NEAREST NEIGHBOUR BASED FUNGAL DISEASE DETECTION APPROACH IN LEAF IMAGES

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ABSTRACT
The study of image processing techniques used to identify and classify fungal disease symptoms affected on different agriculture/horticulture crops. The plant disease diagnosis is limited by the human visual capabilities because most of the first symptoms are microscopic. As plant health monitoring is still carried out by humans due to the visual nature of the plant monitoring task, computer vision techniques seem to be well adapted. One of the areas considered here is the processing of images of disease affected agriculture/horticulture crops. The quantity and quality of plant products gets reduced by plant diseases. The goal is to detect, to identify, and to accurately quantify the first symptoms of diseases. Plant diseases are caused by bacteria, fungi, virus, nematodes, etc., of which fungi is the main disease causing organism. Focus has been done on the early detection of fungal disease based on the symptoms.In existing, to detect the diseases they used the spectroscopic techniques.These techniques are very expensive and can only be utilized by trained persons only.

1. INTRODUCTION

1.1 DIGITAL IMAGING

Digital imaging is a method of improving visibility of objects in a dark environment by detecting the objects' infrared radiation and creating an image based on that information. Digital imaging, near-infrared illumination, low-light imaging and are the three most commonly used night vision technologies. Unlike the other two methods, thermal imaging works in environments without any ambient light. Like near-infrared illumination, thermal imaging can penetrate obscurants such as smoke, fog and haze. Thermal images are normally gray scale in nature black objects are cold, white objects are hot and the depth of gray indicates variations between the two. Some thermal cameras, however, add colour to images to help users identify objects at different temperatures.

1.2 IMAGE PROCESSING

Improve digital image processing routines in the application of thermal image processing. Develop special image processing approaches based on the features of thermal images. Thermal Image processing is any form of signal processing for which the input is thermal 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.

Application of Image processing

- Classification
- Feature extraction
- Pattern recognition
- Projection
- Multi-scale signal analysis
- Segmentation
- Compression

1.3 PROBLEM DESCRIPTION

1.3.1 Crop Disease

Plant disease epidemiology is the study of disease in plant populations. Much like diseases of humans and other animals, plant diseases occur due to pathogens such as bacteria, viruses, fungi, oomycetes, nematodes, phytoplasmas, protozoa, and parasitic plants. Plant disease epidemiologists strive for an understanding of the cause and effects of disease and develop strategies to intervene in situations where crop losses may occur. Typically, successful intervention will lead to a low enough level of disease to be acceptable, depending upon the value of the crop.

Plant disease epidemiology is often looked at from a multi-disciplinary approach ,requiring biological, statistical, agronomic and ecological perspectives. Biology is necessary for understanding the pathogen and its life cycle. It is also necessary for understanding the physiology of the crop and how the pathogen is adversely affecting it. Agronomic practices often influence disease incidence for better or for worse. Ecological influences are numerous. Native species of plants may serve as reservoirs for pathogens that cause disease in crops. Statistical models are often applied in order to summarize and describe the complexity of plant disease epidemiology, so that disease processes can be more readily understood. For example, comparisons between patterns of disease progress for different diseases, cultivars, management strategies, or environmental settings can help in determining how plant diseases may best be managed. Policy can be influential in the occurrence of diseases, through actions such as restrictions on imports from sources where a disease occurs.

In 1963 J. E. van der Plank published "Plant Diseases: Epidemics and Control", a seminal work that created a theoretical framework for the study of the epidemiology of plant diseases. This book provides a theoretical framework based on experiments in many different host pathogen systems and moved the study of plant disease epidemiology forward rapidly, especially for fungal foliar pathogens. Using this framework we can now model and determine thresholds for epidemics that take place in a homogeneous environment such as a mono-cultural crop field.

1.4. MOTIVATION OF THE PROJECT

During plant-pathogen infection, the physiological state of the infected tissue is altered, such as changes in photosynthesis, transpiration, stomatal conductance, accumulation of Salicylic acid (SA) and even cell death. Foliar disease can directly be detected by modern optical sensor technology. Using hyper spectral reflectance images and were able to identify powdery mildew of barley, diseased cucumber leaves and yellow rust of wheat respectively. But digital infrared have the potential to identify and quantify with high spatial resolution management zones in disease control and associated pathogens, as they are sensitive to physiological disorders associated with fungal attack as well as disease, in addition leaf diseases often affect plant transpiration. Digital infrared has been proved by various researchers to be a useful tool for the pre-symptomatic effect of disease and pathogen on plant.

