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Threshold Based Image Binarization Technique for Number Plate Segmentation

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Abstract— Videos and images have become essential part of human life in recent era. These images or videos contain many other features which a person would like to extract. This can be possible by using image segmentation technique. There are many image segmentation techniques available today. In this paper we have discussed various image segmentation techniques developed for different domains and compared this techniques based on the different parameters. Towards the end of this paper we have proposed a threshold based binarization method to locate vehicle number plate of Indian vehicle.

Keywords— ***Binarization, Image segmentation, Object recognition, super Pixel, Threshold***

I. INTRODUCTION TO IMAGE SEGMENTATION

Image segmentation is essential for extracting certain portion of image from the image. It is used to identify various objects from the image or videos. It is a process of assigning label to each pixel based on certain characteristics to locate boundaries, curves or certain objects. From the image of a computer system, identification of various components like keyboard, mouse, cabinet etc. is an example of image segmentation. Image segmentation can be used for various purposes like extracting vehicle number plate from vehicle image [5], identifying certain objects from the medical images [2], [3] extracting certain portions from the satellite images [6], Ultrasound images [9], flood detecting in urban and rural areas [10]. The conventional image segmentation method is shown in fig.1. The entire process works in following manner: First any image is given as input to the image segmentation process. Then the image segmentation engine processes image as per the particular image segmentation algorithm and divides image in different image objects as shown in the fig.1. This different image objects are nothing but the useful information obtained from the image. These image objects or image segments are generally known as super pixels. There are different segmentation techniques like Thresholding, Cluster-based method, Compression based method, and Histogram based method as well as other methods are available. To depict image segmentation process we have captured vehicle image as shown in Fig.2 (a), which contains various components including vehicle number plate. Now it is very difficult to extract vehicle number from the

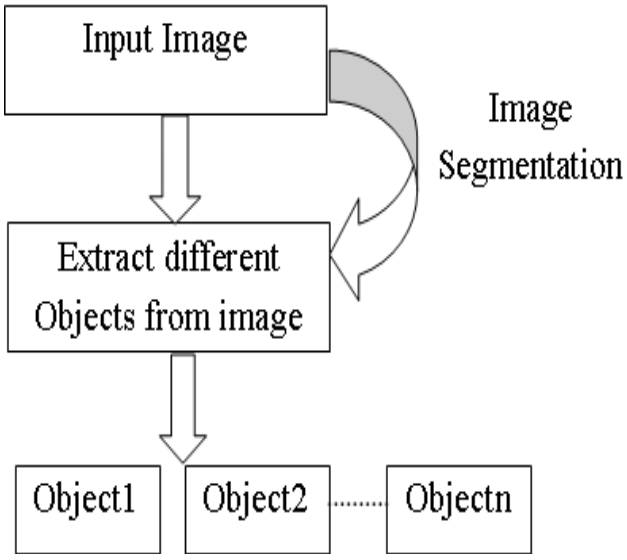

Fig. 1. Block diagram of Image Segmentation process.

entire image. This task can be accomplished by some image segmentation algorithm. After doing image segmentation the vehicle number plate is shown in Fig 2(b). This work is done by using Adobe Photoshop but in real time it should be

(a) (b)

Fig. 2. (a) Image of vehicle (b) Image of vehicle number plate after image segmentation

done automatically without human intervention. In the following sections we have discussed different image segmentation techniques using different technologies.

II. IMAGE SEGMENTATION METHODS

Most of the image segmentation techniques are based on two characteristics: discontinuity and similarity. In discontinuity based algorithm, image is partitioned based on change in the intensity. In the latter approach image is partitioned based on similar regions based on predefined criteria. Image segmentation can be very useful for line detection, point detection and edge detection which are available in many literatures [19],[20], [21].

