Recognition of diseases of infected apple fruits using Image Processing

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***ABSTRACT*: In this paper, a solution for the detection and classification of apple fruit diseases is proposed and experimentally validated. We have used three types of apple diseases namely: Apple Scab, Apple Rot, and Apple Blotch as a case study. The image processing based proposed approach is composed of the following main steps; in the first step K-Means clustering technique is used for the image segmentation, in the second step some state of the art features are extracted from the segmented image, and finally images are classified into one of the classes by using Artificial Neural Network.**

***Keywords:* Apple Fruit Diseases, ANN, Apple Scab, Apple Rot, Apple Blotch.**

I. INTRODUCTION:

India is developing country. In this development there is major contribution of agricultural field. There are so many fruits like mango, grapes, apple etc. that are exported from India and give more profit to the farmers. Smart farming is about empowering today's farmers with the decision tools and automation technologies that seamlessly integrate products, knowledge and services for better productivity, quality and profit.The approach for detection and identification of fruit diseases is based on the naked eye observation by the consulting experts. In some developing countries, consulting experts are very expensive and due to the distant locations of their availability they are very time consuming. Automatic detection and recognition of fruit diseases is essential to automatically detect the symptoms of diseases as early as they appear on the growing fruits. Apple fruit diseases can cause major losses in yield and quality appeared in harvesting. To know what control factors to take next year to avoid losses, it is crucial to recognize what is being observed. Some disease also infects other areas of the tree causing diseases of twigs, leaves, and branches. Some common diseases of apple fruits are apple scab, apple rot and apple blotch.

Fig 1. Apple Scab (a) Apple Rot (b) Apple Blotch (c)

II. LITERATURE SURVEY:

Shiv Ram Dubey et al [1] presented a noval defect segmentation of fruits based on color features with K-means clustering unsupervised algorithm. They used color images of fruits for defect segmentation.

Haiguang Wang et al [2]proposed a method to realize image recognition of plant diseases, four kinds of neural networks including back propagation (BP) networks, radial basis function (RBF) neural networks generalized regression networks (GRNNs) and probabilistic neural networks (PNNs).

Monika Jhuria et al [3] used a concept of artificial neural network to find diseases of grapes and apple. Three diseases of grapes and two of apple have been selected. The system uses two image databases, one for training of already stored disease images and the other for implementation of query images.

A. Rocha, C et al. [4] introduced an unified approach that can combine many features and classifiers that requires less training and is more adequate to some problems than method, where all features are simply concatenated and fed independently to each classification algorithm.

O. Kleynen, et al [5] a multi-spectral vision system including four wavelength bands in the visible/NIR range was developed. Defects were grouped into four categories: slight defects, more serious defects, defects leading to the rejection of the fruit and recent bruises. Stem-ends/calyxes were detected using a correlation pattern matching algorithm.

Shiv Ram Dubey and Anand Singh Jalal [6] efficient detection of 'species and variety' of fruits and vegetables from the images is one of the major challenges for the computers. The input image contains fruit or vegetable of single variety in arbitrary position

and in any number. This paper also introduces a texture feature based on sum and difference of intensity values of the neighboring pixels of the colour images.

