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Detection of Quality in Orange Fruit Image using SVM Classifier

Hardik Patel
PG Scholar, Computer Engineering Department,
Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat, India
hardikpatel04296@gmail.com

Rashmin Prajapati
Asst. Professor, Computer Engineering Department,
Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat, India
rashminprajapati.comp@svitvasad.ac.in

Milin Patel
Asst. Professor, Computer Engineering Department,
Sardar Vallabhbhai Patel Institute of Technology, Vasad, Gujarat, India
milinpatel.comp@svitvasad.ac.in

***Abstract*— Non-destructive quality assessment of Fruits is essential and exceptionally fundamental for the life sustenance and rural industry. The Fruits in the market are ought to fulfill the buyer inclinations. Generally, the reviewing of Orange fruit is done by the visual examination and by utilizing the size as a specific quality characteristics. Picture preparing offers answer for computerized Orange Fruits estimate on solid, predictable and quantitative data which are separated from dealing with extensive volumes that may not be accomplished by utilizing the human graders. This Research shows an Orange size and Bacteria Spot Defect distinguishing and reviewing framework which is dependent on the picture preparing. The early appraisal of Orange quality requires new apparatus for size, color and texture estimation. Subsequent to catching the Orange side view picture, some fruits characters are removed by utilizing and identifying the calculations. As indicated by these characters, reviewing is figured out. It will have a decent prospect of use in Orange Fruit quality distinguishing and evaluating zones. In this paper we will elaborate the different features and classification methods by considering their advantages and disadvantages.**

Keywords*— *Image Processing, Color K-Means clustering, Color features, Texture features, Shape feature, SVM, ANN.

I. INTRODUCTION

It is a well-known fact that, India is the most popular agriculture country with a higher range of export and import of various fruits and vegetables. In fruit production, India has secured a 2nd rank [2]. More than 60% of people are existing with an agriculture domain [1]. Large varieties of fruits like Mango, Apple, Orange, Lemon, Chico, Banana etc. are cultivated by India. Despite the hype, many types of defect and diseases will also occur in the fruits. For instance, apple has three types of defects such as apple scab, apple rot and apple blotch [1]. Here we discuss about the orange fruit. Orange is one of the type of citrus fruits. Orange fruits' per year worldwide production is more than 50 million tones. [7]. as per the reports, Brazil acquires the 1st rank in orange fruit production (17.8 million metric tons) [7]. There are two types of orange fruits, they are Normal and Defected [7]. Generally, Orange Fruit has five types of defect, they are Anthracnose, Stem-End, Unripe, Green Mold and Scarring.

II. RELATED WORKS

Bhavini J. Samajpati and Sheshang D. Degadwala (2016) built a system for a Defect Detection for apple fruit. They have to use various method for detect apple defect like segmentation, feature extraction, classification. In first step they have extract the feature of fruit. Two extraction method are used in this paper colour feature and texture feature. CCV (Colour Coherence Vector) and GCH (Global Colour Histogram) method are used for an extract colour feature. GF (Gabor features), LTP (Local Ternary Pattern) CLBP (Complete Local Binary Pattern), and local binary pattern (LBP) method are used for an extract texture feature. Feature fusion are done after extract all feature like GCH + GF, GCH + LTP, GF + GCH + LBP, GF + CLBP + LTP etc. In second step is classify the fruit using RF (Random Forest) Classifier. In last step use Segmentation for identify the defect. [1]

Manali R. Satpute and Sumati M. Jagdale (2016) Built a system for Defect detection in tomato based on the automatic fruit quality inspection system for detection of defected tomato and sorting and grading of tomato. In First step they have segment the tomato, segmentation based on OTSU algorithm. After segment the tomato, next step is extract the feature. Author use two feature extraction algorithms size detection and colour detection. Dilation and Erosion (Morphological operation), use for size detection. After that shape feature are used for size detection like small, medium and large. Colour detection based on Red, green and yellow tomato use for sorting the tomato. [2]

Tasneem Abass Najeeb and Maytham Safar (2018) build model for Image processing based on Dates Maturity Status and classification. First step is Resize the image (Pre-processing). Then second step is threshold the image (segmentation). After segmentation they have done object measurement image labelling. Last step is extract the feature of the fruit based on Size Detection and Colour Detection. [3]

Nashat M. Hussain Hassan and Ahmed A. Nashat (2018) built model for automatic olive fruits defects detection. In first step they have apply RGB to GRAY (Pre-processing) on the olive fruit. Next step is segmentation based on thresholding. Last step is extract the feature of olive fruit. Two feature extraction technique are used in this paper, Special Image Convolution Algorithm (S.I.C.A) and Texture Homogeneity Measuring Technique (T.H.M.T). [4]

