

Chapter 25

A Novel Fuzzy Logic Classifier for Classification and Quality Measurement of Apple Fruit

Narendra Kumar Kamila
C. V. Raman College of Engineering, India

Pradeep Kumar Mallick
St. Peter's University, India

ABSTRACT

Fruit and vegetables market is getting highly selective and requiring their suppliers to distribute the fruits of high standards of quality and good appearance. So the growing need to supply quality fruits within a short period of time has given rise to development of Automated Grading of fresh market fruits. The objective of this chapter is to classify apples into three grades based on its attributes such as color, size and weight. Initially apple image database is created. Next each image is analyzed using image processing software where images are first preprocessed and useful features like color and size are extracted from the images. Fuzzy logic is used for classification. Color, size features are represented as a fuzzy variables which are used for classification. The apples of different classes are graded into three grades viz. Grade1, Grade2 and Grade3 on the basis of combination of parameters mentioned above.

1. INTRODUCTION

In agricultural industry the efficiency and the proper grading process are very important to increase the productivity. Currently, the agriculture industry has a better improvement, particularly in terms of sorting and grading of fruits, but the process is needed to be upgraded. Grading of the fruit is important to improve the quality of fruits. However, fruits grading by humans in agricultural area are inefficient, labor intensive and prone to errors. Automated grading system not only speeds up the time of the process but also minimize error. Therefore, there is a need of developing an efficient method for grading fruits and vegetables. In recent years, computer vision and image processing techniques have been found in-

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creasingly useful in the fruit industry, especially for applications in quality inspection and shape sorting. Computer vision is a novel technology for acquiring and analyzing an image of a real scene by computers to control machines or to process it. It includes capturing, processing and analyzing images to facilitate the objective and non-destructive assessment of visual quality characteristics in agricultural and food products. The techniques used in image analysis include image acquisition, image pre-processing and image interpretation, leading to quantification and classification of images and objects of interest within images. The overall appearance of fruit object is a combination of its chromatic attributes (color) and its geometric attributes (shape, size, texture), together with the presence of defects that can diminish the external quality (Khoje et. al. 2013). Thus automated fruit gradation plays an important role to increase the value of products. However, automatic fruit classification offers an additional benefit of reducing subjectiveness arising from human experts.

Grading systems give us many kinds of information such as size, color, shape, defect, and internal quality. Among these color, size, weight and texture are the most important features for accurate classification and/or sorting of fresh fruits such as oranges, apples, mangoes etc. Automatic grading system not only speeds up the process but also gives accurate results. Therefore, it needs to develop an efficient fruits grading or classification methods.

Traditionally, classification and grading is performed based on observations through experience. Many new agricultural automation technologies are being developed by university researchers that pose questions about the efficiency and effectiveness with which we carry out grading system practically (Naganur et al. 2012). This has given rise to new avenues to study how to classify and grade fruits and vegetables accurately without loss of generality. Classification is also vital for the evaluation of agricultural product. However, fruit size is the most important physical property while color resembles visual property. Thus classification of fruits is necessary in evaluating agricultural product meeting quality standards and increasing market value. The laborers classify fruits and vegetables based on color, size, etc. manually which is error prone. If these quality measures are mapped into automated systems, then process of classification and grading would be faster and error free. Moreover, manual grading is an expensive and time consuming process and even the operation is affected due to non-availability of labors during peak seasons. The development of graders dated back to five decades ago and the first grader designed was simply a crude slat with a hag attached to the end (Lodhe et al, 2013). Products were inspected on the slat and moved by hand into the bag. These were called slat graders, which led to development of mechanical graders. Grading has been changed very little in the last fifty years. However, the grading process has been fully mechanized. A mechanical grader consisted of a chain conveyor belt, with a bag at the end. Smaller produce fell through the chain, making the grading process easier. Indian grading is still being done by hand. Labor shortages and a lack of overall consistency in the process resulted in a search for automated solutions. In vegetable grading, the need to be responsive to market demand places a greater emphasis on quality assessment resulting in the greater need for improved and more accurate grading and sorting practices. Size variation in vegetables like potatoes, onions provided a base for grading them in different categories. Every vegetable producing country had made their own standards of different grades keeping in view the market requirements.

This automated system is designed to overcome the problems of manual techniques. The image could be captured using a regular digital camera or high resolution mobile phone camera. This image is given as an input to the system for obtaining the fruit's features. The system consists of several steps like feature extraction, texture analysis, sorting and grading.

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