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Potato Leaf Diseases Detection and Classification System

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Abstract— This report describes a neural network based detection and classification of Potato leaf samples using Segmentation of K-Means Clustering. Algorithms are developed to acquire and process colour images of single leaf samples. Different leaves like healthy and diseased are considered for the study. The developed algorithms are used to extract over 24 (colour, texture and area) features. The texture features are extracted from the gray level co-occurrence matrix (GLCM). A back Propagation Neural Network (BPNN)-based classifier is used to identify and classify the unknown leaf that is the leaf is healthy or diseased, if leaf is diseased one then classify the disease by giving description (name, cause, pesticides). The colour, texture and area features are presented to the neural network for training purposes. The trained network is then used to identify and classify the unknown leaf samples. The classification is carried out using different types of features sets, viz., colour, texture and area. Classification accuracies of over 92% are obtained for all the leaves samples (healthy and diseased) using all the three feature sets.

Keywords – Pre-processing, Segmentation, Feature Extraction, Leaves samples and Neural Network.

I. INTRODUCTION

India is an agricultural country where in about 70% of the population depends on agriculture. Farmers have wide range of diversity to select suitable Fruit and Vegetable crops. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by the aid of technological support. Plant disease diagnosis is an art as well as science. Farmers experience lot of problem in detecting and identify the diseases in various plants [7]. Digital image processing and image analysis technology based on the advances in microelectronics and computers has many applications in biology and it circumvents the problems that are associated with traditional photography. This new tool helps to improve the images from microscopic to telescopic range and also offers a scope for their analysis. It, therefore, has many applications in biology [1]. So there is a necessity in detecting diseases in such kind of plants leaves as well as fruits. Automatic identification and classification of diseases based on their particular symptoms are very useful to farmers and also agriculture scientists. Early detection of diseases is a major challenge in horticulture/agriculture science [1, 3]. Plant diseases are important factors because its affects human being as well as animals etc. that's why as it can cause significant reduction in both quality and quantity of crops in agriculture production [3]. Therefore, detection and classification of diseases is an important and urgent task. Traditionally farmers identify the diseases by naked eye observation method. Some researchers have used image processing techniques for fast and accurate detection of plant diseases and identifying the diseases in an early stage only and control them. The steps followed by these researchers in detection of leaf spot diseases are: image acquisition, image pre-processing, disease spot segmentation, feature extraction and disease classification. The accuracy of result depends on method used for disease spot detection. The main obstacle in disease spot detection is noise, which is introduced by camera flash, change in illumination, noisy background and presence of vein in the plant leaf. Therefore a method which wipes out the noise and provides better disease spot segmentation is needed. Among several factors responsible for the low potato production, potato diseases like early and late blights, insect damage, and roll viral diseases, Image segmentation is the first step in image analysis and pattern recognition, it is a critical and essential component in image analysis and pattern recognition system, it is one of the most difficult task in image processing and determines the final result of analysis, image segmentation is the process of partitioning an image into disjoint regions using K-mean clustering technique. The K-Means clustering technique is a well-known approach that has been applied to solve image segmentation tasks [2, 3, and 4].

II. PROBLEM STATEMENT

Farmers Identification of leaf diseases it is the important and one of the major problem in early stages. Disease is caused by pathogen which is any agent causing disease. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants, leaves, symptoms and finding out the pest or diseases, percentage of the pest or disease incidence, symptoms of the pest or disease attack, plays a key role in successful cultivation of crops. What is wrong with my plant; followed by, what can I do to get rid of the problem? It may be too late to help the specific plant when the question is asked, but proper diagnosis may be extremely important in preventing the problem on other plants or in preventing the problem in the future. Control measures depend on proper identification of diseases and of the causal agents. Therefore, diagnosis is one of the most important aspects of a plant pathologist's training. Without proper identification of the disease and the disease-causing agent, disease control measures can be a waste of time and money and can lead to further plant losses. consider various environmental and cultural factors. Be able to identify a disease and disease-causing agent, Be able to narrow the problem down to several possibilities which will require further study in the laboratory before he can make a final diagnosis, or Identify characteristic symptoms. Describing the characteristic symptoms exhibited by a specimen can be very difficult to do accurately. Because of this, it is often difficult, if not impossible, to determine what is wrong with a plant when a person is describing symptoms over the phone. As a test of this you may want to take a plant exhibiting symptoms and have three different individuals describe the symptoms that they observe on a sheet of paper.

