# Fruit Sorting Using Adaptive Network-Based Fuzzy Inference System

L. Rajasekar
Assistant Professor, Department of EIE
Bannari Amman Institute of Technology
Sathyamangalam, Erode, India

Rajalakshmi A
U.G Scholar Department of EIE
Bannari Amman Institute of Technology
Sathyamangalam, Erode, India

Rajarajeswari B
U.G Scholar Department of EIE
Bannari Amman Institute of Technology
Sathyamangalam, Erode, India

Vinothini J
U.G Scholar Department of EIE
Bannari Amman Institute of Technology
Sathyamangalam, Erode, India

**Abstract—Every day high quality fruits are exported to other countries and produce a good income, so the grading process of the fruit is important to improve the quality of fruit. However, fruit classification by manual methods in agricultural industry is not adequate, requires large number of employments and causes human faults. The main objective of such systems includes the classification, quality estimation according to the internal and external characteristics, management of fruit processes during storage or the assessment of new actions. Color, textural and morphological features are the most commonly used to identify the diseases, maturity and classification of the fruits. Sorting is one of the important tasks in production line and it has an appreciable effect to the homogeneous of products. The sorting process including some steps as detecting the object, determining the object properties like color, size, shape, locating of the object using the ability of ANFIS (Adaptive Network-Fuzzy Inference System) The newly method ensures in time saving of farmers regarding the maturity level and reduce fruit and vegetable losses.The main objective of fruit and vegetable processing is to supply wholesome, safe, nutritious and acceptable food to consumers throughout the year.**

## I. INTRODUCTION

In developing countries agriculture is the mainstay of the economy. As such, it should be no surprise that agricultural industries and related activities can account for a considerable proportion of their output of the various types of activities that can be termed as agriculturally based, fruit and vegetable processing are among the most important. The secret of a well planned fruit processing centre is that it must be designed to operate for as many months of the year as possible.

This means the facilities, the material handling and the equipment itself must be inter-linked and coordinated properly to allow as many products as possible to be handled at the same time, and yet the equipment must be versatile enough to be able to handle many products without major alterations. Mangoes are processed at two stages of maturity. Green fruit that should be freshly picked from the tree is used to make chutney, pickles, curries and dehydrated products. Fruit that is bruised, damaged, or that has prematurely fallen to the ground should not be used. Ripe mangoes are processed as canned and frozen slices, nectar and various dried products. Mango has been grown in India since long and is considered to be king of fruits. Its mention has been made in Sanskrit literature as Amra. Mango has attained the status of the national fruit of India. The mangoes are not uniformly matured, therefore, sorting of mangoes into different varieties. In general, the color and size indicates the variety of mangoes. The sorting of mangoes using image processing techniques have been found increasingly useful in the fruit industry and is applicable in many application. Sorting of fruits according to maturity level is most important in deciding the market it can .In present common scenario, sorting and grading of fruit according to maturity level are performed manually before transportation. Grading based on geometry and shape is the two major parameters that consumers identify with the quality of mango fruit.

## II. LITERATURE SURVEY

[1] *Chandra Sekhar Nandi, Bipan Tudu, and Chiranjib Koley* ,A Machine Vision-Based Maturity Prediction System For Sorting Of harvested Mangoes in Instrumentation And Measurement, volume. 63,issue july 2014.This paper explains

about the prediction of maturity level has been performed from the video signal collected by the Charge Coupled Device (CCD) camera placed on the top of the conveyer belt carrying mangoes.

*[2] Neeraj Chauhan, Dr. Ashutosh Kumar Bhatt, Prof (Dr.) Rakesh Kumar Dwivedi*, Quality Testing and Grading Of Fruits Using Non destructive Techniques of Computer vision in 4th International Conference on System Modeling & Advancement in Research Trends (SMART) 2015. This paper explains about the quality testing and grading of fruits using non destructive techniques based on computer vision has been an important issue among researchers in computer, agricultural and food science.
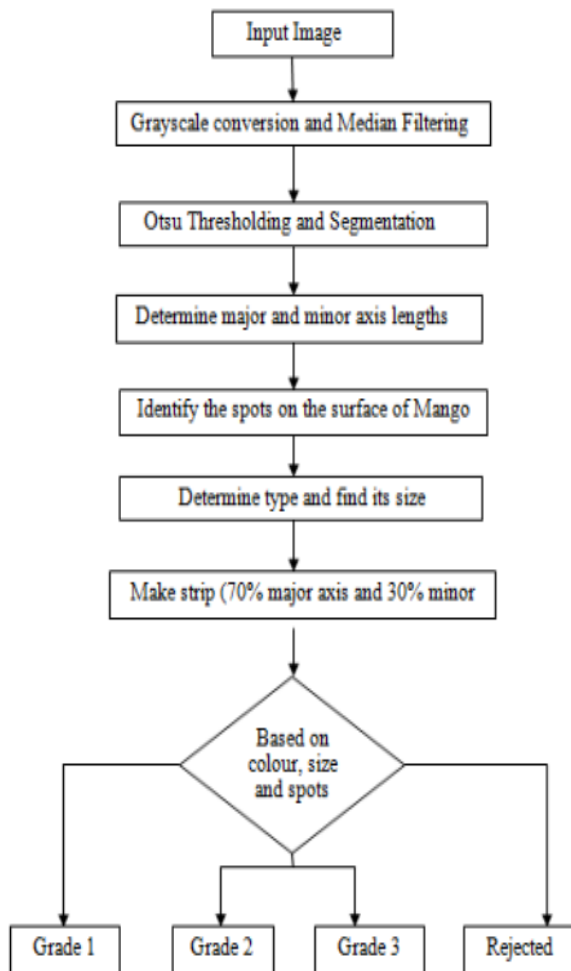
## III. PROPOSED METHOD



Figure 1: Flowchart of Whole Grading Process

### A. Collection of Samples

Due care should be given while choosing a cultivar for commercial use. As per the mango export business plan, there are near about 30 varieties of mangoes which are grown commercially for export business including Totapuri, Alphonso, Dashehri, Banganapalli, Kesar etc. Totapuri mangoes are the most exported mango of India with the value of USD 19504972 from January to April 2017. The Totapuri mango is medium in size and orange yellow in colour. It is soft, firm, fibreless and mid-season variety. Also some fruits of Banganapalli were taken. Both Totapuri and Banganapalli were used for consideration purpose.

