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Fruit Quality Assessment Techniques: A Review

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Abstract: The technique used for the improvement of unprocessed or raw pictures is known as image processing. The raw images or pictures can be obtained from the cameras deployed on aircrafts, space shuttle, satellites or the images captured in daily routine for numerous objectives. A number of image processing methods have been developed in the last few years. The fruit quality assessment is the application of image processing and machine learning. The fruit quality assessment techniques have various phases like pre-processing, segmentation and classification. In this paper, various fruit quality assessment techniques are reviewed in terms of certain parameters
Keywords: Quality assessment, Segmentation, Classification

Introduction

The technique used for the improvement of unprocessed or raw pictures is known as image processing. The raw images or pictures can be obtained from the cameras deployed on aircrafts, space shuttle, satellites or the images captured in daily routine for numerous objectives. A number of image processing methods have been developed in the last few years [1]. Various approaches explored for image processing are acquired from armed forces' scouting flights, interplanetary explorers and rockets. Some factors like effortless accessibility of prevailing personnel processors, big dimensional reminiscence equipments, and graphic software etc play a fundamental role in the popularity of image processing techniques. This technique finds its usefulness in various areas like publishing business; article dispensation, armed forces, forensic Studies, explicit sculptures, film business, non-destructive assessment, fabric discipline and medical Imaging. Image scanning, image storing, image improvement and image elucidation are the general phases involved in image or picture processing. The image processing is mainly of two types [2]. These types are analog image processing and digital image processing. In analog picture processing, electrical methods are used to alter the picture. Different kinds of picture processing methods have been implemented in the last few years for analyzing the farming pictures like vegetables and fruits for acknowledgment and categorization causes. The scheme of fruit detection can be implemented in the form of picture text describer. This scheme comprises ability for the description of low level image characteristics or fruit picture's contents. A number of techniques have been proposed for the detection and categorization of fruit pictures on the basis of color and shapes. The color and texture of various fruits depends on their growth. Color and texture are considered the primary quality of natural descriptions [3]. These factor also a play a significant character in image acuity. Though, dissimilar fruit images can have alike or equal color and shape standards. Therefore, color or shape characteristics scrutiny techniques are not vigorous and adequately

efficient for the identification and differentiation of fruits descriptions. The fruit detection scheme may be implemented for educational reasons in order to enhance knowledge, particularly for little children and down disease patients, of fruits prototype detection on the basis of fruit detection outcomes [4]. The scheme of fruit recognition can also be implemented in grocery stores so that consumers can tag their purchase with the help of computerized fruit detection system. Numerous issues have to be conquered for enabling the scheme to execute computerized detection of the type of fruit or vegetable with the help of pictures taken from the camera. In a fruit recognition system, certain factors like unsure and erratic brightness circumstances in the field surroundings, uneven and multifaceted awning configurations and unreliable shade, figure and dimension of the fruit affects the accurateness of fruit identification and localization. Also, some barriers like leaves, twigs, and other fruits also restrict the precision of fruit recognition in awning pictures [5]. Various researches have been conducted in the last few years for the recognition of fruits in alike external atmosphere. There are various steps followed in this method:

a. Image Acquisition: The main objective of image acquisition is the transformation of a visual picture into a group of arithmetical information. This data or information can be operated on a processor. The picture captured by a camera should be transformed into a convenient unit before the commencement of any video or picture processing. Mainly three stages are included in image acquisition procedure.

b. Image Processing: The second step in fruit recognition system is image processing. The technique used for the improvement of unprocessed or raw pictures is known as image processing. Some examples of image processing are conversion of HIS/HSV color space, histogram equalization and color difference. For the processing of color hallucination RGB or HSV color space is used. HSV color space explains color or shades by the ratio of red, green, and blue colors. This color space explains the color by means of value, hue and saturation. Histogram equalization is considered a non linear structure. Histogram equalization performs the redistribution of pixel value to maintain the similar amount of pixels for every value in an array [6].

c. Fruit Segmentation: The picture is divided into several regions of analogous qualities with the help of image segmentation. In the fruit grading system, picture segmentation plays a significant part. Image segmentation techniques imitate the capabilities of persons in the detection of entities in daily life. Also, image segmentation suggests non-destructive technique for the classification of entities and fabricates additional constant outcomes.

d. Noise Filtering: The probabilities of image dilapidation occur during the transmission of picture for picture processing operations. This degradation may be in the form of unwanted noise. Gaussian, salt & pepper, speckle, poison etc are some kinds of noises. In image processing, noise filtration is considered a fundamental task [7]. Diverse kind of noises makes the picture imperfect and cause barrier in different image or picture processing operations. For the removal of speckles or to make the picture crystal clear, different kind of linear and non-linear filters are utilized.