1.5. OBJECTIVE OF THE PROJECT

- The main objective of this project is to detect the fungal disease from thermal fruit tree images.
- This will be achieved good classification accuracy, sensitivity and specificity.
- NN algorithm is to be achieved the classification rate with minimum false negatives.

2. SYSTEM ANALYSIS

2.1 EXISTING SYSTEM

In the existing system, the edge-based ear recognition method is used. This method including ear edge detection, ear description, feature extraction, recognition method and ear database construction. The feature vector is composed of two vector inner and outer vectors. The accuracy of the this method is very low. To overcome this drawback another approach is produced. This approach uses multiple geometrical feature extraction (such as shape, Euclidean distances of side of a triangle, and angles of a triangle as a feature vector) of ear based method to identify a person using ear biometrics. This method produce the satisfactory accuracy but it is applicable for very small database.

2.1.1 DRAWBACKS

- Perhaps the biggest limitation of the support vector approach lies in choice of the kernel.
- A second limitation is speed and size, both in training and testing

2.2 PROPOSED SYSTEM

To overcome the drawback of the existing system a new approach is proposed. In this method, the preprocessing of ear image is done for enhance the color. Not only that the median filtering is also applied for removing noise from the image. So this method produce the high accuracy. After that apply the canny edge detection approach to find only the ear from the image. And then mathematical morphological approach is applied to extract the ear position only. So this approach reduce the execution time and improve the high accuracy.

Advantages

- It is fast learning speed, ease of implementation, and minimal human intervention.
- ELM has good potential as a viable alternative technique for large-scale computing and artificial intelligence.

2.3 SYSTEM FEASIBILITY STUDY

This can be done in the top-level management. This is very essential for the purpose of decision-making. Three keys consideration are involved in the feasibility analysis. There are

- Economic feasibility
- Technical feasibility
- Social feasibility

The development of a computer based system or product is more likely plagued by scarcity of resources and difficult delivery dates. It is both necessary and prudent to evaluate the feasibility of a project at the earliest possible time.

Regarding this project, it is feasible because of the availability of required resources to develop the project. This project is feasible operationally, technically and economically as all technical and economical requirements are satisfied by the organization.

2.3.1 Technical Feasibility

Technical feasibility centre around the computer system (hardware, software etc.) and to what extend it can support the proposed addition

- This project can be designed an implemented with existing equipment itself.
- There no need of extra hardware and software to implement this design.
- This system needs .NET Framework to implement. This technology is easily implemented. So it is technically feasible.
- This system takes the all kinds of manipulation function through ASP.NET itself

2.3.2 Economical Feasibility

Economic analysis is the most frequently used method for valuably the effectiveness of a system. Most commonly known analysis is cost/benefit analysis. To implement this system what are needed are a computer and a computer literate. This will not cost much more. The cost of the project will include one-time cost like a developer's fee, the hardware costs, cost of the training staff and the operating costs like salaries of data-entry operators.

Manually maintained records have to be maintained with great care for future references but when it is stored in the database in the computer it can be easily maintained. It reduces the maintenance cost. This design is economically feasible one. The benefit gained from the design is more value able compared to the cost occurred. Due to fewer budget, it is accepted economically. So feasibility of the computerization project can be profitable by weighting the cost and the benefits of the computerized system.

2.3.3 Social feasibility

Once the system is developed completely, it must be put into use. A reasonable acceptance form the user side is necessary for the success of the system. The system is designed in such a way that the end user can easily operate it. The admin head and trainee people can easily handle this application. This design is easily implemented. So this proposed design is also operationally feasible one.

2.4 SYSTEM CONFIGURATION

Language Description:

MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. MATLAB is used for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology. More than a million engineers and scientists in industry and academia use MATLAB, the language of technical computing. MATLAB (matrix laboratory) is a numerical computing environment and fourth-generation programming language. Developed by Math Works, 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. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic 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. 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

.3. SYSTEM DESIGN

3.1 SYSTEM ARCHITECTURE

In this project the input thermal image is converted into grayscale. And then the FCM segmentation is applied for detecting the affected parts from the input image. After segmentation the GLCM and Run length features are extracted.The segmentation and feature extraction process for all images in the training folder and NN classification process is applied to find the disease name and its severity.

