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QUALITY IDENTIFICATION OF TOMATO USING IMAGE PROCESSING TECHNIQUES

[1]SAIFALI TAMAKUWALA, [2]JENISH LAVJI, [3]RACHNA PATEL

[1]M.Tech student, Computer Engineering and Information Technology Department, CGPIT, Bardoli, India.
[2]Assistance professor, Computer Engineering and Information Technology Department, CGPIT, Bardoli, India.
[3]Assistance professor, Computer Engineering and Information Technology Department, CGPIT, Bardoli, India.
E-mail: [1]saifalitamakuwala@gmail.com, [2]jenish.lavji@utu.ac.in,[3]rachu.cuty@gmail.com

Abstract- In agricultural and horticulture, image processing is one of the widely used applications. In this paper, automated quality identification using some image processing techniques is there that can be done using some image features which help in quality detection of vegetables like Shape, colour and size. This research work presents identification of good and bad vegetable is focused on the image processing techniques like segmentation and classification. First extract certain features from the input vegetable image, later using different method like thresholding, segmentation using k-means clustering and classification using SVM (Support Vector Machine) and ANN (Artificial Neural Network). It gives results in terms of accuracy in percentage.

Keywords - Quality Identification, Image Acquisition, Image Preprocessing, k- means clustering, SVM, ANN.

I. INTRODUCTION

Agriculture is the major source in India. It is one of the most growing research area which having its participation in different application including the biometric system, biomedical system, etc. One of its applications is the agricultural industry. Image processing is been utilizing in different ways to identify the crop, plant, leaves, fruits, vegetables etc. as well as to identify the disease. It is also used to check the quality of vegetables and fruits. India is second ranked to produce vegetables after china [1]. There are lots of vegetables in the world like potato, tomato, cabbage, carrot, etc. In that, Tomato is widely used food because of its special nutritive value and also because of its wide spread production. Tomato is considered as important commercial and dietary vegetable crop. Other name of tomato is *Lycopersicon esculemtun.* In India, the quality inspections of vegetables are performed by human experts. This manual sorting by human inspection is time consuming and suffers from the problem of inconsistency and inaccuracy in judgment by different human. Automation of the quality identification process is expected to reduce labor cost, improve the efficiency and accuracy of the sorting process. The automated fruit or vegetable system is shown in below figure 1.

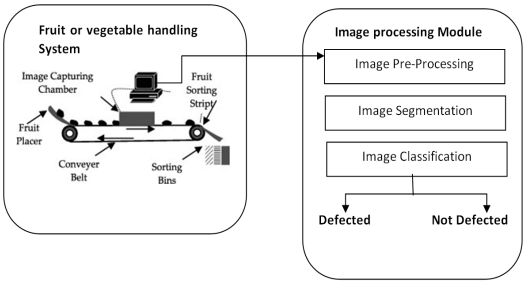

Figure 1: Automated fruit or vegetable quality identification system

Machine vision and image processing techniques have been found increasingly useful in the vegetable industry, especially for applications in quality inspection and defect sorting applications. Quality of tomato, in particular, depends on size, color, shape and the presence and type of skin defects. Color and shape characteristics of tomato are decisive for visual inspection. The healthiness and defecates are the most important factors that determine the quality of the tomato fruit.

With the help of Image processing techniques like Image acquisition, Image pre-processing, image segmentation and image classification, quality of tomato can be identified. Different image processing techniques and algorithms have been developed by researchers using MATLAB (2016a) for accurate tomato quality identification.This survey paper presents image processing techniques for detection and identification of various tomato qualities.

II. PROBLEM DEFINATION

Tomato is healthiest vegetable as a diet food. So tomato consumers demand better quality tomatoes. The criteria for evaluating a tomato's external appearance include distribution of color on the surface. Generally it can be identified by human expert but through eyes, It has resulted in a serious problem because misjudgement occurs frequently due to recurring fluctuations in quality identification criteria. This issue motivate intensive research work to implement flexible and effective systems to sort mangoes. The quality of tomato is identified by some level of image processing that can be shown in below figure 2.

