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# A SURVEY ON IMAGE SEGMENTATION TECHNIQUES FOR NUMBER PLATE DETECTION

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*Abstract:* In recent days, image processing plays a major role all over the world. Image segmentation is one of the most important steps in image processing. An image consists of many pixels and the purpose of a pixel is used to transmit the intensity information. Segmentation is used to partition an image for marking pixel as foreground pixels or background pixels. It helps to enhance the area for analysis more visible can be achieved for both grayscale images and colored images. This paper deals with the detailed survey of various image segmentation techniques for number plate detection. Number plate detection can be used in various things such as for controlling the speed and traffic, stolen cars identification, near toll gates, security application, parking system etc. A lot of researches have been done on this area and it is useful for creating better secured, efficient monitoring system.

*Index Terms* - Segmentation, Thresholding, Region based, Cluster based, license plate

## I. INTRODUCTION

Image Segmentation is used to divide the image into multiple segments. Each segment will represent some information to user in the form of color, intensity, or texture. Hence, it is very important to segregate the borders of any image in the form of segments. This process of segmentation will give a single value to each pixel of an image in order to make it easy to distinguish between dissimilar areas of any image. This differentiation between different segments of an image is done on the basis of three properties of image, i.e., color, intensity, and texture of that image. The importance of image segmentation is used in almost every field of science, i.e., removing noise from an image, medical images, satellite imaging, machine vision, computer vision, biometrics, military, Image Retrieval, extracting features, recognizing objects from the given image etc.

In the current situation, vehicle plays a major role in transportation system and the vehicles usage is also growing exponentially due to the population growth and their requirements. Without human involvement, the system detects the number plate automatically with the help of image processing technology.

Some of the Vehicle identification methods found are number plate extraction, characters segmentation and optical character recognition. Each and every number plate image fonts are different which makes the detection of character is a hard-hitting job. To make it easy, various segmentation techniques have been used for getting an accurate result for the user.

## II. IMAGE SEGMENTATION SURVEY

Image segmentation is based on some point weighting system using accumulative thresholding algorithm [8].Extracting the vehicle license plate for smart transportation using local binary pattern (LBP) algorithm with 90% accuracy for Character recognition but there it needs some improvement of detecting accuracy and reducing the processing time [16]. Therefore many image segmentation techniques for number plate detection were proposed by various researchers and scientists namely edge based segmentation, threshold based segmentation, projection based segmentation, morphology based segmentation, cluster based segmentation, ANN(Artificial neural network) based segmentation and region based segmentation. These techniques are some of the widely used techniques in license plate recognition as they give accurate results with a faster segmentation.*Fig.1*shows the diagrammatic representation of the classification of various commonly used image segmentation techniques for number plate detection.

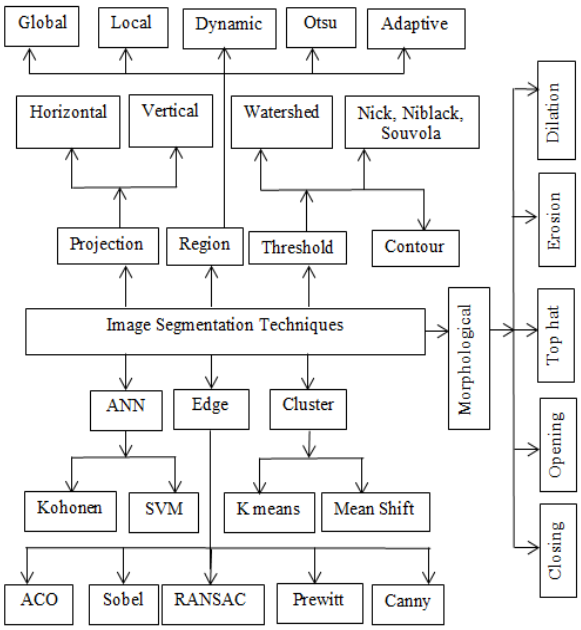


*Fig. 1* Different image segmentation techniques

### A. ANN based Segmentation

An artificial neural network works like a nervous system. ANN based segmentation is a technique used to train the data. First initialize the feed forward neural networks and train it. After training, these networks are simulated and various features are extracted from the image which is assigned as the input patterns to the ANNs. And finally the training is done using back-propagation with both adaptive learning rate and momentum.