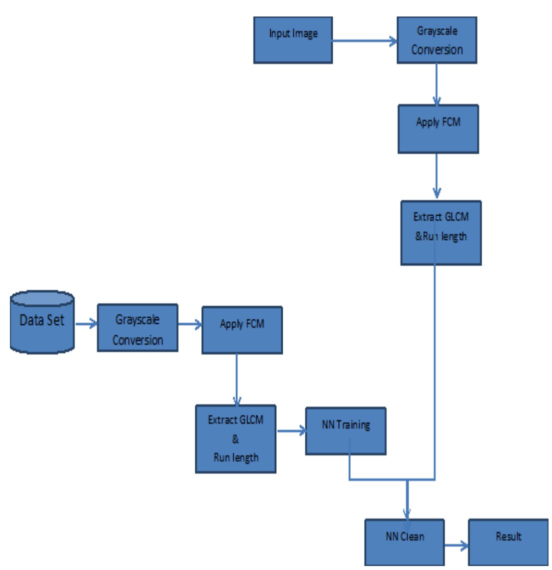

Fig: 3.1System Architecture

The overall block diagram of the proposed method is shown in Fig. 3.1.In the first module, the disease affected part of the input thermal image is segmented. In the second module, the texture features are extracted from the segmented part of the input thermal image. In the last module, the classification approach is used for finding the affected disease in the input thermal image.

3.2. DATAFLOW DIAGRAM

A Data Flow Diagram (DFD) has the purpose of clarifying systems requirements and major transactions that will become programs in system designs. It is the starting point of the design that functionality decomposed the requirements specifications down to the lowest level of detail.

Fig 3.2 represents the flow of data rather that how they are processed. So it does not depend on hardware, software and data structure of file organization. The Data Flow Diagram for the offline application has been developed after closely analyzing the requirements of the system.

The various Data Flow Diagram symbols are

- A rectangle defines a source or destination of system data.
- An arrow indicates the data flow, A one sided open rectangle is a data source.
- A circle or bubble represents a process that transforms incoming data, a one sided open rectangle is a data source.

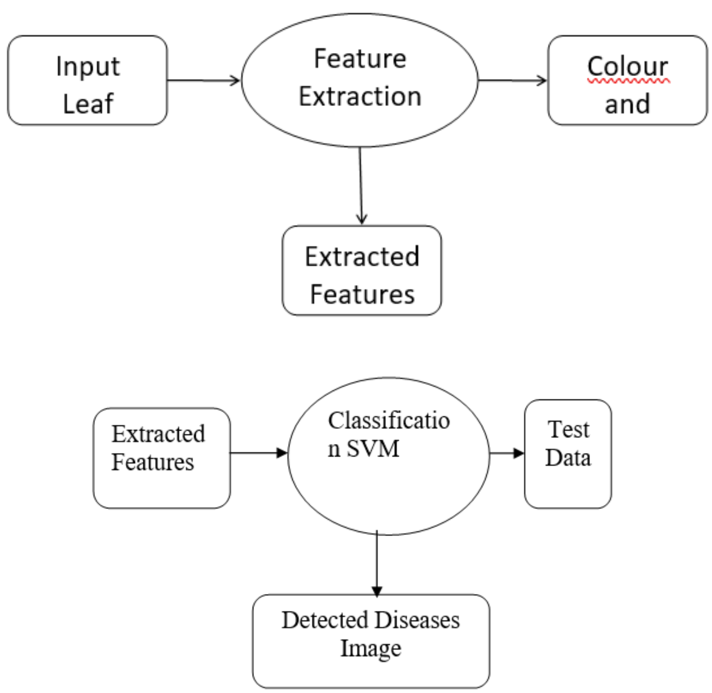

fig 3.2: Dataflow diagram

In Fig 3.2 shows the dataflow diagram about feature Extraction and Classification

4. IMPLEMENTATION & RESULTS

The process of putting the developed system to actual use is called as system implementation. This application is successfully developed and implemented. This application satisfies the entire requirement posted in the proposed system. Implementation is the process of converting a new or revised program into an operation. Implementation is one of the most important tasks and a crucial phase in the system life cycle. The process of putting the developed system to actual use is called as system implementation. Implementation involves creating computer compatible files, training the operating staff and installing the hardware, terminals and telecommunication network before the system is up and running. Depending on the nature of the system executive user training may be required, for minimizing resistance to change and giving the new system a chance to prove its worth.

Types

There are three types of implementation

1. Implementation of computer system replaces a manual system.
2. Implementation of a new computer system to replace an existing one.
3. Implementation of a modified application to replace an existing one using the same computer.

Steps Involved

Several steps involved in implementation are:

- Converting the project plan, test documentation and implementation plan.
- Converting the old files to the new system using test files, which should contain predictable results, simplified error-finding routines and printed results in seconds.
- Contact parallel processing to detect errors and faults in new system
- Log the computer run for reference, which makes it difficult to cover up problems.
- Discontinue the old system.
- Plan for the post-Implementation review that involves evaluating the system in terms of how well performance meets stated objective.

