leads to inappropriate use of pesticides. The goal of proposed work is to diagnose the disease using image processing and artificial intelligence techniques on images of grape plant leaf. In the proposed system, grape leaf image with complex background is taken as input. Thresholding is deployed to mask green pixels and image is processed to remove noise using anisotropic diffusion. Then grape leaf disease segmentation is done using K-means clustering. The diseased portion from segmented images is identified. Best results were observed when Feed forward Back Propagation Neural Network was trained forclassification.

S. Arivazhagan, R. NewlinShebiah, S. Ananthi, S. Vishnu Varthini Detection of unhealthy region of Plant Leaves

and Classification of Plant leaf Diseases using Texture Features,IEEE,2013

Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. The proposed system is a software solution for automatic detection and classification of plant leaf diseases. The developed processing scheme consists of four main steps, first a color transformation structure for the input RGB image is created, then the green pixels are masked and removed using specific threshold value followed by segmentation process, the texture statistics are computed for the useful segments, finally the extracted features are passed through the classifier. The proposed algorithm's efficiency can successfully detect and classify the examined diseases with an accuracy of 94%. Experimental results on a database of about 500 plant leaves confirm the robustness of the proposed approach.

Arti N.Rathod, BhaveshTanawal, Vatsal Shah Image Processing Techniques for Detection of leaf Disease,IEEE,2013

In agriculture research of automatic leaf disease detection is essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect symptoms of disease as soon as they appear on plant leaves. The term disease is usually used only for destruction of live plants. This paper provides various methods used to study of leaf disease detection using image processing. The methods studies are for increasing throughput and reduction subjectiveness arising from human experts in detecting the leaf disease.digital image processing is a technique used for enhancement of the image. To improve agricultural products automatic detection of symptoms is beneficial.

III. EXISTING SYSTEM

Dhaygude and Kumbhar proposed the detection algorithm consists mainly four steps the RGB image are converted into HSV plane. The masking process is done by using the values of mostly green colored pixels. Next useful segments are extracted out using segmentation techniques from the value of SGDM matrices generated. This method highly detect the leaf disease affected area but fails to classify the disease.

DISADVANTAGES:

- Inaccurate detection
- Failed to classify the plant disease

IV. PROPOSED SYSTEM

In the proposed system, there are two steps involved in whole process, one is disease identification part and another one is disease classification part. First the leaf set images are taken with an image acquisition module and then desired pre-processing steps starts. The images under analysis were then segmented by using threshold based methods. The segmented results were used for deciding whether the plant under observation are healthy or not by using SVM classifier. With respective to the disease found in the plant the controller will choose the particular pesticides for the particular disease, then the robot will automatically spray the pesticide in the diseased plant.

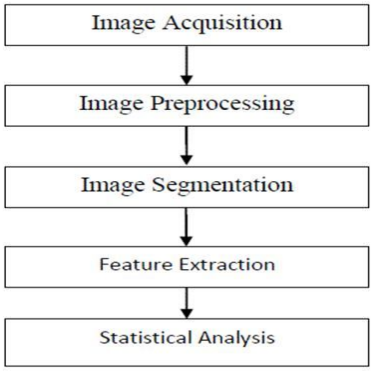

Figure 1.

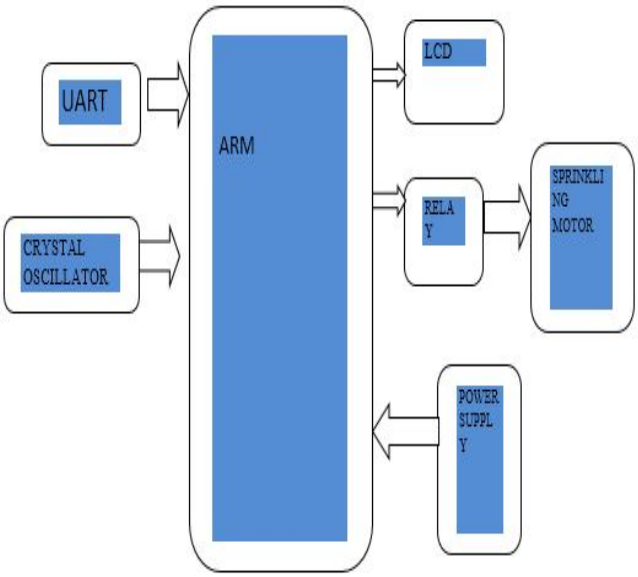

Figure 2.