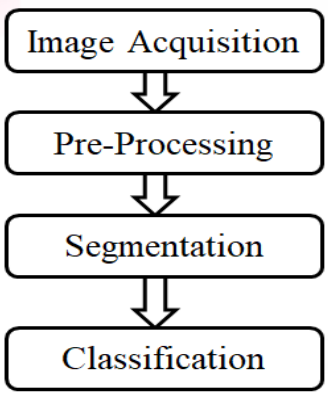

Figure 2: levels of Image Processing

Image processing is suitable choice for quality identification of tomato and it is very useful in big tomato item production industries.

III. STEPS AND METHODS

Steps of disease identification algorithm are shown in above figure 2. In first step Image is acquired and pre-processing steps are used for removing noise. Image is segmented to separate background and foreground. Classification is used to identified tomato is "disease" or "healthy".

A. Sample collection

For research, we have used tomato samples collected for tomato super market located in Surat (Gujarat, India). We have collected two types of tomatoes namely "diseased tomatoes" and "healthy tomatoes" as shown in below figure 3 and 4 respectively.

Figure 3: Diseased Tomatoes

Figure 4: Healthy Tomatoes

1. Image Acquisition and Pre-processing

The images were capture using high professional camera (canon DSLR 700D). Those images contain higher amount of image file size. Experiment was conducted in MATLAB (R2016a) with windows platform. The captured image is in RGB color space which resizes those images for our research that is 300*400 pixels to reduce computational complexity. To get better result, it is necessary to increase brightness or shining of input image that called as contrast image.

Contrast is different in illumination or color that makes an object or representation in an image distinguishable. To remove noises a simple median filter is applied. After image pre-processing generated image is contrast image.

2. Image Segmentation

Image segmentation is nothing but partitioning an image in to some similar features. Segmentation is done using different methods like k-means clustering, converting RGB to HSI model etc.

a. Segmentation using spot detection

RGB image is converted to HSI model for segmentation. Using spot detection infected part of tomato can be founded. HSI stands for Hue, Saturation and Intensity. When human view a color object it is describe by its hue, saturation and brightness.

b. K-means clustering

The k-means clustering is used for classification of object based on set of features into k number of classes.

The algorithm for K –means Clustering [2]:

1. Pick center of K cluster, either randomly or based on some heuristic.
2. Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster canter.
3. Again compute the cluster centers by averaging all of the pixels in the cluster. Repeat steps 2 and 3 until convergence is attained.

The infected tomato shows the symptoms of the disease by changing the color of the tomato.

Classification

Image classification analyzes the numerical properties of various image features and organizes data into categories. Classification is a general process related to categorization. Image classification refers to the task of extracting information classes from image. There are two types of classification: supervised and unsupervised. Here we used supervised classification because our target data is known, that is tomato is diseased or healthy represented as 1 and 0.

c. SVM(Support Vector Machine)

SVM is work in high-dimensional spaces seeking an optimal hyper-plane to separate the categories. SVM comprise of a set of related supervised learning methods used for classification and regression [3]. SVM database contains equal images of infected and non-infected, so it is easily to train all the images. Here we used supervised data. SVM is used for decision making. It is suitable to work with high dimensional data. But it can work only with two classes.

Using SVM, quality identification of tomato is successfully performed and it gives 95% accuracy that shown in below figure 5.

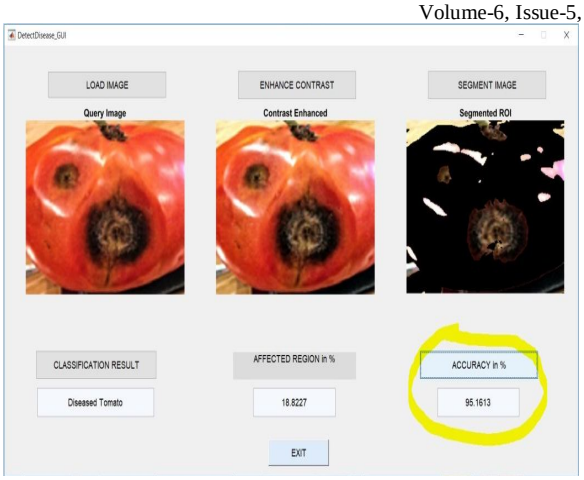

Figure 5: Accuracy of SVM

d. ANN(Artificial Neural Network)

In image processing, ANN has been applied to a variety of data-classification and pattern recognition task and classification tool. ANN contains three layers first is input layer which is input of data, second layer is hidden layer which contain some hidden layer of neural network and last layer is output layer which contain target data. Using ANN, quality identification of tomato is successfully performed.