Implementation is a first-class effort to ensure that whether new system is really apt and whether those software changes are made properly and in time to keep the system in tune with user specifications. Implementing this system, we can avoid the syntax errors.

Implementation Review

It is a formal process to determine how well the system is working, how it has been accepted and whether adjustments are needed. It is also important to gather information for the maintenance. The system is implemented to satisfy all the requirements specified in the proposed system. The system is implemented as new form of the existing web site for the concern. This application provides great services to their share holders, insurance agent.

This system is implemented with the help of the MATLAB features. The forms are designed with MATLAB controls in a user friendly nature. The implemented system is works properly by giving all kinds of inputs. This application provides the output in proper format.

4.1 OVERVIEW OF PROJECT

In this project the input thermal image is converted into grayscale. And then the FCM segmentation is applied for detecting the affected parts from the input image. After segmentation the GLCM and Run length features are extracted. The segmentation and feature extraction process for all images in the training folder and NN classification process is applied to find the disease name and its severity

The overall block diagram of the proposed method is shown in Fig. 4.1.In the first module, the disease affected part of the input thermal image is segmented. In the second module, the texture features are extracted from the segmented part of the input thermal image. In the last module, the classification approach is used for finding the affected disease in the input thermal image. The further details of these modules are discussed below:

4.2 MODULES DESCRIPTION

The proposed method have three modules. They are

1. Affected Part Segmentation
2. Feature Extraction
3. Classification

4.2.1 Modules

Affected Part Segmentation:

This is the first module of this project. In this module from the given input thermal image the disease affected part is segmented. Then only find the type of disease and its severity can also be easily measured. To segment the affected part the FCM Clustering Algorithm is used. It is depicted in Fig.4.2.1.FCM clustering, is an iterative, data-partitioning algorithm that assigns n observations to exactly one of k clusters defined by centroids, where k is chosen before the algorithm starts.

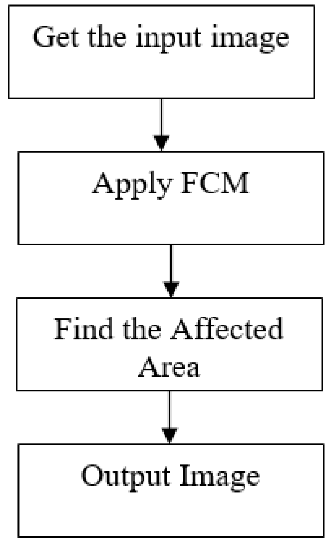

Fig: 4.1 FCM Clustering

Fuzzy c-means (FCM) is a method of clustering which allows one piece of data to belong to two or more clusters. This method is developed by Dunn in 1973 and improved by Bezdek in 1981. This method is frequently used in pattern recognition. It is based on minimization of the objective function: The algorithm proceeds as follows:

1. Initialize U=[uij] matrix, U(0)

2. At k-step: calculate the centre vectors C(k)=[cj] with U(k)

$$C_j = \frac{\sum_{i-1}^{N} U_{ij}^{m} . X_i}{\sum_{i-1}^{N} U_{ij}^{m}}$$

3. Update U(k) , U(k+1)

$$U_{ij} = \frac{1}{\sum_{k-1}^{c} \left(\frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^{\frac{2}{m-1}}}$$

4. If || U(k+1) - U(k)||< then STOP; otherwise return to step 2.

Feature Extraction

After segmenting process the next step is to calculate the features from the part. The feature are used to uniquely identify the disease name and its severity. To extract the features this project uses Gray Level Co-Occurance Matrix (GLCM) and RunLength Matrix (RLC) are used. It is depicted in Fig.4.3.

A GLCM is a histogram of co-occurring greyscale values at a given offset over an image.The GLCM is created from a gray-scale image. The GLCM is calculates how often a pixel with gray with gray-level (grayscale intensity or level (grayscale intensity or Tone) value i occurs either horizontally, occurs either horizontally, vertically, or diagonally to adjacent pixels vertically, or diagonally to adjacent pixels with the value with the value j .