III. METHODOLOGY:

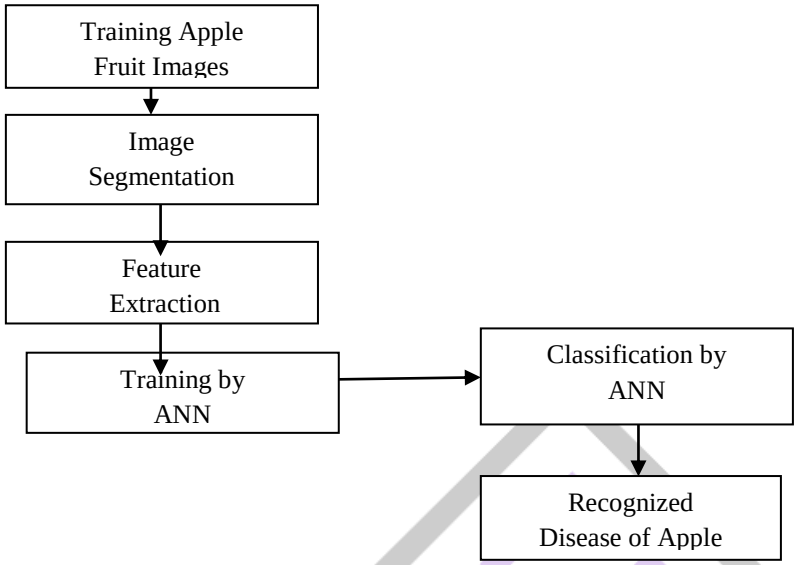


Fig.2 Framework of the proposed approach

- **IMAGE SEGMENTATION**

Image segmentation is the process of partitioning an image into multiple segments, so as to change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is one of the key steps, and the precision of the segmentation directly influences the reliability of feature extraction and the accuracy of recognition.

K-means clustering segmentation algorithm was developed by MacQueen in 1967. It is well known and popular hard clustering technique to partition 'n' pixels into 'k' clusters. The K-means algorithm is a popular data clustering algorithm. To use it requires the number of clusters in the data to be pre-specified.

K-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of clusters (assume k clusters) fixed apriority. The main idea is to define k centers, one for each cluster. These centers should be placed in a cunning way because of different location causes different result. So, the better choice is to place the as much as possible far away from each other. The next step is to take each point belonging to a given data set and associate it to the nearest center.

FEATURE EXTRACTION

In this approach, we have used some state of the art color and texture features to validate the accuracy and efficiency. The features used for the apple fruit disease classification problem are Global Color Histogram, Color Coherence Vector, Local Binary Pattern, and GLCM features
Contrast, Correlation, Energy, Entropy, Homogeneity, Mean and Variance.

a.Global Color Histogram –

The Global Color Histogram (GCH) is the simplest approach to encode the information present in an image. A GCH is a set of ordered values, for each distinct color, representing the probability of a pixel being of that color.

b.Local Binary Pattern –

Local Binary Pattern (LBP) is a simple yet very efficient texture operator which labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number.

c.Color Coherence Vector-

Color coherence as define the degree to which image pixels of that color are members of large region with homogeneous color. These regions are referred as coherent regions. Coherent pixels are belongs to some sizable contiguous region, whereas incoherent pixels are not. In order to compute the CCVs, the method blurs and discretizes the image's color-space to eliminate small variations between neighboring pixels.

- **TRAINING AND TESTING BY ARTIFICIAL NEURAL NETWORK**

A neural network model which is the branch of artificial intelligence is generally referred to as artificial neural networks (ANNs). ANN teaches the system to execute task, instead of programming computational system to do definite tasks. To perform

such tasks, Artificial Intelligence System (AI) is generated. It is a pragmatic model which can quickly and precisely find the patterns buried in data that replicate useful knowledge