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III. PROPOSED METHODOLOGY

As diseases are inevitable in plants, early detection and diagnosis of diseases is a crucial aspect in the field of agriculture. This can be achieved using an automated image processing system in which the following steps have to be undertaken. The methodological analysis of the work has been presented. The leaf type detection and classification of more number of samples is attempted here colour, texture and area features and result of such system is applicable to automation of detection and classifying diseases on leaf in agriculture field. The work involves processing of images of different types of leaves (Healthy and Diseased) as shown below.

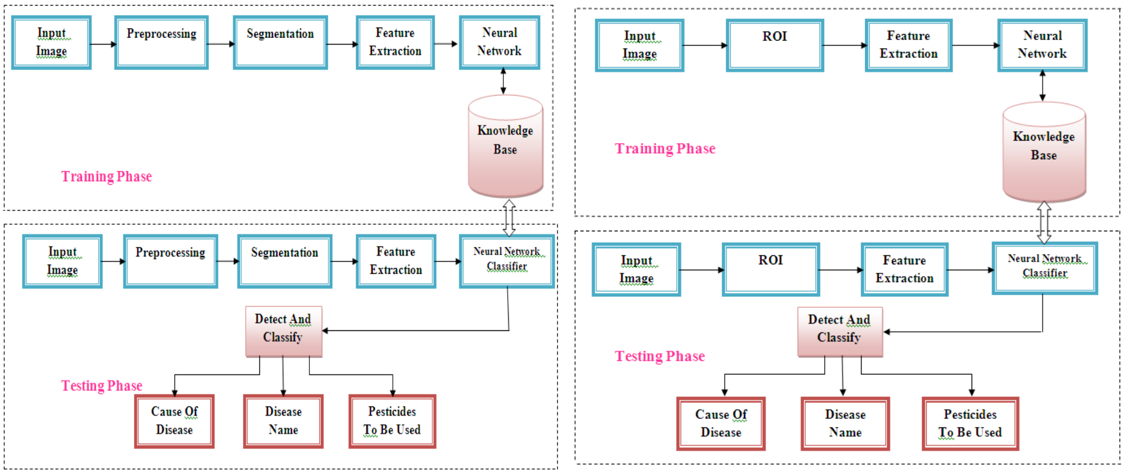


Figure 3.1: Non-interactive proposed systems and Interactive proposed system

The work takes the input as a colour leaf image after accepting the image work do the pre-processing over the leaf image by resizing the size of the image and filtering the image using Gaussian filter technique. In the segmentation the K-mean clustering algorithm is used to extract the leaf part such as if leaf is healthy it extract whole image and for infected leaf image it extract the infected part from leaf image. After extracting the part of the leaf in the image it will send to the feature extraction step to extract the features (colour, texture and area). The extracted features are stored at a set in a knowledge base for future retrieval.

The neural network architecture that is most commonly used with the back propagation algorithm is the multilayered feed forward network. There are four steps in the training process:

I. Assemble the training data.

II. Create the network.

III. Train the network.

IV. Test and validate network response to new inputs.

Training, testing and validation of neural networks are performed using leaf sample images. The color, texture and area feature sets are combined to perform a combined features set that consist of 24 input features. A three layer BPNN used to develop a classifier. In detect and classify step the result will be displayed by analysing the feature set. The result is classified as leaf is healthy or infected (name, cause and pesticides to be used).

3.1 Image Acquisition & Pre-processing

In previous chapter, we have discussed the problems faced by farmers in agriculture field in detecting and classifying of different types of potato leaf diseases and also discussed proposed methodology of work. In this step we are discussing the materials and methods used in the work of detecting and classifying the potato leaf types.

3.2 Imaging System

The images were acquired with digital camera (Sony Corporation made in China, Model No: DSC-W690). The images were stored in a personal computer (Intel Dual-Core processor). Camera was mounted over the simple stand which provided easy vertical movement to finely tune the position of the camera with respect to leaf images were captured and saved in jpg format. We were taken healthy and infected leaf images in natural sunlight and also maintained same distance. The camera has a zoom lens with high quality.

3.3 Leaf Sample Imaging

Here we were consider, the healthy and infected Potato leaf images in this study. Each image in the first and second sets consisted single type of leaf image. Some features (RGB Colour Features, Texture features, Shape Features) were extracted from the first set of images and used to train a classifier. The second set of images is used to test the segmentation algorithm and trained classifier.

3.3.1 Image Samples

Shows an image of the leaf samples. Different types of leaf images (Healthy and Infected) are consider for the study.

