An Approach for Detection and Classification of Fruit Disease

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ABSTRACT

Agriculture is the mother of all cultures. Due to increasing demand in the agricultural industry, the need to effectively grow a plant and increase its yield is very important. Diseases in fruit cause devastating problem in economic losses and production in agricultural industry worldwide. So to protect the product, it is important to monitor the plant during its growth period, as well as, at the time of harvest. In this paper, a solution for the detection and classification of Strawberry fruit diseases is proposed and experimentally validated. For Fruit Disease Detection, the image processing based proposed approach is composed with the following main steps; in first step, Image acquisition is done, After that in second step Preprocessing is done including Noise Remove using masking and Image Enhancement using Discrete Cosine Transform (DCT). In third step Feature Extraction is done, in which, Color Feature Extraction using Color Space Conversion and Texture Feature Extraction using Canny Edge Detection and Dilation. As same as, For Fruit Leaf Disease Detection, the image processing based proposed approach is composed with the following main steps; in first step, Image acquisition is done, in this images are collected from Internet. After that in second step Preprocessing is carried out. In which, Image Enhancement is done using Equalize Histogram and Color Space Conversion. In third step Feature Extraction is done using Gray Level Co-occurrence Matrix (GLCM) for Texture Feature Extraction. After that, classification is done using Support Vector Machine (SVM) Classifier.

Keywords : - Image Processing, Pre-Processing, Segmentation, Feature Extraction, Classification

1. INTRODUCTION

Strawberry is a perennial economically important crop, grown under a wide range of climatic conditions. Total area under cultivation of strawberry at world level was reported 72000 hectares, among this 16160.4 hectare was in Asia .The world production of strawberry was estimated as 3.9 million tons, of this 721566 tons produced from Asia (FAO, 2007) [1]. Wild and cultivated plants are producing small sized fruits with high nutrient value and

were also used as remedy for many human diseases including kidney and liver diseases. Furthermore, extracts from strawberry shoots were used to treat diarrhea.

Today quality is one of the most important factors in marketing of agricultural products. Traditionally Strawberry Fruit is sorted by human. This kind of sorting characterized by low speed and accuracy, this is related to human tiredness and different discrimination. Therefore high speed sorting is inseparable parts of agricultural production and exportation. One of the practical techniques for sorting is image processing. Therefore applying this technique in automatic sorting lines needs appropriate conditions like illumination in order to increase sorting efficiency.

2. ORGANIZATION OF PAPER

This paper presents an improvement to intelligent sorting of agri-produce by considering both shape and color features. The following sections will discuss further on the techniques used in the research, the methodology and design and finally the results obtained. In sections III, related work of proposed system is discussed. In Section IV Proposed Methodology and in Section V Result and Analysis discussed. Finally conclusions are drawn and future enhancements listed in Section VI.

3. RELETED WORK

Suhaili Kutty et. al[2] proposed the process to Classify watermelon leaf Diseases, namely Anthracnose and Downey Mildew. For this purpose, from infected leaf sample, Region of Interest need to be identified based on RGB color component. After that, to reduce noise and for segmentation Median Filter is used. And for classification, Neural Network Pattern Recognition method is used. Proposed method achieved 75.9% of accuracy based on its RGB mean color component.

S. Dubey and R. Jalal [3] explored the concept of detection and classification of apple fruit diseases, namely, scab, apple rot and apple blotch. For that, segmentation is done using K-means clustering technique. After that, feature extraction is done from the segmented image. For classification Multiclass Support Vector Machine (SVM) is used.

The goal of Sanjiv Sannakki et.al[4] is to diagnose the disease using image processing and artificial intelligence techniques on images of grape plant leaf. They classify mainly two diseases, downy mildew and powdery mildew of grape leaf. To remove background, Masking is used and improve accuracy. Anisotropic Diffusion is used to preserve information of affected portion of leaf. Segmentation is carried out using k-means clustering method. After segmentation, Feature Extraction take place by calculating Gray Level Co-occurrence Matrix. And finally classification is done using Feed Forward Back Propagation Network classifier. They have used only Hue feature which gives more accurate result.

