

# Fruit Grading Using Image Processing and Machine learning

Prof. Sneha Shinde<sup>1</sup>, Sushant Shukla<sup>2</sup>, Hrishikesh Rane<sup>3</sup>, Shweta Mundhe<sup>4</sup>, Omkar Tilekar<sup>5</sup>

Assistant Professor, Department of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology,  
Pune, India<sup>1</sup>

Student, Department of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology, Pune, India<sup>2</sup>

Student, Department of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology, Pune, India<sup>3</sup>

Student, Department of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology, Pune, India<sup>4</sup>

Student, Department of Computer Engineering, Marathwada Mitra Mandal's Institute of Technology, Pune, India<sup>5</sup>

**ABSTRACT:** We proposed an automatic fruit quality inspection system for sorting and grading and defected fruit detection discussed here. Visual detection creates problems in maintaining accuracy and consistency and it is time-consuming. the most aim of this method is to switch the manual inspection system. This helps to hurry up the method to boost accuracy and efficiency and reduce time. Anyone anywhere anytime can use this application to test the grading of the fruit. Then image processing is completed to urge the desired features of fruits like texture, color, size. Defected fruit is detected by supported blob detection. Color detection is done by thresholding. Size detection relies on the binary image of a tomato. Sorting is completed supported color and grading once done based on size. Firstly, using an application image is taken and then it processes images to gain features that result in the grading of that fruit.

**KEYWORDS:**Fruit grading, Neural network, Machine learning, Colour feature extraction

## I. INTRODUCTION

To this day, the practices followed to grade and sort fruit in India, are the traditional ones. A manual inspection is still a common approach for fruit grading. However, these methods are quite time consuming and a good human vision is required. Hence, there is an immense need for an automated fruit grading system that apart from being accurate should be cost-effective and fast. To find the quality of fruit many factors are needed to consider such as size, color, shape, defect. If there are no dark spots or soreness on the surface, it is not rotten, etc. then the time required to select the food from a heap takes less time. color and surface defects of fruit detect quality. The ripeness of the fruit depends on the color of it and the area covered by it. It helps to decide the quality of it and the shelf life of the fruit can be decided further.

## II. RELATED WORK

[1] "Machine vision-based automatic fruit grading system using a fuzzy algorithm.", They applied guide grading by using the use of visual inspection poses issues in keeping consistency and accuracy; that is additionally a time-consuming and labor-large method. In this assignment, a new prototype pc imaginative and prescient-primarily based automated fruit grading gadget is proposed.

[2] "A Review on Fruit Grading Systems for Quality Inspection.", In this firstly, the readings from cameras are feed for algorithms and image processing methods for grading.

[3] "A Hybrid Intelligent System for Fruit Grading and Sorting", They proposed algorithms that follow the principle of herbal evolution. A hybrid smart tool is proposed for fruit grading and sorting.

[4] "Image Processing and Machine Learning for Automated Fruit Grading System." In this first machine tries to know shade based totally grading algorithms, its additives, and modern work stated on an automatic fruit the grading system is explained.

## III. METHODOLOGY

Grading is done based on external and internal quality factors. The external factors are color, size, volume, shape, and texture. Various methods are applied for color detection, size and volume calculation, shape, and skin defect detection.

- **Feature Extraction Based on Color**

Color is the important property in defining the quality of it. Color determines the maturity of the fruit. Most of the day's consumer decision to simply accept or reject a specific fruit depends upon its color. It works by comparing the fruit color with the existing predefined reference colors.

- **Feature Extraction Based on Size and Volume**

The cost is related to their size. The size calculation becomes more complex in fruits with irregular shapes. Parameters used for size calculation are area , length , width, and perimeter. Size can be calculated in various ways. In one-dimensional based on length and width.

- **Feature Extraction Based on Texture**

The color identification process is very important for ripeness detection. But instead of that fruit external surface defect detection is also an important process. For that texture analysis is useful. Skin defect identification using Discrete Curvelet Transform. Texture analysis is especially used for fruit quality detection. Texture analysis is done by Discrete Curvelet transform. Discrete curvelet transform, based on the local and global features of that fruit with the help of low and high-resolution capability of DCT are taken. Feature such as Energy, entropy, the mean and standard deviation of each good and defected fruit are calculated. These four characters are used to characterize.