Healthy Early Early Blight disease Roll Viral Disease Insect Damage

Figure 3.2: Images of leaf samples

3.4 Pre-processing Methodology

The quality of image is decisive for the results analysis, affecting both the ability to detect features. It can also be defined as a technique in which the data from an image are digitized and various mathematical operations are applied to the data, generally with a digital computer. This is done in order to create an enhanced image that is more useful or pleasing to a human observer, or to perform some of the interpretation and recognition tasks usually performed by humans. Pre-processing uses the techniques such as image resize, filtering, segmentation etc.

3.4.1 Resize

Initially, the captured images are resized to a fixed resolution so as to reduce the computational burden in the later processing. It is also done to improve the storage efficiency.

3.4.2 Filtering

Image Filtering is a software routine that changes the appearance of an image or part of an image by altering the shades and colons of the pixels in some manner. Filters are used to increase brightness and contrast as well as to add a wide variety of textures, tones and special effects to a picture. During image acquisition, the images might be distorted due to the dewdrop, insects' excrement and dust. They are regarded as the image noises which would disturb the segmentation and the feature extraction of disease spots. Hence they must be removed or weakened before any further image analysis. Filters like Gaussian, median, Linear, Low pass, High pass, Laplacian filters etc can be used to remove the noise.

IV. FEATURE EXTRACTION METHODS

In pattern recognition and image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen, it is expected that the features set will perform the desired task using the reduced representation instead of the full size input. For an image, a feature can be defined as the “interest” part of the image. These features play a fundamental role in classification. In image processing, image features usually include colour, shape and texture features [12]. The features are necessary for differentiating one class of objects from another. The method must be used for describing the objects so that features of interest are highlighted. The description is concerned with extracting of features from an image. In the present work, after the analysis, shape features did not give any differentiation between the diseased and healthy leaf samples. Hence Texture, Area and Colour features are extracted to get accuracy in disease identification.

4.1 Colour Features

Colour moment is a simple and effective colour feature and its math foundation lies that any colour distribution can indicate with its moment. In addition, since colour distribution information is mainly concentrated in low order moment, only the first moment, secondary moment and third moment of colour are enough to indicate image colour distribution. Compared with colour histogram, this method needs not vectoring features. HSI colour model with three components independent and less illumination influence is still used to take H, S and I components respectively to get three low moments of each component. The values of RGB colour components are in the range [0, 1] and Hue (H), Saturation (S) and Intensity (I) components are extracted from these RGB components. The extraction of RGB features is as follows: First step in the extraction of RGB feature is separation of RGB components from original colour image sample (figure 4.1).

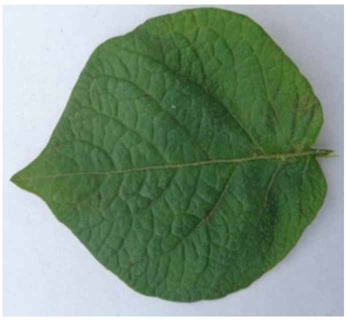


Figure 4.1 Showing Sample Leaf Image

The Red, Green, and Blue Components of original image of a sample leaf and their respective histogram are showing in figure 4.2 The RGB mean, variance, and range are computed using the following expressions:

$$Mean \quad \mu = \sum_{x} x \sum_{y} P(x, y) \tag{4.1}$$

$$Variance = \sum_{x, y} (x - \mu)^2 P(x, y) \tag{4.2}$$

Where, μ x, μ y are means and σ x, σ y are standard deviations defined by,

$$\sigma_x = \sum_x (x-\mu_x)^2 \sum_y P(x,y) \qquad \sigma_y = \sum_y (y-\mu_x)^2 \sum_x P(x,y) \tag{4.3}$$

Maximum element and minimum elements from given input image

Max1=max(image), max2=max(max1) (4.4)

Min1=min(image), min2=min(min1) (4.5)

Range is the difference between the maximum and minimum elements

Range = max2-min2 (4.6)

