

# Survey on Apple Fruit Varieties and classifications

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## Abstract

In a manual sorting of apple fruit varieties results to high cost, subjectivity and inconsistency associated with human beings. It has some methodology like image acquisition, pre processing, segmentation and analysis. The golden delicious apples will be used fuzzy logic for the decision support system to a grade. While in a features such as a color and size will be measured in a data acquisition system consists of apple sorter, webcam and pc. Suppose it has 250 apples means it will be investigated in five different sets or grades ranging like very bad to very good.

## Keywords

Sorting, fruit, apple, RGB, image, pixels, naive bayes, fuzzy logic, good, average, bad, color and harvest

## Introduction

In the world Apple fruit is one of most commonly used consumed product. It has a production estimated around 75 millions of tons according in agriculture organization status[1]. It has an important agriculture commodity for the global market in fresh products. The apples will be depends on external characteristics like color, size, surface texture and internal parameters such as a sweetness, acidity, firmness and tissue texture[1].

The apple produce dealers have a warehouses. That it will be used for store different varieties of apple fruits. It will be easily mixed with varieties during in the harvesting, storage and marketing.

It will be classified for the evaluation of agriculture produce[2]. It has a high cost, subjectivity and inconsistency

to manual sorting will be forcing to the harvest industry for the apple automation in sorting operations.

## Methodology

### Sample

In that experiment apple varieties included golden delicious, honey crisp and pink lady will be brought in local market[3].

In the method it has presented color and size features which will be extracted from Apple images will be used to inputs for the classification into naive bayes algorithm.

### Image acquisition

In this preparation process to obtain the apple varieties images. It has a 150 RGB color images of apple varieties were captured using by a phone camera[4]. And then images will be cropped into smaller images and stored in a JPG format.

### Image segmentation & pre processing

In the classification and grading it will be have a raw data were subjected to several preliminary processing steps for making fictional to the descriptive stages[5]. This methods will be used to converting for the RGB to grayscale images and filtering images will be removed the noise.

#### Converting RGB to grayscale

In this segmentation it has preprocessing task for the initial stages before the image used for the next process. In a main objective the Process will be obtain the binary image[5]. It will be based on the lowest point between two classes of the histogram between class variance.

### Filtering

The filter process will be used for removing noise. In an average filter, the mean of the gray scale values within a rectangular filter window surrounding each pixel [6]. This will be effective for smoothing an image. It can be calculated to the filtered pixel by using an equation like

$$r = a_1 + a_2 + \dots + a_9 / 9$$

### Naive Bayes

In a Naive Bayes classifier, it has a probabilistic classifier considering naive will be strong Independence assumption. It will be assumed that the effect of a variable value to give a class of the independent values for another variable. This type of assumption will be also called as class conditional independence [1]. This will be particularly suited to the high dimensionality for the inputs. The naive Bayes will be used to create models to the predictive capabilities.

Probability = probability A and B / probability.

In golden delicious apples will be based on their color and size using fuzzy logic [2]

### Methods and materials

The fuzzy system for apple grading will be good to bad Apple's RGB Colors and size. In an input data are obtained by a camera.

While in a Fuzzy logic starts from the concept of fuzzy sets, it will contain elements with only a partial degree of membership

$$D = \{ (x, \mu_D(x)) \mid x \in X \}$$

$\mu_D(x) \in [0, 1]$  it is the membership function (M) of fuzzy set D, X is the universal set, x is an element in X, D is a fuzzy subset in X. The Degree of membership (DoM) for any set ranges from 0 to 1. A value of 1 represents 100% membership, while a value of 0 means 0% membership. If there is 5 subgroups of size, then 5 membership functions are required to express the size values in fuzzy rules.

In MF is a curve that defines how each point in the input space is mapped to a membership value (or DoM) between 0 and 1. In an input space is sometimes referred to as the universe of discourse (UoD). The MFs will be usually defined to inputs and output in terms of linguistic variables.

In a fuzzy rules, it has five MFs: it will be Very Low (0 - 25), Low (25 - 50), Normal (50 - 75), High (75 - 90) and Very High (90 - 100) in % for the color and five MFs: it will be Very Small (0 - 45), Small (45 - 55), Normal (55 - 65), Large (65 - 80) and Very Large (80 - 100) in mm for the sizes (length & width) were selected. The totally, 125 (= 5<sup>3</sup>) if-then rules with logical operator of "AND" were used. It has five MFs like Very Bad (60 - 140), Bad (140 - 180), Normal (180 - 220), Good (220 - 260) and Very Good (260 - 290) (data are unitless), the output variable were selected to express grades of apples. These are the rules that have a general agreement with that human expert.

