Image Processing Technique for Fruit Grading

M.Pushpavalli

Abstract: Agriculture plays a major part in the economic growth of India . As there is high demand for quality fruits in the market fruit grading process is considered as very important. Fruit grading by a human may cause inefficient and it may also leads to some error. Another problem is labour intensive and to solve the above problems agricultural industries introduce many automated grading systems. In this paper a concept was introduced to get quality fruits by observing its color, measuring its size and weight. Due to cost and inaccurate process, sorting tons of quality fruits to produce food products made from fruits is an another problem that is faced by most of the agricultural industries. Here a sorting process is introduced where the image of the fruit is captured and analyzed using image processing techniques and the defected fruit is discarding by this process. The main aim of this paper is to do the quality check of the fruits within a short span of time.

Keywords : Image processing, segmentation, classification, mangoes, ripeness, defect, agriculture

I. I INTRODUCTION

This paper deals about the ability to check and improves the quality of the fruits and to receive a gradient increase in the efficiency of production to reduce the cost for labour to work with an automatic unit for detection. Sorting the fruits based on a large scale process is tedious as well consumes more time, proves to be costlier and results inaccuracy. Any detection system has some set of regulation towards its proper working and hence does the system in finding the proper quality of the fruits based on the characteristic detection regulations. The paper concerns about the betterment of the quality of products and food material made out fruits with the instant that the quality of the fruits is maintained. In view with the manual errors, the process of grading the fruits based on its size, color, texture turns out to be less satisfactory and hence the process for creating system. With the growing technology and automation, the usage of hardware and software turns out to be handy enough for improvisation of the grading and quality checking of fruits. The process of the project curtains with the involvement in capturing the image of the fruit under the test for its quality and to analyze the gradation with the software handling by means of the image processing techniques and to discard the defected fruits. The complexity of certain low efficient subsystems is overcome by this standard methodology. This method involves significant way of gradation of fruits and helps in the speed of the process. The critical emphasis involves in the registering the quality check of large quantity of fruits with a small span of time and to process the production of the fruits on a larger scale.

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M.Pushpavalli,ECE,Bannari Amman Institute of Technology

II. RELATED WORK

Rokunuzzaman et al (2013) uses machine vision system for sorting the defected tomatoes. The author discuss about the two major defects in tomatoes like blossom end rot and cracks in the tomatoes. Image processing techniques were used for sorting and for decision based sorting neural networks were used. The accuracy attained by neural network approach was 87.5% . The author also gave a comparison between neural and rule based approaches [1].

V. Leemans et al (2002) authors discuss about the defects present in two variety of apples like Golden Delicious and Jonagold [2]. Machine vision was used for a database of 1000 fruit images. Here all the results were compared with European standards and the error rate was dropped upto 5 to 10% .

Mustafa et al (2009) authors considered one vegetable and four types of fruits for their study and these vegetables and fruits were chosen based on their shape and size. Support Vector Machines (SVMs) were used to classify and identify the shape and size of the fruit and fuzzy logic was used to grade the fruits [3].

Woo Chaw Seng et al (2009) proposes a neighbours classification technique to classify the fruit images based on their feature value. For recognition of fruits KNN algorithm is used , this system recognize all the test frit images selected by the user[4]. The author says that by using this method the accuracy goes upto 90%.

Hongshe Dang et al (2010) introduces embedded technology in agriculture where the fruit size is detected and the grading is done using image processing technique. The simulation and implementation was done using a system processor CPU-S3C2440A[5].

Khojastehnazhand et al (2010) proposed a novel approach to sort and grade lemon images. During the stage of callibration a database of different grades of fruits were created and in the sorting period the calculated values are compared with the stored
database information[6]. This method can also be used for sorting
and grading of eggplant, cucumber and pumpkins.

Yousef Al Ohali (2011) uses back propagation neural network for
classification of images and the accuracy was calculated based on
preselected data samples[7].

III. EXISTING METHOD

Existing method consists of a source and destination units where the images are directly captured from the fields through digital cameras and it is processed by a software which uses digital processing techniques (Sakthivel et al

2014) [8]. Using the software process the captured image is compared with the normal fruit and based on the extracted features sorting of the fruit is done. Two categories are used to sort the fruits, 1. Defected Fruits 2. Healthy fruits. The software displays the number of fruits tested - its height, weight and width, the number of fruits accepted and rejected was also displayed (Devendra et al 2015) .

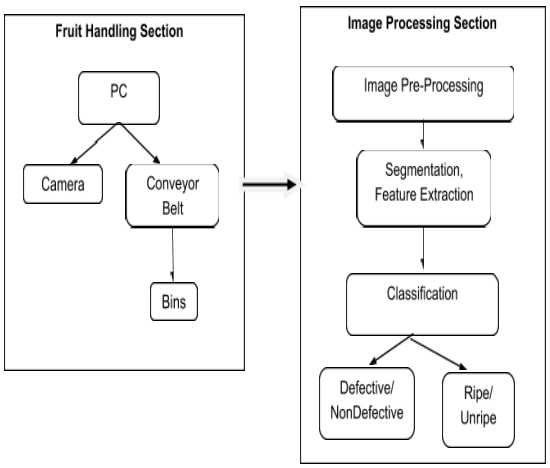

Fig. 1 Architecture for Mango Grading System

To calculate all a reference point was set in MATLAB software by using GUI [9].

IV. PROPOSED METHOD

The proposed system consists of two sections

1. Fruit Handling Section
2. Image Extraction Section.

The architecture of the system is given below Fig. 1. This system is an automated system which reduces the manual handling of fruit sorting. The fruit that was taken for the analysis is mango.

