

# GRADING OF TOMATOES USING DIGITAL IMAGE PROCESSING ON THE BASIS OF COLOR

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## Abstract

This paper presents fruit quality grading system. Technological advancement is gradually finding its applications in the field of agriculture and food, in order to overcome great challenge of needs of the increasing population. Grading and sorting of fruits is one of the foremost necessary processes in fruits production, but this method is usually performed manually which is not efficient as it requires large number of laborers, and causes human errors. Image processing is employed for automated fruit grading based on features such as size and color of the fruit. This project will help in the development of a non destructive automated grading system with high accuracy, high speed and low cost. Development of this project will have applications in fruit quality detecting and grading in areas like food processing and trades where standardization is required.

**Keywords:** Grading, Sorting, Tomato, Image processing, Food processing.

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## 1. INTRODUCTION

Even today eye observation is the approach for detection and identification of plant and fruit quality which is prohibitively expensive in large farms. In developing countries, in order to contact experts the farmers travel long distances, making consultation expensive and time consuming.

To reduce labor intensity and improve quality and production efficiency, non-destructive automatic detection technology are being developed. It is the process of detecting fruits' inside and outside quality without any damage, using some technology to make evaluation according to some standard rules.

With the help of image processing technology and computer software and hardware, detection of fruits quality by using vision detecting technology becomes easier. At present, most systems have the disadvantage of high cost, complexity, low efficiency and low speed of grading.

So it is significant to develop high speed and low cost fruit size detecting and grading system. Software development is the significant step in color classification system and for finding size of a fruit.

### 1.1 Problem Identification

Md. Rokunuzzaman et al. [1] considered the defects on the head of tomatoes as the basis for grading and neural network was used for sorting. Some important parameters like color, size, and texture were not considered and for sorting a pre defined data base was required for comparison. P. Vimala Devi et al. [2] reviewed various methods of fruit sorting and defect detection

using machine vision technique. The paper also reviews the noise removal during the image processing method. Noise removal is one of the pre-processing steps that enhanced the image for further processing. The paper also highlights the machine vision applications used for robot assistance. Chandra Sekhar et al. [3] presented a computer vision based system for automatic grading and sorting of based on maturity level of the agricultural products like mango. The attributes of the individual products are calculated using Gaussian Mixture Model for automatic grading and sorting. The efficiency of system is high. But misclassification occurs when different maturity level mangoes are of similar colour. This automatic system also fails when the surfaces of the mangoes were contaminated with scratches and color patches. Cheng-Jin Du et al. [4] reviewed the application of image processing techniques to different types of food products. Various processing techniques have different degrees of success in various fields. CCD, MRI, Ultrasound, CT and ET sensor techniques for image acquisition of food were studied. Statistical method, Fuzzy logic and Neural Network methods were discussed. Processing speed was a barrier in heavy duty real time applications, unable to handle large data streams.

### 1.2 Motivation

A detailed review of the above papers indicated the need to develop a simple system for grading and sorting of bunch of tomatoes rather than working on a single entity. The entire process is done on the basis of color of the tomatoes which is the first indication about the health and maturity of the produce. The paper presents a methodology of grading of tomatoes using image processing technique.

## 2. METHODOLOGY

The paper aims at grading of tomatoes based on the color of the fruit. A bunch of tomatoes is mounted on the designed platform and the image is taken from the top. The image is then pre-processed to remove noise and separate image of individual tomato from the bunch.

Further the image is processed to detect the color of the tomatoes placed by subtracting the grayscale image from red component of the image.

### Algorithm

The following algorithm is followed in the fruit grading and method:

1. The process starts after the tomatoes are mounted on the platform.
2. A camera fixed atop the position of tomatoes captures its image.
3. The captured image is pre-processed to remove the image noise and cropped to separate images of all the tomatoes.
4. Then the color of the placed tomatoes is detected and graded good or bad based on the red color content on each tomato. The steps involved are:
  - A) The red component of the image is separated.
  - B) The acquired image is converted to a grayscale image.
  - C) The images of A and B are subtracted to get a new image.
  - D) The new image is filtered for noise components using median filter and converted to a binary image.
  - E) Small holes are filled up and then connected components of the binary image are counted.
  - F) If components = '1' "The tomato is of desired color"  
Else "The tomato is undesired or of bad quality".