- **FlOW CHART OF RECOGNIZED DISEASE OF APPLE**

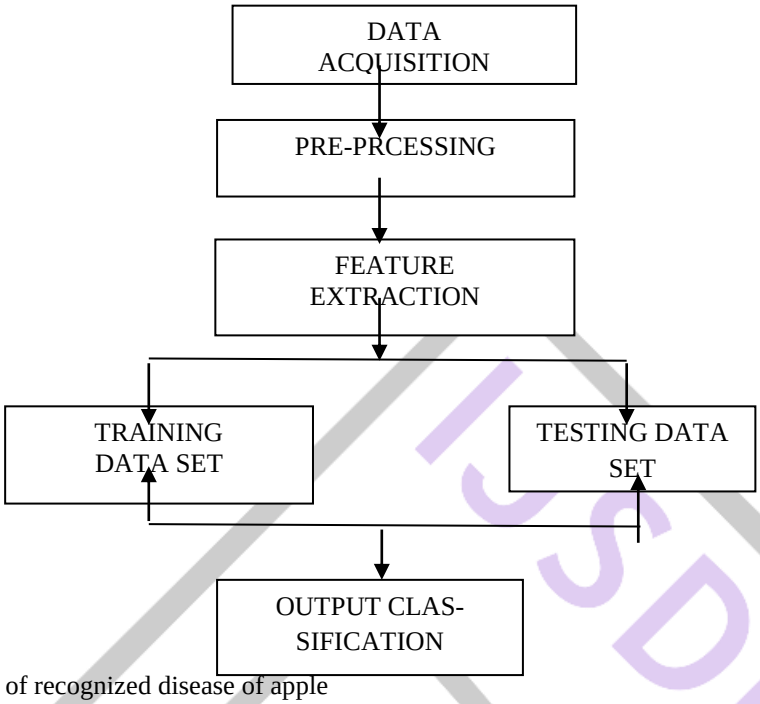
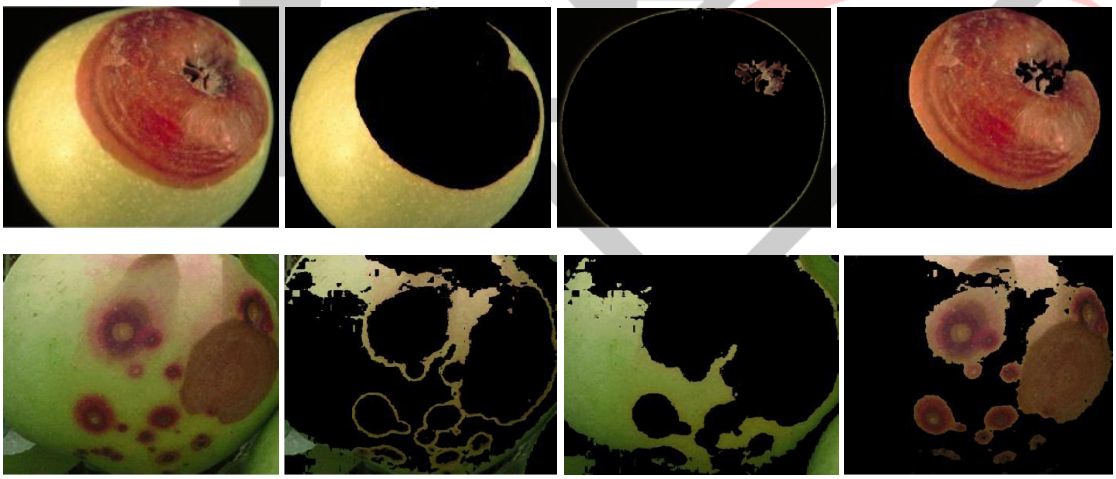


Fig.3 flow chart of recognized disease of apple

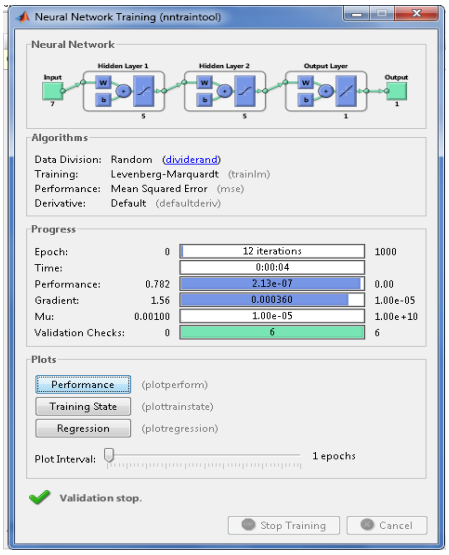
Experimental Result:



(a) (b) (c) (d)

Figure.4 K-Means clustering for defected apples with three clusters (a) The infected fruit images, (b) first cluster, (c) second cluster, and (d) third cluster

Figure 4 shows the results of defect segmentation of two defected apple fruits using K-means clustering method with only three clusters.



