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Object Recognition Using Modified Normalized Cross Correlation

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Abstract –Normalized cross correlation is one of the practical methods for comparing the similarity of the two images.This paper presents a new method to detect objects in the picture based on normalized cross correlation. In this method,the reference image is segmented usingcolor segmentation based on K-means clustering method and various objects in the reference image are extracted.Then, the similarity between pattern binary image and objects binary images, extracted from reference image,is examined using normalized correlation. If rotated desired patterns exist in the reference image, it will be recognized with this method.

KEYWORDS: Normalized cross correlation; Image segmentation;Object recognition

I. Introduction

Nowadays, objects recognition in images is considered one of the most important and extensive research area in computer science, especially computer vision and pattern recognition. Visual features are used in traditional methods of detecting objects as the main source of information to detect objects existing in real-world images. Visual features such as color, shape and texture of the image are able to overcome the apparent changes in a particular class of objects to some extent. Another features used to detect objects are conceptual features. There are various articles in the field of studying different methods for recognizing objects. For instance, in [1],a new method is used to recognize objects in a two-dimensional image based on image segmentation according to their structural information. This article provides an object recognition algorithm using a combination pyramid to display view and a hybrid map to display searching objects. In Another article [2], performs recognition using color and edge features.In [4], a method has been suggested for small object detection in infrared images with complex sea background using context-driven Bayesian saliency model to deal with the issues of detection ambiguity and scale variance in small object detection. Another research [5],a new approach for edge detection of satellite images with low contrast has been suggested. In [6], provided a survey on recent advances in the field of object recognition in remote sensing images.In [7],a new method based on stereo camera fuzzy color histograms is provided to calculate the depth of object and its recognition in image.The paper is organized as follows:in Section 2,normalized cross correlation is discussed. Section 3 discusses image segmentation.In Section 4, experiments and results areprovided. Finally, Section 5 draws the conclusions.

$$C(u,v)=\frac{\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} I_C(i,j)\cdot I_R(i+u,j+v)}{\sqrt{\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} I_C(i,j)^2}\times\sqrt{\sum_{i=0}^{N-1}\sum_{j=0}^{N-1} I_R(i+u,j+v)^2}} \quad (1)$$

II. Methodology

Normalized Cross Correlation :

One way to measure the similarity between two images is calculating normalizedcorrelation between two images.Normalized cross correlation is a well-liked approach to find 2-D pattern in image. Normalized cross correlation between two images is being calculated using formula (1)[3]:

As mentioned in the above formula,I_C is pattern image and I_R is reference image and N is dimensions of pattern image. U and V are local coordinates of reference image compared with pattern image. TheAbsolute NCC[1]has value between 0 and 1.Where the normalized cross correlation is close to 1 means a close similarity between the two images

Image segmentation:

Image segmentation implies the separationof an image into different regionsso that pixels of each area have a common special feature that may belong to an object.. Different approaches of image segmentation include:

1. Threshold methods
2. Color based segmentation methods
3. Converting methods
4. Texture based segmentation methods

Through this paper, we used color image segmentation method based on K-means clustering method.The reason for using color image segmentation in this paper is to separate objects by different colors and to avoid detecting them as an object and also extracting them from the reference image.

In the first part,the reference and pattern imagesare recalled, and then we applied preprocess to remove noise and preparethe pattern image.The pattern image preprocessing is composed of the following steps:

1. Remove pattern image backgrounds
2. Binary the obtained pattern images
3. Remove noiseand improve the binary pattern image using morphologyinstructions and fill holes inside an object

[1]Normalized Cross Correlation

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4. Extractobject patternfrom image pattern and remove additions in image
5. Obtain object edges image of extracted pattern using Canny edge detection operators

In the second part, the reference imageis segmented using color segmentation based on K-means clustering method. Therefore,deriving binary images are obtained from the original image that the derivingimages includeobjects with identical color. In obtained binary images using MATLAB commands,we removed the existing noise and conjoin separated parts of an objectusing morphology operations. Eventually, we filled the holes created inside an object.