III. RELATED WORK IN IMAGE SEGMENTATION

An Image segmentation technique based on morphological tools is discussed by Hai Gao et al.[1]. The main focus of their work is on image segmentation in video processing. It is a three stage process including simplification, marker extraction and boundary decision to detect object. To detect fat content from beef images Lucia Ballerini et al [2] proposed an image segmentation technique based on Nuclear Magnetic Resonance (NMR), which is useful for that specific purpose. It contains three steps: background suppression (histogram thresholding), no uniformity removal (median filtering and subtraction), fat extraction (convolved image thresholding), for fat content extraction. An image segmentation technique for ultrasound images based on boundary extraction is presented by P. Abolmaesumi and M. R. Sirouspour [3]. The authors were able to achieve 98% accuracy of segmentation in less than 1 second. A wrapper based approach presented by Farmer, M.E and Anil K. Jain[4] is based on region based image segmentation technique. The authors achieved 91% accuracy among 2000 images. Some segmentation techniques are able to extract only one object from the image but there are some techniques in which multiple objects can be extracted. Ana C. Teodoro et al.[7] developed image segmentation technique for extracting Douro River Plume Size from MEdium Resolution Imaging Spectrometer (MERIS) data. This method uses two techniques: watershed and region based for extracting douro river plum size. Some techniques are useful in medical imaging and can be very handy for special purposes. A system proposed by Mouloud Adel et al.[8] is based on Maximum a posteriori (MAP) probability criterion. It is used for detecting blood vessels from medical images of retina. The authors were able to achieve 0.8 of maximum true positive rate (TPR) and corresponding false positive rate (FPR) as 0.094. Chitsaz, Mahsa and Seng Woo [11] proposed a system for detecting object from medical images. They developed software agent with Reinforcement Learning Approach for extracting several objects simultaneously from Computed Tomography (CT) images. It is a several stage process with some actions in each stage. The authors are able to achieve accuracy of more than 95% with two different datasets of CT images. The processing time for first dataset was 13 seconds and second dataset was 7 seconds. An article written by Kharinov Mikhail Vyacheslavovich [12] is based on adaptive hierarchical segmentation of the digital image for identifying nested image segments. This method divides image segments in various levels starting from 0. A robust image segmentation technique is proposed by Fan Zhong et al. [13]. This system is designed for high reliability of image

segmentation in case of similar color distribution in background and foreground. The work is limited by mainly one parameter i.e. the likelihoods learnt based on color distribution. More improvement can be possible by considering other parameters like curves boundaries etc. In some images, segmentation becomes a difficult task to do.

TABLE I
DIFFERENT IMAGE SEGMENTATION TECHNIQUES

Ref.	Technique	Platform/ Development	Multiple Object segmentation	Image Size
[1]	Morphological	Not reported	Not reported	Not reported
[2]	NMR	Not reported	Not reported	512 X 256 (256 Gray level)
[3]	MATLAB	Pentium IV 2.4 GHZ processor	Yes	Not reported
[4]	Wrapper based approach	Not reported	Not reported	Not reported
[7]	watershed and region based	Not reported	Not reported	Not reported
[11]	software agent with Reinforcement Learning Approach	2.00 GHz Intel Core 2 Duo And java platform	Yes	512 X 512
[12]	adaptive hierarchical segmentation	Not reported	Yes	Not reported
[13]	Constrained Mapping	Not reported	Not reported	Not reported
[14]	Least squares support vector machine (LS-SVM)	Not reported	Not reported	Not reported
[15]	Dual multiScalE Graylevel mOrphological open and close recoNstructions (SEGON)	Not reported	Not reported	Not reported
[16]	Fuzzy possiblistic C-Means Algorithm	MATLAB 7.10	No	Not reported
[17]	Rough Set theory and K-Means	Not reported	No	Not reported
[18]	Evolutionary Iso (EIso) data clustering	Not reported	Yes	Not reported
Proposed	Threshold based binarization	C#. NET	Yes	640 X 480

Hong-Ying Yang et.al. [14] discussed an image segmentation technique based on Least squares support vector machine (LS-SVM). It is a several stage process including new pixel level color feature. Content based image retrieval [15] is also important in the image and video processing. In [15] authors used dual multiScalE Graylevel mOrphological open and close reconstructions (SEGON) for building a background (BG) gray-level variation mesh to identify BG and object regions. The authors claims that the object segmentation method outperforms others by 21% in the the normalized probability random index (PRI).