In imaging science, image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, 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. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Images are also processed as three-dimensional signals with the third-dimension being time or the z-axis.

Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging. Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans). In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization (of often large-scale complex scientific/experimental data). Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance.

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems. Digital image processing allows the use of much more complex algorithms, and hence, can offer both more sophisticated performance at simple tasks, and the implementation of methods which would be impossible by analog means. In particular, digital image processing is the only practical technology for:

Classification, Feature extraction, Multi-scale signal analysis, Pattern recognition, Projection, Some techniques which are used in digital image processing include: Anisotropic diffusion, Hidden Markov models ,Image editing, Image restoration, Independent component analysis ,Linear filtering

- Neural networks
- Partial differential equations
- Pixelation
- Principal components analysis
- Wavelets

Image processing basically includes the following three steps: Importing the image with optical scanner or by digital photography. Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs. Output is the last stage in which result can be altered image or report that is based on image analysis.
Purpose of Image processing:

The purpose of image processing is divided into 5 groups. They are:

1. Visualization - Observe the objects that are not visible.
2. Image sharpening and restoration - To create a better image.
3. Image retrieval - Seek for the image of interest.
4. Measurement of pattern – Measures various objects in an image.
5. Image Recognition – Distinguish the objects in an image.

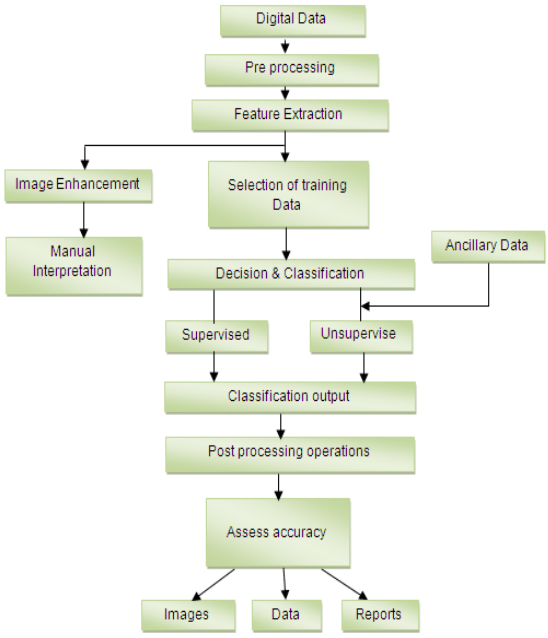

Figure 3. basic steps in image processing

Types : The two types of methods used for Image Processing are Analog and Digital Image Processing. Analog or visual techniques of image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. The image processing is not just confined to area that has to be studied but on knowledge of analyst. Association is another important tool in image processing through visual techniques. So analysts apply a combination of personal knowledge and collateral data to image processing. Digital Processing techniques help in manipulation of the digital images by using computers. As raw data from imaging sensors from satellite platform contains deficiencies. To get over such flaws and to get originality of information, it has to undergo various phases of processing. The three general phases that all types of data have to undergo while using digital technique are Pre- processing, enhancement and display, information extraction.

SVM CLASSIFIER: In machine learning, support vector machines (SVMs, also support vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classifier (although methods such as Platt scaling exist to use SVM in a probabilistic classification setting). An SVM model is a representation of the examples as points in space, mapped so that the examples of the separate categories are divided by a clear gap that is as wide as possible. New examples are then mapped into that same space and predicted to belong to a category based on which side of the gap they fall.