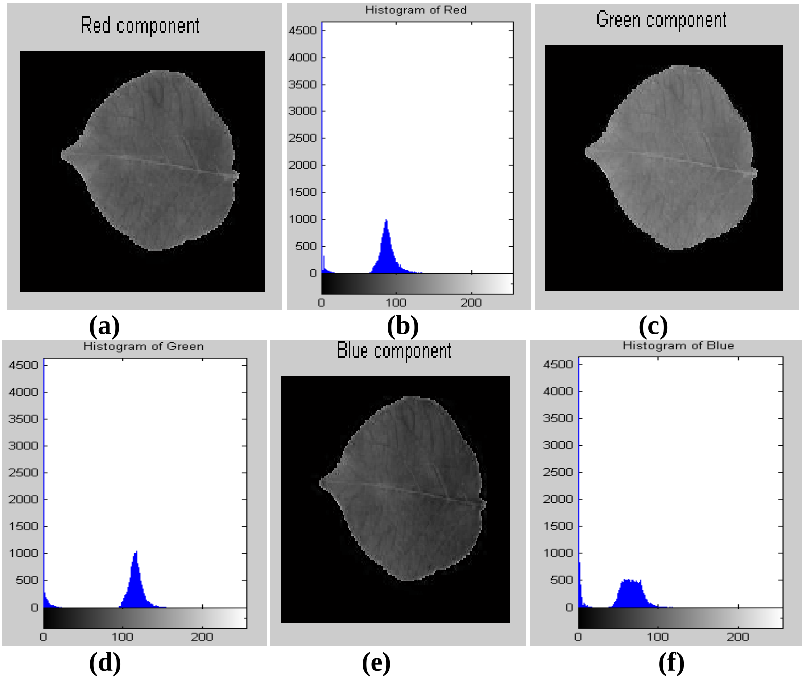


Figure 4.2: (a) Red Component (b) Red Component Histogram (c) Green Component (d) Green Components Histogram (e) Blue Component (f) Blue Component Histogram

Algorithm 4.1: Nine Colour Feature Extraction

RGB features are very important in classifying leafs. Here in this algorithm, the RGB components are separated and mean, variance, and range is computed for each component.

Input: Original 24-bit colour image.

Output: 9 colour features.

Start

Step 1: Separate the RGB components from the original 24-bit input colour image.

Step 2: Compute mean, variance, and range for each RGB components using the equations 4.1, 4.2, 4.3, and 4.6

Step 3: Find the mean, variance, and range for each RGB components

Stop.

The colour images are recognized by quantifying the distribution of colour throughout the image, change in the colour with reference to average/ mean and difference between the highest and the lowest colour values. This quantification is obtained by computing mean, variance and range for a given colour image. Since these features represent global characteristics for an image, we have adopted mean, variance and range colour features in this work. The equations are used to evaluate mean, variance and range of the image samples. The procedure adopted in obtaining the colour features is given in Algorithm 4.1.

SL.NO.	Features
1	Red Mean
2	Red Variance
3	Red Range
4	Green Mean
5	Green Variance
6	Green Range
7	Blue Mean
8	Blue Variance
9	Blue Range

Table 4.1 Nine colour Features

Algorithm 4.2: Eighteen Colour Feature Extraction

Input: Original 24-bit colour image.

Output: 18 colour features.

Start

Step 1: Separate the RGB components from the original 24-bit input color image.

Step2: Obtain the HSI components from RGB components using the equations:

The equations (4.7), (4.8) and (4.9) are used to evaluate H, S and I components for a given image sample.

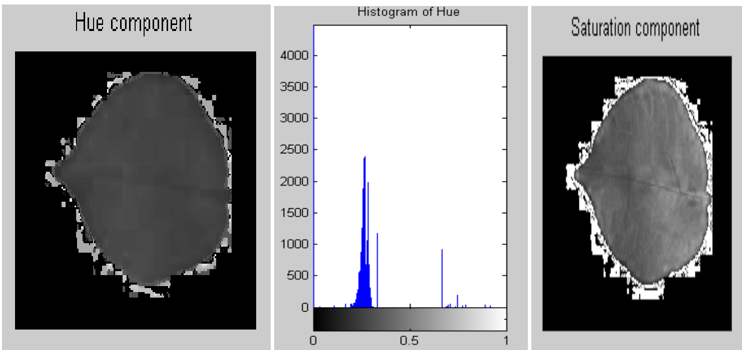
$$H = cos^{-1}\left\{\frac{\frac{1}{2}[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{1/2}}\right\} \quad (4.7)$$

$$S = 1-\frac{3}{(R+G+B)}[min(R,G,B)] \quad (4.8)$$

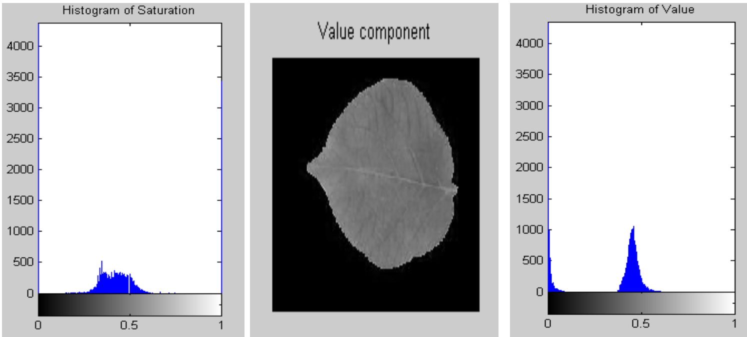
$$I = \frac{1}{3}(R+G+B) \quad (4.9)$$

Step 3: Find the mean, variance, and range for each RGB and HSI components.

