

# Grading and Sorting Of Fruits Based On Image Processing

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**Abstract-** In recent years, automated machine vision based technology has become more potential and important in many areas like agricultural sector and Food Processing Industry. Sorting and Grading of the fruit is one of the most important process, but this procedure is mostly carried out manually which is not efficient as it tends to human error. An automatic fruit quality inspection system helps in speed up the process improve accuracy and efficiency and reduce time. The Grading process is carried out by capturing the fruit image using camera and this image is interpreted using image various processing techniques. The sorting process is done by sorting the fruits based on Color and Shape parameters. Then image processing is done Defected fruit is detected Size detection is based on binary image of Fruit Sorting is done based on color and grading is done based on size.

**The Main aim of the proposed system is to Sort and Grade the variety of Fruits by implemented Image Processing Techniques. By using Image Processing Techniques we can make the the sorting and grading process more efficient than the manual work. It will improve the quality as well as it will take less time.**

**Indexed Terms-** Fruits, Arduino, Software, Python, Open CV, Contours, Robotic Arm, Rally, Image Processing, Edge Detection, Color Detection, Canny edge Detection, Neural Network, Camera.

## I. INTRODUCTION

To design and develop an algorithm for fruit classification based on shape and color. Classification based on Shape and Color will help to provide the perfect sorting and grading of fruits. To evaluate the system performance for fruit sorting and classification in term of accuracy and precision. As there are many manual systems available in market but it much more

time consuming than the Automated System. To optimize the system performance by manipulating the illumination, thresholding value and distance of camera. The Threshold value plays an important role for the Color Module for RGB where we will take average of R, G, and B and for shape the Edge Detection will provide proper shape and size of a fruit. In this paper we are using different types of Fruits like Apple, Orange, Strawberry, and so on. The quality of the fruits is important for the customers and become the requirements from the suppliers to provide fruits with high quality. The grading are considered as the most important step to achieve the high quality standards. Generally, the fruits quality depends upon parameter such as SIZE, COLOR, SHAPE, and INTENSITY, but Color and Size is the most important factor for Grading and Sorting of fruits. Color is very important in the sorting of fruits but due to the similarity of colors between some of the fruits, the size also help in solving problems. Different types of algorithm and classifier are available to extract features of the fruits so that we can provide the exact result about the fruits

## II. LITERATURE REVIEW

A. Orange Sorting by Applying Pattern Recognition on Colour Image.

The objective of this paper is to provide Automated Grading based on Pattern Recognition. This paper proposes the research work for automated grading of Oranges using pattern recognition techniques applied on a single color image of the fruit. This research is carried out on 160 Orange fruits collected from varied geographical locations in Vidarbha Region of Maharashtra. System designed can automatically classify an Orange fruit from this region, given its single color image of 640 480 pixel resolution, taken inside a special box designed with 430 lux intensity light inside it, by a digital camera. Only 4 features are

used to classify oranges into 4 different classes according to the maturity level and 3 different classes as per size of oranges.

- Weaknesses: Blue color is least significant hence can be neglected.
- How to Overcome: We will use this information and make a system which will predict the size of fruits.

#### B. Automated Sorting and Grading of Vegetables using ImageProcessing Description.

The computer vision based system for automatic grading and sorting of agricultural products like strawberry and brinjal based on maturity level is presented in this paper. The application of machine vision based system, aimed to replace manual based technique for grading and sorting of fruit and vegetable. The manual works obtained problems in maintaining consistency in grading and uniformity in sorting. To speed up the process as well as maintain the consistency, uniformity and accuracy, a prototype computer vision based automatic grading and sorting system is developed. The proposed method is implemented by means clustering segmentation and color detection process with strawberry and brinjal. Feature extraction for various features like Entropy, Mean and standard deviation are calculated. The main aim of the proposed system is to sort and grade the variety of vegetables like strawberry and brinjal is implemented using image processing techniques.

- Weaknesses : It has used various maturity level
- How to Overcome: We will use this information and make a system which will provide more accuracy.