In the third section, we extracted objects fromeachderiving binary image and obtain the image of each object edge using Canny edge detection operators. Then, we computedthe normalized correlation between the extracted object edge image from the original image and pattern object edge image and any of its rotations from 1 ° to 359 ° by step 1 °,hence we have 360values .Then, we store the highest amount among these 360 values.In order to eliminate effects of different sizesin comparing extracted objects with pattern image and its rotations,at first these images are resized to have the same size. Then, we computed the normalized correlation betweenthe edge images. The objectwhich resembles pattern image most has the highest amount.

III. Results

In the following two pattern images and two reference images have been selected and above presented method has been implemented. The similarity of each object in the reference image to pattern image is displayed on the reference image with a value representing the correlation between two images.To make the similarity more practical, the normalized correlation values have multiplied by 1000. Then, they are displayed on the original image.

The first pattern image is displayed in figures 1.

Fig. 1: The first pattern image

deriving binaryimagesextracted from the first reference image which containobjectswithspecific color are displayed in figure 2.

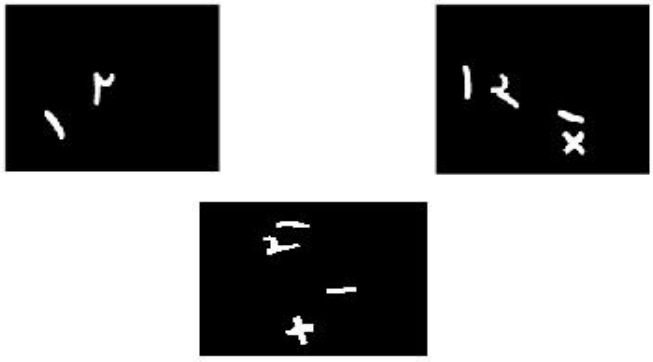

Fig .2: Deriving binaryimages extracted from the reference image

The values of the normalized correlation between the different object edge images in the original image and the pattern object edge image, multiplied 1000, is depicted in figure 3. As it is illustrated in this figure, the pattern image was number 2 has the largest value among valuesand symbols on the reference imageare dedicated to number 2 which is the most similar object to pattern image.

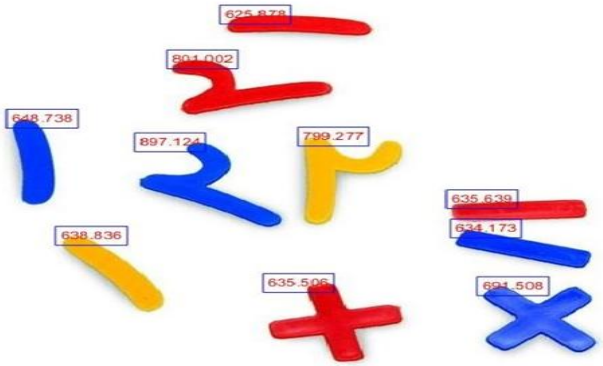

Fig .3: The reference image illustrating the values of the normalized correlation.

The second pattern image isdisplayed in figure 4

Fig .4: The pattern image

The values of the normalized correlation between the various object edge images in the original image and the pattern object edge imageis shown in figure 5. As it is illustrated in this figure,

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the pattern image is the fighter aircraft image and the largest values are dedicated to fighter aircrafts in the reference image which are the most similar objects to pattern image.

Fig .5: The reference image displaying values of the normalized correlation

The approach introduced to detect object on image has its advantages and disadvantages.Its major advantage is that the pattern image is recognized if it is not precisely in the reference image and its rotations exist in the reference image. Another benefit is that this method removes the effect of object radiation as well since images become binary and comparing is provided according to their shape. Additionally, equalizing the size between detected objects in the reference image and the intended pattern binary image makes changes in size have much smaller impact on recognition. Moreover, different sizes of pattern image existing in the reference image can be detected.this method is not practical in elaborate images with complicated background as well as images of different objects of the same colorstick together, as it could cause problem for segmentation and object extraction. Since any object's image is compared with pattern image and its rotations, in terms of computational capabilities, it requires almost large amounts of computation. Therefore, it reduces the speed of system which is considered the disadvantages of this approach.

IV. Conclusion

the proposed method in this article to object recognition is not working properly on some complex images. Howeverif the objects are extracted properly, presented approaches will be rather practical.Eventually, using more appropriate approach for segmentation of reference images with high complexity and accurate object extraction is desired

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