Fruit Quality Analysis Using PNN

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Abstract— **Every year tons of fruits are processed in agro and food processing industry and Plenty fruits and vegetables are imported from the other nations such as oranges, apples etc. so manual identification of defected fruit is very time consuming which mainly affect on quality of fruit. . here we have discuss apple recognition techniques of normal and infected..In this paper quality of fruit is measured. As we know fruit quality depends on several factors such as size, shape, color and weight. This paper presents the work done for detection of fruits . we discussed for infected and noninfected fruit by using k-means clustering as a segmentation method and used PNN as classifier.**

Index Terms— **Cross correlation, Feature extraction, Image Processing, Image segmentation ,K-means clustering,PNN.**

I. INTRODUCTION

Accurate automatic classification of agricultural products is very necessary in agricultural marketing to increase the speed and minimize the miss-classifications. For economic growth of nation, fruit industry contributes a major part, but because of lack of proper cultivation and maintenance, lack of knowledge of preservation there has been a decrease in production of good quality fruits. In this case there is the demand of a rapid, economic, consistent and nod-destructive inspection method to get rid from problem of rising labor costs. [1]. fruits plays very important role in our life. As diseases of the fruits are inevitable, detecting disease is very necessary in the field of Agriculture and fruit industry. As it reduces quantity and degrades quality of the agricultural products. this require careful diagnosis and detection. for this we require automation which can reduce the costs by promoting production efficiency. Automatic fruit grading and sorting requires the implementation of computer vision systems[2]. In this paper we are going through an work of detection of different fruits using PNN. We have used apple in case for study in this paper.

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II. METHODOLOGY USED

A. Image preprocessing

To produce good quality fruits it is necessary to find defects in a fruit. Human operators examine the fruits by visually which is tedious and takes more time to process. So machine vision and image processing techniques are used[3]. The image processing can be used to detect disease, to quantify the affected area by disease, to find shape and color of affected area and to determine size and shape of fruit in agricultural applications[4] . Studies have been conducted on the automation of plant classification and recognition. these studies were based on the extraction of a single feature from the image of a plant part such as the leaf, or the flower or fruit. Some studies were based on the extraction of multiple. Features for image-based plant classification and image-based plant recognition [5]. Digital image processing is a computer based technique, has been extremely used by scientists to solve problems in agriculture.

B. Image segmentation

Image segmentation is generally defined as a process of partitioning an image into homogenous groups such that each region is homogenous but the union of no two adjacent region is homogenous . Efficient image segmentation is one of the most critical tasks in automatic image processing .Image segmentation has been interpreted differently for different applications.like in machine vision applications, it is viewed as a bridge between low level and high level vision subsystems and in medical imaging as a tool to delineate anatomical structure[6]. In other words Segmentation of an image entails the division or separation of the image into regions of similar attributes. Also image segmentation is nothing but pixel classification. The level to which the segmentation process is to be carried out depends on the particular problem being solved. It is one of the most critical components of an image analysis and/or pattern recognition system. Image segmentation algorithms are generally depends on one of two basic properties of intensity values of the image pixels: discontinuity and similarity Based on the similarity or discontinuity criteria, image segmentation methods can be broadly classified into six groups[7,38]: (1) Edge Detection, (2) Histogram based method, (3) Clustering (K-Means clustering, Fuzzy C-means clustering etc.), (4) Region based methods (Region growing, Region splitting & merging), (5) Physical Model based method,(6) methods based on Neural segmentation In this paper we have used Kmeans clustering method for image segmentation.