Meunkaewjinda et. al [5] presents automatic plant disease diagnosis using multiple artificial intelligent techniques. They focus on a system having composed of only three main parts which are (1) Grape leaf color extraction, (2) Grape leaf disease color extraction and (3) Grape leaf disease classification. For Grape leaf color extraction, they enhanced image using anisotropic diffusion. Then H and B components are used from HIS and LAB color space respectively. After that Back Propagation neural network is applied to extract grape leaf color from other background color. In Grape leaf disease color extraction, to reduce illumination effects, A, U, and Cr components are applied from LAB, UVL and YCbCr color space respectively. Then SVM classification is used for better segmentation compare to neural network. And finally for Grape leaf disease classification process, some irrelevant pixels are eliminated using thresholding, and H and Cr components from HIS and YCbCr color space respectively, are applied to extract most important color feature of grape leaf disease. MSVM classification is used for Grape leaf disease classification.

Monika Jhuria et. al[6] investigated an approach of image processing for detection of disease and the fruit grading. They have used artificial neural network for classification of disease. They consider three feature vectors, namely, color, textures and morphology. Among all, morphological feature gives better result. It can detect two disease of grape which are Black Rot and Powdery Mildew and two of apple which are Apple Scab and Rot. Two methods are used for fruit grading which are spread of disease and automated calculation of mango weight.

Sachin Khirade and A. B. Patil[7] discussed about the main steps of image processing to detect disease in plant and classify it. It involve steps like image acquisition, image preprocessing, image segmentation, feature extraction and classification. For segmentation, methods like, otsu's method, converting RGB image into HIS model and k-means clustering are there. Among all, k-means clustering methodgives accurate result. After that, feature extraction is carried out like, color, texture, morphology, edges etc. Among this, morphology feature extraction gives better result. After feature extraction, classification is done using classification methods like Artificial Neural Network and Back Propagation Neural Network.

Ms. Kiran R. Gavhale et al.[8] presented number of image processing techniques to extract diseased part of leaf. For Pre-processing, Image enhancement is done using DCT domain and color space conversion is done. After that segmentation take place using k-means clustering method. Feature extraction is done using GLCM Matrix. For classification of canker and anthracnose disease of citrus leaf, SVM with radial basis kernel and polynomial kernel is used.

Zulkifli Bin Husin et al.[9] explored a system to detect disease on chili leaf. Health status of leaf is going to check. So chemicals only applied if it is affected by any disease, which is inexpensive technique. In this, preprocessing operations are done which are Fourier Filtering, Edge Detection and Morphological Operations. Input image is also enhanced to preserve information of affected pixels. For reducing effect of illumination, they used color space. Using this technique, unnecessary use of harmful chemicals in plant is reduced and ensure a healthier environment and provide high quality of chili.

4. PROPOSED METHOD

As we had seen, there are two parts of this research. One is to detect disease in Strawberry fruit and classify its healthiness. This system will be very much helpful in Production System where Jam, Jelly and other things are going to make. Whereas the other is to detect diseases of Strawberry leaf and classify it. This system will became helpful in Farm, at where Strawberry's farming is going to be done. So using this, unnecessary spreading of harmful chemical can be reduced.

I. Strawberry Fruit Disease Detection
II. Strawberry Leaf Disease Detection

I. Strawberry Fruit Disease Detection

First we will concentrate on Strawberry Fruit Disease Detection. It's a flow diagram and steps are as below.

At first, Image acquisition is done using Olympus Digital Camera. After that preprocessing step is carried out, in which Image Enhancement is done with the help of DCT method and Noise Remove is done using masking. After that Segmentation is done using Partition Clustering method. Feature Extraction is done using Color Feature Extraction and Texture Feature Extraction. After Feature Extraction, Classification of Strawberry's healthiness is done.

