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Date Fruits Grading and Sorting Classification Algorithm Using Colors and Shape Features

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Abstract

The kingdom of Saudi Arabia produces almost 400 varieties, is the largest producer of dates in the worlds in dates fruit industries. The date's industries have facing problems in date grading and sorting during harvesting and agriculture products industries. Since human experts have some limitations such as tedious and timing delay consuming the processing delay as a result of date products costly. The computer vision algorithms are used to reduce the powers of mankind by automatically detect and classify an image. The main aim of the computer vision-based algorithms for data fruits grading and sorting is to make the procedure fully automated and reduce human interference. The computer vision algorithm uses RGB pictures, which automatically abstracts the aforesaid exterior date class arrangements. Based on the extracted algorithms, the proposed vision-based machine automatically classifies dates into three different quality based categories (class A, B, and C) defined by the user. The paper studied the accuracy of the computer vision-based algorithm based on pre-selected date fruits samples from different field in Al-Qassim, Sudi Arabia. The experimental grades classification illustrated that the proposed algorithm is able to sort the date's fruits up to 99% precisely.

Keywords: Image detection, Image segmentation, feature extraction, Image Classification, Grayscale threshold.

I. INTRODUCTION

Dates are very popular and common fruits in the Middle East. Dates have very numerous important, traditional, and religion evidence that date trees have been cultivated in the Arabia region as far back as 6000 BCE [1]. Dates fruits also carrying significance and importance in the holy month of Ramadan and other religious associated events. The Middle-East and the North African countries are presently the main date creator countries in the world, According to the Food & Agricultural Organization (FAO) [2]. Loutfy Ibrahim [12] express the manufacturing quantity in tons of dates for the topmost fifteen countries in 2010 shown in Figure 1. There are above 40 different kinds of dates, over 400 variations, which shelter an extensive range of flavor, color, and shape, as well as the expense is an important factor for date grading. Dates are naturally tasty and ironic in nutrition. The garden-fresh date is a significant source of vitamin C, show the classification of dates into different grades. Thus, it is difficult for human vision to differentiate between them as shown in Figure 2. Many different types of dates that might even imagine a cell phone camera-based application, is used by consumers in the market place. Many researchers showed the importance of date's fruits soring for the automated dates grading system as shown in the Figure-2. Al-Ohali stated in 2011 that the process of sorting dates manually by individuals is wasting time, energy intensive, and source of delay [3, 4]. Thus, implementation of real-time classification based on computer vision system has improved the entire date jam industry. Lee built a system which successfully sorting the dates based on image processing algorithms. The system operates only in packing facility not to classify into different classes [5]. He reports that his system, operate on manual grading and sorting as shown in Figure 2, provided more human vision and high-cost operation.

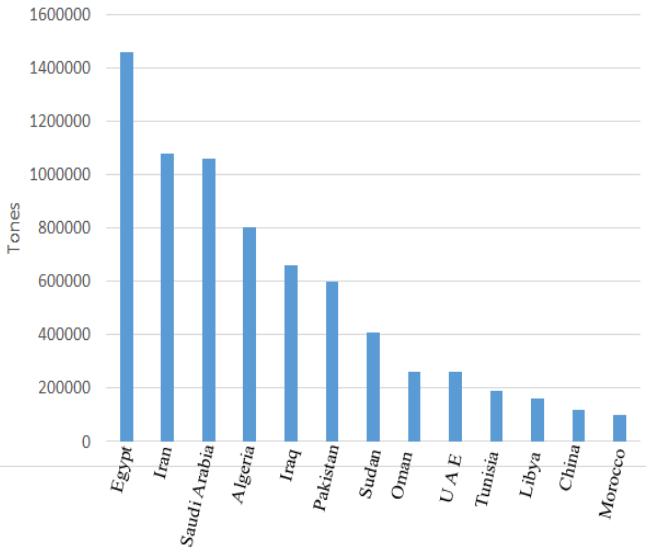

Figure 1: Production amount of top fifteen countries [12]

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Figure 2: Manual grading and sorting [3,4]

