ISSN:0975-9646

Drashti Jasani et al, / (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (6) , 2015, 4851-4854

Review of Shape and Texture Feature Extraction Techniques for Fruits

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Abstract- Fruits grading has been updated from traditional ways and perform automatic grading. All the task of assembling of object done manually in India today. Shape and texture are important visual features of an image, which helps, in automated fruit grading. Using Digital image processing, one can fulfill many kind of tasks like object shape, size and color detection and other feature extraction etc. Using image processing, we can detect shape of objects as well as we can extract texture of objects. In this paper various algorithms of shape detection and texture feature extraction are explained and conclusions are provided for best algorithm. Merits and demerits of algorithms and methods are also provided.

Index Terms - Image Processing, Fruits, Shape, Texture.

I. INTRODUCTION

In India, 70% of people are depended on agriculture because India is an agricultural country [1]. Now-a-days the people of India wants to use some technology that make them work easier, faster and with more perfection and with less cost. A large variety of fruits are grown in India of which apples, bananas, grapes, mangoes are the major ones. Besides, India is a large low cost producer of fruits and horticulture has huge export potential. Farmers are finding difficulty in the fruits assembling which results provide huge loss of time and money to the farmers [2]. In the past few years, automation and intelligent sensing technologies have revolutionized our fruits production and processing routines.

Computer vision is a rapid, economic, consistent and objective inspection technique, which has expanded into many diverse industries. Its speed and accuracy satisfy ever-increasing production and quality requirements, hence aiding in the development of totally automated processes [3]. Detecting and locating object in digital image has become one of the most important applications for industrial use to ease user and save time. This technique has been developed year ago but improvement of it still requires in order to achieve the targeted objective more efficiently and accurately. The goal of this paper is to review methods for shape and texture detection [4].

The aim of this review paper is to research the use of image processing and computer vision techniques in the food industry. Brief summary about different fruits grading technologies using shape and texture feature extraction are described in section II, different methods are explained in section III, method comparison are described in section IV, at last conclusion of review paper is described in section V.

II. LITERATURE REVIEW

Object can be defined by texture or shape. Shape is one the important visual feature of an image which helps in automated fruit grading. Grading applied on many fruits and vegetables. In this section review is made on how different parameters can be used for automatic fruit grading system.

Paper [5] describes image processing & analysis techniques for finding weight of mango. The size of mango is estimate by weight. Relationship between weight and pixel of mango was analyzed with the help of statistical method.

Image processing algorithm is used for sorting and detecting mango with help of captured image in [6]. To identify type of mango, the features of mango were collected. Mangoes are classified with the help of its physical features. Structure of mangoes is help in classification process. Object's pixels and defective area is classified with the help of threshold technique. This algorithm describes brown and green pixels. Brown pixels are considered as defective area and Green pixels are considered as good area.

Sorting system for lemon grading based on color and size parameters is presented in [7]. During calibration stage, the volume and color of fruit is determined and saved in database. During sorting stage, the calculated color and volume is compared with the information saved in the database. Finally grade of fruit was determined. Efficiency achieved was 94.04%.

In [21], authors had presented automated mango grading system using fuzzy image analysis. In proposed system, the process of mango grading had done based on size, color and skin feature. Firstly size of mango is determined by calculating area of image object. Secondly RGB component was extracted from image and mean of three colors was determined. Then edge detection algorithm was applied for shape analysis. Fuzzy inference rule is applied for grading

mango into different classes. An advantage of this method is the use of fuzzy inference engine without depending on human experts.

Reduced color and texture features based identification and classification of affected fruits is done in [2]. Two color techniques are used in this work: i) RGB ii) Gray scale. The advantages of features, namely color and texture, are combined RGB component is separated from the original image. From RGB component Hue (H), Saturation(S), luminance(Y) is separated.

Digital image processing technique can be used to detect the mango from mango tree. CHT [Circular Hough transform] is used to detect the mango in [4]. If we want to detect the shape it will detect through edge detestation method. And we detect through color method it will give 100% result and if we detect through CHT then it will 60% result. Firstly it will convert the original image into grey scale after that it will convert into binary image. Grayscale will filter the smoothness of the object and clear the edge.

Analysis of the genetic diversity of the Indian mango cultivars using the RADP markers is done in [8]. In this paper, comparison of 27 cultivars and two clones had been done. The total genomic DNA was extracted from the flushing tender leaves by using TAB method.