A. Image Acquisition
B. Image Pre-processing

C. Segmentation
D. Feature Extraction
E. Classification

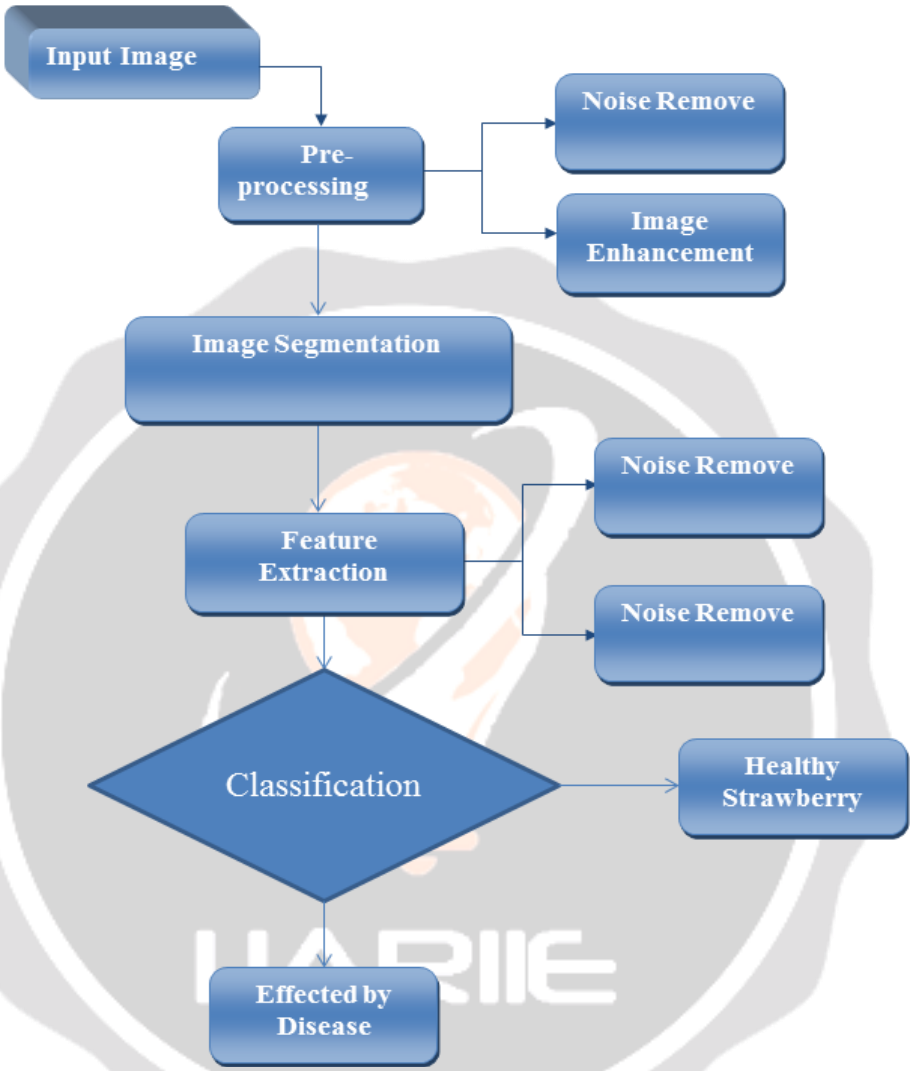

Fig.1: Flow Diagram of Proposed Approach for Fruit diseases detection

A. Image Acquisition

This is the first step to collect sample images of fruit which are going to be decided, is it healthy or not. For this, Strawberry images are captured using Olympus Digital Camera Model VG120, D705 having 14 Mega Pixel. All this images are stored as .JPG standard format and resize into 429x322 pixels. The main application of this task is in production system. So for that the environment remain same including white background.

B. Image Preprocessing

The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing. Here there are two approaches used for Image Pre-processing.

a) Image Enhancement
b) Noise Remove

a) Image Enhancement

Enhancement of the image is necessary to improve the visibility of the image subjectively to remove unwanted flickering, to improve contrast and to find more details. In general there are two major approaches [10]. They are spatial domain, where statistics of grey values of the image are manipulated and the second is frequency domain approach; where spatial frequency contents of the image are manipulated. Although Spatial Domain methods are developed for gray valued images. And it can be applied directly on pixels. Whereas in Frequency Domain methods, operations applied on Fourier transform of an image. Here we used Discrete Cosine Transform method to transform an image from RGB scale to Gray Scale.

b) Noise Remove

To remove Noise, in this phase Masking is used. A mask is a filter. Concept of masking is also known as filtering. The general process of filtering and applying mask is consists of moving the filter mask from point to point in an image. At each point (x,y) of the original image, the response of a filter is calculated by a pre-defind relationship [13]. All the filter values are pre defined and standards.

C. Image Segmentation

In this step for Segmentation Partition method is used. Partition clustering algorithm splits the data points into k partition, where each partition represents a cluster[8]. The partition is done based on certain objective function. One such criterion functions is minimizing square error criterion which is computed as,

$E = \Sigma \Sigma || p - mi || 2$

Where p is the point in a cluster and mi is the mean of the cluster[8]. The cluster should exhibit two properties, they are (1) each group must contain at least one object (2) each object must belong to exactly one group. The main drawback of this algorithm is whenever a point is close to the center of another cluster, it gives poor result due to overlapping of data points.