Stop.



(a) **(b)** **(c)**



(d) **(e)** **(f)**

Figure 4.3: HSI Components and Respective Histograms of a leaf sample (a) Hue Component (b) Hue Component Histogram (c) Saturation Component d) Saturation Components Histogram (e) Value Component (f) Value Component Histogram

SL.NO.	**Features**	**SL.NO.**	**Features**	**SL.NO.**	**Features**
1	Red Mean	7	Blue Mean	13	Saturation Mean
2	Red Variance	8	Blue Variance	14	Saturation Variance
3	Red Range	9	Blue Range	15	Saturation Range
4	Green Mean	10	Hue Mean	16	Value Mean
5	Green Variance	11	Hue Variance	17	Value Variance
6	Green Range	12	Hue Range	18	Value Range

Table 4.2 Eighteen colour Features

4.2 Texture features

Orientation of the shape is represented by the texture. Different texture features extracted from the diseased images are energy (EG), entropy (ET), contrast (CT), homogeneity (HG) and co-relation (CR), as mentioned in below. The basic assumption of selecting EG as a feature is based on the concept that the energy distribution in frequency domain able to identify a texture. Besides providing acceptable retrieval performance from large texture database, EG based approaches are partly supported by physiological studies of the visual cortex. Another feature ET is a statistical measure of randomness and invariant to scaling, translation and rotation, used to characterize the texture of the image. It does not depend on the actual value of the gray level but only on the probabilities of gray level distribution. Local variations present in an image are measured by texture feature CT that helps to distinguish objects by their colour and brightness within the same field of view. In general, HG is defined as the quality or state of being homogeneous, used to evaluate the intensity uniformity of a local region based on high-pass operators as texture. CR measures the pixel linear dependencies of neighbouring pixels, based on which uniformity in neighbouring regions of image is determined. Texture analysis refers to the characterization of regions in an image by their texture content. Texture analysis attempts to quantify intuitive qualities described by terms such as rough, silky, or bumpy in the context of an image. In this case, the roughness or bumpiness refers to variations in the brightness values or gray levels. Following are the texture features which can be considered for the classification.

4.3 Shape Feature

As **area** feature mainly depends on the portion of the leaf being affected by the disease, it is unpredictable. If the entire leaf is affected by the disease, then total area of the healthy / diseased leaf will be same. Hence taking Area as one of the feature, gives dissatisfactory results.

V. EXPERIMENTATION

Basic Concept of K-mean clustering

Image segmentation refers to the process of partitioning the digital image into multiple segments to change the representation of an image into something that is more meaningful and easier to analyse. In our work, the very purpose of segmentation is to identify regions in the image that are likely to qualify as diseased regions. There are various techniques for image segmentation such as clustering methods, compression-based methods, histogram-based methods, region growing methods etc. Clustering is the process of partitioning or grouping a given set of patterns into disjoint clusters. This is done such that patterns in the same cluster are alike and patterns belonging to two different clusters are different. Clustering has been a widely studied problem in a variety of application domains including neural networks. The K-Means clustering technique is a well-known approach that has been applied to solve low-level image segmentation tasks. This clustering algorithm is convergent and its aim is to optimize the partitioning decisions based on a user-defined initial set of clusters that is updated after each iteration. The experimental results demonstrate that the proposed technique is a robust technique for the detection of plant leaves diseases.

Steps:

1. RGB image acquisition.
2. Create the colour transformation structure.
3. Convert the colour values in RGB to the space specified in the colour transformation structure.
4. Apply K-means clustering.
5. Masking green-pixels.
6. Remove the masked cells inside the boundaries of the infected clusters.
7. Convert the infected (cluster / clusters) from RGB to HSV Translation.

We present a general k-means-based clustering algorithm that can identify natural clusters in datasets, whether they are embedded in the original space or subspaces. Like traditional k-means clustering algorithm, the time complexity of the algorithm is linear with the number of the data points, the dimensionality of the data, and the number of clusters in the dataset. The experiment results show that our algorithm is an efficient algorithm with high clustering accuracy. Standard versions of k-means algorithms seem be better in finding high fitness solutions. In the same time results obtained in standard and genetic versions of k-means algorithms relative to validity indices are also comparable. During extensive search of solution space, genetic versions of k-means algorithms most often find solutions with slightly worse fitness values but at the same time with exceptionally good values of individual validity indices. Further investigation into this matter could present starting point into improvement of k-means based image clustering techniques. Recent resurgence of interest in artificial neural networks has resulted in different modules for real-world applications. Neural network models have been applied in low level image processing, image segmentation, clustering techniques for image coding, image restoration and reconstruction, nonlinear image filtering, target detection, radar imaging, medical imaging, document analysis, character signature, face and object recognition. It has also found applications in three-dimensional object recognition, motion estimation, stereo vision and expert systems.