Another Fuzzy Possiblistic C-Means Clustering Algorithm is proposed in [16], to segment the text from comic images. Before applying modified fuzzy possiblistic C-Means clustering algorithm, pre-processing steps such as color separation and linear stretch model are applied. In color separation process the RGB color space is converted into L * a * b color space where L refers to luminously layer, a indicates that the pixel falls in red-green axis and b indicates that the pixel fall in green axis. Then after Euclidean distance between two points is calculated as per the formula given in this paper. The linear stretch model is used to improve or adjust the picture element as per the formula given in this paper. In fuzzy possiblistic C-Means clustering algorithm, the function is calculated by using different fuzzy partition matrices, which are mentioned in the paper. Amiya Halder and Avijit Dasgupta [17] proposed similar approach by using rough set based K-Means algorithm. It is a two-step process involving K-means algorithm followed by rough set theory to reduce redundant cluster centers. A novel approach is proposed in [18], which is based on Isodata clustering. The proposed algorithm is four step process involving proposed coding, proposed fitness function, proposed mutation operation and proposed Evolutionary Iso(EIso) algorithm.

A comparison of various image segmentation techniques is shown in table I.

IV. PROPOSED WORK

Image segmentation can be further exploited to detect different kind of objects from the video sequences. It can be used to detect certain objects from satellite map, detection and localization of license plate from the vehicle. Our idea is to segment Indian vehicle number plate from the vehicle image. So for the offline image of vehicle we have proposed threshold based binarization based which is discussed in this section.

An image with M number of rows (Width) and N number of columns (Height) can be represented as matrix of 2-Dimensions (2-D) as per the following equation:

$$f(x,y) = (xi, yj), \text{where } i = 0, i < N, j = 0, j < M \qquad (1)$$

Now it can be converted to gray scale as per the formula presented in [22]. After converting color image to gray scale, an adaptive threshold T is calculated to convert image into binary image as per the following equations:

$$\text{black\_white} = 255 \text{ if u } \mu(x,y) > T \text{ and}$$
$$\text{black\_white} = 0 \text{ if u } \mu(x,y) \leq T \qquad (2)$$

Here,

$$\mu(x,y) = \frac{\Sigma\big((x,y)r, (x,y)g, (x,y)b\big)}{3} \; \forall(x,y) \; where$$

$$0 \leq r \leq 255, 0 \leq g \leq 255, 0 \leq b \leq 255 \qquad (3)$$

$$(x,y)r = black\_white \qquad (4)$$

$$(x,y)g = black\_white \qquad (5)$$

$$(x,y)b = black\_white \qquad (6)$$

In above equations r, g and b are the red, green and blue color values of the pixel (x, y). The mean μ is calculated by using the formula given in equation (3), which is mentioned in [22]. If the mean greater than threshold value then 255 is stored in the variable black_white and 0 is stored otherwise as shown in equation (2). Then after value of black_white is assigned to each red, blue and green color components of pixel (x, y). Here value of threshold T is taken as 160 for this specific purpose. The results are presented in fig 3 to fig 5. We have tested this algorithm on 50 Indian vehicles and obtained 88% of number plate segmentation rate which is mentioned in the graph shown in the fig 6. Some of the

Fig. 3. Original Image

vehicle number plates are not as per the standard of RTO so it was difficult to segment those number plates. In few number plates the shadow and illumination conditions are the reasons of unsuccessful segmentation rate.