#### 1) SVM

Automatic number plate detection in long distance has been created using Support Vector Machine(SVM), Zonal density and adaptive thresholding methods and this method yields an accuracy of 89.77%, 82.86% and 65.22% for 1, 3, and 5 meters capturing distance images. In this work, Zernike Moment or Principal Component Analysis (PCA) was not used [21].Segmentation of the license plate for detection has been enhanced by using Support vector machines, Morphological operations and edge based segmentation techniques and it achieved better accuracy for number plate recognition. But here the real time vehicles number plate cannot be detected [24]. Recognizing the license plate based on supervised K-means and Support Vector Machine with an achievement of hierarchical design is 98.89% in character recognition[17].

#### 2) Kohonen

License plate segmentation has been recognized by using Kohonen Neural Network is adaptable for the real-time system. However the performance was not upgraded because the matrix size and image down sampling are not taken [33]. Segmentation of number plate detection based on Ant's colony optimization, connected component analysis, Kohonen Neural Network and SVM with an accuracy of 94%. But here the computational requirement is high [26].

B. Clusterbased Segmentation

A clustering is defined as the process of organizing objects into groups whose members are similar in some way. A cluster is used to group the similar objects in one group and the others in some other similar group.Segmenting the license plate recognition using connected component analysis and clustering methods increases overall performance by 93.54% [18].

1) K mean

Segmentation of the license plate based on supervised K-mean and Support Vector Machine achieved good accuracy in character recognition and better improvement in recognition rate but it doesn't support Android and IOS application [17]. Lebanese License plate is automatically recognized by using labeling and K means algorithm with the western writing number plate but the method is not robust [2].

2) Mean shift

The License plate localization application based on morphological operation, thresholding method and mean shift algorithm shows that it is more accurate and robust. But this algorithm contains number of loops which takes longer time to produce the result[29].A number plate is detected by using mean shift algorithm and Mahalanobis classification showed that this algorithm produces high robustness and accuracy. However, the gradient variance information is not used [35].

C. Edge based Segmentation

An edge filter is accurate to the image, pixels are divided as edge or non-edge dependent on the filter output, and pixels which are not detached by an edge are allocated to the same category. Here, the detected edges in an image signify object borders, and handled down to recognize these objects. The easiest way to detect edges in an image is to concentrate for places in the image where the intensity changes promptly.

1) *ACO*

Segmentation of number plate image has been improved by using Ant's colony algorithm, Robert and sobel edge detection techniques with 92.6% accuracy on 30 varying test cases. But here the detection task of edge is memory and time consuming without optimization [9].

2) Sobel

Automatic vehicle number plate recognition system on OCR has been improved using sobel edge detection, horizontal projection and artificial neural network with good accuracy results. However, this system is not suitable for real time system because of the larger processing time [14].Number plate segmentation has been enhanced by using Ant's colony algorithm, Robert and sobel edge detection techniqueswith an achievement of 92.6% accuracy on different test cases [9].

3) RANSAC

Detecting the dirty vehicle number plate for high speed applications in an accurate manner using Adaptive threshold and RANSAC (Random Sampling Consensus) algorithm with an achievement of 98.7% accuracy for plate detection, 99.2% accuracy for character segmentation and 97.6% accuracy for plate recognition[23].