Sheikh Ziauddin, NaeemSattar, Ahmad R. Shahid, Sajida Kalsoom, Rafi Ullah, Amir H. Dar (2015) build system for Orange fruit defect detection. In first step, RGB image convert in to a GRAY scale image (Pre-processing). Second step is segment the orange fruit image based on OTSU technique. After segmentation last step is, Author algorithm use for find the defect. Last step is find size of fruit based on Shape feature. [7]

Ahmed M. Abdulsalami and Mohammed S. Sayed (2016) build system for Orange Citrus Fruits defect detection. First they have done Image Acquisition using two CCD scan camera. After capture the image Second step is pre-processing. Pre-processing based on Illumination Equalization, Contrast Equalization and De-nosing the image. After pre-processing third step is segmentation based on sobel technique. Last step is classification, author used a voting technique for a classification. [6]

Chandan Kumar, Siddharth Chauhan, R.Narmadha Alia and Harika Mounica gurram (2015) build model for classify the citrus fruit using GLCM parameter. In first step they have convert RGB image in to the GRAY scale image. After pre-processing second step is extract the feature, in this paper GLCM are used for Feature extraction. GLCM feature are four type like Contrast, Energy, Correlation and Homogeneity. That all GLCM feature are used for feature extraction. [9]

Nur Badariah Ahmad Mustafa, Syed Khaleel Ahmed, Zaipatimah Ali, Wong Bing Yit, Aidil Azwin Zainul Abidin, Zainul Abidin Md Sharrif (2009) build model for a Sorting and grading agriculture product. First RGB image convert in to the GRAY scale image (Pre-processing). After preprocessing second step is Feature extraction, in this paper feature extrection based on Shape feature. And last step is classify the fruit based on two algorithm, Support vectored machine and fuzzy logic.[15]

III. DIFFERENT METHODOLOGIES

A. Dataset

Five type of defect in orange fruit give as input image [6].

Steam–End: Steam–end are developed in each seasons on fresh orange fruit. In steam-end defected area is irregular in shape and they become sunken and dark [12]. This defect is generally associated with a Drying condition, this condition arise from some factor like High air movement around the orange fruit, Fruit store in high temperature and low humidity, delay in fruit packing [12].

Scarring: Scarring occur on fruit because of trips, Trips are feeding on the developing orange fruit its call a scarring and Trips feeding on mature fruit its call bleaching or scarring [14]. Scarring are responsible for damage developing and mature orange fruit [14].

Anthracnose: Anthracnose usually only occurs on citrus fruit that have been damaged by other factor like bruising sunburn, pest damage, chemical burn, or extended storage periods [11]. The damaged area of fruit are brown to black spots of 1.5 mm or greater than 1.5mm [11]. The decay is generally dry and firm but if deep enough can soften the orange fruit [11].

Green Mold: Green mold is the most serious and common and postharvest defect of orange fruit in many country. Green mold occur rapidly at temperature near 240 C [13].

Unripe: We all are known citrus fruit unlike other fruit because citrus fruit don't ripen after being picked from the tree.

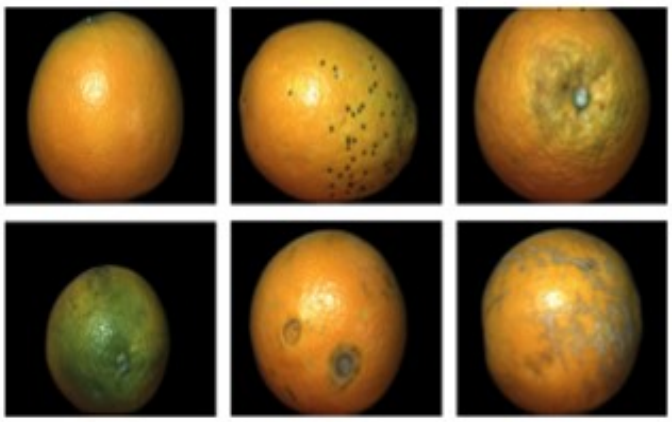

Fig. 1. From upper left: Defect Free, Anthracnose, Stem-End, Unripe, Green Mold and Scarring

B. Image Pre-Processing

Median filter: Median filter are used for remove a noise like salt and pepper. Two type of filter are use before a segmentation median filter (3*3) and box filter (3*3). This both filter find by Jane in 1995 [20].

C. Image Segmentation

OTSU: OTSU method developed by Nobuyuki Otsu .OTSU is automatically done in grouping based on image. And it is very fast approach [2]. Show in fig 3 left figure is original image and right figure is after apply Otsu image.