e. Image classification: Various techniques are used for image classification. These techniques are described below:

i. K-means clustering: K-means clustering is considered an inclusive unsupervised classification method [8]. As a learning algorithm, K-means clustering divides the key information sample into dissimilar clusters on the basis of their intrinsic detachment amid one another. This approach also reduces the sum of distance amid entities and particular cluster hubs. This approach causes the movement of entities amid clusters till the minimization of sum. Therefore, this approach is considered iterative.

ii. Bayesian classifier: This classifier is considered a probabilistic classifier which relies on Bayes' theorem. This approach creates arithmetical explanation on the basis of previous information and possibility allocations. Several factors like minimization of Bayes risk, minimization of probability error, or maximization of posteriori probability are the base of Bayesian classifier approach. The Bayesian classifier uses a priori prospect for the classification of oranges on the basis of color information. In this approach, mean and covariance values of red, green, blue (RGB) colors and backdrop pixels are used for classification [9].

iii. KNN clustering: As a supervised learning method, KNN clustering is extensively utilized in categorization and deterioration phenomena [10]. This approach is utilized for the classification of unidentified characteristic vector to the level which consist most frequent assets amid its K nearest neighbor with the help of accessible training sets. For classification purpose, various K number of nearest neighbor is utilized. A number of investigators have used and are using KNN clustering approach for the classification of oranges.

Literature Review

Jyoti Jhawar, et.al (2016) proposed an investigative study for automatic ranking of Oranges with the help of prototype detection methods implemented on fruit's sole shade picture [11]. This study was implemented on 160 Orange fruits gathered from diverse biological places. The intended approach could classify the orange fruit from this area in an automatic manner. The single color image was provided with a resolution of 640 × 480 pixels. A particular box intended with 430 lox brightness intensity was used for the storage. It was identified that Linear Regression based method could forecast the maturity of the unknown orange fruit in an explicit manner and also enabled the categorization into numerous modules with preferred lifetime. The tested outcomes indicated an achievement range of 90 and 98 percent.

Ab Razak Mansor, et.al (2016) presented that fruit size is one of the most important criteria for classification and grading of mangoes [12]. Currently, the size of a mango is determined by weight. In this project, a new model for classifying mango size using RGB color sensor and fuzzy logic are designed as an alternative automated grading of fruit size based on weight. RGB color sensor was used to measure the dimensions of mango such as major length, width and height in terms of reference color intensity value. Then, the fuzzy logic was used to classify mango size into small, medium, and large size. The proposed model is able to distinguish the three different classes of mango size automatically with more than 85 % accuracy.

Thendral Ravi et.al (2016) proposed a novel approach for the improvement of a real-time computerized vision based model for automatic orange fruit peel defect detection. In this paper at first, different filtering methods and wavelet based method has been used to denoise the given input image and performs their comparative study [3]. Based on this study, the wavelet based approach is used for smoothening of the images together with removing the higher energy regions in an image for better defect detection as well as makes the defects more retrievable. Finally, orange fruit skin color defects are identified by using RGB and HSI color spaces. The experimental test results indicate that the designed algorithm is scalable, computationally effective and robust for identification of orange fruit surface defects.

Payman Moallem, et.al (2016) projected a novel approach named as computer vision-based algorithm for the scoring of golden tasty apples [14]. The proposed approach was implemented in six phases. In the first phase, Non-apple pixels in the form of backdrop were detached from key descriptions. An amalgamation of morphological techniques and Mahalanobis remote classifier was used for the recognition of twig end point. For the refining and marking of apples, stem end and calyx areas were detached from faulty areas. For the evaluation of apple scoring, a comparison between different classification techniques was conducted. The tested results depicted that the SVM approach performed well with an recognition rate of 92.5% and 89.2% for normal and faulty apples in comparison with various others classification approaches

M.M. Sofu, et.al (2016) proposed a novel robotic apple sorting and quality inspection system on the basis of concurrent dispensation [15]. Different factors like shade, dimension and mass were used for used for the classification of Golden and Starking Delicious and Granny Smith apple cultivars. The fruits affected by coating, blemishing and rotting were also recognized by this approach. A combination of roller, transporter, class carrier's device visional enclosed cabin, and load cell and control panel units was implemented in the projected scheme. With the help of picture processing software, four descriptions of any apple undulating on the carrier could be incarcerated and practiced in merely 0.52 second. The scheme plan was experienced with the help of three dissimilar carrier group paces. The proposed approach showed the accuracy rate of 73–96% for the sorting and inspection of apples.