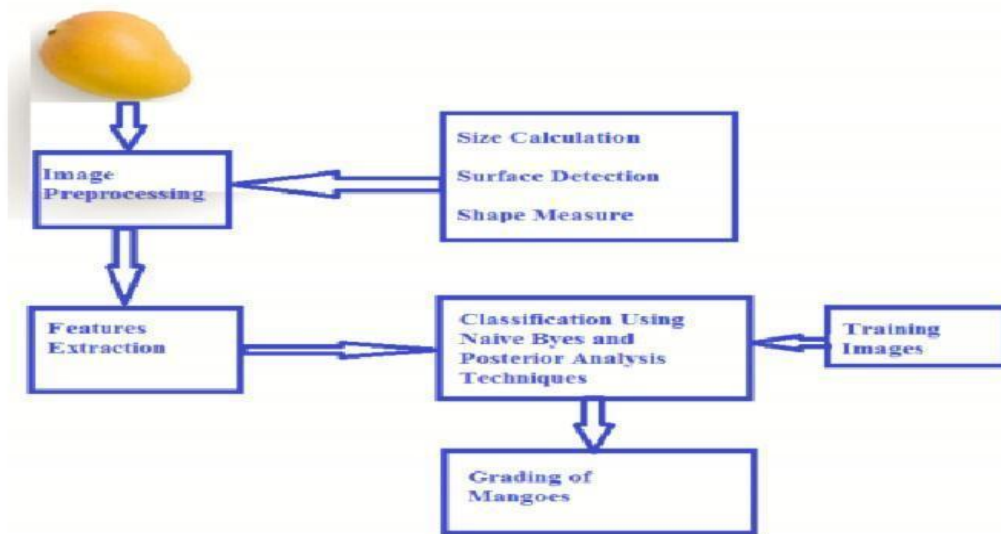


Fig.1: System Architecture

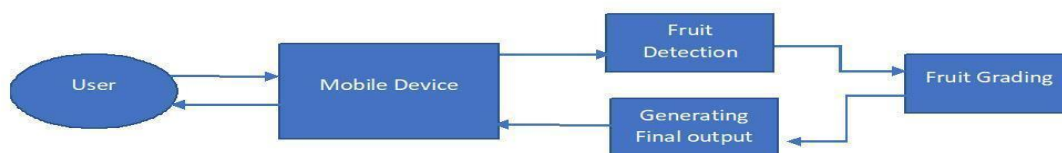


Fig. 2: Data Flow Diagram

- **Mathematical Model**

Neural network models are mostly defined as a function that takes an input and produces an output. A common use of the phrase "ANN model" is basically the definition of a category of such functions (where members of the category are obtained by varying parameters, connection weights, or properties of the architecture such as the number of layers or their connectivity). Mathematically, a neuron's network function  $f(x)$  is defined as a composition of other functions  $g_{i(x)}$  where  $f(x) = K(\sum_i w_i g_{i(x)})$ .

- **Artificial Neural Network (ANN)**

The artificial neural network is an extension of many classification techniques. The first neural network (A) is used to decide if the color of the surface is normal red or abnormal red. The second Neural Network (B) is used for grading the color of the apples into the final five qualities (AA, A, B, C, D).

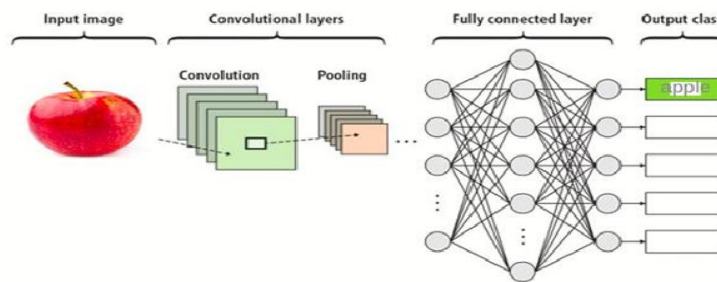


Fig. 3 : Working of ANN

- **Algorithms**

[1] Linear Discriminant Classifier:

LDC is a statistical classifier. First, the new feature is constructed from a linear combination of original features. Then, these new features are used to separate the set of features into their respective categories. It tries to search for a linear decision boundary that separates the feature space into two half-spaces by minimizing the criterion function. Equation of LDC:  $g(x) = wtx + w_0$ .