4) Prewit

Segmenting the license plate on edge detection algorithms such as Sobel, Prewitt, Roberts and Canny with the recognition rate is above 95%. This method does not provide a good result for extra challenging background images [22]. License plate detected by using edge detection methods such as Prewitt, Sobel, Canny, LOG and Robert with the method of detection of license plate image positioning is feasible and effective. But optical character recognition process has not been found [34].

5) Canny

Segmentation of the vehicle's number plate which is either stationary or running at a high speed using morphological operations, canny detection algorithm and thresholding techniques with the success rate is about 92% accuracy with varying light conditions. The reason of failure in certain cases were mostly due to the irregular size of the number plate or the images were taken from a long distance

[12].Vehicle number plate recognition has been created using robust algorithm such as morphological operations and edges detection techniques as such by sobel, canny and Fuzzy logic, convolution, median filtering and scaling image for boosting visual spatial feature and extraction of number plate achieved 90.18% accuracy. However cracked number plate, unclear images and low determination of the characters has not been considered [20].

*D)* Morphological *operations*

Morphology is a widespread set that the process is based on shapes of images. There are 4 operations namely closing, opening, dilation and erosion. Morphological operations are used to apply a structuring element to an input image, for creating an output image of the same size. Detecting the license plate based on morphological operations and gentle boost algorithm achieved 97.52% accuracy in detection but it does not give an accurate result in illumination condition of the images [19].

1) Opening

License plate detection recognized by using otsu algorithm, morphological opening, closing and Top hat filtering operation achieved better accuracy results in all shadow and dirty images and 100% accuracy in all clear images [36]. License plate detection is based on morphologicalopen and close operations to increasingly reject the non-plate region and enhancing the plate region and this method achieved 98% accuracy, low computational complexity but artificial neural network has not been used for train the data [39].

2) Closing

Indian license plate images has been detected in a real time application using vertical edge detection algorithm, morphological closing operation and Top Hat Transformation suppresses the background image and remove the radiance which are not uniform. However the location error has been taken place in the case of dirty and fuzzy images [3].

3) Top hat

Detecting the vehicle number plate recognition using top hat transformation, median filter and sobel edge detector with an accuracy of image segmentation is 86.67% and recognition is 93.33% but blurred images and broken number plate cannot be segmented [4].Extracting the license plate recognition using top hat morphology transformation, local and global thresholding method and it achieved better results of using machine learning methods [28].

4) Dilation

Applying various conditions such as edge detection, image dilation, otsu's thresholding method for number plate detection was achieved successfully by edge detection techniques but noisy, visibility in the darkness and tilting images has not been segmented accurately [6]. License plate has been automatically recognized using vertical edge detection algorithm and morphological operations of dilation, erosion has been used with good efficiency and the execution time but there is an issue in which the recognition of mobile license plates was not extended [25].

5) Erosion

Extracting the number plate detection and character recognition by using robust algorithm, morphology operations, Spatial image filtering with an accuracy of the novel algorithm is 79.30% and there is limitation in this algorithm is broken number plate, blurred images of the vehicle plate which was not working properly [20].

D. Projection based segmentation

The projection based segmentation is based upon the idea of projecting the image data onto the X-axis. It is implemented by collecting the number of non-white pixels in each column of the image parallel to the Y-axis. The projection in the X-axis will gradient to appear large and unstable, when a component represents a character rather than an item of disorder. Therefore, by computing a component's projection value and its variance value it is possible to differentiate between disordered components and character components.

1) Vertical

Tracing the license plate based on median filtering double edge detection and vertical projection segmentation algorithm. In optical character recognition, the recognition method reduces the amount of calculation and time-consuming and also increases the accuracy. But it consumed a large memory [7]. Calculating fee of automated parking vehicle system has been proposed using edge detection and vertical projection methods with better accuracy. In this method, there is a limitation in which the low resolution and reflection images are not applicable for this system [37]. Detecting license plate has been segmented by median filtering algorithm and vertical projection technique and it achieved that the method is simple, fast and low-cost but real time vehicles is not applicable [10].