D. Feature Extraction

In this phase, There are two methods are used namely Texture Feature and Color Feature. For Color Feature color space conversion method is used. For Texture Feature Canny edge detection and Dilation methods are used.

- **Texture Feature**

1) Canny Edge Detection

When sudden changes of discontinuities in an image are called as edges. Significant transitions in an image are called Edges. Canny Edge Detection is a popular edge detection algorithm. It was developed by John F. Canny in 1986. It is a multi-stage algorithm. Since edge detection is susceptible to noise in the image [14]. So first step is to remove the noise in the image with a 5x5 Gaussian filter. In Gaussian blur also known as Gaussian smoothing is the result of blurring an image by a Gaussian function. It is a widely used to reduce image noise. And after that Canny Edge Detection will be applied.

2) Morphology (Dilation)

Morphological Image Processing is a collection of non linear operations related to the shape or morphology of features in an image [12]. Morphological operations relay only on the relative ordering of pixel values, not on their numerical values, not on their numerical values, and therefore are specially suited to the processing of binary images. Morphological operations can also be applied to gray scale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest.

A morphological operation on a binary image creates a new binary image in which the pixel has a nonzero value only if the test is successful at that location in the input image. Morphological techniques

probe an image with a small shape or template called a structuring element [12]. The structuring element position is positioned at all possible locations in the image and it is compared with corresponding neighborhood pixels. The structuring element is a small binary image, for ex a small matrix of pixels, each with a value of zero or one.

Dilation:

The Dilation of an input image f y a structuring element s produces a new binary image g= fos with once in all locations (x, y) of a structuring element s hits the input image f, for example g(x, y) = 1 if s hits f and 0 otherwise, repeating for all pixel co-ordinates (x, y). Dilation has the opposite effect of Erosion. It adds a layer of pixels to both the inner and outer boundaries of regions [12].

- **Color Feature**

It is the main features that are easily recognized by humans in various images. In content based image retrieval color feature is widely used. Most of the images are in the red, green, blue (RGB) color space. There are various color feature based techniques such as color spaces, color histogram, color moment etc. used for retrieval process.

II. Strawberry Leaf Disease Detection

The flow diagram and steps for the proposed approach for Strawberry Leaf Disease Detection are as below.