Fig. 4. After Converting image to gray scale

Fig. 5. Segmentation of license plate after threshold based binarization

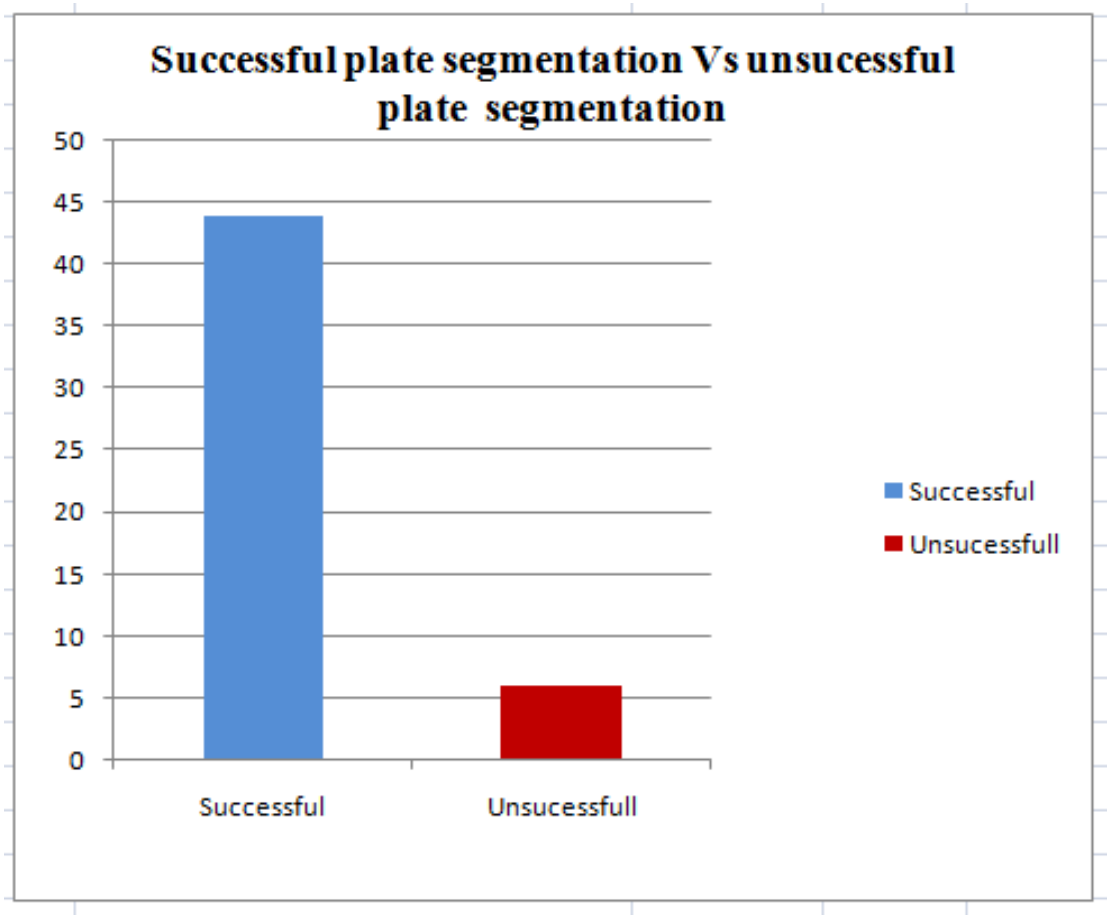

Fig. 6. Graphs of plate segmentation success and failure

V. CONCLUSION

The proposed system works for fixed threshold of 120 and it works for Indian vehicle number plates, which are as per the Indian Road Transport Office (RTO) guidelines. So it might not work for other non uniform number plates and other image objects. In the comparative study of different image segmentation techniques it quite clear that none of the existing image segmentation technique provides 100% accuracy. Some of the techniques work for particular size of image only. It is also not clear that whether these techniques support multiple object segmentation or not. Few image segmentation techniques support multiple object segmentation. As image segmentation technique is not easy task to perform no image segmentation also can provide 100% accuracy but still there is a scope for developing an image segmentation technique to detect multiple objects which can also work on different size of images.

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