Artificial Neural Network Based Classifier:

We have used a multilayered back propagation neural network (BPNN) as a classifier of different produce and in automatic detection of disease. The number of neurons in the input layer corresponds to the number of input features and the number of neurons in the output layer corresponds to the number of classes. The classifier is trained, validated and tested using images of different agriculture/horticulture produce. The procedure adopted in classification is given in

Algorithm

Algorithm: BPNN Classifier.

Start

Step 1: Accept images of the agriculture/horticulture Produce.

Step 2: Extract different color and texture features

Step 3: Train the BPNN with extracted features

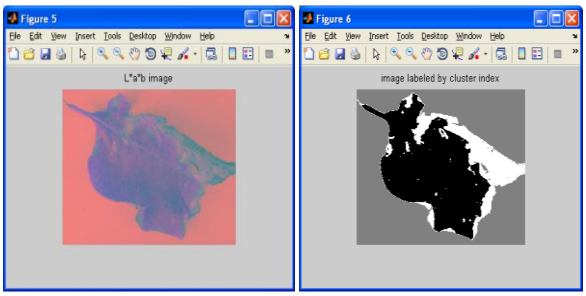
Step 4: Accept test images and perform Step 2

Step 5: Recognize and classify the produce images using BPNN classifier.

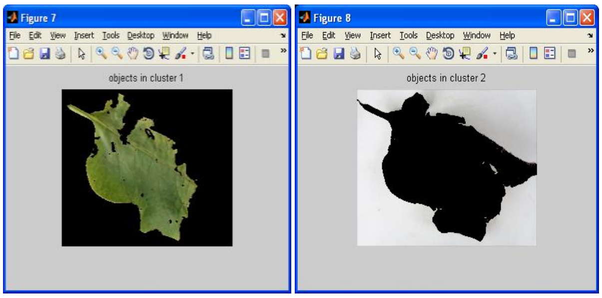
Stop.

VI. RESULTS AND DISCUSSION

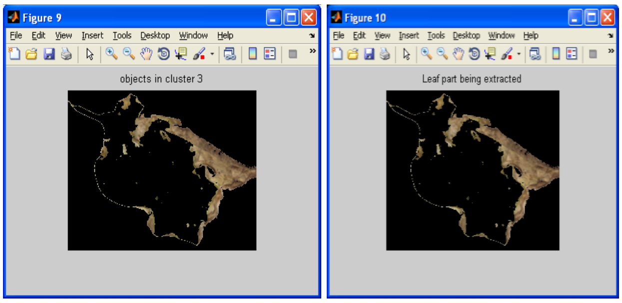
We have presented Neural Network Model for classification of leaf and working of Neural Network Model. In this study of the twenty four features used in the work is presented, and comparative study using feature sets is discussed. This section gives the results of exhaustive experimentation of developed methodology. A total of 150 images of potato leaf samples (50 Healthy and 100 Infected) are used in this experiment. BPN feed forward Neural Network is used for training, learning, testing, detecting and classifying the leaf types. When K-Means algorithm is run for the given input image with K=3 , for most of the cases, the result fails to separate the clusters and thus the diseased portion gets merged into other colour cluster. But in few cases, the diseased portion was extracted along with some part of the leaf veins. The below figures shows the segmentation results when K value is three.



(a) L*a*b* imag (b) Cluster indexed image



(c) Objects in Cluster 1 (d) Objects in Cluster 2



(e) Objects in Cluster 3 (f) Disease portion

Figure 7.1: Segmentation Results when k=3

In the contemporary exertion, features are extracted for the classification result. Initially colour features are extracted for the classification results. Features namely colour (18), texture (5) and area are extracted for both healthy and diseased samples. The extraction of diseased part of the leaf and binary image of that part are shown below.