In addition to performing linear classification, SVMs can efficiently perform a non-linear classification using what is called the kernel trick, implicitly mapping their inputs into high-dimensional feature spaces. When data are not labeled, supervised learning is not possible, and an unsupervised learning approach is required, which attempts to find natural clustering of the data to groups, and then map new data to these formed groups. The clustering algorithm which provides an improvement to the support vector machines is called support vector clustering and is used in industrial applications either when data are not labeled or when only some data are labeled as a preprocessing for a classification pass.

THRESHOLDING:

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images

The simplest thresholding methods replace each pixel in an image with a black pixel if the image intensity $I_{i,j}$ is less than some fixed constant T $(\text{that is, } I_{i,j} < T)$, or a white pixel if the image intensity is greater than that constant. In the example image on the right, this results in the dark tree becoming completely black, and the white snow becoming completely white. To make thresholding completely automated, it is necessary for the computer to automatically select the threshold categorize thresholding methods into the following six groups based on the information the algorithm manipulates

- **Histogram shape**-based methods, where, for example, the peaks, valleys and curvatures of the smoothed histogram are analyzed
- **Clustering**-based methods, where the gray-level samples are clustered in two parts as background and foreground (object), or alternately are modeled as a mixture of two Gaussians
- **Entropy**-based methods result in algorithms that use the entropy of the foreground and background regions, the cross-entropy between the original and binarized image, etc.[1]
- **Object Attribute**-based methods search a measure of similarity between the gray-level and the binarized images, such as fuzzy shape similarity, edge coincidence, etc.
- **Spatial methods [that]** use higher-order probability distribution and/or correlation between pixels
- **Local methods** adapt the threshold value on each pixel to the local image characteristics. In these methods, a different T is selected for each pixel in the image.

Colour images can also be thresholded. One approach is to designate a separate threshold for each of the RGB components of the image and then combine them with an ANDoperation. This reflects the way the camera works and how the data is stored in the computer, but it does not correspond to the way that people recognize colour. Therefore, the HSL and HSV colour models are more often used; note that since hue is a circular quantity it requires circular thresholding. It is also possible to use the CMYK colour model

a) IMAGE ACQUISTION:

The images of the plant leaf are captured through the camera, this image is in RGB (Red, Green and Blue) form, color transformation structure for the leaf image is created, and then an independent color space transformation for the color transformation structure is applied.

b) PRE-PROCESSING:

To remove noise in image or other object removal, pre-processing techniques is considered. Image clipping i.e. 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 into the grey images using color conversion using equation(x) =0.2989*R + 0.5870*G + 0.114*B Then the histogram equalization which distributes the intensities of the images is applied on the image to enhance the plant disease images. The cumulative distribution function is used to distribute intensity values

c) SEGMENTATION:

Segmentation of leaf image is important while processing image from that Segmentation means partitioning of image into various part of same features or having some similarity. The segmentation can be done using various methods like Otsu' method, k-means clustering.

d) FEATURE EXTRACTION:

Feature extraction plays an important role for classification of an image. In many application feature extraction of image is used. Color, texture, morphology, edges etc. are the features which can be used in plant disease classification, texture means how the color is distributed in the image, the roughness, hardness of the image. In this paper considers color, texture and morphology as a feature for disease detection. They have found that morphological result gives better result than the other features. It can use for identify the infected plant leaf of classification plant image.

ARM7 Based Microcontroller (LPC2148) :

Increasingly, embedded systems developers and system-on-chip designers select specific microprocessor cores and a family of tools, libraries, and off-the-shelf components to quickly develop new microprocessor-based products and applications. ARM is one of the major options available for embedded system developer. Over the last few years, the ARM architecture has become the most pervasive 32-bitarchitecture in the world, with wide range of ICs available from various IC manufacturers. ARM processors are embedded in products ranging from cell/mobile phones to automotive braking systems. A worldwide community of ARM partners and third-party vendors has developed among semiconductor and product design companies , Including hardware engineers, system designers, and software developers. ARM7 is one of the widely used micro-controller family in embedded system application. This section is humble effort for explaining basic features of ARM-7.

