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Food (fruit) Quality Recognition by External Appearance and Internal Flavor Factors

Deepak Khot[1], Prof. Dr, M. Sankar[2]

[1]PG Student, Department of ENTC, AMGOI Wathar, Lonere, Maharashtra, India.
[2]Professor, Department of ENTC, AMGOI Wathar, Lonere, Maharashtra, India.

Abstract - *The quality of the fruits is important for the consumers and become the requirement rom the suppliers to provide fruits with high standards quality. So, in the past few years, fruit grading systems have established to fulfill the needs of the fruit processing industry inspection. Besides that, the process of fruits involves several steps that can generally be classified into grading, sorting, packaging, transporting and storage. The grading are considered as the most important steps towards the high standard of quality. Fruits are almost graded the fruit grading by visual inspection suffers from the problem of inconsistency in judgment by different persons. There is a need for an automatic fruit classification machine replacing the expensive human labor with a smart fruit quality classification system. This study proposed a practical real-time smart fruits quality grading system classifying by appearance and internal flavor factors in order to decrease human labor cost in fruit industry. The proposed system applies color image processing techniques for the computation of the fruits appearance features and the near-infrared spectroscopy analysis methods for the estimation of internal flavor factors. This study also suggests an artificial neural network model in order to be able to classify fruit grading.*

Key Words: MATLAB, fruit quality, image processing, ANN,

1. INTRODUCTION

The manual fruit grading by visual inspection is employment intensive, time unbearable and suffers from the difficulty of inconsistency in judgment by different persons. Currently, cheap labor is mostly unavailable in many country orchards and fruit farms. There is a need for an automatic fruit classification machine replacing the expensive human labor with the real-time smart fruit quality classification system. However, it is very difficult to determine the quality classification of a variety of fruits using the nondestructive technology in real time. There are numerous issues that need to be considered in fruit grading. Appearance features including size, weight, volume, shape, color, and outside defects are very important factors for fruit quality grading. Internal flavor factors such as sweetness, bitterness, acidity, saltiness, and moisture and texture of fruit such as hardness, crispness and nutrients also seriously affect fruit grading.

The previous system has the disadvantage of time consuming, low efficient, having low speed and high cost. To overwhelmed this problem currently automatic food/fruit grading, quality detection, size detection and prediction is done using image processing and using Naïve Bayes algorithm. Advantage of this system is its speed is faster than previous techniques, having low cost, and it is easy to operate.

The proposed system applies color image processing techniques for the computation of the fruits appearance features and the near-infrared spectroscopy analysis methods for the estimation of internal flavor factors. This study also suggests an artificial neural network model in order to be able to classify fruit grading. It has achieved the classification accuracy rate of 97.4% in reference experiment.

1.1 The maturity of fruits is defined as following parameters:

a) Color: Verities of fruits having different color. It measures fruit in various classes that is dark, medium, light green color of fruits.

b) Size: It measures diameter, size by (x,y) coordinators. Fruits size is determined by maximum diameter of fruits. It will be measured as center of the origin.

c)Shape: It will be measured for aspect ratio, roundness of the fruit.

d)Data: Some fruit images have been collected for fruits quality System. These fruit images will be classified into high quality, medium quality and low quality of fruit. Fruit images are required to be sent in and processed by the system when develop the classification algorithm for the fruits quality system. RGB Values for every fruits pixel computed by using mean function provided.

1.2 Objectives

- Time and Effort saving of grading.
- Increase Reliability Compared to Manual Grading.
- Grading Based on External Quality Factor.
- Better Accuracy than manual Sorting.