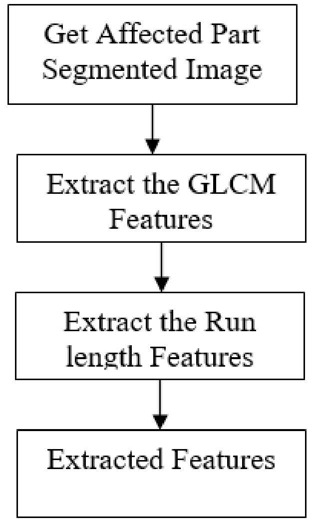

Fig 4.2 GLCM & RLC Matrix

A GLCM is a matrix where the number of rows and columns is equal to the number of gray levels, G, in the image. The matrix element P(i, j | Δx, Δy) is the relative frequency with which two pixels, separated by a pixel distance (Δx, Δy), occur within a given neighbourhood, one with intensity i and the other with intensity j. One may also say that the matrix element P(i, j | d, θ) contains the second order statistical probability values for changes between gray levels i and j at a particular displacement distance d and at a particular angle (θ).

It is also possible to define the matrix across two different images. Such a matrix can then be used for colour mapping.Note that the (Δx, Δy) parameterization makes the co-occurrence matrix sensitive to rotation. This project choose one offset vector, so a rotation of the image not equal to 180 degrees will result in a different co-occurrence distribution for the same (rotated) image. (that is, sequences in which the same data value occurs in many consecutive data elements) This is rarely desirable in the applications co-occurrence matrices are used in, so the co-occurrence matrix is often formed using a set of offsets sweeping through 180 degrees (i.e. 0, 45, 90, and 135 degrees) at the same distance to achieve a degree of rotational invariance.

Run-length encoding is used to represent strings of symbols in an image matrix. For a given image a gray level run is defined as a set of consecutive, collinear pixels having the same gray level. Length of the run is the number of pixels in the run. Run-length encoding (RLE) is a very simple form of data compression in which runs of data are stored as a single data value and count, rather than as the original run.. It is not useful with files that don't have many runs as it could greatly increase the file size.RLE may also be used to refer to an early graphics file format supported by CompuServe for compressing black and white images, but was widely supplanted by their later Graphics Interchange Format. RLE also refers to a little-used image format in Windows 3.x, with the extension RLE, which is a Run Length Encoded Bitmap, used to compress the Windows 3.x start up screen. Typical applications of this encoding are when the source information comprises long substrings of the same character or binary digit.

Classification

The final process is to classify the disease name and its severity. To do this process the Nearest Neighbor Classifier is used. The k-Nearest Neighbours algorithm is a simple Nearest Neighbor Classifier

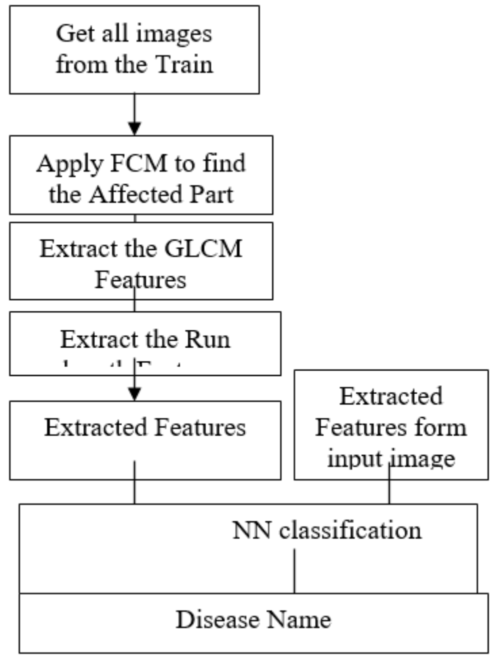

Fig:4.3 Training Phases

Algorithm. The input consists of the k closest training examples in the feature space. The output is a class membership. An object is classified by a majority vote of its neighbours, with the object being assigned to the class most common among its k nearest neighbours. If k = 1, then the object is simply assigned to the class of that single nearest neighbour. It is depicted in Fig.4.3.1.

The training examples are vectors in a multidimensional feature space, each with a class label. The training phase of the algorithm consists only of storing the feature vectors and class labels of the training samples.

In the classification phase, k is a user-defined constant, and an unlabeled vector (a query or test point) is classified by assigning the label which is most frequent among the k training samples nearest to that query point.

A commonly used distance metric for continuous variables is Euclidean distance. For discrete variables, such as for text classification, another metric can be used, such as the overlap metric (or Hamming distance).

