American-Eurasian J. Agric. & Environ. Sci., 7 (3): 336-340, 2010
ISSN 1818-6769

Determining Barberry Quality Based on Color Spectrum Histogram and Mean Using Image Processing

[1]Hossein Shirgahi, [2]Najmeh Danesh, [3]Abdol Ghaffar Ebadi and [2]Homayun Motameni

[1]Member of Young Researchers Club, Islamic Azad University, Jouybar Branch, Jouybar, Iran
[2]Department of Computer, Islamic Azad University, Sari Branch, Sari, Iran
[3]Member of Young Researchers Club, Islamic Azad University, Sari Branch, Sari, Iran

Abstract: In recent years, much research has been done on the classification of agricultural product. This research was based on image processing. Image processing was used to determine the quality of barberries in terms of amount of impurities and qualitative degree. At first, 100 samples, out of 10 high quality and pure barberries were chosen as initial date and their average color limits in each color spectrum in CMY color mode was determined. In addition, we determined the limits of changes in color histogram of color spectrums for 10 levels to improve the accuracy of the calculations. Then we took in to consideration 200 samples of high quality of barberry pictures as test data. And divided images in to blocks k*k to improve the accuracy of the system and then calculated the quality of each block based on the mean and the histogram of color spectrum. At last, the final quality of barberries is determined after calculating the average of the quality of all blocks of each image. Based on the observed experimental results, this method is more efficient than the previous ones and determines the quality of barberries with an accuracy over 98 percent.

Key words: Image processing · Color histogram · CMY color mode · Barberry

INTRODUCTION

Increase in customer satisfaction is one of the most important objectives that companies producing agricultural products and foods are following [1]. Today, very careful system of packaging were designed based on image processing algorithms. Scientists did a lot of research to mechanize agricultural operations. Some of this research concerns packaging and classification. Important operations in this research are divided in to two groups of classification and detection. Detection is carried out externally using a camera and image processing algorithms. Classification is done using statistical algorithms and data obtained in the phase of detection [2-3].

More research done up to new was on products in industrial countries or products of more public consumption or production. But products produced in developing countries are packaged and graded traditionally. And barberries are one of these products. Barberries are thorny shrubs that an 1-5 m tall. The word is red, brown or yellow. The leaves are oval and the fruits are oval in shape and purple in color and sure in taste. It is native to temperate and subtropical regions. Iran is the largest producer in the world [1].

In this article, we determined the apparent quality of barberries using image processing algorithms. We used CMY color mode for better differentiation of impurities from the original product of barberries. The most impurities observed were barberry spines, the leaves, grits and unripe barberries which have a different color limits from the main product. The second section concerns the background of the study and the suggested method is described in the third section. The fourth section deals with experiments And tests carried out and the fifth section contains conclusions and final recommendations.

Background: In recent years, much research was done on the classification and grading of agricultural products based on external features using image processing which those important are discussed here.

In a research, automatic date classification was done using a machine vision system. And as a result, a system

Corresponding Author: Hossein Shirgahi, Department of Computer, Islamic Azad University, Jouybar Branch, P.O. Box: 47715-195, Jouybar, Iran. E-mail: h.shirgahi@jouybariau.ac.ir.

of date grading was devised. The system was based on the image of product and two important factors of size and flaking of date [4].

They improved machine vision and the reflection of image near to ultra violet and two-dimensional image analyzing to measure the quality of date. The parts of the system are ultra violet images, vision algorithm, lens, lighter, controller and carrier. This system improved the precision of grading considerably and decreased the expenditure [4].

In a study done in 2007, classification of apple color was carried out based on external features parameters in four groups. The system is an improved machine vision system containing a CCD camera, a moving line and a light source. Four pictures at 90° angle were taken of each apple. And 17 parameters extracted from each picture. They used 318 apples in this system. Nervous network and SVM were used for classification [5].