2. PREVIOUS WORK DONE

An automatic fruit grading system was developed. This system consists of mechanical part such as rotating desk that act as a place for inspection; electrical parts such as DC motor, Arduino, computer and software such as image processing in MATLAB. This automatic grading system has been designed to meet the demands in grading fruits operation compared to manual grading. The grading of the fruits is based on the external quality factor based on surface defect and decay. This automatic inspection system has saved time, effort and better accuracy than manual sorting. This system starts with a DC motor that is programmed by Arduino to rotate 180° twice for each of the fruit. If there is a defect on the inspected surface of fruit, a red circle will appear around the defect at the analyzed image. The other parameters such as size, shape should also be included in this project in future research. These parameters will play valuable role for quality analysis process. In addition, since there will have some kind of fruits with same color such as tomato and apple, so, there will be having some misclassification. Hence one feature can be added also namely texture while classifying such kinds of fruits.

The manual fruit grading by visual inspection suffered from the problem of inconsistency in judgment by different persons. We need for an automatic fruit classification machine replacing the expensive human labor with a smart fruit quality classification system. This study proposed a practical real-time smart fruits quality grading system classifying by appearance and internal flavor factors in order to decrease human labor cost in fruit industry. The proposed system applied color image processing techniques for the computation of the fruits shape features and the near-infrared spectroscopy analysis methods for the estimation of internal flavor factors. The proposed system computed and estimated automatically weight, long axis, short axis, volume, sweetness, acidity, hardness, and moisture of a fruit. This study suggested an artificial neural network model in order to be able to classify fruit grading. It had achieved the classification accuracy rate of 97.4% in our experiment. If the proposed system is commercialized, it will improve the efficiency of the production and decrease the production cost by eliminating the labor-intensive process of manual fruit sorting.

The proposed background subtraction algorithm, mainly based on Otsu's thresholding and Convex Hull active contours can be successfully applied for continuous visual inspection during long term food storage in container. The standard deviation of the segmented sample did not exceed 22% of the average segment area, and 7% of average segment perimeter length when operating on 940 nm key wavelength LED illumination.

An application of infrared LED illumination decreases the variations of background subtraction results when the shape and shading effects changes over time. The detected contours allows the further analysis for the food quality identification.

Image processing has a very important phase termed as image segmentation. Under image processing, a digital image is divided into several areas. The concerned region being refined for the duration of the examination phase of that object by removing the background. For the extraction of the local features of fruits, speeded up robust feature technique is used. Subtraction of the input image and the classified image based on fruit quality is classified. Out of the many segmentation techniques, the most widely used are thresholding and clustering. The separation of the digital picture into various regions based on gray level of images makes it simpler. The two classes of pixel characterization in thresholding are region of interest (pixels having different gray level) and background area(pixels with same gray level).Separation of diverse area based on its resemblance without prior information is done. routinely, leading to the processing of gray level image, while the method is involving the extra time for the computation for identification of the most favourable threshold value of images with a huge figure of clusters. In present, containing one item each. It is a process of cluster analysis, seeking to partition 'n' observation into 'k' clusters, each observation belonging to a cluster with the nearest mean. In Fuzzy C-means (FCM) method data items are classified into various clusters automatically and accurately. Implementation and effectiveness for segmentation of images under controlled environment makes this method much more effective. Quality of segmented images is affected by brightness intensity of the images. Extraction of the neighboring characteristics of fruits and its descriptions can be done by a speeded up robust technique. Fruit quality is revealed when the input image is subtracted with the blemish classified image. Ocular properties, electrical properties and computed tomography determine the fruit quality. The Watershed method performs the gray-scale image transformation. The image to be operated like a topographic map, where height is represented by brightness of each point. The result is converted to graph display using hierarchical watershed segmentation. MATLAB programming can be used as a tool to locate the fruit quality and to distinguish it further. For the packaging, marketing and transportation operations, fruit size estimation is crucial. Partioning of an image is done by thresholding technique. This method proves to be effective for segmentation if one can identify, or "mark" foreground objects and background locations. In graphs, nodes on the edges are represented, by the watershed lines, or by the hybrid lines present on both nodes and edges. In Texture method, when an element or pattern on a surface is repeated on a regular basis, it is termed as Texture. Texture being the most crucial attribute, in many image analysis and computer vision analysis. The procedures are further divided into structural approach, model based approach, statistical approach and filter based approach. In this paper various 2017 6th International Conference on Reliability, Info com Technologies and Optimization (ICRITO) (Trends and Future