In the context of gene expression microarray data, for example, k-NN has also been employed with correlation coefficients such as Pearson and Spear man. Often, the classification accuracy of k-NN can be improved significantly if the distance metric is learned with specialized algorithms such as Large Margin Nearest Neighbour or Neighbourhood components analysis.

performance, constraints and validation criteria for software are established. Moving inward along the spiral, we come to design and finally to coding. To develop computer software we spiral in along streamlines that decrease the level of abstraction on each turn .A strategy for software testing may also be viewed in the context of the spiral. Unit testing begins at the vertex of the spiral and concentrates on each unit of the software as implemented in source code. Testing progress by moving outward along the spiral to integration testing, where the focus is on the design and the construction of the software architecture. Talking another turn on outward on the spiral we encounter validation testing where requirements established as part of software requirements analysis are validated against the software that has been constructed.

5. EXPERIMENTAL RESULTS

5.1 Image Choosing and Preprocessing

In Fig:5.3 Image Processing shows the input image is converted RGB to Lab and it is separated L, a, b and Eliminate L. Name the separated image as A image and B image. After image processing the segmentation process is done

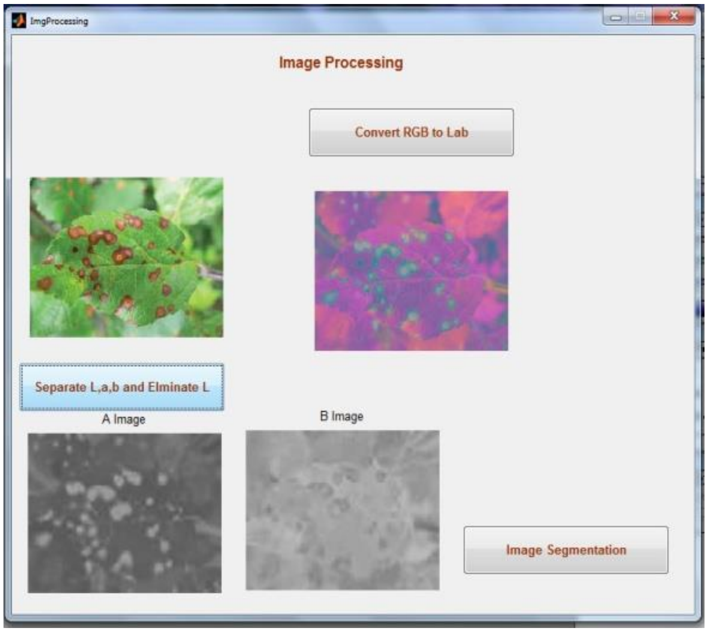

Fig: 5.1 Image Processing

In Fig:5.1 Image Processing shows the input image is converted RGB to Lab and it is separated L, a, b and Eliminate L. Name the separated image as A image and B image. After image processing the segmentation process is done

5.2 Affected Part Segmentation

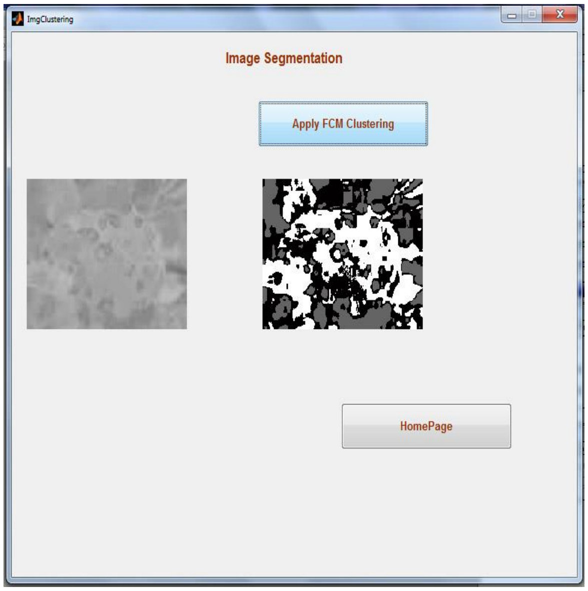

Fig:5.2Affected Part Segmentation

In this fig 5.2 shows the image segmentation process the affected part is segmented by applying the FCM clustering.

