

Detecting Guava Quality Using Gradient Function Histogram Plotting

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Abstract— In India Agriculture and Horticulture is in great boom. Farmers are trying their best to take care of their crop. As there is no such technique in India by which farmers may be able to check the quality of guava. A lot of time is wasted in the fields for checking the quality of the guava. There is no process with which we can check the quality of the guava considering their color.

In this dissertation an automatic technique is developed to check the quality of the guava based on color gradient of image of guava. We are taking image of product whose quality has to be checked. Then we are converting RGB image into HSI (Hue Saturation Intensity) image. After conversion of image in to HSI, Hue is extracted from image and histogram is plotted. Now, maximum point of histogram is chosen and its longitude is found out. Then according to some conditions quality of guava is checked out. In this we calculate the PSNR and MSE parameters value for Primary colors RGB as to calculate intensity.

Index Terms— Agriculture, Horticulture, HSI (Hue Saturation Intensity), histogram, PSNR, MSE.

I. INTRODUCTION

Here we are analyzing the quality of the product with the help of image processing toolbox in MATLAB After checking the quality of the guava we control the speed of the grinder according to the quality of the vegetables and fruits. Guava of grade A being more ripe needs less speed of the grinder for converting it into juice. Similarly more speed of the grinder is required of grade B, C and grade rejected vegetables and fruits. Thus, here we have a fully automated system with the help of which farmers and the manufacturers of juice and jam making units can easily check the quality of the Guava and also control the speed of the process according to the quality of the Guava.

The color fundamentals are used to access the color content of the Guava. As the Image Acquisition is not a part of this project so it is assumed that the image acquired through a Digital Camera is stored in the computer memory [13]. Then the Image Processing Fundamentals are taken into consideration. These details out the representation of the Image in space coordinate form. The types of resolution along with the bit depth are explained henceforth. The software description details out the code along with the brief description of the various commands of MATLAB version 12.

II. COLOR IMAGE PROCESSING

The human visual system can distinguish hundreds of thousands of different color shades and intensities, but only around 100 shades of grey [10, 11]. Therefore, in an image, a great deal of extra information may be contained in the color, and this extra information can then be used to simplify image analysis, e.g. object identification and extraction based on color. Three independent quantities are used to describe any particular color. The hue is determined by the dominant wavelength. Visible colors occur between about 400nm (violet) and 700nm (red) on the electromagnetic spectrum.

The saturation is determined by the excitation purity, and depends on the amount of white light mixed with the hue. A pure hue is fully saturated, i.e. no white light mixed in. Hue and saturation together determine the chromaticity for a given color [4]. Finally, the intensity is determined by the actual amount of light, with lighter corresponding to more intense colors.

Resolution of Digital Images

The resolution of digital images can be described in many different ways.

Pixel resolution: The term resolution is often used as a pixel count in digital imaging. An image of N pixels high by M pixels wide can have any resolution less than N lines per picture height, or N TV lines [1, 7]. But when the pixel counts are referred to as resolution, the convention is to describe the pixel resolution with the set of two positive integer numbers, where the first number is the number of pixel columns (width) and the second is the number of pixel rows (height), for example as 640 by 480. Another popular convention is to cite resolution as the total number of pixels in the image, typically given as number of mega pixels, which can be calculated by multiplying pixel columns by pixel rows and dividing by one million. Other conventions include describing pixels per length unit or pixels per area unit, such as pixels per inch or per square inch. None of these pixels resolutions are true resolutions, but they are widely referred to as such; they serve as upper bounds on image resolution.

Spatial resolution: The measure of how closely lines can be resolved in an image is called spatial resolution, and it depends on properties of the system creating the image, not just the pixel resolution in pixels per inch (ppi) [9]. For practical purposes the clarity of the image is decided by its spatial resolution, not the number of pixels in an image. The spatial resolution of computer monitors is generally 72 to 100 lines per inch, corresponding to pixel resolutions of 72 to 100 ppi.