Image compression is the method through which we reduce the storage space and it also helpful the increasing storage and transmits process performance. The performance of the transforms are compared in Mean squared error (MSE) and Energy Retained (ER) in [9]. In this paper, main objective is to comparison of the grayscale image using the wavelet theory. The result is given in the form of .jpg format. When the threshold value is set the 0, the meaning is the detailed has not been changed. If any value is changed then energy will be lost and is called lossy comparison. The lossy comparison lost the information so we can't restore it. As possible during comparison the no of zeros and the energy retention will be higher. The wavelet energy Retained is better. In the 2-D DWT can be as a 1-D wavelet scheme that transferred along the rows and the 1-D wavelet transform along the columns. The 1st level of decomposition. The array divided into two vertical halves, the 1st half is storing the average coefficient and the second half is detail coefficient. Repeat the same as column. The image consist of the pixels that arrange two dimension matrix. In the comparison of the image, these redundancies existing among pixels need to eliminate that one prominent feature of JPEG2000 standard.

Shape analysis methods works on object recognition, matching, registration, and analysis. In paper [10], shape boundary is used for interior part classified. Shape analysis method is classified on different criteria: i) It is based on shape boundary and its result is also known as boundary and global. ii) To determine the quality of object through shape description is difficult.

Paper [11] detects segment and physical properties of mango. Such as size, shape and color. Fruits analysed of the digital camera. The segmentation is applied on mango. There is various sizes graded by experienced farmer's eyes and hands. And this method used in good alternative and grading mango.

Computer vision based technique for grading and sorting of fruit is proposed in [12]. Grading is done based on maturity level. And this technique can be used in automatic fruit grading and sorting system. This technique can be low cost effective and more intelligent. The speed of sorting system is limited.

Algorithms can be used in rapid shape retrieval by representative shape context. Two method can be used i) Feature based ii) Brightness based [13]. Feature based method is used in shape similarity and uses boundaries of image. Brightness base method same as feature based method. Method is used for object recognition. The result are achieved on handwritten digits and visual CAPTCHAs.

Computer vision is used for the agriculture and food industry in [14]. Computer vision system they provide rapid, economic and objective assignment. This technology analysis can be based on standard requirement and automated grading in fresh product. The non-destructive method can be used in food industry, agriculture including and grading of fruit and vegetable.

Shape and texture based method for vein recognition is proposed in [15]. In paper, two kinds of shape matching methods are used:1) Hausdorff distance and 2) Line Edge Mapping(LEM). A sets of 100 persons of different ages above 16 and also different gender. In this, 5 images per person are used. In biometric method, most important is fingerprint which widely used in person identification. The five individual processing stages are available: image acquisition, image enhancement, vein pattern segmentation, feature extraction and matching. Hausdorff, LEM methods are used to detect the shape and Gabor magnitude method, is use for nearest neighbour classifier to texture and achieved results are 58%, 66%, and 80%.The most secure method is biometric.

Finding the object and background using parallel Genetic algorithm (PGA). There are two strategies: 1) Featureless and 2) Feature Based [16]. Featureless method is used to determine the optimal threshold from the discrete nature of the histogram distribution. The Featured Based method is use on feature histogram distribution. Above two methods compared with the Otsu's and Kwon's method and Feature Based method is found the best results. PGA is interconnection model which provide quality of solution. Featured Based method describes segmentation results with less percentage of misclassification error.

Paper [17] describe the work done on shape based leaf image retrieval. Using two approaches: centroid-contour distance (CCD) curve and eccentricity and angle code

histogram (ACH).It describe as CCD: in this approach, it finds centre point of leaf. CCD method also knows the movement of leaf through curved. ACH describes how leaf's shape is increased. By using both methods, it has experienced 1400 leafs. Through experience of leafs, we got the result that CCD method is batter.

In [18], shape and vein, color, and texture features were incorporated to classify objects. In paper, a neural network called Probabilistic Neural network (PNN) was used as a classifier. The experimental result shows that the method for classification gives average accuracy of 93.75% when it was tested on Flavia dataset that contains 32 kinds of plant leaves.

An image texture is a set of attribute of image processing designed to find texture of an image. Image texture gives us information about the image color or intensity. Image textures are one way that can be used to help in segmentation or classification of images. Shape means graphical data that contains location, size and rotational effects are filtered out [19].

Feature extraction is a method, which defines same kind change in full image that's why in paper [20], first RGB image convert into grey scale image now check all the value of each pixel. Some group of pixels have same type of change after some number of around all 8 pixels this change got in some type small image which have only 1 or less percentage from full image these small images join and create one big image is called texture of this image.

III. METHODS

There are several methods and algorithms for detecting shape are explained.