5.3Feature Extraction

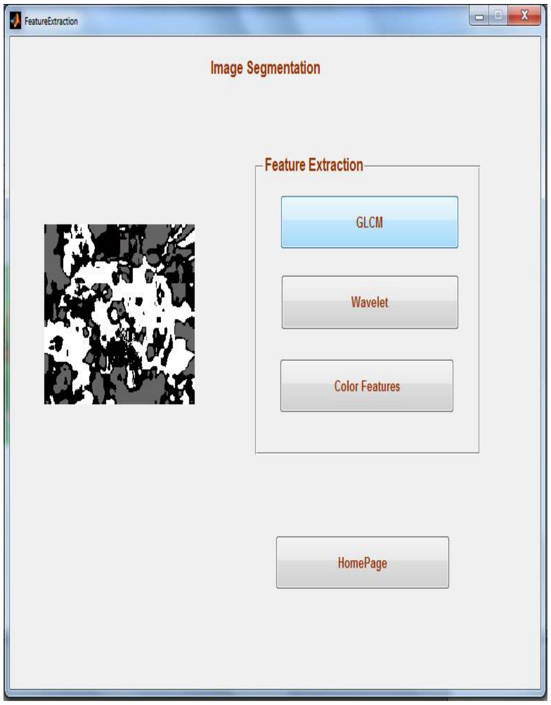

Fig 5.3:feature Extraction

This fig5.3 shows three methods in feature extraction

International Research Journal in Global Engineering and Sciences. (IRJGES)
ISSN : 2456-172X | Vol. 7, No. 3, September 2022 – November 2022 | Pages 63-81

5.5.1 GLCM Feature Extraction

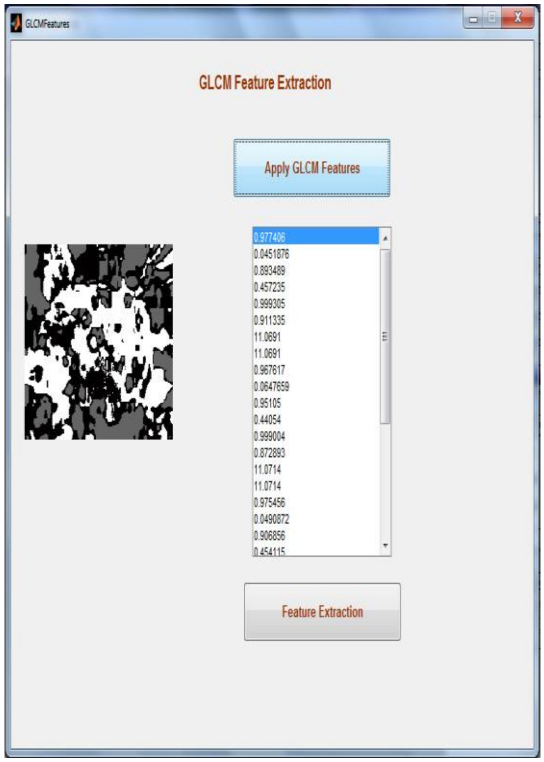

Fig: 5.5.1 GLCM Feature Extraction

In Feature Extraction GLCM(Gray Level co-occurrence matrix) is used to Extract the feature by applying the GLCM feature.

5.5.2 Wavelet Feature Extraction

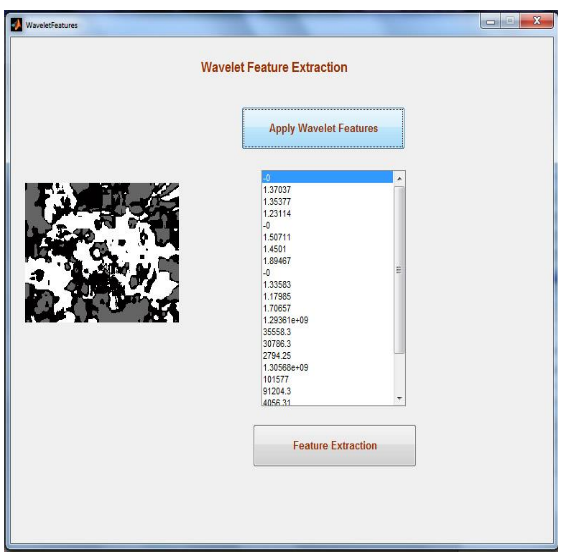

Fig: 5.5.2 Wavelet

feature extraction

In Feature Extraction wavelet is used to Extract the feature by applying the wavelet feature for finding high level and low level images.

5.5.3 Colour Feature Extraction

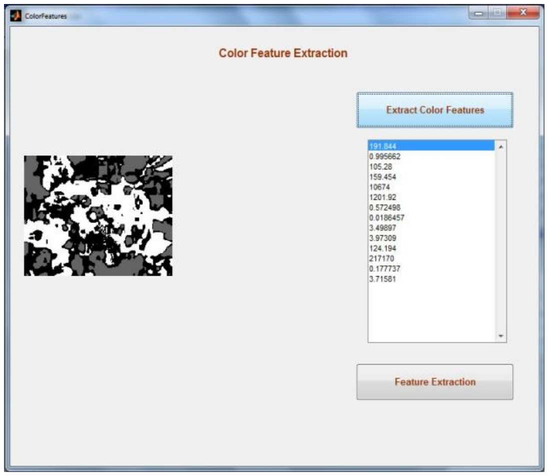

Fig:5.8 Colour feature extraction

The Colour Feature Extraction is using colour co-occurence method in which both texture and colour of an image are considered to come the unique feature