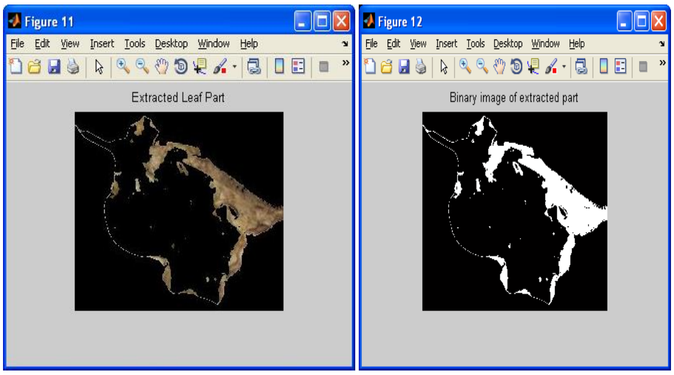


Figure 7.2: (a) Extracted Leaf Part (b) Binary Image of Extracted Part

Comparative study using feature set

Figure shows the comparative study using feature set from the figure it is clear that classification using 24 feature analyses is done in better way. The classification accuracies obtained for the above mentioned features is over 92%.

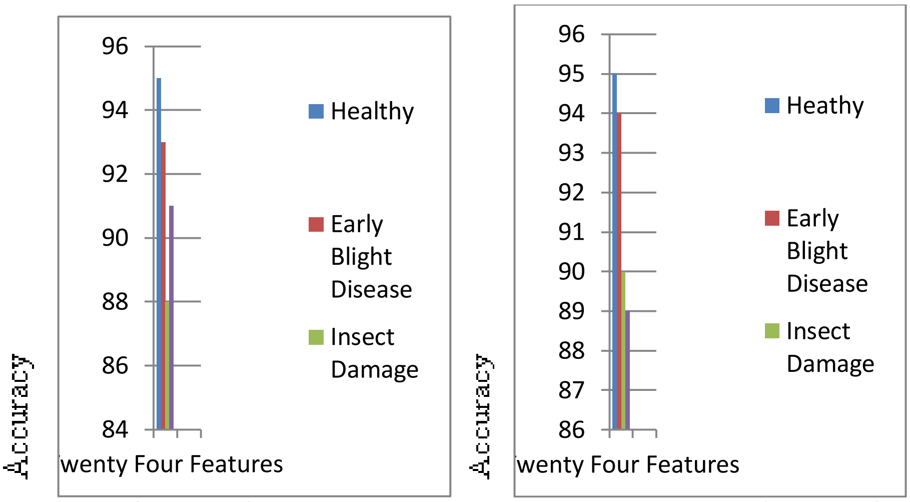


Figure 7.3: Comparative Graph of Accuracy for Non-interactive System and Comparative Graph of Accuracy for Interactive System

RESULTS

Leaf Type	Sample No.	Red Mean	Red Variance	Red Range	Green Mean	Green Variance	Green Range	Blue Mean	Blue Variance	Blue Range
Healthy	1	8.3340	-1	159	11.0007	1	176	6.2561	-1	131
	2	9.4347	-1	131	13.5595	1	155	7.9299	1	126
	3	9.4359	1	190	12.7082	-1	194	7.5790	-1	179
Early Blight Disease	1	17.4995	-1	174	21.4290	1	180	12.1142	1	161
	2	4.0844	1	219	3.9853	1	220	3.5589	1	215
	3	7.9283	-1	152	11.1943	-1	153	6.3271	-1	152
Insect Damage	1	6.7853	1	146	9.2398	1	157	5.2990	-1	124
	2	6.8234	1	162	9.2625	1	167	5.3377	-1	145
	3	6.8183	1	153	9.2635	1	162	5.3276	-1	131
Roll Viral Disease	1	19.8391	-1	188	23.9772	-1	191	16.1572	1	184
	2	19.2887	-1	175	21.2992	1	188	12.1995	1	169
	3	24.7989	1	236	22.9977	1	231	16.9029	1	207

Leaf Type	Sample No.	Hue Mean	Hue Variance	Hue Range	Saturation Mean	Saturation Variance	Saturation Range	Value Mean	Value Variance	Value Range
Healthy	1	0.1009	1	0.9583	0.2158	1	1	0.0439	1	0.6902
	2	0.1107	1	0.9833	0.2269	1	1	0.0540	1	0.6078
	3	0.0962	1	0.9583	0.2023	1	1	0.0505	1	0.7608
Early Blight Disease	1	0.1130	1	0.9583	0.2421	1	1	0.0849	1	0.7059
	2	0.0342	1	0.9815	0.0794	1	1	0.0166	1	0.8627
	3	0.1086	1	0.9583	0.2285	1	1	0.0448	1	0.6000
Insect Damage	1	0.0727	1	0.9583	0.1496	1	1	0.0368	1	0.6157
	2	0.0748	1	0.9583	0.1562	1	1	0.0369	1	0.6549
	3	0.0752	1	0.9667	0.1569	1	1	0.0369	1	0.6353
Roll Viral Disease	1	0.1675	1	0.9815	0.3473	1	1	0.0952	1	0.7490
	2	0.1434	1	0.9444	0.3298	1	1	0.0850	1	0.7373
	3	0.0916	1	0.9833	0.2822	1	1	0.0984	1	0.9255