A. Discrete Wavelet Transform (DWT)

In paper [9], Wavelets convert the image into a series of wavelets that can be stored more efficiently than pixel blocks. Wavelets have rough edges. They are able to render pictures better by eliminating the noise pixels. Image consists of pixels that are arranged in two dimensional matrixes, each pixel represents the digital equivalent of image intensity. In spatial domain adjacent pixel values are highly correlated and hence redundant. In order to compress images, these redundancies existing among pixels needs to be eliminated. DWT processor transforms the spatial domain pixels into frequency domain information that are represented in multiple sub-bands, representing different time scale and frequency points. It is classified as Hear Transform and Daubechies wavelet.

B. Fourier Transform of Boundary[9]

The shape description methods under this category use the Fourier Transform of the one dimension boundary representation and Region-based Fourier descriptor to characterize the shape.

1) One-dimensional Fourier descriptors:

Fourier descriptor (FD) is obtained by applying Fourier transform on a shape signature that is a one-dimensional function which is derived from shape boundary coordinates [9]. The normalized Fourier transformed coefficients are called the Fourier descriptor of the shape. FD derived from different signatures has significant different performance on shape retrieval.

2) Region-based Fourier descriptor:

The region-based FD is referred to as generic FD, which can be used for general applications.

The steps are

Step 1. The approximated normalized image is rotated counter clockwise by an angular step sufficiently small.

Step 2. The pixel values along positive x-direction starting from the image center are copied and pasted into a new matrix as row elements.

The steps 1 and 2 are repeated until the image is rotated by 360°.

C. Scale Space

This group contains methods that rely on the scale-space representation. In scale space theory a curve is embedded into a continuous family $\{Ta: a \geq 0\}$ of gradually simplified versions. Scale-space filtering approach provides a useful representation for representing significant object features. The representation was created by tracking the position of infection points in signals filtered by low-pass Gaussian filters of variable widths. The infection points that remained present in the representation were expected to be "significant" object characteristics. The concept of multi-scale filtering is also present in mathematical morphology. Thus due to different scales, it is possible to separate small details from relevant shape properties [9,10].

D. Recognize boundaries of objects

In paper [15], the image is a two dimensional array with binary elements. First, setting a single pixel on the object-background interface as a starting point recognizes boundaries of the objects. Then moving in a clockwise or counterclockwise direction and searching for other object pixels. The pixels may be searched either diagonally (in 8-connected pixels) or edge-adjacent pixels (in 4-connected pixels). By hunting for object pixels in a fixed direction, the object's boundary can be recognized.

IV. METHOD COMPARISON

Method	Advantages	Disadvantages	Reference
Circular Hough Transform (CHT)	1)Easy implementation. 2) Handles missing and occluded data very gracefully.	1) Computationally is complex for objects with many parameters. 2) The length and the position of a line segment cannot be determined. 3) Co-linear line segments cannot be separated.	[4]
Discrete Wavelet Transform	1) Wavelets are well localized in both time and frequency domain whereas the standard Fourier transform is only localized in frequency domain.	1) The disadvantage is loss of generality. 2) Wavelets have not been used widely in image processing due to the difficulty in designing complex filters which satisfy a perfect reconstruction property.	[9]
Fourier Transform of Boundary	1) The major advantage of this method is that it is easy to implement and based on a well-developed theory of Fourier analysis.	1) Fourier transform does not provide local shape information. After the Fourier transform, local shape information is distributed to all coefficients and not localized in the frequency domain.	[9]
Probabilistic Neural network (PNN)	1) This method provide 93.75% accuracy in texture extraction	1) Neural network also detect Gaussian noise as a texture.	[18]
Chain Code	1) The advantage is reduction in storage volume	1) The disadvantage is loss of generality. 2) The basic chain code is very sensitive to noise & it is not rotationally invariant	[7]
Scale Space	1) The great advantages are the high robustness to noise and the great coherence with human perception.	1) Computational complexity is average in scales-space method.	[9][10]

V. CONCLUSION

This paper basically reviewed the advancement of the information and communication technology in the field of agriculture. Some image processing approaches used in the field of agriculture and fruits classification is described in this paper. In this paper we reviewed the work on the shape and texture extraction methods. In future we will extend our task on fruits shape detection or texture extraction algorithms. Here some methods are introduce like fractal dimension technique, *Edge Detection and Boundary Tracing,* Fourier Transform of Boundary, Scale Space fruit, Fourier Transform of Boundary etc. From these all methods Circular Hough Transform (CHT) and *Edge Detection and Boundary Tracing also* provide better results. Chain code method provides better results but in chain code comparison is difficult. Other future work includes the implementation of such systems in real life which detect fruit type from single image and tries to provide best classification accuracy.

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