5.6 TRAINING PHASE

5.6.1 Training Image Preprocessing

Fig: 5.9 Training image preprocessing

In this fig 5.6.1 shows that training phase already we are processing the same task. the input image is converted RGB to Lab and it is separated L, a, b and Eliminate L. Name the separated image as A image and B image. After image processing the segmentation process is done

5.6.2 Training image segmentation

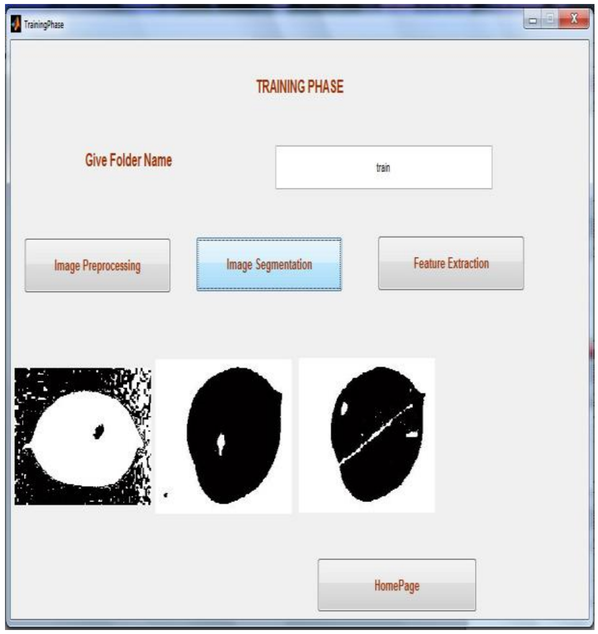

Fig:5.6.2 Training image segmentation

In this fig 5.10 shows the image segmentation process the affected part is segmented by applying the FCM clustering.

5.6.3 Training Feature Extraction

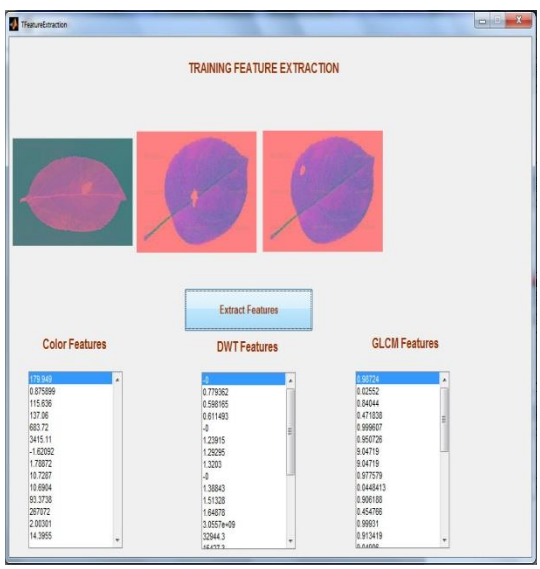

Fig:5.6.3 Training feature extraction

In Feature Extraction GLCM(Gray Level co-occurrence matric) is used to Extract the feature by applying the GLCM feature.

5.7 Classification

.The corresponding feature value are stored in the dataset. Then the classification is done by applying KNN

Fig: 5.7 Classification

6.CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

In this project the input thermal image is converted into grayscale. And then the FCM segmentation is applied for detecting the affected parts from the input image. After segmentation the GLCM and Run length features are extracted. The segmentation and feature extraction process for all images in the training folder and NN classification process is applied to find the disease name and its severity.The Disease Signature created helps to keep track of fungal disease symptoms of fruit crops that have been processed in this project. The task of fungal disease symptoms classification using image processing techniques was successfully implemented four agriculture/horticulture fruit crops affected by fungal disease were used for the considered work. Algorithms for feature extraction and classification based on image processing techniques were designed. The work aims at development of methodology for identification and classification of fungal disease symptoms affected on horticulture and agriculture crops. This architecture remotely monitor the crop for possible disease and detect as early as possible to avoid further loss of crop using GSM, remote sensing or other modern means of telecommunication technologies resulting in intelligent farming.

6.2 FUTURE ENHANCEMENT

In future some other texture feature extraction techniques such as DWT, Gabor will be included. Instead of using k-NN classifier some other classification techniques such as SVM, ELM will be considered for further improvement.

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