2) Horizontal

Segmentation of the license plate character detection by using horizontal projection, connected component analysis with an average accuracy of license plate has been created [1]. Indian vehicle license plate detected by using KNN classifier, vertical and horizontal projection technique with an accurate percentage of day time vehicle image is 78% and night time vehicle image is 70%. But it doesn't get higher frequency because neural network was not used [11].

F. Region based segmentation

In region based segmentation, it operates iteratively by grouping together pixels that are neighbors are similar in value and splitting groups of pixels are dissimilar in value. The main goal of region based segmentation is to partition an image into regions.

1) Nick, Niblack and Souvola

Automatic number plate has been segmented by using Nick, Niblack and Souvola algorithms with an average performance of plate area detection algorithm is 94.458% but here Markov chain algorithms are not used for the improvement of character recognition [5].

2) Contour

A security application for parking a vehicle without any discomfort using contour detection and KNN algorithm has been proposed. Any authorized personnel can access the data and track the vehicle information from the webpages using an application. However, it is not suitable for blurred images and number plates which are broken [31].

3) Watershed

Localization of vehicle number plate has been segmented using watershed algorithm, morphological operations and visualization techniques as it handled real time traffic images and results in 93% accuracy but ANN techniques was not used [32]. A vehicle license plate detection is based on the method of slant correction watershed algorithm (SCWA) is more efficient than Principle component analysis. However, a more images were not used for testing SCWA method [40].

G. Threshold based segmentation

In threshold based segmentation, pixels are assigned to types according to the range of values in which a pixel lies. Pixels with values less than 128 have been placed in one category, and the remaining was placed in the other category. Thresholding method is based on image space regions. It is used to alter a multilevel image into a binary image that is, it chooses a particular threshold T, to segregate image pixels into several regions and separate objects from background.

1) Local threshold

Segmentation of the license plate recognition using top hat morphology transformation, local and global thresholding method, machine learning techniques achieved better results. However the vehicle speed approximation, rain streaks removal, vehicle model identification and owner identification was not concentrated [28].

2) Global threshold

3) License plate detection has been created by using feedback based method which is fusion of local and global thresholding method and it achieved 98% accuracy in feedback method but it does not affect the timing performance significantly [30].

4) Dynamic

Detection of the number plate is automatically done by using Gaussian morphological operation, dynamic thresholding and connected component analysis, an image with different backgrounds and illumination condition was proven effective. But artificial neural network is not used in optical character recognition process for an accurate result [13].

5) Otsu method

Detection of vehicle license plate with segmentation and enhancing the template matching approach using Otsu's thresholding, bounding box feature in which the segmented number plate has been matching with the trained template in an accurate manner. However the roaming vehicle plate has not been detected and it does not enhance the application [38]. License plate detected by applying different conditions such as otsu's thresholding, edge based detection and dilation with good accuracy results [6].

6) Adaptive

Real time vehicle plate has been segmented using contour detection, homographic filter, adaptive threshold and OCR algorithm with the accuracy of Contour Threshold based segmentation.

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11) Adaptive

Real time vehicle plate has been segmented using contour detection, homographic filter, adaptive threshold and OCR algorithm with the accuracy of Contour

## III. DISCUSSION

An elaborate survey of various segmentation techniques for license plate detection has been discussed in this paper. The data was not trained because an artificial neural network was not used. Detection task of an image is a memory and time consuming process without optimization. Real time application and varying illumination condition images has not been considered in a better way.

## IV. CONCLUSION

This paper provides a brief survey of various segmentation techniques for number plate detection. From the comprehensive study of several image segmentation techniques, it is clear that each technique has its own diagnoses and limitations. Each and every image varies in several aspects like color, intensity, texture and pattern. Therefore, the process of segmentation technique diverges from one image to another and the single image segmentation technique doesn't show the accurate results. Using multiple approaches for segmenting the captured image can give us an exact output without any inconvenience.

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