Spectral resolution: Color images distinguish light of different spectrum. Multi-spectral images resolve even finer differences of spectrum or wavelength than is needed to reproduce color. That is, they can have higher spectral resolution.

Temporal resolution: Movie cameras and high-speed cameras can resolve events at different points in time. The time resolution used for movies is usually 15 to 30 frames per second (fps), while high-speed cameras may resolve 100 to 1000 fps, or even more.

Radiometric resolution: Radiometric resolution determines how finely a system can represent or distinguish differences of intensity, and is usually expressed as a number of levels or a number of bits [9], for example 8 bits or 256 levels which is typical of computer image files. The higher the radiometric resolution, the better subtle differences of intensity or reflectivity can be represented, at least in theory.

III. RGB COLOR MODEL

The RGB color model is composed of the primary colors Red, Green, and Blue. This system defines the color model that is used in most color CRT monitors and color raster graphics [10, 13, 15]. They are considered the "additive primaries" since the colors are added together to produce the desired color. The RGB model uses the Cartesian coordinate system as shown in Figure 1.1.

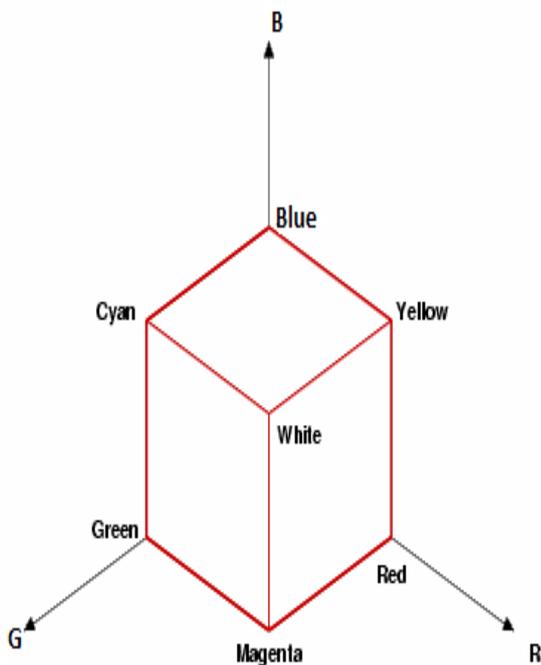


Figure 1: RGB coordinates system

Notice the diagonal from (0, 0, and 0) black to (1, 1, 1) white which represents the grey-scale. Figure 1.2 is a view of the RGB color model looking down from "White" to origin.

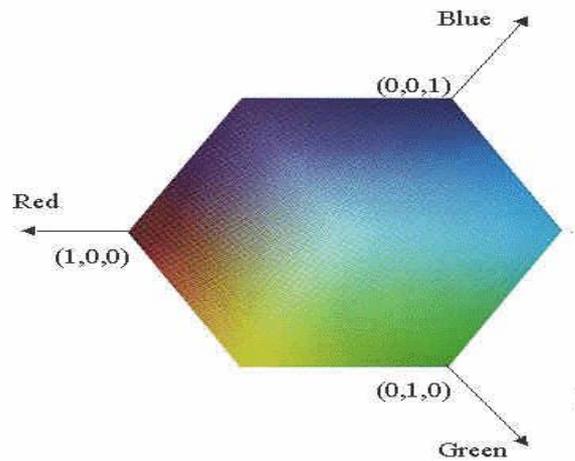


Figure 2: RGB color model

The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors [15]. The name of the model comes from the initials of the three additive primary colors, red, green, and blue. The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the electronic age, the RGB color model already had a solid theory behind it, based in human perception of colors. RGB is a device-dependent color model: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels vary from manufacturer to manufacturer, or even in the same device over time.

Thus an RGB value does not define the same color across devices without some kind of color management. Typical RGB input devices are color TV and video cameras, image scanners, and digital cameras. Typical RGB output devices are TV sets of various technologies (CRT, LCD, plasma, etc.), computer and mobile phone displays, video projectors, multicolor LED displays, and large screens such as Jumbo Tron [15]. Color printers, on the other hand, are not RGB devices, but subtractive color devices (typically CMYK color model).