Al-Ohali [6, 7] using computer vision algorithms used to classify the dates fruits according to their size, shape, and intensity. Further study showed the date's classification by using three perimeters, length, width, and length-to-width ratio features together with multi-layer neural network classifier [8]. Alavi [9] and Abdellah Halimi [10] also proposed a real-time date grading system. These classifications either use fuzzy interpretation, computer-based algorithms, or distinguished camera and sensors but not classified into different classes by their quality. Almost all the previous researchers to classify the dates by a human vision based on the quality. The scientific research in classification equipment and shape recognition techniques are manufacture it to automate check the process of date's fruit classification [13]. In this paper, automatic date fruits are classified based on computer vision algorithms. In the proposed approach, the date is classified into three classes to manufacture different types of date fruits products. The main of this approach in date fruits grading is to make procedure fully automated and to reduce the human vision interference.

II. METHODOLOGY

Dates fruit classification based on computer vision has two subsystems: image preprocessing system and fruit classification system shown in Figure 3. An image capturing system that can be review fruit by visually, detect its quality and sorted into different classes. The system consists an electro-mechanical system that can place the date fruits on taking a strap to carry through a computer-based classification system to different sorting boxes. The take strap carried the date fruits where the camera captured the image and transmits it to an image processor using computer vision algorithms. The system, after processing the date's fruit data, presents it to a shape recognizer box through the computer-based classifier. The classifier performs the quality assessments and recognizes the date's fruit into different classes, and directs the sorter to the appropriate box for future manufacturing.

The flow chart of date fruits classification shown in Figure 4. The flow chart describes that the image read in RGB to get the intensity of the shape using a computer vision algorithm. The image fill and image open techniques used to fill and open the small intensity in the image respectively. The complete image intensity calculated by summing all the intensity of the image, which classified different shapes of date fruits and put in the different boxes.

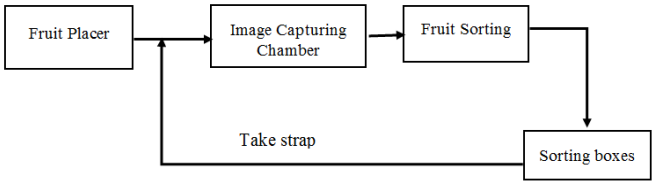

Figure 2: Block Diagram of Date Fruits Classification

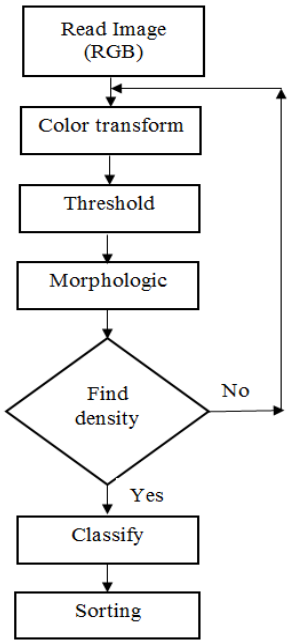

Figure 3: Flow chart of date fruit classification

The proposed date fruits classification consists four stages is shown in Figure 5 (a) Date fruits segmentation (b) labeling disconnect the region of date fruits; (c) Extraction of density and summing for each pixel of shape; (d) classification of date fruits by decision-making procedure.

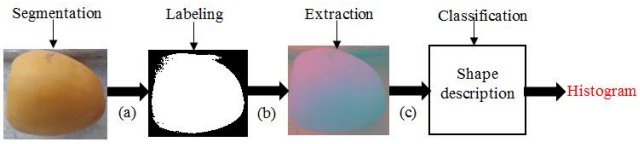

Figure 4: The proposed date fruits classification consists of five stages

(a) The segmentation of date fruits cover in two steps, firstly, each pixel of the original image (I) is applied to create an RGB index.

$$GrayScale\ (I) = r.I(R) + g.I(G) + b\ I(B)$$

Where $r = -0.884; g = 1.262; b = -0.311$ [11]

The original image transforms the grayscale image

transformation to get the one-dimensional image. Secondly, closing and opening morphologic operation used to avoid the overlapping among each pixel.