#### C. Automated Fruit Grading System.

The quality of the fruits is important for the consumers and become the requirement from the suppliers to provide fruits with high standards quality. So, in the past few years, fruit grading systems have established to fulfil the needs of the fruit processing industry inspection. Besides that, the process of fruits involves several steps that can generally be classified into grading, sorting, packaging, transporting and storage. The grading are considered as the most important steps towards the high standard of quality. Two kinds of fruits

have been inspected in this project; namely are apple and mango. A prototype of an automated fruit grading system is designed and developed in this paper to detect the defects on of the surface of fruits. The system is capturing the fruit's image using camera and the fruits are placed onto of a rotating desk.

- Weaknesses: Capturing of fruit and Focusing on fruit.
- How to Overcome: We will use this information and make a system where we will avoid the light so to get the perfect image of the fruit.

### III. SURVEY ON EXISTING SYSTEM

In this research is carried upon, the classification of the fruits based on the types of defects. Two types of fruits are being chosen for this project that are apple and mango. Then, mangoes are divided into two groups that are ataulfo and normal mango. Apples are divided into two groups also that are winesap and normal apple. Firstly, the camera captures the image of the surface of fruits and will analyze the types of defects of the fruits. The system was tested by using a samples of apples and mangoes. Firstly, the fruit is brought manually to the rotating desk which is connected to the shaft of the 12V DC motor. The DC motor is then set by Arduino to rotate 180° twice for each of the fruits in order to be able to detect the defects of the whole lateral surface of fruits. Then, the camera will capture the image and show the analyzed image at the Graphical User Interface (GUI). We can then observe

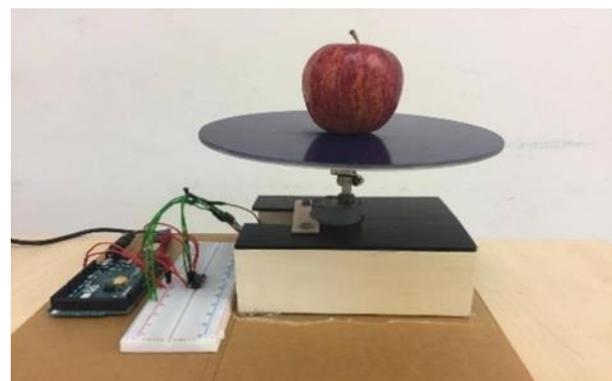


Fig. 1. System setup

the surface defects and decay of fruits through GUI. This system consists of mechanical part such as rotating desk that act as a place for inspection;

electrical parts such as DC motor, Arduino, computer and software such as image processing in OPENCV. after fabrications. In this project, camera from laptop is positioned to detect the lateral surface of the fruit. The sample of fruits are brought to the rotating desk for grading. The DC motor is used to rotate the desk which allow the camera to capture the lateral surface of the fruits

A. Equations

The DC motor required for rotating desk holding fruits has to be chosen based on the following considerations:

- Maximum weight of fruit sample is considered to be less or equal to 1.0kg
- Weight of rotational desk is = 0.3kg
- Torque of DC motor= 0.784N.m
- Weight of fruit sample + weight of rotating desk = 1.0kg
- + 0.3kg
- Radius of DC-Motor = 1.8cm

Torque needed to turn the rotating desk and sample of fruit

$$=1.8cm \times 1.3kg = 2.34kgcm = 2.34kgcm \times \gamma = 0.23N.m \quad (1)$$

IV. PROPOSED SYSTEM

In our system, we are going to work on both the software as well as hardware. Our system will help to provide the Grading and Sorting of fruits based on parameters (size, color, shape, intensity) we have two most important module 1.Grading Module, 2.Sorting Module

The Following Sorting Module is divided in two sub parts: RGB Module and Gray Scale Module.

RGB Module: In the RGB model, an image consists of three independent image planes, one in each of the primary colours: red, green and blue. Specifying a particular colour is by specifying the amount of each of the primary components present.