ARM is a family of instruction set architectures for computer processors based on a reduced instruction set computing (RISC) architecture developed by British company ARM Holdings.A RISC-based computer design approach means ARM processors require significantly fewer transistors than typical processors in average computers. This approach reduces costs, heat and power use. These are desirable traits for light, portable, battery-powered devices—including smartphones, laptops, tablet and notepad computers), and other embedded systems. A simpler design facilitates more efficient multi-core CPUs and higher core counts at lower cost, providing higher processing power and improved energy efficiency for servers and supercomputers.

LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.Let us go through the features of LPC214x series controllers.8 to 40 kB of on-chip static RAM and 32 to 512 kB of on-chip flash program memory.128 bit wide interface/accelerator enables high speed 60 MHz operation.

UART

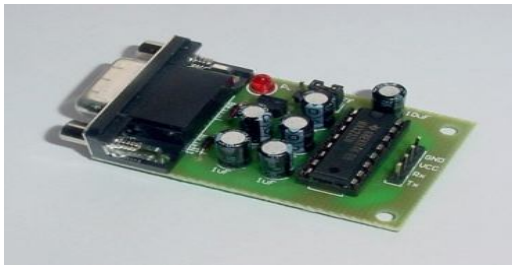

Figure 4.

A universal asynchronous receiver/transmitter is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. UARTs are commonly used in conjunction with other communication standards such as EIA RS-232.A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A dual UART or DUART combines two UARTs into a single chip. Many modern ICs now come with a

UART that can also communicate synchronously; these devices are called USARTs.

The Universal Asynchronous Receiver/Transmitter (UART) controller is the key component of the serial communications subsystem of a computer. The UART takes bytes of data and transmits the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Serial transmission of digital information (bits) through a single wire or other medium is much more cost effective than parallel transmission through multiple wires. A UART is used to convert the transmitted information between its sequential and parallel form at each end of the link. Each UART contains a shift register which is the fundamental method of conversion between serial and parallel forms.

MAX232: The MAX232 is an integrated circuit that converts signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. The MAX232 is a dual driver/receiver and typically converts the RX, TX, CTS and RTS signals. The drivers provide RS-232 voltage level outputs (approx. ± 7.5 V) from a single + 5 V supply via on-chip charge pumps and external capacitors. This makes it useful for implementing RS-232 in devices that otherwise do not need any voltages outside the 0 V to + 5 V range, as power supply design does not need to be made more complicated just for driving the RS-232 in this case. The receivers reduce RS-232 inputs (which may be as high as ± 25 V), to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a typical hysteresis of 0.5 V.

A. LCD Display

Liquid Crystal Display is combination of two states of matter, the solid and the liquid. It uses a liquid crystal to produce a visible image. It's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology. The combination of colored light with the grayscale image of the crystal forms colored image. This image is then displayed on the screen like shown below. The liquid has a unique advantage of having low power consumption than the LED or cathode ray tube.

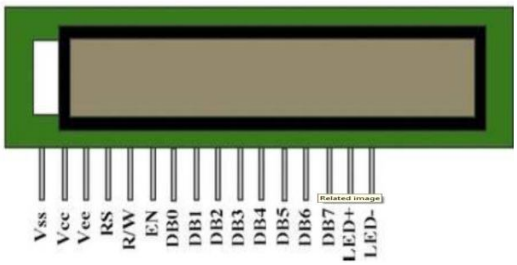

Figure 5. LCD Pin Configuration

The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus that particular area will become dark compared to other.

