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Short Communication

Application of image segmentation in mango fruit analysis using Hough transform

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Abstract

In recent years, Image processing tools havebeen broadly utilized as a part of the agronomic field. The mango fruit classification and identification are valuable in the grocery stores and can likewise be used in enterprises for the programmed sorting of fruits from a set comprising of various sort of fruits for picking fruits. The majority of it connected to the robot that can be utilized for picking foods grown from the ground examination vehicle. Identification and classification is a noteworthy test for the computer vision to accomplish close human levels of recognition. In this field, identification and classification of mango fruits utilizing image processing comprise of for the mainly three noteworthy steps i.e. background subtraction, feature extraction, and classification. The performance of this system mainly depends on background subtraction of mango fruit from images with clutter background, shadows, and shadings. To deal with this challenge, an efficient and precise segmentation method is required. The shapes of the object are significant features applied for content representation and require good segmentation to detect objects. To deal with this problem, the segmentation method using Hough Transform is implemented in this work, which can detect the shape of a mango. MATLAB have been used as the programming tool to implement and investigate the performance of the segmentation method using image processing toolbox.

Keywords: Agriculture image processing, Background subtraction, Circle Hough transform, Feature extraction.

Introduction

Recently, a considerable measure of investigates have been done on fruit grading system by utilizing image processing and computer vision technology, and a many critical results have been acquired. There are many research reports, however so far they are in the exploratory stage, and the examination technique is a long way from actual application. Particularly in the defect/dieses identification, the present strategy used to manage moderate, can't be utilized as a part of genuine online work. In this manner, it is of prodigious significance to concentrate the classification strategy appropriate for generation. Figure-1 demonstrates the generalized block diagram of defect identification and maturity detection of mango fruits.

Recognizing different kinds of fruits is a difficult task in grocery stores, where the customer and cashier must be able to find out the class of particular fruits (i.e. mango, orange) but correspondingly its diversity (i.e. Golden Delicious, Fuji, etc.), which will determine its price[1,2]. Wherein the application of robotics is very substantially improved the pace of development of agriculture.

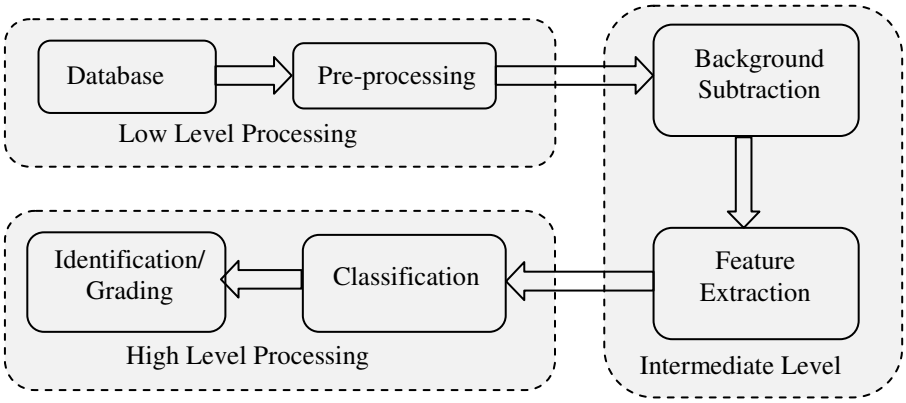

Figure-1: A Generalized block diagram of defect and maturity detection of mango fruits.

Regarding robot technology instead of manual labor and its significance will be very important. Fruits and vegetables to harvest work are very complex. It is affected by many factors. First, the growth of the fruit itself is uncertain, over time, the growth of the fruit location, color, and size will continue to change, even if the fruits of the same tree, the size, and color are different. Second, the fruit growth environment is changing, unknown, openness, and other land affected by seasonal weather and natural conditions of the large fruit of the same species in different locations; different growing seasons vary, but also by the seasonal precipitation, the amount of light, and other factors. Further, when fruit picking, affected the weather, leaves and another shelter, the fruit has acquired robot image difference or light fruit incomplete and so on.