C. K-means clustering

K-Means is the one of the unsupervised learning algorithm for clusters. Clustering the image is grouping the pixels according to the some characteristics. In the k-means algorithm initially we have to define the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function. Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has shortest distance among all. Then the centroid is reestimated. Again each pixel is compared to all centroids. The process continuous until the center converges[8]. K-means is a fast and simple clustering algorithm, which has been applied to many applications. The goal of K-means algorithm is to partition the observations into K groups[9]. based on attributes/features. K is positive integer number. The grouping is done by minimizing the sum of squares of distances between data and the corresponding cluster centroid[10]. K-Means clustering provides efficient results in Segmentation of RGB image. By using K-Means segmentation multiple values of cluster have been tested. for Best result number of clusters should be four[11]. K-means method is an unsupervised clustering method that classifies the input data objects into multiple classes on the basis of their inherent distance from each other[12].

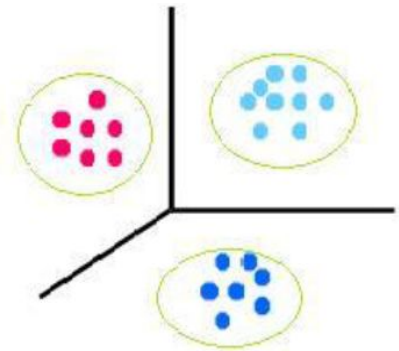

Fig.1. Similar data points grouped together into Clusters.

The above fig. shows how the clusters are formed during clustering.[13]. In this experiment, squared Euclidean distance is used for the K-means clustering. We use L*a*b* color space because the color information in the L*a*b* color space is stored in only two channels (i.e. a* and b* components), and it causes reduced processing time for the defect segmentation[14].

D. Feature Extraction

Some qualitative information is extracted from the objects to be analyzed in the images. These extracted information or attributes are called 'features' and a vector of such features is called a 'pattern'. Features are used as inputs to the algorithms for classifying the objects into different categories[16]. This is a method of capturing visual content of an image. It is used to represent raw image in its reduced form to facilitate decision making process such as pattern classification. Feature extraction step is important step to get high classification rate. A set of features are extracted in order to allow a classifier to distinguish between defect and non defect pattern. The non defect fruit can be identified on the basis of textural appearance. Several features are extracted such as texture feature, shape feature and intensity based features.we have used texture feature in our experiment. Texture features have been widely used in fruit quality classification. Texture is an alteration and variation of surface of the image. In general, texture can be characterized as the space distribution of gray levels in a neighborhood[15]. Texture is calculated by the outer part of an object which is used to measures the roughness, coarseness and smoothness. Texture is classified by the spatial distribution of gray levels in a neighborhood. It also helps in surface determination and shape determination. Gray level co-occurrence matrix is used to calculate different texture features[17]. co-occurrence matrix is used to extract textural features. It is a single level dependence matrix that contains the relative frequencies of two coordinate elements separated by a distance d. As you move from one pixel to another on the image, entries of the initial and final pixels become the coordinates of the co-occurrence matrix to be incremented, which in the end will represent structural characteristics of the image. Therefore, moving in different directions and distances on the image will lead to different co-occurrence matrices[18]. In this paper, we used Wavelet concept for image segmentation which reduces the computation time by considering approximation band of an image which is small in dimensions and contains significant information of original image[19]. Wavelets are mathematical functions that decompose data into different frequency components and then study each component with a resolution matched to its scale. Wavelet provides a more flexible way of analyzing both space and frequency contents by allowing the use of variable sized windows. So , Wavelet Transform provides better representation of an image for feature extraction[20]. The wavelet transform has similar properties to Fourier transform as a mathematical technique for signal analysis, the main difference between both is that wavelets are localized in both time and frequency, whereas the standard Fourier transform is only localized in frequency[21]. Many researchers used principle component analysis (PCA) in conjunction with spectral imaging to grade fruits according to their ripeness level[22]. Principal component analysis is a statistical procedure that uses an orthogonal transformation. The PCA approach is used to reduce the dimension of the data by means of data compression basics and reveals the most effective low dimensional structure of image patterns. This reduction in dimensions removes information that is not useful and precisely decomposes the face structure which involves transformation of number of possible correlated variables into a smaller number of orthogonal (uncorrelated) components known as Principal Components[27]. it is the general name for a technique which uses sophisticated underlying mathematical principles to transforms a number of possibly correlated variables into a smaller number of variables called principal components. PCA uses a vector space transform to reduce the dimensionality of large data sets.[23].