IV. PROBLEM FORMULATION

The main problems in the post-harvest processing of fruits are the detection of visual defects in order to classify the fruit depending on their appearance. Species and cultivars of citrus present a high rate of unpredictability in texture and color that makes it difficult to develop a general, unsupervised method able of perform this task. There is Scalability problem that is related to changing color of fruits. Another major problem for tackling with complex task is inclusion of knowledge in automatic grading system. We observed problems in detecting the flabbiness from the color. An impact sensor might improve flabbiness detection. Our fruit quality grading into three grades was based on human perception that is difficult to identify the ripeness of the fruit i.e Guava. There are different methods to identify the quality of fruits, there is SVM and neural network method that is used to detect the quality of fruits but there is problem that it detects the 2-class

fruits. Artificial neural networks can be regarded as an extension of many classification techniques.

These networks are inspired by the concept of the biological nervous system, and have proved to be robust in dealing with the ambiguous data and the kind of problems that require the interpolation of large amounts of fruits data. Main problems in the image analysis of agricultural products are; how to acquire images with accurate external information, and how to analyze the images. Many studies for evaluation of agricultural products have been made using image analysis and we have been making some works on evaluation of color and shape of agricultural products. In particular, an image acquisition system we developed enabled us to obtain accurate external information of agricultural products. Efficient locating the fruits on the tree is one of the major requirements for the fruit harvesting system. In India Agriculture and Horticulture is in great boom. Farmers are trying their best to take care of their crop. As there is no such technique in India by which farmers may be able to check the quality of Guava.

V. OBJECTIVE OF WORK

The following objective is studied to fulfill the requirements of the above problem formulation:

- To convert the RGB image to HSI (Hue, Saturation Intensity) check the /Guava quality basis on image gradient.
- To Draw the histogram of input image then analyzes the image.
- Analyze the quality of Guava based on their color the result being obtained.
- Calculate the different parameter i.e. PSNR (Peak Signal Noise Ration), MSE (mean square error) correlation coefficient etc.
- Design the GUI to analyze the quality of Guava .

VI. METHODOLOGY

It is based upon GUI (graphical user interface) in MATLAB. It is an effort to further grasp the fundamentals of MATLAB and validate it as a powerful application tool. There are basically different files. Each of them consists of m-file and figure file. These are the programmable files containing the information about the images. Method to check quality of Guava is that first colored image of Guava is converted in RGB. Then it's RGB color will be extracted and then image will be converted into HSI, then it's histogram is calculated and values are checked according to those value quality of Guava is checked. Its detailed steps are given below:

Algorithm 1: (Main)

Step 1. Read the Guava image with the help of digital camera or browse it from window.

Step 2. Draw the polygon around the area of image to check its quality or Cut any small part of the image.

$[mask,c,r] = riopoly(image)$

Where, mask is mask to store information of selected portion of image using c,r are as x,y co-ordinate vector.

Step 3: Distinguish the red, green and blue color of selected area and display the concatenation of these three. Analyze the small partition of the image based on their color.

Step 4. Convert it into the HSI image by calling Algorithm 2:
rgb2hsi

Step 5. Draw the histogram of HSI features of image

Step 6: Find the grade of the image.

$$\begin{cases} \text{grade A} & \text{if } ind \leq 2 \\ \text{grade B} & \text{if } ind > 2 \wedge ind \leq 5 \\ \text{grade C} & \text{if } ind > 5 \wedge ind \leq 10 \\ \text{grade D} & \text{if } ind > 10 \wedge ind \leq 15 \\ \text{Rejected} & \text{otherwise} \end{cases}$$

Step 6. Find the different parameters value such as PSNR and MSE.

Step 7. Stop the process

Algorithm 2: rgb2hsi

Portion of RGB image to convert into HIS

Step 2.1: Filter the red, green and blue colors of image.