### B. Image Acquisition

There are many methods of processing signals from the camera to access the properties of objects. Image processing process includes the image acquisition using the fixed camera placed above the conveyor which captures images with short scanning cycle. To increase the quality of images, the high resolution camera was equipped to collect the images (Cannon - EOS 600D-18 MP), position of the camera is very important, set the camera in the image acquisition chamber so that the field of view of the camera is wide enough and not impede the actuators during operation.

### C. Pre-Processing of Images

The images obtained during image acquisition is not directly suitable for the process of identification of fruits because of its poor resolution and unwanted background, noise, weather conditions, The sorting and grading performance of the system depends on the quality of the images captured by camera, since various measures/features calculated from the images of the mangoes will be used for sorting and grading. The mechanism for the image capturing is shown in Figure 2
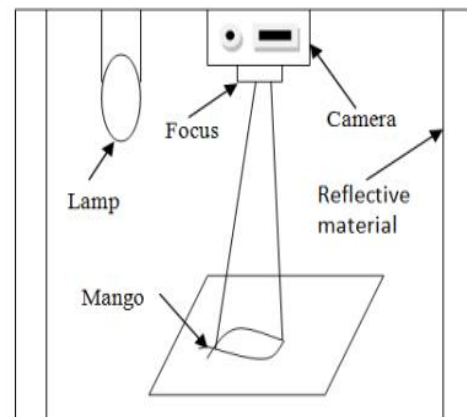


Figure 2: Setup for Image Acquisition

## IV. CLASSIFICATION USING ANFIS CLASSIFIER

An adaptive neuro –fuzzy inference system is a kind of artificial neural network. It integrates both  the principles of neural network and fuzzy logic .ANFISIS considered to be a universal estimator.

Artificial neural network (ANN) is a parallel-distributed information processing system. This system is composed of operations interconnected via one-way signal flow channels. ANN stores the samples with a distributed coding, thus forming a trainable nonlinear system. Adaptive Neuro-Fuzzy Inference System is a feed forward adaptive neural network which implies a fuzzy inference system through its structure and neurons. An adaptive neuro-Fuzzy Inference System (ANFI S) is a cross between an artificial neural network and a fuzzy inference system (FIS).

## V. RESULT

A modified dominant color feature extraction technique had been proposed. The results of the ANFIS system evaluated are against the human graders method to measure the accuracy for mango size. The proposed method has increased the accuracy of grading by as much as 93%. This shows that the grading system using ANFIS has a high potential of accurateness in grading the mango fruit. After the implementation of the algorithm, comparison of the two methods have been shown in the table 6.1

| Grade | Correctly classified samples | Total correct samples | Accuracy full mango |
|-------|------------------------------|-----------------------|---------------------|
| Grade 1 | 8 | 7 | 95 |
| Grade 2 | 11 | 14 | 86 |
| Grade 3 | 6 | 4 | 90 |

Table 1: Accuracy With the Proposed Method

## VI. CONCLUSION

Based on accuracy this proposed algorithm classified the mangoes into various grades .Focusing on the texture on the surface of the mango can also be used as a feature parameter for grading so that the overall accuracy can be improved.

## REFERENCES

[1]. Chandra Sekhar Nandi, Bipan Tudu, and Chiranjib Koley ,A Machine Vision-Based Maturity Prediction System For Sorting Of harvested Mangoes in Instrumentation And Measurement, volume. 63,issue july 2014.

[2]. Zalak R. Barot ,Narendra sinh Limbad ,An Approach For Detection And Classification Of Fruit Disease ,Volume 4 Issue 12, December 2015.

[3]. Neeraj Chauhan, Dr. Ashutosh Kumar Bhatt, Prof (Dr.) Rakesh Kumar Dwivedi, Quality Testing and Grading Of Fruits Using Non destructive Techniques of Computer vision in 4th International Conference on System Modeling & Advancement in Research Trends (SMART) 2015.

[4]. Trupen Meruliya, Pooja Kadam, Sapan Naik ,Image Processing For Fruit shape and Texture feature extraction in International Journal of Computer Applications Volume129 – No.8, November2015.

[5]. Hridkamol Biswas, Faisal Hossain, Automatic Vegetable Recognition System in International Journal of Engineering Science Invention ,Volume 2 Issue 4 April. 2013. 19.

[6]. Monika Jhuria, Ashwani Kumar, Rushikesh Borse, "Image processing for smart farming: Detection of disease and fruit grading," IEEE, Second International Conference on Image Processing, Shimla, pp 521 – 526, 2013.

[7]. Khoje S. and Bodhe S., "Comparative Performance Evaluation of Size Metrics and Classifiers in Computer Vision based Automatic Mango Grading", International Journal of Computer Applications ,vol. 61, no. 9, pp.1-7,2013.

[8]. J. B. Cunha, "Application of Image Processing Techniques in the Characterization of Plant Leafs," Proc. IEEE Intl' Symposium on Industrial Electronics, 2003.