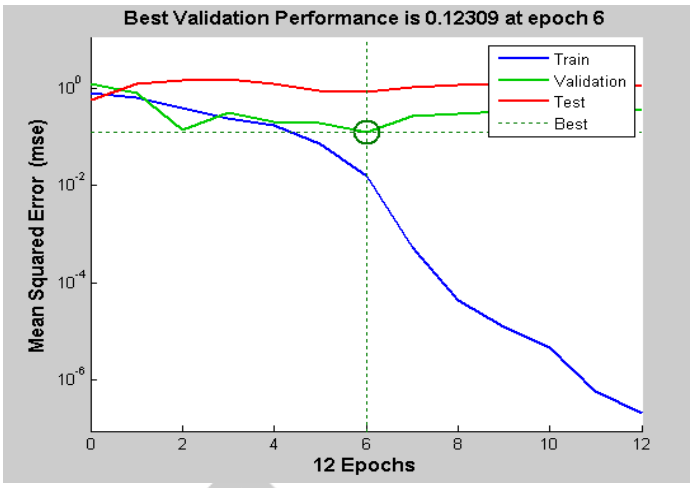
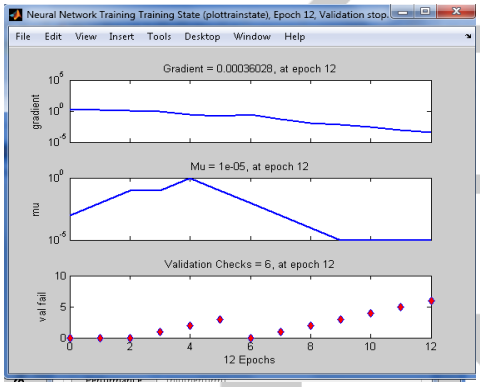


Figure. 5 Neural Network Training

Figure .6 Graph depicting the performance analysis

Figure 5 shows NPR Training Tool used for train the neural network. It consists of three layers namely: input layer, hidden layer and output layer. The data set has given to the toolbox for training purpose.

Figure 6 shows the graph of performance after training. Here, green color lines show the validation data, red color line shows the tested data and blue color line shows the trained data. The dotted line shows the best performance of the graph.



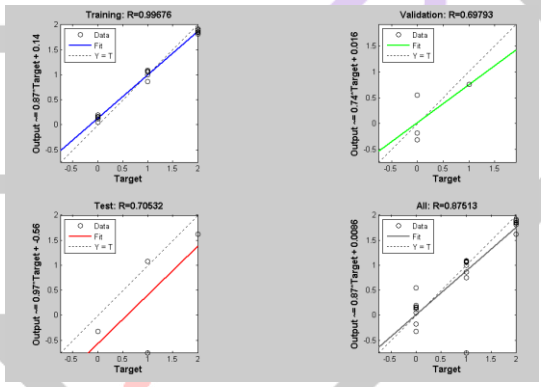


Figure .7 Plots of the training states

Fig.8 Regression Plot

Figure 7 shows the plot of the training stage. Two plots are available in the graph blue color plot is showing the gradient of the data and pink and dotted plot are checking the validation of the data.

IV. CONCLUTION

An image processing based solution is proposed and evaluated in this paper for the detection and classification of apple fruit diseases. The proposed approach is composed of mainly three steps. In the first step image segmentation is performed using K-Means clustering technique. In the second step features are extracted. In the third step training and classification are performed on Artificial neural Network. We have used three types of apple diseases namely: Apple Scab, Apple Rot, and Apple Blotch as a case study and evaluated our program.

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