E. Cross correlation

Cross Correlation is the basic statistical approach to image registration. It is used for template matching or pattern recognition. Template can be considered a sub-image from the reference image, and the image can be considered as a sensed image[24].we have used cross corelation as a classifier

for quality measurement of apple fruit. In this paper we are goimg through two classifiers comparision. NCC method is a simple template matching method. This method has better accuracy and can be use for high speed industrial applications. this is very simple and straight approach for finding the multiple patterns from a given image. It (NCC) is very helpful for pattern based classification and pattern based analysis in an image. Normalized Cross-Correlation (NCC) is the best approach for face or object matching. It gives perfect image matching in the given target image. The Maximum Cross-correlation coefficient values indicate the perfect matching of extracted image with the target image. This approach gives registered image, if the sensed images do not have any rotation or scaling ,But this template matching method quickly fails by influence of disturbance, such as with illumination changes, and rotation of the object. For example, a circumstance where template matching can fail is when real world image objects sometimes have different appearance because of acquisition in outdoor settings affected by the changes in sun location and cloud cover etc.[25]. a robust and simple technique is proposed to improve the performance of NCC as a similarity measurement for the template matching approach. This technique is based on increasing the pixels values of the input image by using n-means kernel. It will reduce the effects of illumination problems. The result showed the significant improvement in NCC performance[26].

F. *Probabilistic neural network(PNN)*

The probabilistic neural network was developed by Donald Specht. This network provides a general solution to pattern classification problems by following an approach developed in statistics,called Bayesian classifiers[28].the basic concept of PNN is taken from Bayesian Decision Rule[29]. Probabilistic neural networks can be used for classification problems. It has parallel distributed processor that has a natural tendency for storing experiential knowledge. PNN is derived from Radial Basis Function (RBF) Network. PNN basically works with 3 layers. First layer is input layer. The input layer accepts an input vector. When an input is presented, first layer computes distances from the input vector to the training input vectors and produces a vector whose elements indicate how close the input is to a training input. The second layer sums these contributions for each class of inputs to produce as its net output a vector of probabilities. Radial Basis Layer evaluates vector distances between input vector and row weight vectors in weight matrix. These distances are scaled by Radial Basis Function nonlinearly. The last layer is competitive layer which in PNN structure produces a classification decision, in which a class with maximum probabilities will be assigned by 1 and other classes will be assigned by 0. A key benefit of neural networks is that a model of the system can be built from the available data[30]. PNN is derived from Radial Basis Function (RBF) Network. The advantage of PNN is that training is easy and instantaneous .Weights are not “trained” but assigned.

Existing weights will never be alternated but only new vectors are inserted into weight matrices when training. So it can be used in real-time. The speed of PNN is very fast, Since the training and running procedure can be implemented by matrix manipulation[31]. Bayesian strategies are decision strategies that minimize the expected risk of a classification[32]. It has features like PNN is guaranteed to converge to a Bayesian classifier provided that it is given enough training data.it doesn’t required learning processes. No need to set the initial weights of the network.there is no relationship between learning processes and recalling processes and the differences between the inference vector and the target vector are not used to modify the weights of the networks[33].