[2] Nearest neighbor classifier (k-NN):

K-NN focuses on the similarity of samples measured by a distance metric. It assigns data to the most represented category within its closest k neighbors'. The Fruit Recognition System using the KNN algorithm as a classifier to classify fruit based on mean color values, shape roundness value, area, and perimeter values of the fruit is presented by Woo Chaw Seng and SeyedHadiMirisaee.

#### IV. EXPERIMENTAL RESULTS

Overall performance of the proposed machine is examined with the database of images. In experimental result evaluation 80% images used for training and 20% pictures used for testing. The equal is as compared with the present technique in phrases of the specificity, sensitivity, and accuracy.

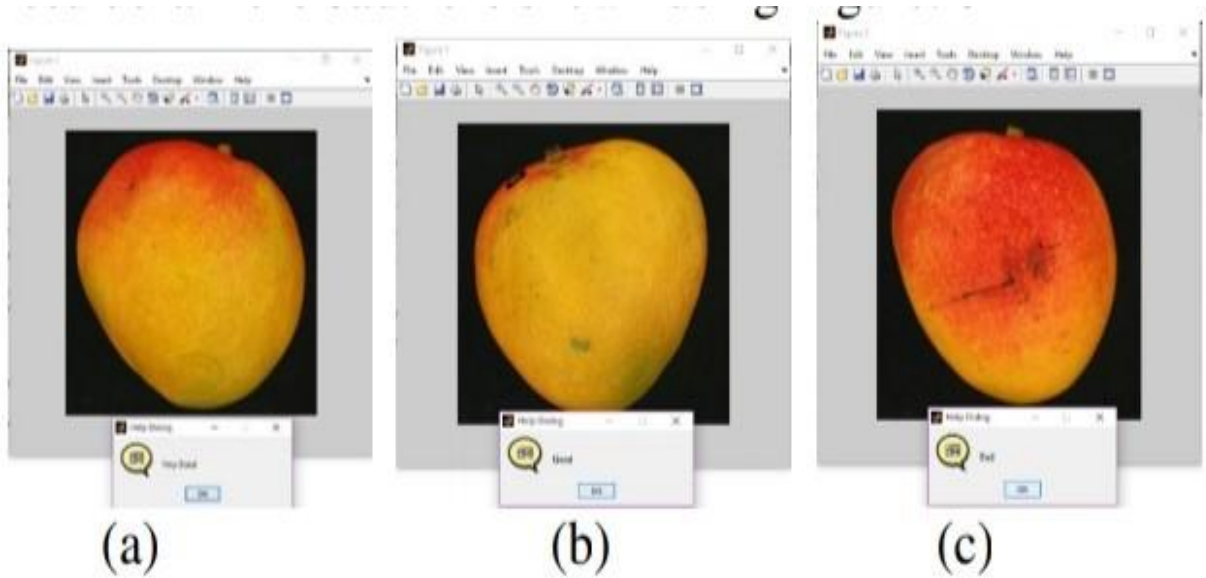


Fig.4: Input Images

The type of mango has been accomplished with the assist of the multi-class SVM wherein the facts has been skilled, label and take look at for you to classify the images of the mango and grading hence. The Multi-magnificence classifier reduce the educate information and label which is found to deliver end result consistent with the classes right here 3 classes has been very good, good and bad