Step 2.2: To calculate intensity of image use formula

$$Intensity(I) = \frac{r + g + b}{3}$$

Step 2.3: To find Saturation (S) of image following conversion formula is used:

$$min = \text{minimum of } (R, G, B)$$

$$Saturation(S) = 1 - \frac{min}{Intensity(I)}$$

Step 2.4: To find Hue (H) of image following conversation formulas are used:

$$num = 0.5 \times ((r - g) + (r - b))$$

$$den = \sqrt{((r - g)^2 + (r - b) \times (g - b))}$$

$$theta = \text{acos} \left(\frac{num}{(den + eps)} \right)$$

$$theta(b > g) = 2 \times pi - theta(b > g)$$

$$Hue(H) = \begin{cases} 0 & \text{if } S = 0 \\ theta / (2 \times pi) & \text{if } S \neq 0 \end{cases}$$

VII. RESULTS AND DISSCUSSION

In this, we consider our first screen figure1 which after running our work asked us for Browsing images of fruits such as Guava from a Browsing window as shown below.

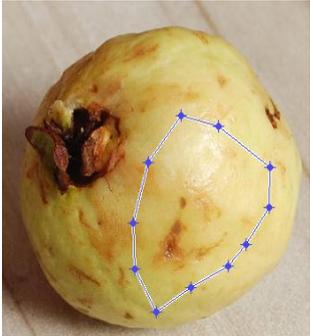
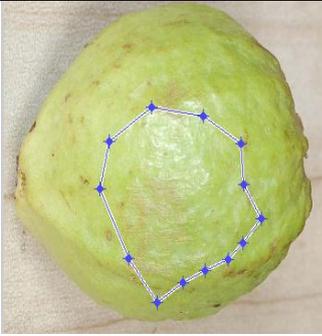
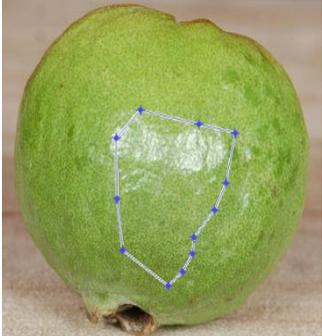
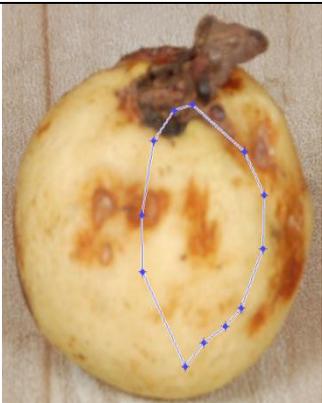
Selected image	Quality Grading
	A Grade Quality
	B Grade Quality
	C Grade Quality
	Rejected Quality

Table 1 Images name and with their quality grade

Name of image	12<10 && 10<= 30	30<1 0& & 10< =50	50<10 && 10<=56	56<10 && 10<=100	Grade
A.jpg	X	34	X	X	A
A1.jpg	X	37	X	X	A
A2.jpg	X	35	X	X	A
B.jpg	X	X	52	X	B
B1.jpg	X	X	54	X	B
B2.jpg	X	X	52	X	B
C.jpg	X	X	X	57	C
C1.jpg	X	X	X	60	C
C2.jpg	X	X	X	57	C
REJECT ED1.jpg	29	X	X	X	Rejected
REJECT ED2.jpg	28	X	X	X	Rejected
REJECT ED3.jpg	27	X	X	X	Rejected

The Table 1 Shows the Gradient value of the image basis on color of the Guava. Here each image has its single gradient value .