In a study done in 2008, olive products were classified based on external damage. They considered a model to classify olives. The model was based on the extraction of external features of the image (external faults and skin faults of the products) . they classified the products in to 7 groups. The obtained results improved 75 to 90 percent [6].

In a study done in 2008, impurities of barberry products were detected using image processing algorithm. They studied an algorithm, which receives the color image of the products and then passes it to magenta field. Then convert to the image in to a 2-surface image using a threshold limit and detects the impurities [1].

In another study in 2008, an image processing technique was used to evaluate the quality of barberries. The technique was used to measure the external materials and homogeneity of barberries. The correlation between the sense evaluation of the factors and the results obtained from the classification was calculated using the spearman correlation coefficient [7].

Suggested Method: We received initial images of high quality barberries using a 8 mega pix camera in RGB color mode and then studied the different spectrum of color modes such as CMY, HSB and RGB. We found out that the color spectrum M of the color mode CMY is very efficient to differentiate the color features of high quality barberries from that of low-quality barberries or unripe barberries. Based on these factors, we used these stages:

- At first, we received 100 images of 10 high quality barberry products as initial data of the system in the color mode RGB. Then we converted these RGB color mode images in to CMY color mode [8]. This was done on image pixels based on formula 1.

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 255 \\ 255 \\ 255 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (1)$$

- In the last studies on barberry product, we used a threshold limit on only one spectrum of the image (spectrum M or spectrum R) to differentiate barberries from impurities. We use all three spectrum C,M and Y to improve the accuracy. The probability of effect of we used for spectra M,Y and C was 0.5,0.25 and 0.25 respectively and used all three spectra for color mean according to formula 2 in which S_{TC}, S_{CC},S_{CM} and S_{CY} are the amount of the final similarity of the color spectra, the similarity of spectrum C, the similarity of spectrum M and the similarity of spectrum Y. at the same time, we don't use the same threshold limit for each spectrum, because the probability of error is very high. We use an acceptable range of the values close to the average with the probability of 1 using the color average obtained based on 100 first images of high-quality barberries and an acceptable range for each color spectrum. In addition we use two other close ranges based on different samples with a probability of 0.5, which the considered limit for all 3 spectra C,M and Y are in Table 1. The similarity among S_{CC}, S_{CM} and S_{CY} are calculated based on the accordance among the spectrum of each new image and these values.

$$S_{TC} = 0.25 * S_{CC} + 0.5 * S_{CM} + 0.25 * S_{CY} \quad (2)$$

Table 1: Color average and acceptable assurance range for spectrum C, M and Y

Spectrum	Average color spectrum	Acceptable range of assurance with the probability of 1	Low Bound acceptable range of assurance with the probability of 0.5	High Bound acceptable range of assurance with the probability of 0.5
C	142.5	[130 150]		(150 160]
M	207.5	[200 215]		(215 222]
Y	214.5	[207 222]		(222 229]

- In the last section, we considered the color average and acceptable assurance for the color spectra C, M and Y. but based on the tests we had, we can't evaluate barberry products with a high precision by calculating average and determining assurance because based on Overlapping of some image pixels over the threshold limits with those with lower than threshold limit, average values are obtained in the threshold limit. This Overlapping has a bad effect on determining the right quality of barberry products. We use a histogram of color spectra C,M and Y as a new parameter in decision making to remove this problem.

In this study, we considered a histogram of 10 levels, for each color spectrum and then calculated the probability of each level for the spectra C,M and Y for each one of the 100 first samples based on the equations 3, 4 and 5.

$$P_{HC_i} = N_{HC_i} / N_T \quad 1 \le i \le 10 \tag{3}$$

$$P_{HM_i} = N_{HM_i} / N_T \quad 1 \le i \le 10 \tag{4}$$

$$P_{HY_i} = N_{HY_i} / N_T \quad 1 \le i \le 10 \tag{5}$$

Which P_{HC1} is Probability of level I for spectrum C, P_{HM1} is Probability of level I for spectrum M, P_{HY1} is Probability of level I for spectrum Y, N_{HC1} is Number of pixels in spectrum C of the image in level i, N_{HM1} is Number of pixels in spectrum M of the image in level i, N_{HY1} is Number of pixels in spectrum Y of the image in level i, N_T is Total number of image pixels.