K-means: Macqueen has find the k-means clustering algorithm in 1967 [1]. K- Means clustering is a one of the best method of Vector quantization. K-means is use for data mining and cluster analysis. Show in fig 4 how to k-means are work.

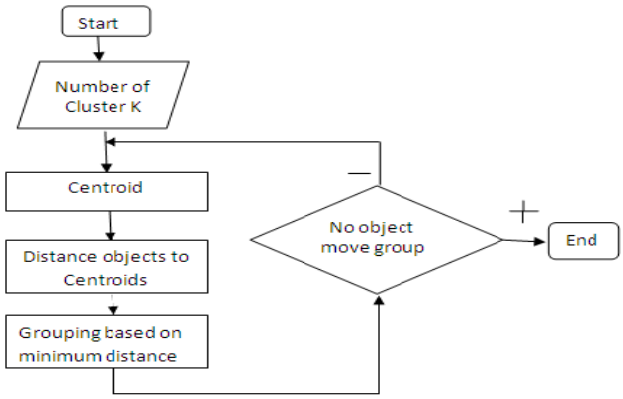

Fig. 2. Diagram for K-means

RGB to CMYK: Emittance of light represent by RGB. Absorption of light represent by CMYK [19]. RGB all primary color are combine from white and CMYK all primary color are combine from black [19].

RGB to LAB: RGB has Three Color channel. Two color channel are used for a color information and one channel are used for luminosity. When you work on only on luminosity you can done with LAB Conversation without changing the image. . When you work on only on luminosity you can done with LAB Conversation without changing the image.

D. Feature Extraction

Three type of method to extract the feature Color feature, Shape feature and Texture. Show in below Table.

Table I. Color Feature

Method		Description
Color Histogram [1] [16]	Mean	$\sum_{i=0}^{255} i * h(i) / \sum_{i=0}^{255} h(i)$
	Variance	$\sqrt{\frac{\sum_{i=0}^{255} h(i) * (i - mean)^2}{\sum_{i=0}^{255} h(i)}}$
Color Coherent Vector [1] [16]	CCV stand for a color coherent vector use for a find the total number of coherent pixel in image. That all pixel are connected pixel	
Color Moment [1] [16]	Mean	$\sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} / mn$
	Variance	$\frac{1}{nm} \sum_{i=1}^{n} \sum_{j=1}^{m} (X_{ij} - mean)^2$
	Stddev	$\sqrt{variance}$

Where h is the histogram of the image, f_q f_t represent query feature vector and database feature vectors and n is the number of features in each vector, and X^{ij} is the Pixel value of the i^{th} row and jth column.

Table II. Texture Feature

Method		Description
Local Binary Pattern (LBP) [1] [22]		$\sum_{n=0}^{n-1} s(v_n - v_c) 2^n, s(x) = \begin{cases} 1, x \geq 0 \\ 0, x < 0 \end{cases}$
Local Ternary Pattern (LTP) [1] [21]		$\sum_{n=1}^{8} 3^{n_2} (i_n - i_c) and s(u) = \begin{cases} -1 if u \leq i_c - t_0 \\ 0 if i_c - t < u < i_c + t \\ 1 if u \geq i_c + t \end{cases}$
GLCM [9] [18]	Energy	$\sum_{i=0}^{G-1} \sum_{j=0}^{G-1} P_{ij}^2$
	Correlation	$\frac{1}{\vartheta_x \vartheta_y} \sum_{i=0}^{G-1} \sum_{j=0}^{G-1} [ijP_{ij} - \mu_x \mu_y]$
	Contrast	$\frac{1}{\vartheta_x \vartheta_y} \sum_{i=0}^{G-1} \sum_{j=0}^{G-1} [ijP_{ij} - \mu_x \mu_y]$
	Entropy	$\sum_{i=0}^{G-1} \sum_{j=0}^{G-1} P_{ij} \log P_{ij}$
Gabour Feature [1]	Mean	$\frac{\sum_x \sum_y \lvert f(x,y) \rvert}{P \times Q}$
	Variance	$\sqrt{\frac{\sum_x \sum_y (\lvert f(x,y) \rvert - \mu_{mr})^2}{P \times Q}}$

Where, vc = central pixel value, vn = value of neighbors, R = radius of the neighborhood, N = total number of neighbors, t = user-defined threshold

Table III. Shape Feature

Method	Description
Area[2] [7]	Area means counting total no of Non-zero pixel on the image region
Major Axis[2] [7]	Major axis represent distance of major axis of the ellipse, and that distance measure in length of major axis
Minor Axis[2] [7]	Minor axis represent distance of minor axis of the ellipse, and that distance measure in length of minor axis
Perimeter [2] [7]	Perimeter represent a Distance between successive Boundary pixels

E. Classifier

SVM: SVM stand for "Support Vector Machine". SVM use for classify the object based on feature. SVM is a one of the best accurate Classifier [9]. SVM use for Multi-class Classification [9]. SVM divided the class by Hyperplane [25].