These are made to be able to adapt to the vagaries of picking robot natural environment, with a very high visual intelligence, knowledge, reasoning, judgment and so on[3]. One of the real difficulties of the framework results from occlusion. The vast majority of the mangoes are either mostly or covered up by other mango or branches/ leaves. Figure-2 indicates images of distinct mangos[4]. It is significant the variation in the measure of occlusion. At times, because of serious occlusion, it is difficult to identify the mongoes even physically accurately.

Figure-2: Variation of occlusion.

The performance of this system mainly depends on segmentation of mango fruit from images with clutter background, shadows, and shadings. To deal with this challenge, texture segmentation has been applied for estimation of mango crop yield using image analysis[5]. Randomized Hough transform has been applied for the determination of mango fruit from binary image[6].

K-means clustering has been used for automatic detection of pomegranate[7]. Graph based algorithm and K-mean method havebeen used for fruit defect detection[8]. To deal with above mentioned challenge in this work, Hough transform has been applied for mango fruit analysis.

A tool to recognize mango fruits by its shape is exhibited on this paper. The fruit shape is recognized utilizing the Hough Transform, and after that each fruit is divided for further color investigation. Image Segmentation is one of the initial phases of image processing.

It discusses the way toward segmenting a digital image into non-overlapping regions by relegating marks to every pixel so that pixels with the same name correspond to a typical feature. Each of the pixels in a related to few qualities or calculated property, for example, color, intensity, or texture. The edges are the most fundamental feature of the image, and they are imperative for image segmentation[5].

In this paper, application of image segmentation in mango fruit analysis using Hough transforms is presented. This paper has been organized as follows: An introduction is presented in the Section-I. The methodology used in this work has been shown in the Section-II, Discussions about Hough Transform are presented in the section-III Results and discussions are presented in the Section-IV and conclusions of the work have been provided in the last Section.

Methodology

Proposed methodology adopted for mango fruit image segmentation is shown in Figure-3. In this work, thediscussionis focused on mainly image grayscale and binarization, edge detection and Hough transform. Database of different mango images is obtained from the web[4]. The parameter and settings of the camera used for the acquisition are: Resolution: 3456x2592 pixels; Camera: SONY DSC-H50; Exposure Time: 10/1250; ISO: 125; Focal Length: 389/10. In Figure-3, theinitially RGB image is pre-processed in step-I, then the image is converted to grayscale and binarization is performed in step-II. In step-III, edge detection and Hough transform of the image are performed in step-IV. The detail discussion of all steps is explained below:

Algorithm 1: Image Segmentation of Mango Fruit using Hough Transforms

1. Start
2. Step 1: Read RGB image into the MATLAB from the specific folder of mango dataset.
3. Step 2: Convert the first image into greyscale image and binary image.
4. Step 3: Edge detection.
5. Step 4: Segmentation using Hough Transform.
6. Stop.

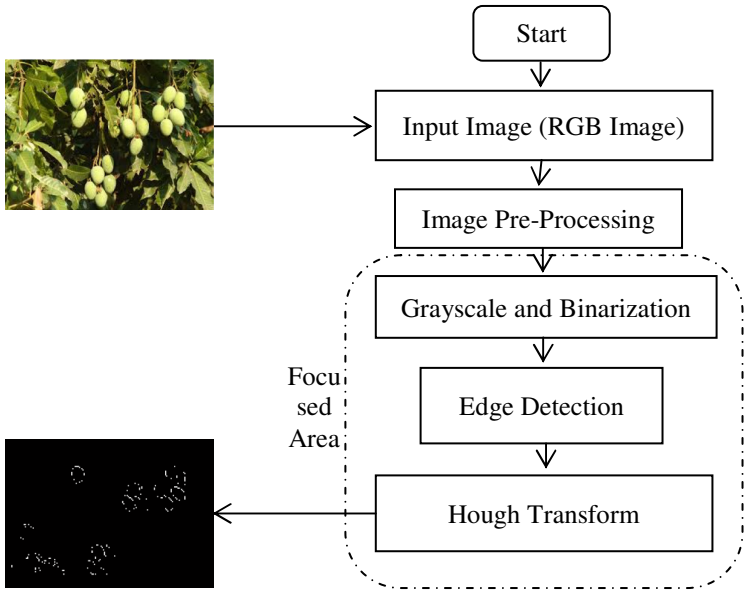

Figure-3: Proposed Method and focused discussion.