Then we calculate the average of the probability obtained for the spectrum levels of 100 first images to obtain the average probability of the levels of the color spectra C,M and Y. in Figure 1, you can see a view of high quality barberry products along with the spectra C,M and Y and their histograms.

- We calculate the similarity of the histogram parameter of image spectra according to the equation 6, after obtaining the average probability of the levels of the color spectra C,M and Y.

$$S_{TH} = 0.3 * S_{HC} + 0.4 * S_{HM} + 0.3 * S_{HY} \tag{6}$$

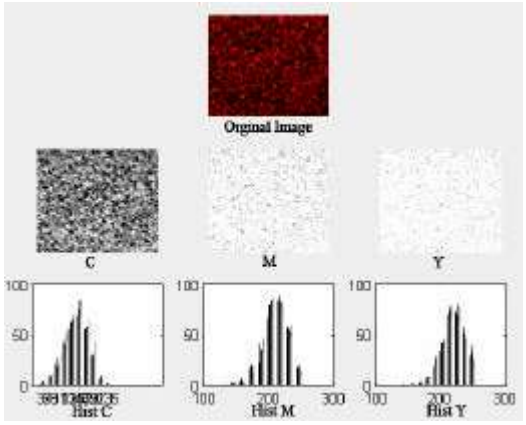

Fig. 1: Barberry product with C,M,Y spectrum and histogram

Which STH is Final similarity of the histogram of the color spectrum, SHC is similarity of the histogram of the spectrum C, SHM is similarity of the histogram of the spectrum M, SHY is similarity of the histogram of the spectrum Y.

Final similarity is obtained according to the equation 7 based on color average and color spectrum histogram after calculating S_{TC} and S_{TH}.

We designated the effect coefficient as 0.6 for color spectrum histograms because the effect of color spectrum histograms on images are more.

$$S_T = 0.4 * S_{TC} + 0.6 * S_{TH} \tag{7}$$

Which S_T is Final similarity, S_{TC} is Similarity of color average, S_{TH} is Similarity of color spectrum histogram.

- We increased the accuracy considerably considering the color histogram of image spectrum. But we used image blocking to prevent the decision making based on color average and the histogram of image spectrum, because of the amount of hidden error based on Overlapping. We divided the incoming image in to k*k blocks and calculated S_T for each block according to the previous stated stages and at last we obtained the total similarity, which is the quality of the barberry product, according to the equation 8.

$$S = \frac{\sum_{i=1}^{NOFB} S_{Ti}}{NOFB} \tag{8}$$

Which S is Total similarity, S_{Ti} is Similarity of i th block, NOFB is number of image blocks.