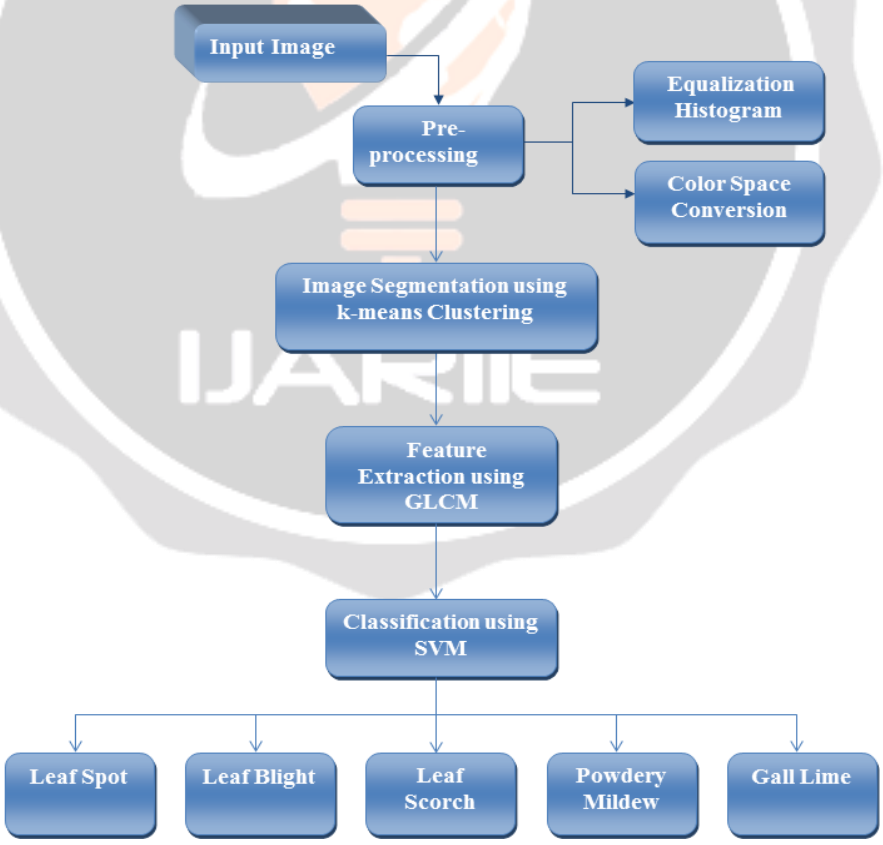

Fig. 2: Flow diagram of proposed work for Leaf Disease Detection

At first, Image acquisition is done. After that, preprocessing step is carried out, in which Image Enhancement is done with the help of Equalization Histogram and Color Space Conversion method. After that Segmentation is done using k-means Clustering method. Feature Extraction is done using GLCM. After Feature Extraction, Classification of leaf disease is done using SVM classification.

A. Image Acquisition
B. Image Pre-processing
C. Segmentation
D. Feature Extraction
E. Classification

A. Image Acquisition

Firstly, the images of various leaves of are taken from Internet having better quality. The input photo image is then resized to 600x450 pixels. The database of image, itself is responsible for the better efficiency of the classifier which decides the robustness of the algorithm.

B. Image Pre processing

Image enhancement is the process of improving appearance or quality of a given image so that the result is more suitable than the original image for a specific application. Histogram equalization is used to enhance contrast [15]. Histogram equalization is a spatial domain method that produces output image with uniform distribution of pixel intensity means that the histogram of the output image is flattened and extended systematically. This approach customarily works for image enhancement paradigm because of its simplicity and relatively better than other traditional methods. We acquire the probability density function (PDF) and cumulative density function (CDF) via the input image histogram. Apply these two functions PDF and CDF for replacing the input image gray levels to the new gray levels, and then we generate the processed image and histogram for the resultant image. And when we discriminate input image histogram with the processed image histogram we found that the gray level intensities are stretched and depressed systematically. Consequently, we obtain that the histogram of the output image is systematically distributed [15]. After that, color space conversion is done. In that original RGB image is converted into HSV. It can be give better input result for segmentation.

C. Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Basic clustering k-means algorithm is used for segmentation in textured images. The K-means clustering algorithm used to classify pixels based on a set of features. The classification achieved by minimizes the sum of squares of distances of the objects and the corresponding cluster. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster.

D. Feature Extraction

When the input data to an algorithm is too large to be processed and it is suspected to be redundant, then it can be transformed into a reduced set of features. This process is called feature extraction. After Segmentation, Feature Extraction is carried out and interested area is extracted. Texture is one of most popular features for image classification and retrieval. At here, GLCM –Gray Level Co-occurrence Matrix, method is used for feature extraction. It creates a gray-level co-occurrence matrix by calculating occurrence of a pixel value I with the pixel value j in a specific spatial relationship [12].

E. Classification

A support vector machine constructs a hyper-plane or set of hyper-planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks.SVM is supervised learning model with associated learning algorithms that analyze data which used for classification. Given a set of training examples, each marked for belonging to one of two categories, an SVM training algorithm builds a model that assigns new examples into one category or the other, making it a non-probabilistic binary linear classifier [11].

5. RESULT ANALYSIS

The proposed algorithm was tested on the different images. Evaluate the system regarding the effectiveness in terms of Accuracy. The result of proposed approach is shown below. The Accuracy values are computed for Strawberry Fruit at three different phase. As indicated very high Accuracy value is obtained for the phase in which color and texture features are combined. Further the Accuracy values are computed for Strawberry Leaf at two different approaches, using only Color Feature and using only Texture Feature. As indicated very high Accuracy value is obtained in which only texture feature is used.