ADC 0808/0809:

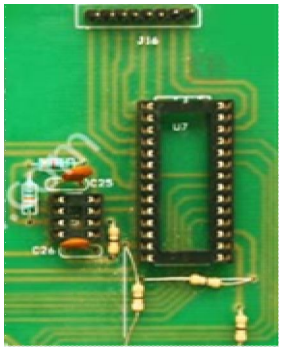

Figure 6.

The ADC0808, ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The ADC0809 data acquisition component is a monolithic CMOS device with an 8-bit analog-to-digital converter, 8-channel multiplexer and microprocessor compatible control logic. The 8-bit A/D converter uses successive approximation as the conversion technique

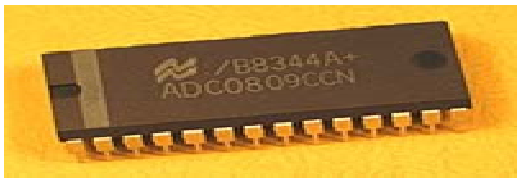

Figure 7.

The converter features a high impedance chopper stabilized comparator, a 256R voltage divider with analog switch tree and a successive approximation register. The 8-channel multiplexer can directly access any of 8-single-ended analog signals. The device eliminates the need for external zero and full-scale adjustments. Easy interfacing to microprocessors is provided by the latched and decoded multiplexer address inputs and latched TTL TRI-STATE® outputs.

The design of the ADC0808, ADC0809 has been optimized by incorporating the most desirable aspects of several A/D conversion techniques. The ADC0808, ADC0809 offers high speed, high accuracy, minimal temperature dependence, excellent long-term accuracy and repeatability, and consumes minimal power. These features make this device ideally suited to applications from process and machine control to consumer and automotive.

RESULT:

1. IMAGE ACQUISTION:

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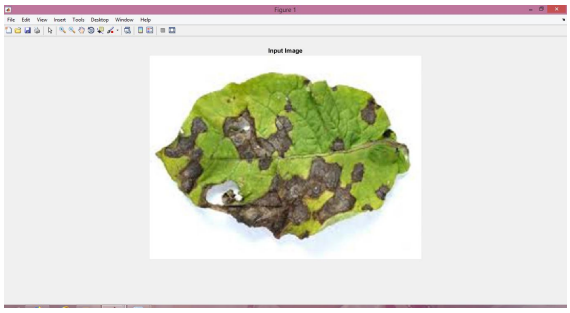

Figure 8.

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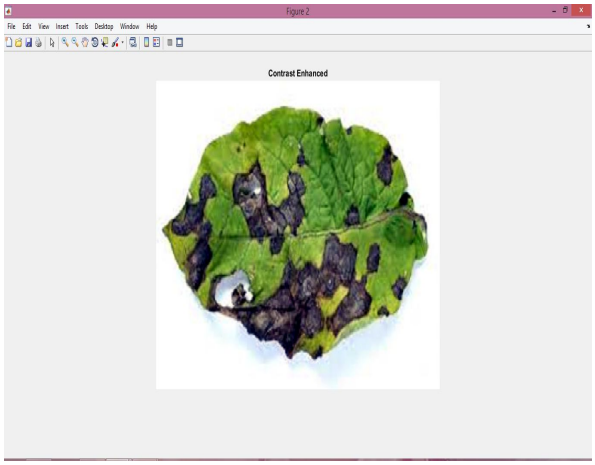