Directions), Sep. 20-22, 2017, AIIT, Amity University Uttar Pradesh, Noida, India 605 methods of segmentation namely Otsu, K-means, Texture filter and Watershed have been used and the corresponding detection of blemishes of the apple has been observed. The performance by four segmentation methods namely Otsu, K-means, FCM, and TsKNM has been evaluated. Steps involved were Image Acquisition, Image Pre-processing, Image- Segmentation In section II, the work which has previously been done is specified in detail. Furthermore, in section III, methodology along with the mathematical equations is shown. The result is shown in section IV. And in next section the research is concluded and discussed in details.

2.1 Problem Statement

Now a days, automatic visual inspection technique has become more important and potential for fruit grading applications. This is due to that the quality of fruits are the important factor for the consumer and so essential for marketing a uniform high quality products. The automation in fruits grading technique have been set up to replace the manual technique, improve fruit quality and reduce the production costs for grading of fruits as manual examination is facing difficulties in maintaining its uniformity and consistency.

3. PROPOSED SYSTEM

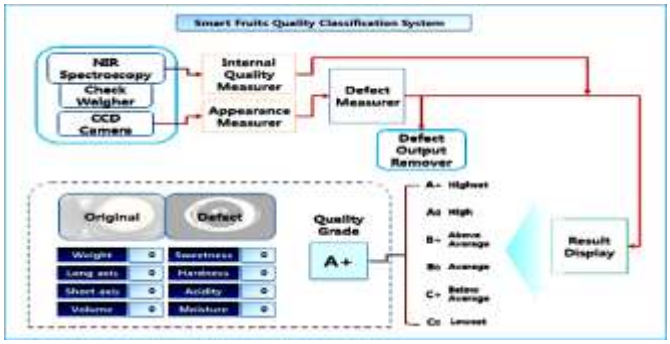

Fig1. A schematic design diagram of the smart fruits quality grading system.

Design architecture of the smart fruits quality classification system is shown in Figure 1. In this study, the designed system was configured to a model of quality grading system for Korean pear. Design components of the fruit quality grading system are described in Figure 1. The weight checker measures the weight of a fruit which is placed on the cup of the This work was supported by Technology Transfer Business R&D funded at the INNOPOLIS Foundation in 2017, automatic conveyer system. The CCD camera takes a fruit picture for processing the color fruit image. This fruit color image is used for the preprocessing, segmentation for defects detection, feature extraction, and fruit image analysis. The near-infrared(NIR) spectroscopy is used for measuring the internal qualities of the fruits such as sweetness, acidity, hardness, and moisture of the fruit. Figure 1. A schematic design diagram of the real-time smart fruits quality grading system some of the known flavor factors useful for pear classification are sweetness, hardness, and moisture. In our designed system, the spectrum range of the NIR wavelength is applied in 400~1100 nm. The data controller is used for the initialization of the system hardware components such as CCD camera sensor, NIR spectroscopy sensor, weight checker calibration, initial values of the LCD display, moving speed of the conveyed system, and the number of fruit grading channel connected in the automatic conveyer system. The LCD display resents all measured values of the fruit external shape, NIR spectroscopy analysis values, along with the original fruit image, preprocessed fruit image, and the final value for fruit grading.

4. CONCLUSION

The manual fruit grading by visual inspection suffered from the problem of inconsistency in judgment by different persons. We need for an automatic fruit classification machine replacing the expensive human labor with a smart fruit quality classification system. This study proposed a practical real-time smart fruits quality grading system classifying by appearance and internal flavor factors in order to decrease human labor cost in fruit industry.

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