REFERENCES

- [1]. Arivazhagan S., Newlin Shebiah R., Nidhyandhan Selva S., Ganesan L., “ Fruit Recognition using Color and Texture Features”, *Journal of Emerging Trends in Computing and Information Sciences*, vol. 1, no. 2, Pages: 90-94, Oct 2010.
- [2]. Blasco J., Aleixos N., Molto E., “ Machine Vision System for Automatic Quality Grading of Fruit”, *Biosystems Engineering* , Vol-85, Issue 4, Pages-415- 423, August 2003.
- [3]. Bulanon D.M., Burks T.F., Alcahnatis V. , “Improving Fruit detection for robotic fruit harvesting”, *ISHS Acta Horticulturae 824: Internation Symposium on Application of Precision Agriculture for Fruits and Vegetables*.
- [4]. Daniel Guyer, Xiukun Yang” Use of genetic artificial neural networks and spectral imaging for defect detection on cherries “*Computers and Electronics in Agriculture* 29 (2000) 179–194.
- [5]. Dr Vishwanath.B.C, S.A.Madival and Sharanbasava.Madole (2012), “ Recognition of Fruits in Fruits Salad Based on Color and Texture Features”, *International Journal of Engineering Research & Technology (IJERT)*, Vol. 1 Issue 7, pp1-6.
- [6]. Devrim Unay, Bernard Gosselin (2004), “A Quality Grading Approach For 'Jonagold' Tomatoes”, *Proceedings of SPS 2004 (IEEE Benelux Signal Processing Symposium)*, pp 93-96.
- [7]. Fernández, L., Castillero, C. and Aguilera, J. M., “An application of image analysis to dehydration of vegetables and fruits discs” *Journal of Food Engineering*, vol.67, pp.185-193, 2005.
- [8]. Ghobad Moradi , Mousa Shamsi, Mohammad H. Sedaaghi, Setareh Moradi” Using Statistical Histogram Based EM Algorithm for Apple Defect Detection” *American Journal of Signal Processing* 2012, 2(2): 10-14 DOI: 10.5923/j.ajsp.20120202.02.
- [9]. Hayashi Shigehiko, Ota Tomohiko, Kubota Kotaro, Ganno Katsunobu and Kondo Naoshi, “Robotic Harvesting Technology for Fruit Vegetables in Protected Horticultural Production”, *Information and Technology for Sustainable Fruit and Vegetable Production FRUTIC05, France*.
- [10]. Hetal N. Patel, Dr. R.K.Jain “Fruit Detection using Improved Multiple Features based Algorithm “*International Journal of Computer Applications*, Volume 13– No.2, January 2011, ISSN NO: 0975 – 8887, pp 1-5.
- [11]. Ismail Wan Ishak Wan, Razali Mohd. Hudzari, “Outdoor colour recognition system for oil palm fresh fruit bunches (FFB)”, *International Journal of Machine Intelligence*, Vol-2, Issue 1, pp: 01-10, 2010.
- [12]. Jimenez A.R., Ceres R., Pons J.L., “A Survey of Computer Vision Methods for Locating Fruit on Trees”, *Transaction of the ASAE*, Vol. 43(6), pages: 1911-1920, 2000.
- [13]. Judith A. Abbott” Quality measurement of fruits and vegetables “*Postharvest Biology and Technology* 15 (1999) 207–225.
- [14]. Leemans, V. and Destain, M.-F, “A real-time grading method of tomato based on features extracted from defects” *Journal of Food Engineering*, vol.61, pp.83-89, 2004.
- [15]. Lopez Jose J., Cobos Maximo and Aguilera Emanuel, “Computer-based detection and classification of flaws in citrus fruits”, *Internation conference on natural image processing (ICONIP-2009)*.
- [16]. Meenu Dadwal, V. K. Banga” Color Image Segmentation for Fruit Ripeness Detection: A Review” *2nd International Conference on Electrical, Electronics and Civil Engineering (ICEECE'2012) Singapore April 28-29, 2012*.
- [17]. Shasi Buluswar (2002), “Models for Outdoor Color Vision”, *Doctoral dissertation, University of Massachusetts, Amherst*.
- [18]. Woo Chaw Seng and Seyed Hadi Mirisae, “A New Method for Fruits Recognition System”, *MNCC Transactions on ICT*, Vol. 1, No. 1, June 2009.