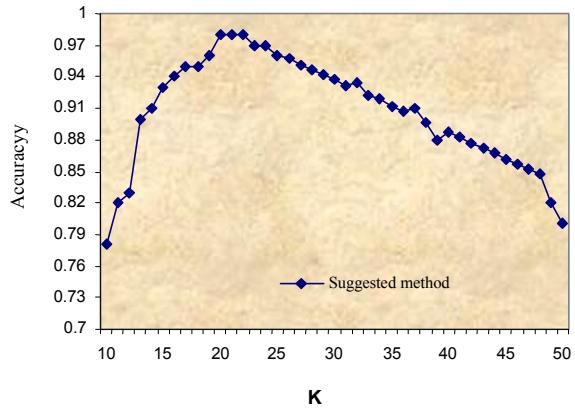

Fig. 2: Assessment of accuracy suggested method

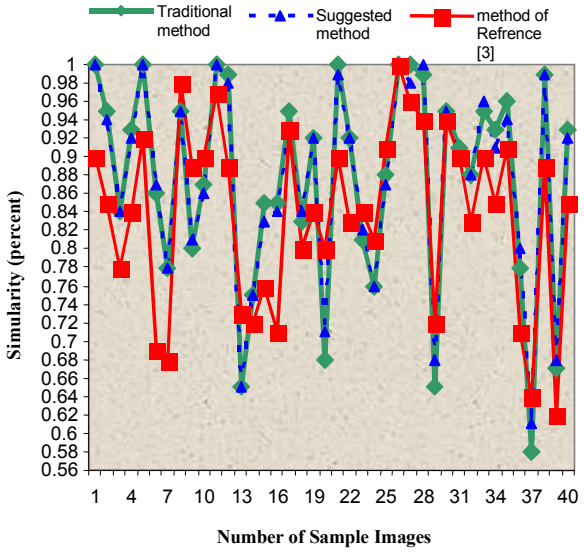

Fig. 3: Comparison of similarity of images by suggested method and traditional methods

TESTS AND EXPERIMENTS

We did this research using matlab 7. First we chose 100 initial images of 10 types of high quality barberries as main data. We obtained the average of the color spectrum of C, M and Y and their limits using these initial data and the average probabilities for each one of the histogram levels of the color spectrum C, M and Y.

Then we chose 200 images of different samples of high quality barberries and of different purity and calculated the quality of these images of the barberries According to the tests carried out, the most suitable value for k in the test was 20 (based on Figure 2).

We compared the accuracy in this method and previous method which are seen in Figure 3.

In this figure we compared the results from the recommended methods and the traditional method. For traditional method, we chose 5 experimented panelists in the field of the evaluation of barberries and their views were described as the result of the traditional method.

CONCLUSION

After studying tests and experiments, the following results were obtained:

The desired recommended method was an efficient method and determines the quality of the barberries products with the high accuracy of 98 percent.

The recommended method has 10 to 15 percent more accuracy than the method stated by Brosnan and Sun [3]. In addition, we decreased the Overlapping's side effect of the total image average using the histogram of image spectra to develop the study in the future. We should use the phase variables of color average and histograms of color spectra instead of a specified assurance range and we should calculate the similarity based on phase laws.

REFRENCES

1. Esfahani, S.H., S.M. Esfahani and S. Rahimi, 2008. Identifying impurities apple product using image processing algorithms, the first National Conference of saffron and barberry, Islamic Azad University Ghaen, Iran, pp: 161-166.
2. Barreio, P. and C. Zheng, 2008, Non-destructive seed detection in mandarins: Comparison of automatic threshold methods in Flash and Comspira MRIs. Postharvest Biology and Technology, 47(2): 189-198.
3. Brosnan, T. and D. Sun, 2004. Improving quality inspection of food products by computer vision -a review. Journal of Food Engineering, 61(1): 3-16.
4. Lee, D. J., R. Schoenberger, J. Archibalda and S. McCollumc, 2008. Development of a machine vision system for automatic data grading using digital reflective near infrared imaging. Journal of Food Engineering, 86(3): 388-398.
5. Xiaobo, Z. and Z. Jiewen, 2007. Apple color grading base on organization feature parameters. Pattern Recognition Letters, 28(15): 2046-2053.

6. Riquelme, M.T., P. Barreiro, M. Ruiz-Altisent and C. Valero, 2008, Olive classication according to external damage using image analysis. Journal of Food Engineering, 87(3): 371-379.
7. Rajai, B. and K. Nourbakhsh, 2008. Using qualitative assessment of image processing techniques barberry, eighteenth Congress of Science and Food Research Institute Food Khorasan, Mashhad, Iran, pp: 83-87.
8. Gonzalez, R. and R.E. Woods, 2007. Digital Image Processing, 3rd edition, Addison Wesley publishing company, New York, USA.