Leaf Type	Sample No.	Contrast	Energy	Correlation	Homogeneity	Entropy	Area
Healthy	1	0.2087	0.7850	0.8289	0.9652	2.2098	4.7796e+03
	2	0.1853	0.7413	0.86561	0.9640	2.4728	6.7504e+03
	3	0.2343	0.7893	0.8554	0.9667	2.2267	4.7829e+03
Early Blight Disease	1	0.3195	0.6505	0.8725	0.9524	2.8357	8.9646e+03
	2	0.2533	0.9155	0.6220	0.9801	1.1867	1.4396e+03
	3	0.1550	0.7737	0.8563	0.9707	2.2078	5.4069e+03
Insect Damage	1	0.1133	0.8105	0.8723	0.9752	1.7492	4.5108e+03
	2	0.1212	0.8077	0.8638	0.9741	1.7800	4.52432e+03
	3	0.1246	0.8083	0.8598	0.9735	1.7789	4.5274e+03
Roll Viral Disease	1	0.6539	0.6162	0.7909	0.9232	3.4762	8.9944e+03
	2	0.5680	0.6496	0.7922	0.9394	3.3107	8.1154e+03
	3	0.6764	0.6415	0.8244	0.9324	3.2392	8.4925e+03

Table 8.1: Values of RGB Colour, HSV, Texture and Shape Features Extracted by Considering Some Images

VII. CONCLUSION

The current work aims to develop a quick, automatic and accurate system for disease identification and classification for potato leaves. The potency (related to) of the system is the capability to extract the diseased portion in the query images. The system employs diverse image processing techniques. Neural Network, one of the Machine Learning Techniques, has been used to categorize the query leaf image as either healthy or diseased sample. Implementation is carried out using the MATLAB Image Processing and Bioinformatics Tool Box. The results showed that BPNN could effectively detect the disease spots and classify the particular disease type by mentioning name of disease, cause of disease and pesticides to be to prevent the diseases with accuracy of 92%. Thus the system can be satisfactorily used for disease detection and classification over Potato Plant leaf which ultimately helps the agriculturists/farmers.

REFERENCES

[1] Dickson, M.A., and Bausch, W.C. “Plant recognition using a neural network classifier with size and shape descriptors”, *Transactions of the ASAE,* vol. 1, pp. [97-102] 1997.

[2] Zhang, M., Laszlo, L. Mark, M., Krutz, G., and Cyrille, P, “Application of colour vision machine in the agriculture and food industries”, *Proceeding of SPIE, The International Society for optical engineering,* vol. 3543, pp. [208-219] 1999.

[3] Sabah Bashir, Nav deep Sharma“Remote Area Plant Disease Detection Using Image Processing” *1, 2[Amity School of Engineering and Technology, Amity University Uttar Pradesh, India]* Sep-Oct 2012.

[4] Leszek Wojnar, “Image analysis- applications in Material engineering” *CRC Press LLC,* 1999.

[5] A. A. Bernardes, J. G. Rogeri, N. Marranghello and A. S. Pereira “Identification of Foliar Diseases in Cotton Crop” [Volume 17– No.1], March 2001.

[6] Basvaraj .S. Anami, J.D. Pujari and Rajesh.Yakkundimath. “Identification and Classification of Normal and Affected Agriculture/horticulture Produce Based on Combined Color and Texture Feature Extraction”. [VOL I, ISSUE III], September 2011.

[7] Mr. Viraj A. Gulhane and Dr. Ajay A. Gurjar. “Detection of Diseases on Cotton Leaves and Its Possible Diagnosis”. *International Journal of Image Processing (IJIP),* [Volume (5): Issue (5)],2011.

[8] Sanjay B. Patil, Dr. Shrikant K. Bodhe.“Leaf disease severity measurement using image processing*”. [IEIT Journal of Adaptive & Dynamic Computing,* [(4), 25–30], 2012.

[9] Piyush Chaudhary, A. “Color Transform Based Approach for Disease Spot Detection on Plant Leaf”. nand K. Chaudhari, Dr. A. N. Cheeran and Sharda Godara. *International Journal of Computer Science and Telecommunications* [Volume 3, Issue 6], June 2012.

[10] Tushar H Jaware, Ravindra D Badgujar and Prashant G Patil. “Crop disease detection using image segmentation”. *World Journal of Science and Technology* [2(4):190-194], 2012.