Table 1: Result Analysis table for Strawberry Fruit Disease Detection

Disease	Texture (%)	Color (%)	Color + Texture (%)
Diseased Strawberry	95	83	97
Healthy Strawberry	93	79	98

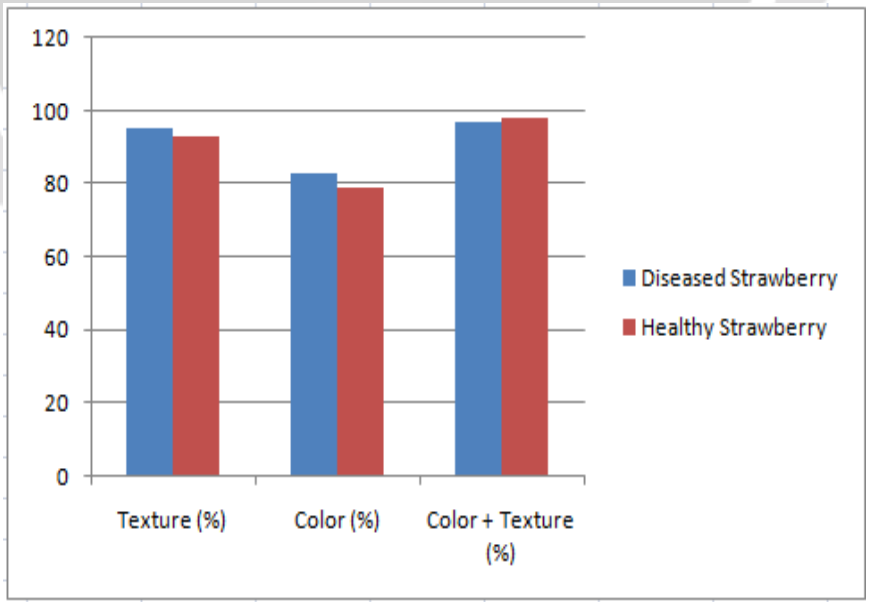

Fig. 3: Graphical Representation of Strawberry Fruit Disease Detection

Table 2: Result Analysis table for Strawberry Leaf Disease Detection

Disease	Color (%)	Texture (%)
Leaf spot	82	93
Leaf Blight	81	90
Leaf Scorch	84	95
Powdery Mildew	83	91
Mite Galls	80	97

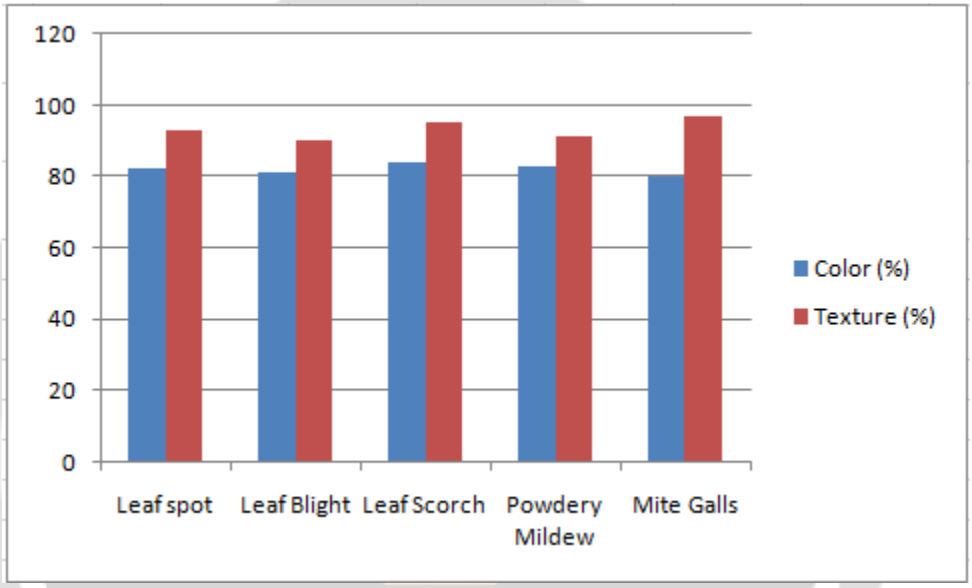

Fig. 4: Graphical Representation of Strawberry Leaf Disease Detection

6. CONCLUSIONS & FUTURE SCOPE

Proposed work presents an efficient approach for image pattern classification in Strawberry Fruit Disease. There are various disease can be present on Strawberry like Anthracnose, Powdery Mildew, Downey Mildew, Gray Mold and etc. Here those diseases are extracted and classified, is it healthy or not. For this purpose, combination of Color Feature and Texture Feature Extraction are used. Because of using any single feature, accuracy of detection of disease can be degrade. So for that purpose both, Color and Texture feature are used. Dilation and Canny Edge Detection methods are used for Texture Feature Extraction and Color Space Conversion is used for Color Feature Extraction. Here own created database having 170 images is used. Using same environment and same lighting condition, we can achieve accurate result.