In general, the implementation of analgorithm for segmentation of mango fruit using Hough Transforms comprises the following four consecutive steps, namely i. Dataset preprocessing; ii. Grayscale conversion and binarization; iii. Edge detection; iv. Segmentation (Hough transform). The illustration of steps is as follows:

Step-I: In the initial step read RGB image into the MATLAB from the particular location of mango dataset, at that point change over the first image into greyscale image and binarazied image. In this work, image taken is a truecolor 24-bit image in JPG design.

Step-II: Dataset pre-processing has been performed in the second step. From the RGB image, the imageanalysis will be performed. This technique will characterize the limit of the fruits, and its background as the surface of the mango fruit is smoother contrasted with the surface of the blended backgrounds (leaves, tree stems, grass, sky, and soil). In the wake of applying image analysis method, the edge of each mango fruit begins to appear. This can help isolating the overlapped fruit. From the dataset pre-preparing step, the framework will create the binary image that contains the regions that has conceivably represented the mango fruits[6].

Step-III: Edge is an important feature of an image, which is the basis for pattern recognition, vision, etc., and edge detection is an important partof image processing. It detects object edges, detected contour points, then the origin of the detected contour points are connected, the simultaneous detection, missing connecting boundary points and removes the false boundary points. Many edge detection algorithms, such as Sobel operator, Roberts's operator gradient operator, Prewitt operator, and canny edge detection. This paper deals with Sobel operator edge detection, Sobel operator is a first order differential operator, contains two sets of 3x3 matrixes horizontal and vertical.

Step-IV: Hough transform has been executed as a computational tool to recognize and measure shape primitives in images, especially within the sight of noise. The Hough Transform is a vigorous algorithm for feature extraction, for example, straight edges, circles or ovals, additionally primitives characterized by polygons from images and after that depict them parametrically. The Hough Transform is utilized as one stage in ananalysis chain. The quality of this change to determine, remove and evaluate shapes depends on its capacity to distinguish those shapes and features regardless of the possibility that the layout is broken, inadequate or ruined by noise in the threshold image. Hough Transform has been described in Section-III.

Hough Transform: Feature extraction from image is most difficult task in image processing and computer vision. In subjective object detection algorithm, the main issue is object of intrigue may be of different shape and size. To solve this issue there is need to develop that can be extract information of any shape or size of object in an image. That extracted feature or information may be used for further classification process. Hough Transform algorithm is generally used to achieve this objective. Initially, Hough Transform develops to distinguish arbitrary shapes of for various objects. The HT was then improved to recognize rounded objects in low-contrast noisy image, frequently referred to as Circular Hough Transform (CHT). This strategy relies on upon changing over grayscale images to binary images using edge detection strategies, for example, Sobel or Canny. The objective of this method is to design and implement sporadic examples of objects within a pre-characterized set of shapes by a voting technique.

The equation of the circle is,

$$r^2 = (x-a)^2 + (y-b)^2 \quad (1)$$

Where: a and b represent the coordinates of the center, and r is the radius of the circle. The parametric representation of this circle is

$$x = a + r * \cos(\theta)$$
$$y = b + r * \sin(\theta) \quad (2)$$

A CHT depends on three parameters, which requires a bigger calculation time and memory for storage, increasing the multifaceted nature of extracting data from image. For ease, most CHT algorithm set the radius to a constant value or furnishes the user with the alternative of setting range before running the application. The Hough change calculation is given underneath.