The original goal of the ANN approach was to solve problems in the same way that a human brain would. An ANN is based on a collection of connected units or nodes called artificial neurons (analogous to biological neurons in an animal brain). Each connection (analogous to a synapse) between artificial neurons can transmit a signal from one to another. The artificial neuron that receives the signal can process it and then signal artificial neurons connected to it. Here are some results of ANN shown in below figure 6.

IV. COMPARATIVE ANALYSIS

Technique	Advantage	Remark
Artificial neural network[4]	Robust, user friendly and can handle noisy data. -Analyze complex problem	-Not scalable -Require more process time because it require large training image
Support vector machine[8]	Classification accuracy is more -Robust	-Learning process can be time consuming. -It can work only with two classes [1].

Table 1 Comparative Analyses of classification techniques

V. RESULT AND ANALYSIS

Here is simulation steps of support vector machine which shown in below table 2. Overall accuracy of SVM is 95% which shows in above figure 5.

Input: No of tomato samples
For every tomato image
Do
Take query image
Convert into contrast image
Apply k – means cluster
get the classification result
calculate the affected area
Output:Classification in healthy and diseased category

Table 2 Simulation of SVM

Here is result of Support vector machine (SVM) which contains some amount of image and give result in terms of accuracy in percentage.

No of images	Set	Accuracy in %
200	Train Set	95
70	Test Set	83

Table 3 Result Analyses of SVM technique

In neural network, input data contain extracted feature of images and output data contain class or category of image. In below figure 6 there are two classes: diseased tomato and healthy tomato.

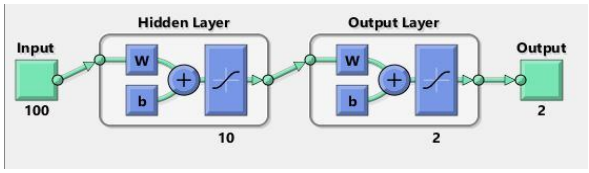

Figure 6: Created Neural Network

Here are simulation steps of ANN as below in table 4 which contain how ANN works for quality identification of tomato.

Input: Data set in input images
Do
Import input data in tool
Import target data in tool
Create neural network shown in figure 6.
Train Network
Output: Accuracy of data set

Table 4 simulation steps of Artificial Neural Network

From below figure 7, result should be mentioned as ANN gives 73% Accuracy for quality identification of tomato.

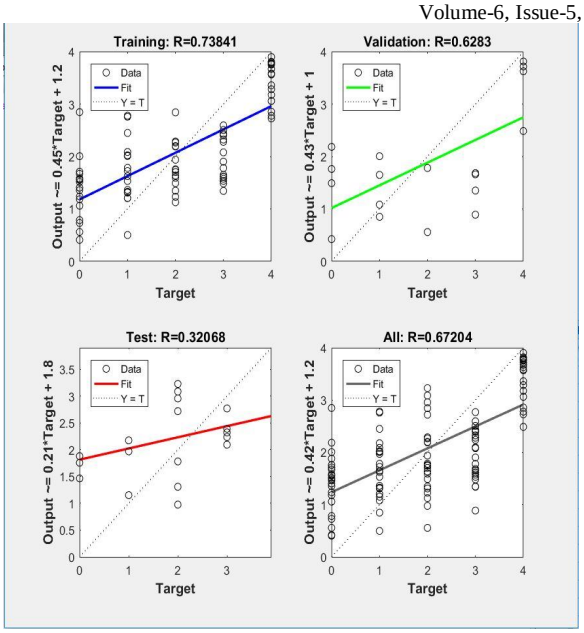

Figure 7: Result of ANN

Technique	Accuracy in %
Artificial Neural Network	73
Support Vector Machine	95

Table 5 Comparative Result of Classification Technique.

CONCLUSION

Image processing technique has been proved as faithful system for agriculture domain. It can be used more conveniently for the quality identification of tomato crop based on color that is measured by accuracy in terms of color. For Color based quality identification of tomato, other segmentation techniques and classifiers like neural network, support vector machine, and fuzzy logic should use to evaluate for this problem statement. In this system, Classification is performed using ANN and SVM but SVM gives 95% accuracy and ANN gives 73% accuracy. So here conclude that SVM gives batter accurate result then ANN. In Future, try to get better accurate result using hybrid classification technique using SVM-ANN.

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