For example, the 11 rules that define the "Very Good" grade of apples like

R1: If a Color is Very High and Height is Very Large and Width is Very Large then Grade is Very Good

R2: If a Color is Very High and Height is Very Large and Width is Large then Grade is Very Good

R3: If a Color is Very High and Height is Very Large and Width is Normal then Grade is Very Good

R4: If a Color is Very High and Height is Large and Width is Very Large then Grade is Very Good

R5: If a Color is Very High and Height is Large and Width is Large then Grade is Very Good

R6: If Color is Very High and Height is Normal and Width is Very Large then Grade is Very Good

R7: If a Color is High and Height is Very Large and Width is Very Large then Grade is Very Good

R8: If a Color is High and Height is Very Large and Width is Large then Grade is Very Good

R9: If a Color is High and Height is Very Large and Width is Normal then Grade is Very Good R10: If a Color is High and Height is Large and Width is Very Large then Grade is Very Good R11: If a Color is High and Height is Normal and Width is Very Large then Grade is Very Good Where "High", "Very High", "Normal", "Large", etc. They are the linguistic variables (MFs) in the universal set. "Grade" is the apple grade (or output variable). In the Height and Width in the above rules are the major and minor diameters (sizes) of each apple, respectively. Finally Color is a indication to the overall RGB content of each apple. It is calculated from the following equation:

$$\text{Color} = \frac{R}{R+G+B} \times 100$$

R, G and B are the red, green and blue content of each pixel to RGB color space. It has a Spectral components in these primary colors combine additively to produce a resultant color. In a overall color of each apple is then determined by averaging over all pixels. Since the decisions are based on the testing of all of the rules in the FIS, rules must be combined in some manner in order to make a decision. The Aggregation is the process to the fuzzy sets that represent the outputs of each rule are combined into a single fuzzy set. In a Aggregation only it occurs once for a each output variable, just prior to the fifth and final step, defuzzification. To input of the aggregation process is the list of truncated output functions returned by the implication process for each rule. For output it will be aggregation process in one fuzzy set for each output variable.

### Apple fruit description

In a Fruit and foliage are two main components of the apple tree canopy. Based on the images of the apple tree canopy, the fruit number (FN) and the fruit area (FA) are the first two essential features for yield prediction[7]. While a third feature to the area for the apple clusters (FCA), because apple clusters are a conspicuous characteristic

of canopy structure, which can be comprised of more than two apples. It will be Compared with a pixel proportion of the bright red calibration sphere which was size range for a apple fruit in period 1, if the fruit domain exceeded in the size to the calibration sphere by a 3-fold, it was assumed to be an apple cluster. Since the leaves can impact apple Fruit and foliage are two main components of the apple tree canopy[7]. Based on a images to the apple tree canopy, the fruit number (FN) and the fruit area (FA) are the first two essential features for yield prediction. While third feature for the area of the apple clusters (FCA) in the image, because apple clusters are a conspicuous characteristic of canopy structure, which can be comprised of more than two apples. Compared with a pixel proportion to the bright red calibration sphere, which was of the size range for an apple fruit in period 1, it was assumed to be an apple cluster. Since in the leaves can be impact apple yield estimation by occluding fruit, foliage area (LA) is the fourth one. As we can consider the FA, FN, LA, and FCA extracted from canopy images as essential parameters for yield prediction [5], we converted them to the ratios F1, F2, F3 and F4. These ratios were subsequently employed for modelling and the different steps in the modelling process[8]. Outline of the processing steps. In a yield estimation by occluding fruit, foliage area (LA) is the fourth one. As we can consider the FA, FN, LA, and FCA extracted from canopy images as essential parameters for a yield prediction, we converted them to the ratios F1, F2, F3 and F4. These ratios were subsequently employed for modelling and the different steps in the modelling process.

IA- sum of a pixels of the whole images

FA- sum of a pixels belonging to apple fruits

FN- number of a fruit

FCA- sum of a pixels belonging to apple cluster

F1- FA/IA

F2-FN/200

F3-(FA-FCA)/IA

F4-LA/IA

### Conclusion

The apple classification system prototype using by a image processing technique and naive Bayes algorithm. In the apple it has three varieties Like honey, crisp, golden delicious and pink lady. It will shows the averaged values of the estimated accuracy, sensitivity and precision. The fuzzy logic is successfully applied to a serve as a decision support technique in grading golden delicious apples. In a grading results it will be obtained from fuzzy logic shows a very good general agreement with the results from the human expert. The selection of Colorado and two perpendicular diameters (size) of apples are 3 important criteria in apple grading.

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