Algorithm-2: Hough Transforms.

```
1.  for each pixel (x,y)
2.      for each radius r = 10 to r = 50 // the possible
        radius
3.          for each theta t = 0 to 360  // the possible
            theta 0 to 360
4.              a = x – r * cos(t * PI / 180); //polar
                coordinate for center
5.              b = y – r * sin(t * PI / 180);  //polar
                coordinate for center
6.              A[a,b,r] +=1; //voting
7.          end
8.      end
9.  end
```

Initially, a circle is drawn with that point as origin and radiusr for each edge point. The CHT likewise utilizes an array (3D) with the initial 2D representing the directions of the circle and the last third determining the radii. The qualities in the accumulator are increased each time a circle passes through coordinate's edge point. The accumulator, which kept numbers of a number of circles go through coordinates of each edge point, continues to a vote to locate the highest count.

Results and discussion

For implementing proposed methodology, we take the raw image from the web. The simulation is performed in MATLAB software by using image processing toolbox. In this result Figure 4 shows the result obtained from Image 1 and Figure 5 shows the result obtained from Image-2.

In both the Figure-4(a) is the input image, Figure-4(b) is the grayscale image, Figure 4(c) is output after Sobel edge detection, and Figure 4(d) is the Hough transformed an image in which mango is segmented from the cluttered background. Once the transform was completed parameter from the image were obtained; then parameter detected were segmented from the background, saved in sub-images for further processing.

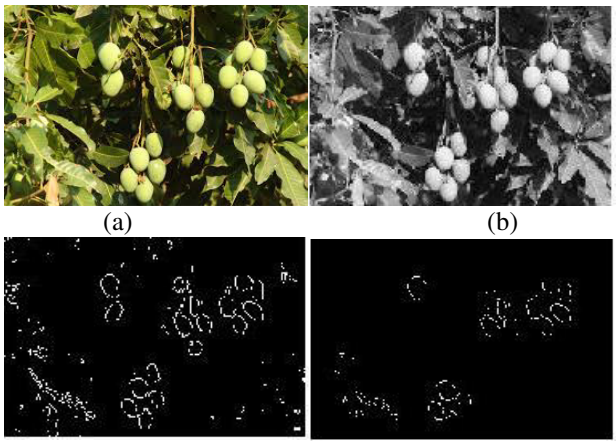

Figure-4: Result of Image 1: (a) Input image, (b) Gray scale image, (c) Edge Detection, (d) Hough transform.

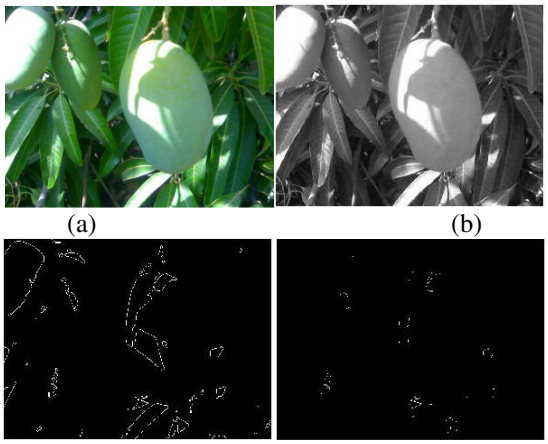

Figure-5: Result of Image 2: (a) Input image, (b) Gray scale image, (c) Edge Detection, (d) Hough transform.

In this simulation, we found small circle detection than the original picture mango, as well as the Figure-5(a), there is a mango covered by another part, but we cannot on the final round of pattern detection seen. Detecting small circle than mango should be made in the detection threshold edge there is a problem caused when using Sobel operator edge detection, edge detection than the figure of a small mango. We will be changed by changing the threshold. As there is a mango is not detected, we can solve this problem by changing the shooting angle, shooting from different angles, we can make all mango are all detected.

Conclusion

Through image analysis can recognize fruit characteristics with a specific objective to optimize selection procedures in the horticultural business. With the efficient segmentation of mango fruits, the time taken by classification is minimized. Applying image processing tool is conceivable setup shape parameters of mango fruits and thereby increases the quality of grading

system. Utilizing image analysis progressively is conceivable enhance and increase production in different ventures focussed in the classification and selection beginning with defined characteristics. With systematized characterization procedures, it can build an objective classification of a product, mainly agricultural products where selection in most cases is subjective.

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