Segun Emmanuel Adebayo, et.al (2016) presented a detailed analysis of banana optical properties' latent [16]. In order to predict the quality attributes of fruits, several factors like amalgamation, abridged dispersion and efficient reduction coefficients retrieved from backscattered images were captured at five dissimilar wavelengths of 532, 660, 785, 830, and

1060 nm. A very strong association was found amid analyzed optical properties and the banana maturing phases at different wavelengths. A pessimistic association was shown by amalgamation and efficient reduction during growing phases. The maximum classification accuracy of 97.53% was given by the noticeable wavelength region in order to classify the banana ripening stages. The proposed work also demonstrated that visual assets of banana may be utilized for non-destructive forecasting and categorization of banana maturing phases.

Dian Rong, Xiuqin Rao et.al (2017) proposed a novel segmentation approach named as sliding comparison window local segmentation algorithm [17]. A comprehensive picture processing method involving local segmentation with the help of picture binarization, picture diminution, picture morphological alteration, elimination of stem end pixels and elimination of backdrop pixels was projected to detect the façade imperfection in a orange gray level picture. This approach was an authentic addition which permitted the flourishing sectioning of different kinds of surface imperfections like thrips scarring, scale infestation, copper burn, dehiscent fruit, and wind scarring and so on. Total 1191 orange samples were tested for the demonstration of proposed approach performance. The tested results depicted that the projected approach accurately detected the ninety seven percent of the rotten oranges. Entire surface and speedy on-line assessment will be carried out in future.

Asutosh Mohapatraa, et.al (2017) proposed a novel scheme named as dielectric properties measurement scheme for measuring the alteration of red banana's dielectric aspects [18]. The measurement was performed at dissimilar maturing temperatures throughout the ripening procedure. During ripening treatment, capability of proposed scheme was utilized for the forecasting of bananas maturity evaluation. The experimental outcomes depicted that the proposed approach was capable for the estimation of bananas' quality parameter alterations in maturing phase. FCM clustering technique depicted superior outcomes for classification during image processing. In future, the main focus of researchers will be on the development of a more reliable banana's quality forecasting model during the banana ripening procedure.

Table of Comparison

Authors Names	Year	Description	Outcomes
Jyoti Jhawar,	2016	An investigative study was proposed for automatic ranking of Oranges with the help of prototype detection methods implemented on fruit's sole shade picture	The tested outcomes indicated an achievement range of 90 and 98 percent.
Ab Razak Mansor	2016	In this project, a new model for classifying mango size using RGB color sensor and fuzzy logic are designed as an alternative automated grading of fruit size based on weight.	The proposed model is able to distinguish the three different classes of mango size automatically with more than 85 % accuracy.
Thendral Ravi	2016	A novel approach was proposed for the improvement of a real-time computerized vision based model for automatic orange fruit peel defect detection.	The experimental test results indicate that the designed algorithm is scalable, computationally effective and robust for identification of orange fruit surface defects.
Payman Moallem,	2016	A novel approach named as computer vision-based algorithm was proposed for the scoring of golden tasty apples.	The tested results depicted that the SVM approach performed well with an recognition rate of 92.5% and 89.2% for normal and faulty apples in comparison with various others classification approaches
M.M. Sofu,	2016	A novel robotic apple sorting and quality inspection system was proposed on the basis of concurrent dispensation.	The proposed approach showed the accuracy rate of 73–96% for the sorting and inspection of apples.
Segun Emmanuel Adebayo,	2016	In order to predict the quality attributes of fruits, several factors like amalgamation, abridged dispersion and efficient reduction coefficients retrieved from backscattered images were captured at five dissimilar wavelengths of 532, 660, 785, 830, and 1060 nm.	The maximum classification accuracy of 97.53% was given by the noticeable wavelength region in order to classify the banana ripening stages.

Dian Rong, Xiuqin Rao	2017	A novel segmentation approach named as sliding comparison window local segmentation algorithm was proposed.	The tested results depicted that the projected approach accurately detected the ninety seven percent of the rotten oranges.
Asutosh Mohapatraa,	2017	A novel scheme named as dielectric properties measurement scheme was proposed for measuring the alteration of red banana's dielectric aspects.	The experimental outcomes depicted that the proposed approach was capable for the estimation of bananas' quality parameter alterations in maturing phase. FCM clustering technique depicted superior outcomes for classification during image processing.