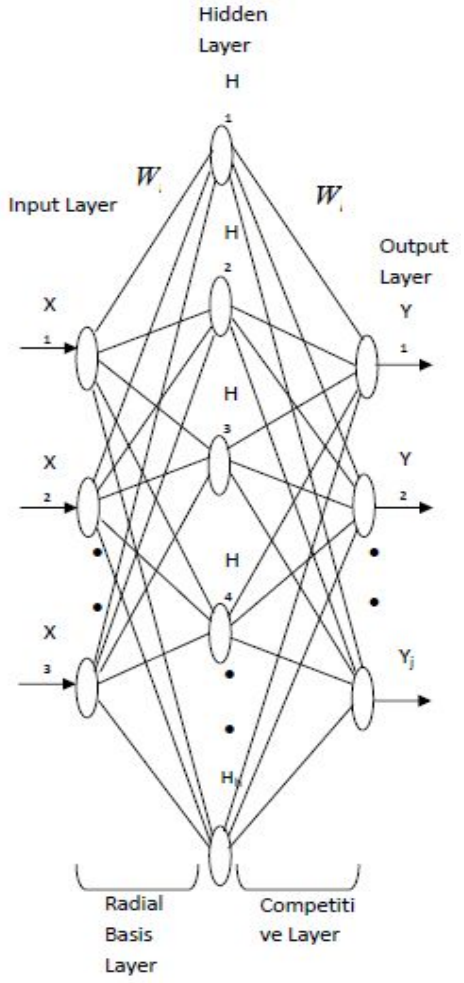

Fig.2.Architecture of PNN

The probabilistic neural network uses a supervised training set to develop distribution functions within a pattern layer[34]. In PNN When an input is presented, the first layer computes distances from the input vector to the training input vectors and produces a vector whose elements indicates how close the input is to a training input. The second layer sums these contributions for each class of inputs to produce as its net output a vector of probabilities. Finally, a complete transfer function on the output of the second layer picks the maximum of these probabilities to choose the class[35].

III. ARCHITECTURE OF PROPOSED SYSTEM

As our proposed system is used for detection of the fruit for quality analysis, which includes the following steps.
Step 1-capture the image.
Step 2-imafe segmentation using k-means clustering method.
Step 3-feature extraction using wevlet transform and PCA
Step 4-classification of fruit as infected and non infected using PNN and CC.

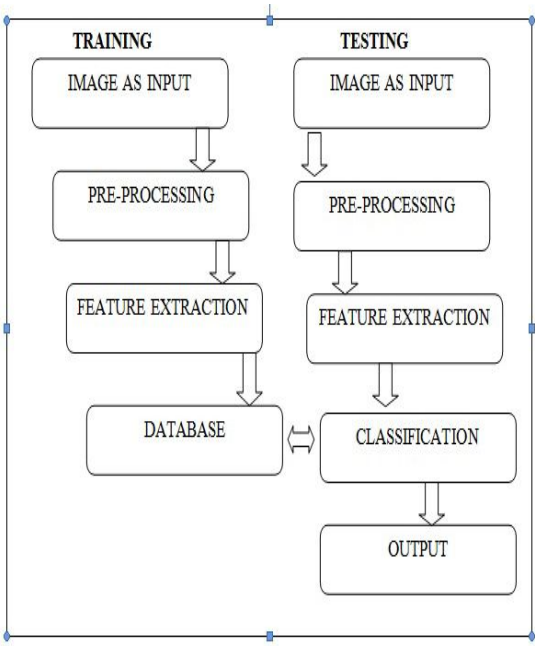

Fig. 3. Framework of system

IV. RESULT AND COMPARISION

Sr No	Input Images	Accuarcy of Calssification (Accuarcy in %)		Result
		Cc	PNN	
1		75	87.5	Non Infected fruit
2		75	87.5	Infected fruit

V. CONCLUSION AND FUTURE SCOPE

According to the result table it is clear that the Probabilistic Neural Network is much faster and more accurate than any other identification technique.PNN networks are relatively insensitive to outliers. PNN networks generate accurate predicted target probability scores and PNNs approach Bayes optimal classification. The general approach can be applied to determine the color and feature of the affected area of the diseased plant, to identify the Object correctly and to find diseased stem, fruit also along with the leaf.due to higher accuracy and faster recognition it has very wide future scope in detection of diseases, face and ship identification.

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NOTE:-COLOUR IMAGES ARE REQUIRED IN FIGURES WHERE SHOWN.

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