There is also proposed work on Strawberry Leaf Disease Classification. There are various diseases are available on leaf. Among them, Leaf Spot, Leaf Blight, Leaf Scorch, Powdery Mildew and Gall Mite are classified. Here texture feature is used for feature extraction and SVM Classifier is used for classification. Here database collected from Internet having 100 images in it.

In future. this framework can also be extend as Mobile application for better and easy use for Farmer.

7. REFERENCES

1. Kamil S Juber, Hurria H.Al-Juboory and Saba B. Al- Juboory, " FUSARIUM WILT DISEASE OF STRAWBRRY CAUSED BY *Fusarium oxysporum* f. *sp*. *fragariae* IN IRAQ AND ITS CONTROL", Journal of Experimental Biology and Agricultural Sciences, ISSN No. 2320 – 8694, Volume – 2(4), pp 419-427,2014.
2. Suhaili Beeran Kutty, Noor Ezan Abdullah, Dr. Hadzli Hashim, A'zraa Afhzan Ab Rahim, Aida Sulinda Kusim,Tuan Norjihan Tuan Yaakub, Puteri Nor Ashikin Megat Yunus, Mohd Fauzi Abd Rahman, "Classification of Watermelon Leaf Diseases Using Neural Network Analysis,"IEEE, Business Engineering and Industrial Applications Colloquium (BEIAC), Langkawi, pp 459 – 464, 2013
3. Shiv Ram Dubey, Anand Singh Jalal," Detection and Classification of Apple Fruit Diseases using Complete Local Binary Patterns," IEEE Computer and Communication Technology (ICCCT), 2012 Third International Conference on Computer and Communication Technology, Allahabad, pp 346-351, 2012
4. Sanjeev S. Sannaki, Vijay S. Rajpurohit, V B Nargund,PallaviKulkarni,"Diagnosisand Classification of Grape Leaf Diseases using Neural Network," IEEE , Tiruchengode, pp 1 – 5, 2013
5. Meunkaewjinda, P.Kumsawat, K. Attakitmongcol, A. Srikaew, "Grape leaf disease detection from color imagery using hybrid intelligent system," IEEE, 5th International Conference on , Krabi , pp 513-516, 2008
6. Monika Jhuria, Ashwani Kumar, Rushikesh Borse, "Image processing for smart farming: Detection of disease andfruitgrading," IEEE, Second International Conference on Image Processing, Shimla, pp 521 – 526, 2013
7. Sachin D. Khirade, A. B. Patil, "Plant Disease Detection Using Image Processing," IEEE, International Conference on Computing Communication Control and Automation, Pune, pp 768-771, 2015
8. Ms. Kiran R. Gavhale, Prof. Ujwalla Gawande, Mr. Kamal O. Hajari, "Unhealthy Region of Citrus Leaf Detection Using Image Processing Techniques," IEEE, International Conference for Convergence of Technology, Pune, pp 1-6, 2014
9. Zulkifli Bin Husin, Abdul Hallis Bin Abdul Aziz, Ali Yeon Bin Md Shakaff, Rohani Binti S Mohamed Farook, "Feasibility Study on Plant Chili Disease Detection Using Image Processing Techniques," IEEE, Third International Conference on Intelligent Systems Modelling and Simulation, Kota Kinabalu, pp 291-296, 2012
10. Neeraj Kumar 1, Sushree Mahapatro 2, Sukanti Pal, "Implementation of Color Image Enhancement using DCT on TMS320C6713", IJECSE, Volume 1, ISSN 2277-1956, pp 1244-1253.
11. Zalak R. Barot, Narendrasinh Limbad, "An Approach for Detection and Classification of Fruit Disease: A Survey", International Journal of Science and Research, ISSN: 2319-7064, pp 838-842, 2015
12. https://www.cs.auckland.ac.nz/courses/compsci773s1c/lectures/ImageProcessing-html/topic4.htm/ time: 1.33pm date: 5/12/2015
13. http://www.tutorialspoint.com/dip/concept_of_masks.htm/ time: 12.45am date: 24/12/2015
14. http://opencv-python-tutroals.readthedocs.org/en/latest/py_tutorials/py_imgproc/py_canny/py_canny.html/ time: 9.10am date: 5/04/2016
15. http://www.tutorialspoint.com/dip/histogram_equalization.htm/ time: 10.15p.m date: 15/03/2016