ANN: ANN stand for artificial neural network. ANN is less Accurate thane SVM because it is Binary Classifier [25]. It is use for High degree of non-linearity possible [23].

IV. PROPOSED APPROACH

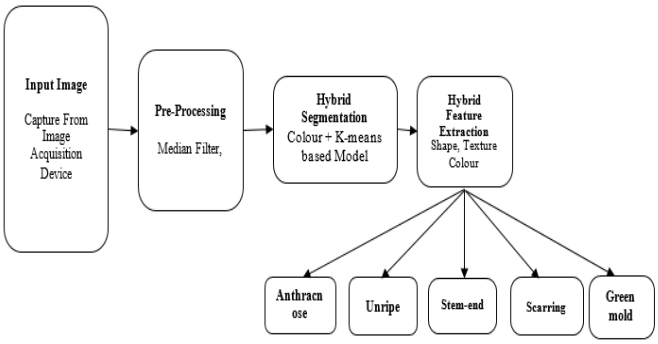

Fig. 3. Proposed Approach Block Diagram

Algorithm

Step 1: Input orange image is given to the system.

Step 2: Apply Pre-Processing task of using Median Filter

Step 3: Hybrid Segmentation method (Color + K means) is apply on Image.

Step 4: After that Color, Shape and Texture Feature is extract and given to the Classifier.

Step 5: classifier classify the image and give the type of Defect name.

V. RESULTS AND ANALYSIS

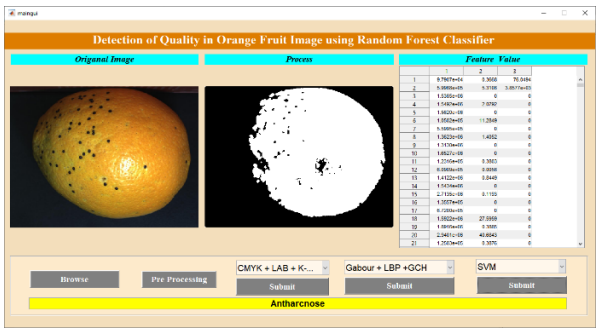

Fig. 3. Gabor+LBP+GCH

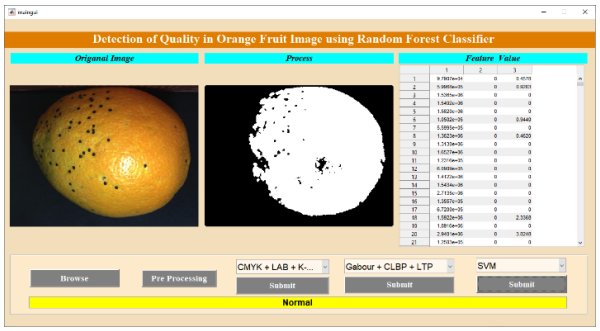

Fig. 3. Gabor+CLBP+LTP

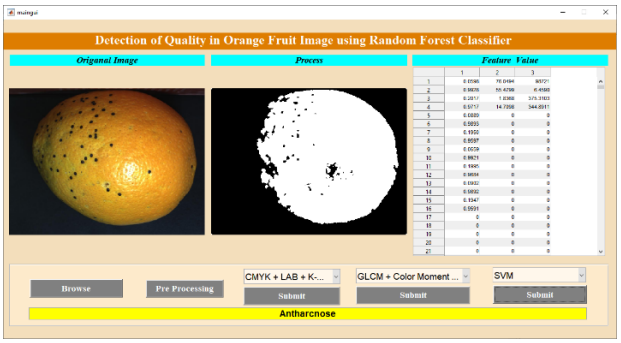

Fig. 3. ColorMoment+GLCM+Shape

TABLE IV. ANALYSIS

Method	Accuracy
Gabor+LBP+GCH	61.29%
Gabor+CLBP+LTP	64.52%
ColorMoment+GLCM+Shape	67.74%

CONCLUSION

In this paper explain four features shape, size and color and Texture based feature Selection. It is also observed that the SVM classification result changes when we change training/testing Ratio. So making theory is used for combining features and combine color and cluster based methods for actual part segmentation. This system is batter works for orange fruit defects classification. In Future by use of image processing and combining two or more classification system would give batter output for fruit industry.

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