Conclusion

In this paper, it is concluded image processing is the approach which can process the information stored in the form of pixels. The quality assessment is the application of image processing and machine learning. In the paper, various technique are reviewed which are proposed previously for the quality assessment. It is analyzed that classification techniques are best performing techniques for the fruit quality assessment. In future novel classification method will be designed for the quality assessment of fruits

References

[1] M.A. Momin, M.T. Rahman , M.S. Sultana , C. Igathinathane , A.T.M. Ziauddin , T.E. Grift, "Geometry-based mass grading of mango fruits using image processing", Information Processing in Agriculture 4 (2017) 150-160.

[2] Kaveh Mollazade, Arman Arefi, "Optical analysis using monochromatic imaging-based spatially-resolved technique capable of detecting mealiness in apple fruit", Scientia Horticulturae 225(2017) 589-598.

[3] Yue Wang, Jun Luo, Qiaohua Wang, Ruifang Zhai, Hui Peng, Liang Wu, and Yuhua Zong, "Automatic Color Detection of Grape Based on Vision Computing Method", Springer International Publishing AG,vol.541,(2017).

[4] Dian Rong, Yibin Ying, Xiuqin Rao, "Embedded vision detection of defective orange by fast adaptive lightness correction algorithm", Computers and Electronics in Agriculture 138(2017) 48-59.

[5] Lorenzo A. Saraiva, Florence P. Castelan, Bruna L. Gomes, Eduardo Purgatto, Beatriz R. Cordenunsi-Lysenko, "Thap Maeo bananas: Fast ripening and full ethylene perception at low doses", Food Research International 105 (2018) 384-392.

[6] Jason Sun, Rainer Künnemeyer, Andrew McGlone, Nathan Tomer, "Investigations of optical geometry and sample positioning in NIRS transmittance for detecting vascular browning in apples", Computers and Electronics in Agriculture 155(2018) 32-40.

[7] Sashuang Sun, Qian Wu, Lin Jiao, Yan Long, Dongjian He, Huaibo Song, "Recognition of green apples based on fuzzy set theory and manifold ranking algorithm", Optik 165 (2018) 395-407.

[8] Sajad Sabzi, Yousef Abbaspour-Gilandeh, Gine´s Garcı´a-Mateos, "A new approach for visual identification of orange varieties using neural networks and metaheuristic algorithms", 2018, Information Processing in Agriculture 5 (2018) 162-172.

[9] Xin Xie, Songlin Ge • Mingye Xie2 • Fengping Hu, Nan Jiang1 • Tijian Cai, Bo Li, "Image matching algorithm of defects on navel orange surface based on compressed sensing", Journal of Ambient Intelligence and Humanized Computing,vol.325,(2018).

[10] Kun Zhang, Xiaoyan Chen, and Haifeng Wang, "Research on External Quality Inspection Technology of Tropical Fruits Based on Computer Vision", Springer International Publishing AG, part of Springer Nature ,vol.213,(2018).

[11] Jyoti Jhawar, "Orange Sorting by Applying Pattern Recognition on Colour Image",Procedia computer science 78(2016)691-697.

[12] Ab Razak Mansor,Mahmod Othman,Mohd Nazari Abu Bakar,Khairul Adilah Ahmad and Tajul Rosli Razak, "Mango size classification using RGB Colour Sensor and Fuzzy Logic Technique", Springer Nature Singapore Pte Ltd, vol.324,(2016).

[13] Thendral Ravi and Suhasini Ambalavanan, "Image Analysis for Efficient Surface Defect Detection of Orange Fruits", Proceedings of 3rd International Conference, Springer India, vol .256,(2016).

[14] Payman Moallem , Alireza Serajoddin, Hossein Pourghassem, "Computer vision-based apple grading for golden delicious apples based on surface features", Information processing in agriculture, vol.452,(2016).

[15] M.M Sofu,O.Er.,M.C.Kayacan,B.Cetisli, "Design of an automatic apple sorting system using machine vision", Computer & electronics agriculture 127(2016) 395-405.

[16] Segun Emmanuel Adebayo, Norhashila Hashim, Khalina Abdan, Marsyita Hanafib,Kaveh Mollazade, "Prediction of quality attributes and ripeness classification of bananas using optical properties", Science Horiculture212(2016) 171-182.

[17] Dian Rong, Xiuqin Rao, Yibin Ying, "Computer vision detection of surface defect on oranges by means of a sliding comparison window local segmentation algorithm", Computers and Electronics in Agriculture 137(2017) 59-68.

[18] Asutosh Mohapatraa, S. Shanmugasundaram, R. Malmathanraj, "Grading of ripening stages of red banana using dielectric properties changes and image processing approach", Computers and Electronics in Agriculture 143(2017)100-110.