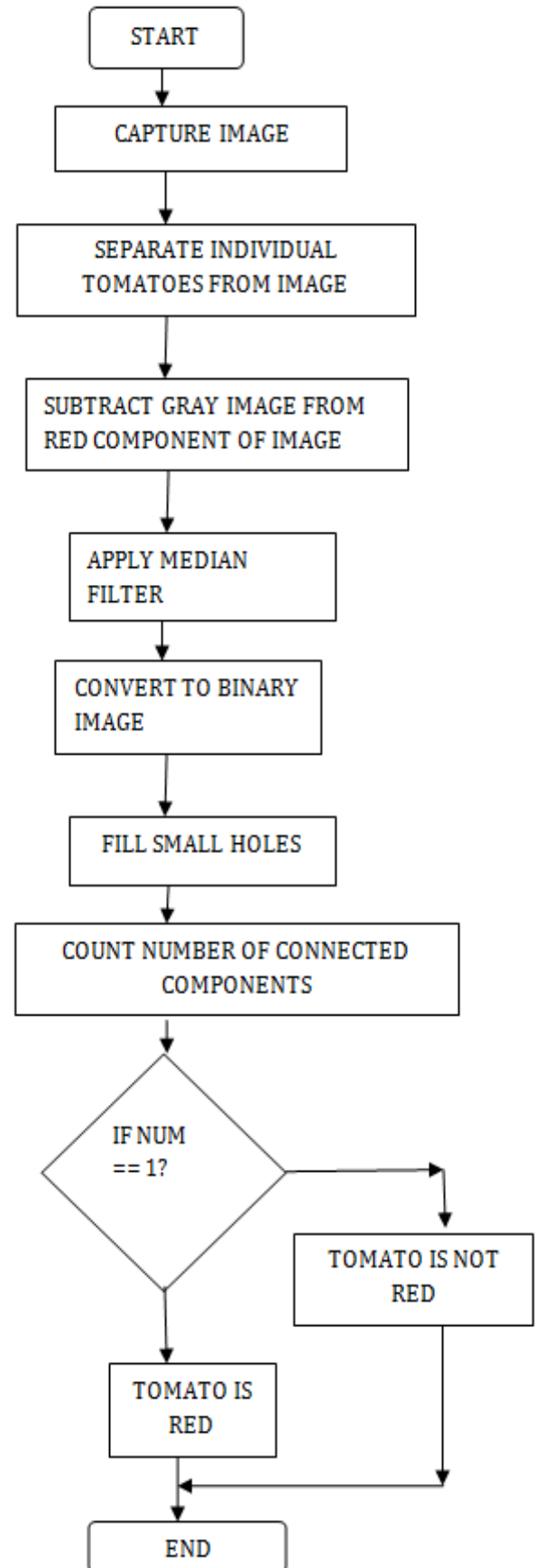


Fig 1: Flow chart of the grading process Result:

Fig2 grading of good quality tomato

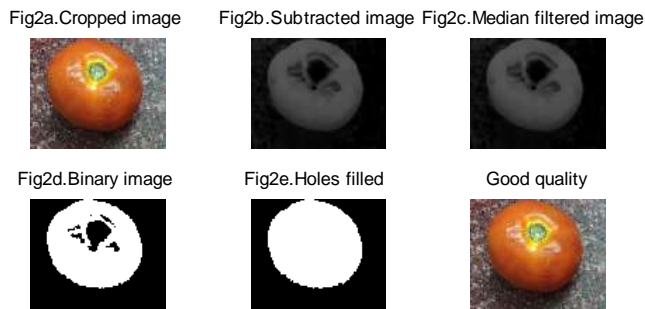
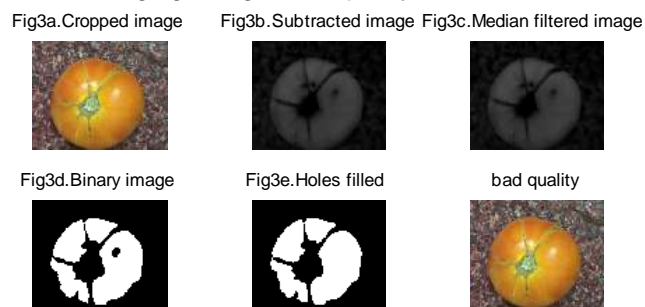


Fig3 grading of bad quality tomato



The project grades the tomatoes based on its color. The figure above shows the steps involved in carrying out image detection and grading of tomato. Figure 1 shows a good tomato and figure 2 shows a bad quality tomato. The experimental data is given below:

Total tomatoes graded	20
No. of good tomatoes present	17
No. of good tomatoes detected	15

Thus the accuracy of the system is 90%. Moreover this system is cost efficient and effective. Also it is hardly affected by the external lighting conditions since gray scale image is used which is less sensitive to the varying light intensity. The logics used are easy and effective and hence better than other complex systems used for grading of fruits.

### 3. CONCLUSION

The proposed project is the demo version for grading of tomato fruit based on the color. This is the first step towards sorting and grading of fruits based on color. Later size of the fruit will also be considered along with design of a hardware interfaced with the system to enable the sorting process. However the model can be used for large scale application by making the necessary changes in the hardware design as per the quantity of fruit to be processed simultaneously. Here we have used tomatoes but the system will be applicable to any other fruit of different color equivalently.

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