Fig. 5: Input image (a) graded as very good

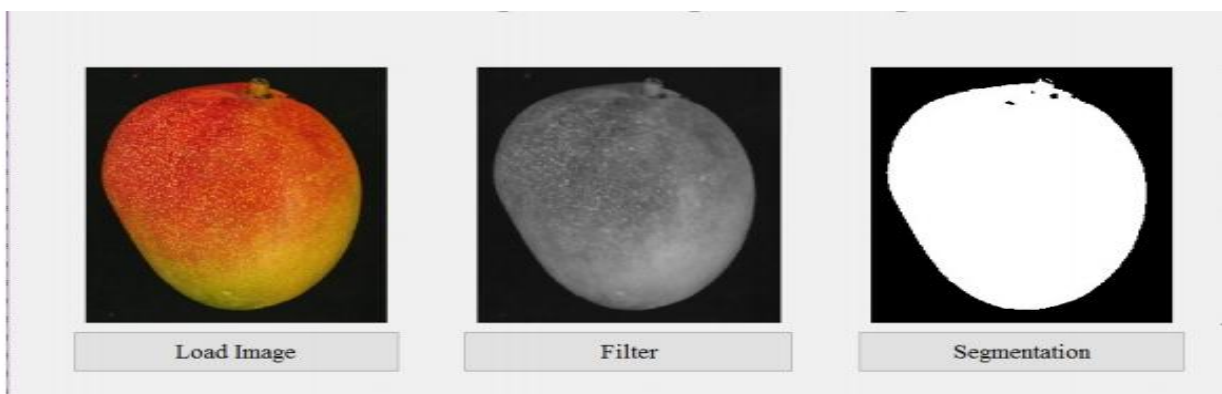


Fig. 6: Input image (b) graded as good

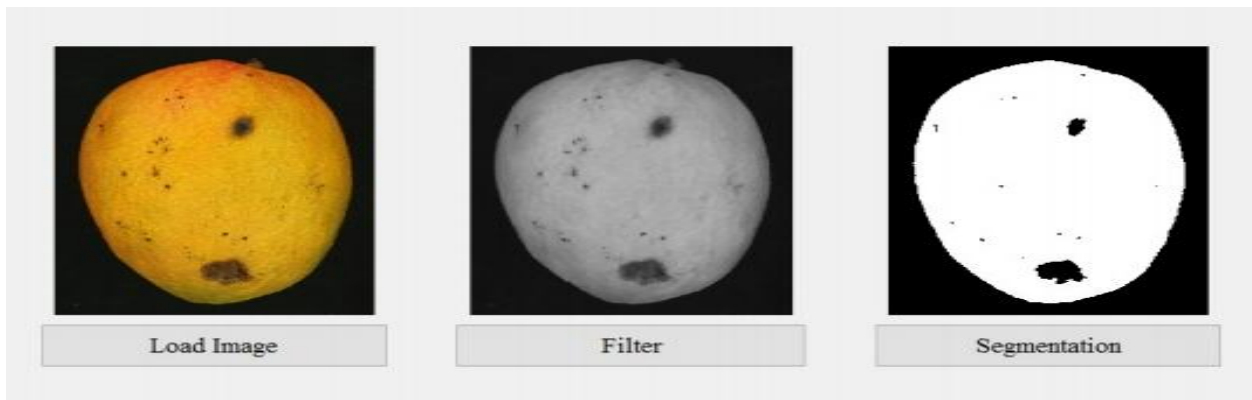


Fig. 7: Input image (c) graded as bad

#### V. CONCLUSION

Using image processing and machine learning applications fruit grading system is created. Image processing systems are capable of replacing labour percent inspection of fruit grading. The major problem for tackling complex tasks is the inclusion of knowledge in the automatic grading system. Classification accuracy varies between 75 percent to 86 per cent.

#### REFERENCES

- [1]. Chandra Sekhar Nandi, BipanTadu, University Institute of Technology. Machine vision based automatic fruit grading system using fuzzy algorithm.
- [2]. R. B. Kanchanadevi . A Review on Fruit Grading Systems for Quality Inspection. July, 2014
- [3]. JasmeenGill ,Akshay Girdhar and Tejwant Singh. A Hybrid Intelligent System for Fruit Grading and Sorting.
- [4]. Rashmi Pandey, Sapan Naik. Image Processing and Machine Learning for Automated Fruit Grading System. Nov 2015.
- [5]. Anuradha P. Gawande , Prof. S.S. Dhande. Implementation of fruit Grading System by Image Processing and Data Classifier. Nov, 2014.