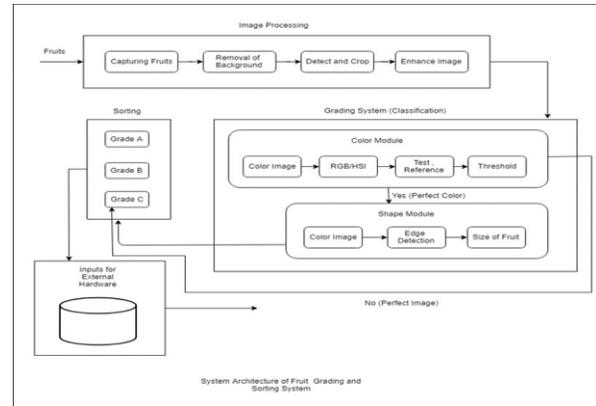


Fig. 2. System Architecture

Gray Scale Module: A gray scale (or graylevel) image is simply one in which the only colors are shades of gray. The reason for differentiating such images from any other sort of color image is that less information needs to be provided for each pixel. In fact a ‘gray’ color is one in which the red, green and blue components all have equal intensity in RGB space, and so it is only necessary to specify a single intensity value for each pixel, as opposed to the three intensities needed to specify each pixel in a full color image

The Following Grading Module is Shape Module.

Shape Module: In Shape Module, the important detection is an Edge Detection from which we can get the accurate shape of the Fruits. In edge detection, we find the boundaries or edges of objects in an image, by determining where the brightness of the image changes dramatically. Edge detection can be used to extract the structure of objects in an image detection uses an approach where the intensity variations occur in the image points is declared as the edge. It is a series of actions used to identify the points in an image where clear and defined changes occur in the intensity. This series of action is necessary to extract the image related information e.g. image sharpening, enhancement and object location present in the image

ALGORITHM: Color Detection Algorithm

- Step 1: Start.
- Step 2: Read the input color image using imread function.

- Step 3: Read the input pixel of color image in three different planes (RGB) and store it into three variable r,g and b.
- Step 4: Read the small region of fruit to detect color of fruit.
- Step 5: Store in different variable r1, g1, b1.
- Step 6: Calculate the mean of r1, g1, b1 and store into variable r2, g2, b2.
- Step 7: Compare the value with Threshold.
- Step 8: if  $g2 \geq \text{threshold}$ , Color detected is green.
- Step 9: if  $r2 \geq \text{threshold}$ , Color detected is red.
- Step 10: END.

## V. HARDWARE MODULE

Irrespective of any reference papers, we thought of something new which can be implemented using some old methods which we can say re usability in terms of power. As you can see in the above image of our hardware section, we are using multiple motors in our project not just because of the main function but also to generate energy from the previously used energy. As we know Electricity can be generated by using magnetic flux and dc motor already contains the magnet and the magnetic flux Hence when one motor is rotated the rotation

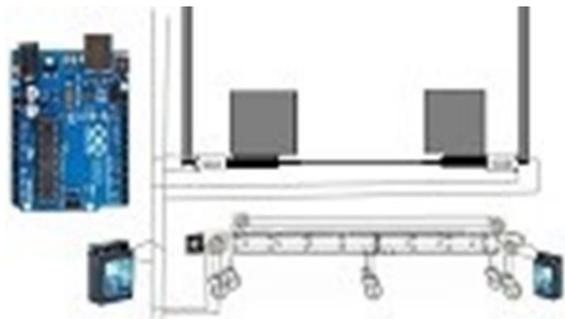


Fig. 3. Hardware Setup.

part is connected to another motor which makes it rotates too and this rotation initiates the magnetic flux by which energy is generated and this energy can be later used in the project, looking it as an industrial perspective the machines can still run even when there is no Electricity. And it also decrease the power consumption.

## VI. CONCLUSION

Our system will provide an Automatic Fruit Grading System, which will save time, effort and provide better accuracy than the Manual Sorting. The techniques contains, the Color Detection and Edge Detection. Color Detection is used to identify the defected part with the Threshold level. Edge Detection is used for finding the boundaries of objects within images. Our System consists of Mechanical Part such as DC motor, Arduino, Computer and Software such as image processing in Python using Open CV. We are going to design this System to meet the demands in Grading Fruits operation compared to manual grading.

In our System, we have one Important Module which is GRADING Module in which we have two sub Modules A)Color Module and B)Shape Module. The Color Module is further divided into RGB and Gray-Scale. In Color Module we will capture an Image it will detect the number of Pixels of RGB an image is having by using the Threshold. In shape Module we will be focusing on the Edges of the Fruits so that we can get the accurate shape of the Fruit. These is how our system is going to work and will provide the Best Image. In addition, since there will have some kind of fruits with same color such as Tomato and apple so, there will be having some misclassification

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