A.Fruit Handling Section

The fruit handling section consists of a PC, Camera, Conveyor Belt, lights, ATMEL-AT89S52 Microcontroller, DC gear motor , Motor Driver and UART bridge. The camera is connected to the PC where the platform is an embedded platform which has both the software and hardware technologies. The Stable part of the fruit grading system is made up of a wooden stall and lights are mounted on it. The fruits are passed through a conveyor belt from one side to another side on the wooden stall. At the middle portion of the conveyor belt we fix a digital camera to capture the image of the fruits. When the fruit is passed through the belt it is stop at this point where camera is fixed and the image of the fruit is captured and is given to a processor through USB ports.

B. Image Processing Section

Image Processing Section consists of Image preprocessing,Segmentation, Feature Extraction and Selection, Classification. In image processing section a median filter is applied to suppress the noises and the reflections that are found in the captured image. Segmentation is done by converting the image into binary by using OTSU (Rafel C Gonzalez,2009) conversion methodology of MATLAB[10]. Here two partition regions of the image was taken as a result. One is background region and the other one is mango region and if the defects in mango is most similar to the background means then the region of mango consists of holes. These holes are filled by pixels to extract the complete region of mango and the value of the pixel is taken as 1.

C. Feature Extraction, Selection and Classification

Feature Extraction is used to detect where the mango is defective or non defective, to do this the color statistical and texture details are extracted(RGB) (Venkata Ramana Chary et al 2012). The color channel such as color mean, standard deviation , skewness, contrast, correlation, energy and color texture is used to extract color statistical features and the mango ripeness is calculated related to this color[11]. Thus we can also classify the ripe or unripe of the mangoes by using this color features. The average value is calculated by acquiring the R,G,B values of the mangoes and a threshold is fixed. The mean R is compared with this threshold value and if it is greater than threshold value means it is decided that the mango is ripe or else it is taken as unripe. After the mango image is classified it is given to the hardware section via RS232 serial transmission , so that the mango can be moved to respective bins.

ATMEL - AT89S52 microcontroller was used in the hardware section for implementation. It consists of two IR sensors, one is to detect the mango on the conveyor belt and the other one is used to detect the mango in front of the camera. When the first sensor gives a high to low signal means the fruit is detected on the conveyor belt and when the signal goes from low to high means it indicates that the mango reaches below the camera. When the second pulse low to high is detected the microcontroller stops the moving of conveyor belt and an indication was given to the PC through RS232 cable. The camera gives the image of mango as an input to MATLAB software and the image processing techniques was used to find out the defective or non defective and ripe or unripe mangoes. The output was displayed using a LCD display unit.

D. Experimental Results

The experiment consists of 350 images dataset of unsorted mangoes. In the dataset all types of mangoes like defected, non-defected, ripe and unripe images were taken. The hardware that was used for fruit grading is shown in the below Fig.2 and the size of the captured image consists of 512 x 512 as shown in Fig. 3

Step 1: In fruit handling section, the conveyor belt along with the

mango is moved based on the signal

that is send by the MATLAB to the microcontroller unit.

Step 2: The mango is moved to a position, so that the digital camera can capture the mango image.

Step 3: The Image Processing Section, receives the captured image of mango and performs, segmentation, feature extraction and classification process. The mango image is loaded into the interface and the mango is analyzed for defects. If a mango is defective means the conveyor belt moves the mango into the bins ,indicating that it is a defective one.

Fig 2. Hardware

Step 4: If the mango is not a defective one means the software proceeds to check the ripeness of the mango. After classifying whether the mango is ripe or unripe, the grading is done by the system and the mangoes are moved to different bins automatically with the help of conveyor belt.

Fig. 3 Image captured by camera

The input images are sent over the system with various textures and size. Automatically the images were acquired and segmented under cluster division across the system and the defective images were found.

Fig. 4. Defective Mangoes

Fig 5 Unripe Mango

Table 1: Results for non defective mangoes

Statistical	Mean	124.73	103.85	79.862
	Standard Deviation	9.224	7.8011	10.665
	Skewness	189	189	193
Texture	Contrast	1.673e+03	1.718e+03	1.761e+03
	Color (Energy)	0.1840601504	0.9917913086	0.4680111102

Table 2: Results for defective mangoes

Statistical	Mean	104.333	93.65	56.165
	Standard Deviation	4.82	4.96	5.877
	Skewness	140	138	155
Texture	Contrast	180	181	144
	Color (Energy)	4.856e-04	6.988e-04	6.890e-04

Based on the above results from Table 1 and Table 2 grading and classification was done by calculating Euclidean distance, K nearest neighbor algorithm was used for grading.

V. CONCLUSION

This paper presents hardware for fruit grading where all the mangoes were graded using computer vision techniques. Based upon the output of image processing section the hardware moves the mangoes to the respective bins after the decision of defected/non defected and ripe/unripe. The accuracy that is obtained through classification is 96% . Thus this hardware is very cheap so that a former he himself can analyze the quality of mangoes in the field itself. In this only 300 mangoes /hr is accepted for processing. For industrial purpose furthur improvement is needed with respect to speed and accuracy.

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AUTHORS PROFILE

Dr.M.Pushpavalli completed her B.E in Electronics and Communication Engineering and M.E in Applied Electronics. She has completed her Ph.D in the year 2014. She has 15 Years of teaching experience and here area of Interests are wireless networks, Embedded System and VLSI.