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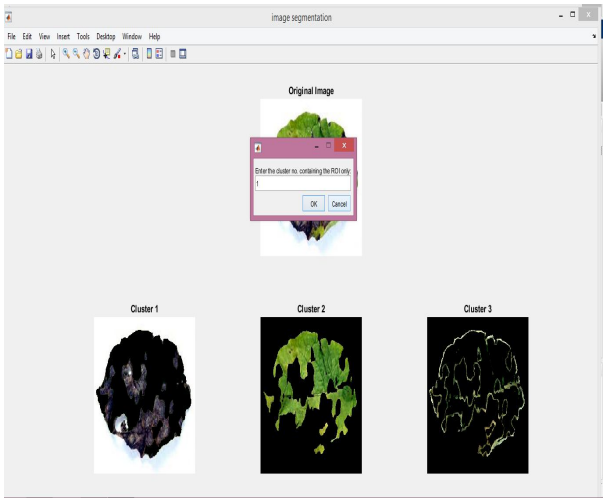

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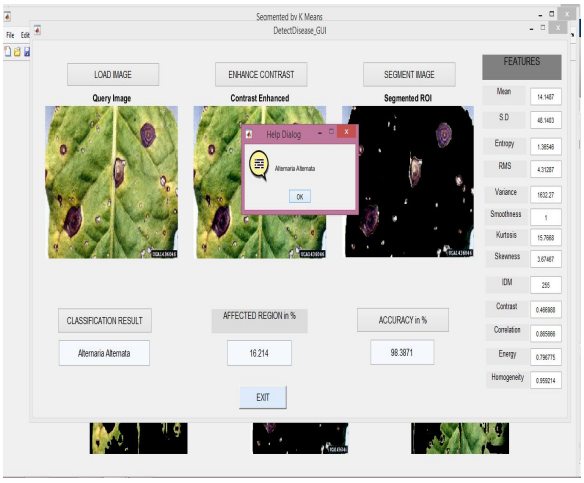

Figure 11.

V. SYSTEM SPECIFICATIONS

LANGUAGE SPECIFICATION:

This chapter describes the requirement analysis in accordance with the input and the resources and it also describes the implementation of the project with the technology used.

REQUIREMENT ANALYSIS

Requirement analysis determines the requirements of a new system. This project analyses on product and resource requirement, which is required for this successful system. The product requirement includes input and output requirements it gives the wants in term of input to produce the required output. The resource requirements give in brief about the software and hardware that are needed to achieve the required functionality.

MATLAB

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User Interface building
- An interactive numerical computing environment
- Matrix computations
- Graphics

Programming (M-files),Toolboxes (signal processing, statistics, optimization, symbolic math) MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar noninteractive language such as C or Fortran.The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation.

MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to learn and apply specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

matlab (matrix laboratory) is a numerical computing environment and fourth-generation programming language. developed by mathworks, matlab allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including c, c++, java, and fortran. althoughmatlab is intended primarily for numerical computing, an optional toolbox uses the mupadsymbolic engine, allowing access to symbolic computing capabilities. an additional package, simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

in 2004, matlab had around one million users across industry and academia. matlab users come from various backgrounds of engineering, science, and economics. matlab is widely used in academic and research institutions as well as industrial enterprises.

The MATLAB System

The MATLAB system consists of five main parts:

The MATLAB language

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

The MATLAB working environment.

This is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

Handle Graphics.

This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

The MATLAB mathematical function library

This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

The MATLAB Application Program Interface (API)

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

APPLICATIONS OF MATLAB:

- Mathematical Calculations
- Data Analysis & Visualization
- Software Development
- Simulation

ADVANTAGES:

- It's very easy for a beginner in computer programming.
- It comes with well-written manuals.
- Large user community, sharing free codes.It lets you work in Matrices easily. It lets you do some complicated calculations quickly, without having to write a whole program or spreadsheet. Tons of add-ons and workbenches available to do a variety of tasks.
- Easy, interactive environment
- Fast numerical algorithms
- Inexpensive software

Fun and easy environment for learning Linear Algebra!

VI. CONCLUSION

The accurate Disease detection and classification of the plant leaf image is very important for the successful cultivation of cropping and this can be done using image processing. This paper discussed various techniques to segment the disease part of the plant. This paper discussed classification techniques to extract the features of infected leaf and the classification of plant diseases throw svm classifier

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