(b) Labeling operation is used to differentiate between the date fruit and background. It can identify the self-containing binary image. Figure 6 shows the connectivity between self-image and background image.

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

(a) (b)

Figure 6: Image connectivity (a) date fruits image (b) background image

(c) The shape description used the intensity of each pixel in the one-dimensional image. The intensity of each image is determined by summing the intensity of each pixel in an image. The following equation used to calculate the density.

$$d_i = \sum_{i=0}^{255} \left(\frac{(Grayscale)_i - \min(Grayscale)}{\max(Grayscale) - \min(Grayscale)} \right)$$

(d) Class of date fruits sorted by their respective density. The date's fruits are classified into three classes, Class A, B, and C.

(e) To verify the effectiveness of the system by using histogram Labelling operation is used to differentiate between the date fruit and background. It can identify the self-containing binary image. Figure 6 shows the connectivity between self-image and background image.

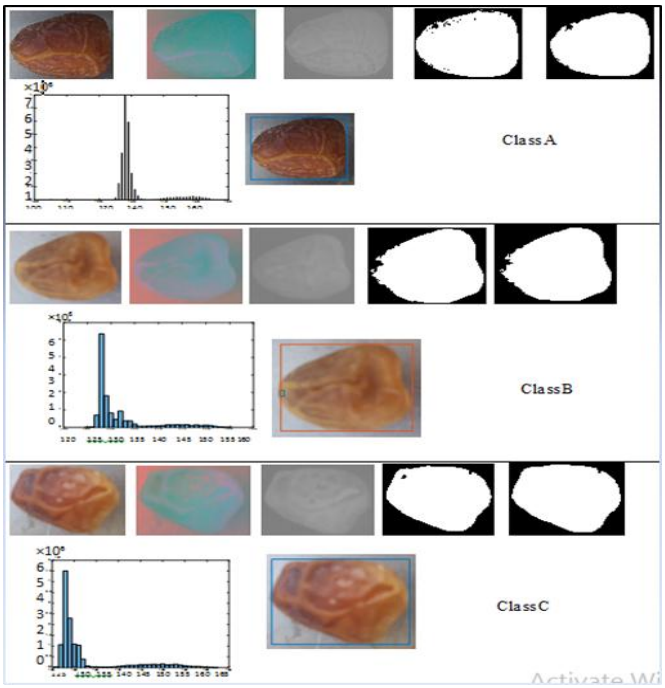

Figure 5: Dates fruits sorting system Class A, B, and C

III. RESULTS

The date fruits images shown in this paper taken from the date festival Unaizah, which held in summer every year in Saudi Arabia. The date fruits are classified into three classes (class A, class B, and class C). An ordinary camera used for the captured images but quality can be improved using the high quality of the camera.

Different images were select from the different types of images to classify into respective classes. Figure 7 shows, the extracted regions by the approach of steps (a) and (b) correctly. The original image can be classified into a different class. The tests corresponding to the proposed algorithm making decision based on density explain in the methodology section. The histogram was taken to verify the difference between each date fruit. The density of different date fruits images shown in Table 1. The tables show that the date fruits are classified according to their shape into three different classes.

Table 1: Density and threshold-based classification of date fruits

No of Class	Density	Histogram Max	Percentage
Class A	$7.8245e^{-08}$	7*106	99%
Class B	$6.8245e^{-07}$	6.5*106	99%
Class C	$7.6245e^{-06}$	5.8*106	99%

IV. CONCLUSION

This paper presents the novelty approach for date's fruits grading and sorting, which purely based on computer vision algorithms. The method has proven successful and effectively simple. The images taken are classified and sorted according to their respective class. Image pre-processing approach used to effectively to recognize the date fruits intensity. The decision-making approach easily recognizes the shape of different date fruits and sorting into their respective box for further processing. The algorithm processing fast and simple for classification, therefore, it is concluded that the approach can sort date fruits into thee classes up to 99%, which can reduce the human vision intervention and time required for grading process.

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