A Review Paper on Automatic License Plate Recognition System (ALPR) using Enhanced Image Processing Techniques for Criminal Surveillance

[1]Siddharth U. Mishra(Author)
B. E. Computer,
Department of Computer Engg.,pune

[2]Amit A. Badgujar(Author)
B. E. Computer,
Department of Computer Engg.,pune

[3]Sushant N. Asija(Author)
B.E. Computer,
Department of Computer Engg.,pune

[4]Bhavana Julme(Guide)
Professor,
Department of computer Engg.,pune

***Abstract*—Automatic license plate recognition system aims at extracting the license plate from a vehicle and using it for various purposes. In this paper we do a systematic study of the existing ALPR systems, the basic algorithm used, the variations in the existing algorithm to improve the overall system. We also present the list of applications where this system could be used, we elaborate one such application which is the criminal surveillance. The system which we are developing recognizes a six digit license plate which could be also modified to detect various other types of license plates as well. The algorithm mostly concentrates on localization of license plates and then go on to extract the characters by using morphological operations such as dilation, eroding the image, dilating, filtering etc. All these morphological operations leads to the efficiency of overall system.**

Index Terms – Automatic license plate recognition(ALPR), Vehicle license plate recognition(VLPR) , character recognition.

I. INTRODUCTION

Automatic number plate recognition systems (ANPR) provide a means to overcome the drawbacks and deficiency of successful surveillance of the cctv cameras. The ANPR system is well developed in certain countries such as USA and Dubai, and existed from a long time, but only in the late 90s it became an important application because of the large increase in the number of vehicles. The information extracted from the license plates is mainly used for traffic monitoring, access control, parking, motorway road tolling, and border control, making car logs for parking systems, journey time measurement for toll booth etc. by the law enforcement agencies. The recognition problem is generally sub-divided into 5 parts: (1) image acquisition i.e. capturing the image of the license plate (2) pre-processing the image i.e. normalization, adjusting the brightness, skewness and contrast of the image (3) localizing the license plate (4) character segmentation i.e. locating and identifying the individual symbol images on the plate, (5) optical character recognition. There may be further refinements over these (like matching the vehicle license number with a particular database to track suspected vehicles etc.) but the basic structure remains the same. A guiding parameter in this regard is country-specific traffic norms and standards. This helps to fine tune the system i.e. number of characters in the license plate, text luminance level (relative index i.e. dark text on light background or light text on dark background) etc. So the problem can then be narrowed down for application in a particular country. For example, in India the norm is printing the license plate numbers in black color on a white background for private vehicles and on a yellow background for commercial vehicles. The general format for the license plate is two letters (for state code) followed by district code, then a four digit code specific to a particular vehicle. In U.S.A no strict guidelines have been set regarding the fonts that can be used for this purpose.

II. STEPS

Number plate is a pattern with very high variations of contrast. If the number plate is very similar to background it's difficult to identify the location. Brightness and contrast is changes as light fall changes to it. The morphological operations are used to extract the contrast feature within the plate. The work is divided into several parts. The basic four stage algorithm for ALPR system is:

- Image acquisition
- License plate localization
- Segmentation
- Character recognition

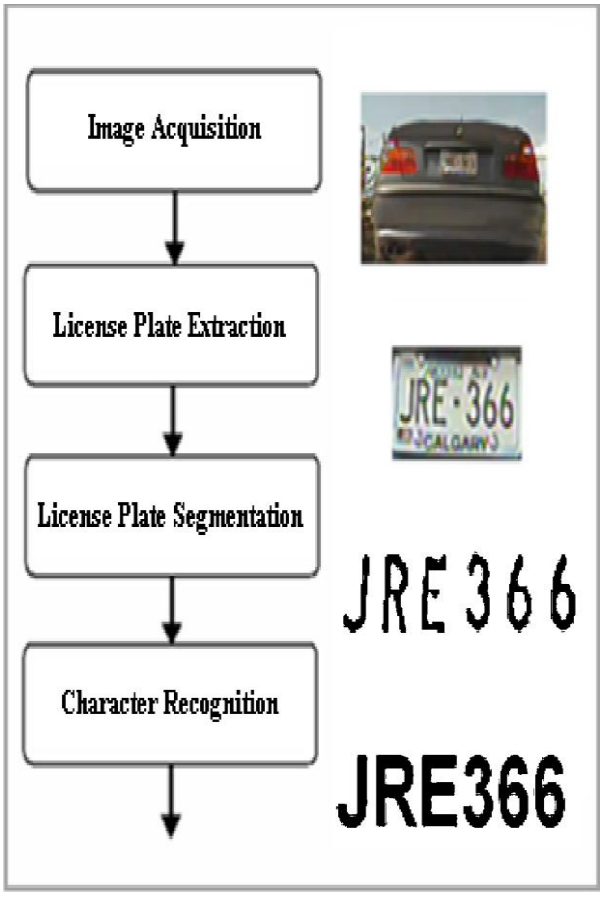

Fig.1. Four basic steps.

In the basic four stage algorithm, first of all the image containing the license plate is acquired, then the license plate is localized followed by license plate segmentation and character recognition. The aforesaid four stage algorithm could be elaborated to improve the efficiency of the system as per the requirement, to elaborate this basic algorithm here we present the proposed system in detail which is as follows:

- Input raw image
- Grey scale conversion
- Median filtering or noise reduction
- License plate localization
- Segmentation of the characters

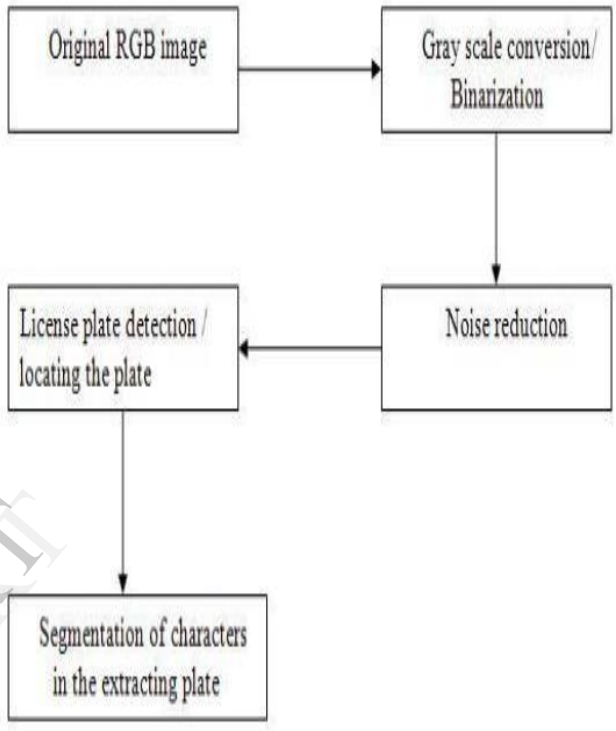

Fig.2.Block Diagram of proposed approach

III. OPERATIONS

A. Input Raw Image B. Gray Scale Conversion: From the input RGB image it has to be convert to gray scale and the 8it gray value is calculated. After grey scale conversion the morphological operations begin which starts with dilation of an image, in figure 3 we show the process of dilation.

Fig. 3.After Dilation of gray scale image.

After the dilation of image we erode the image and apply median filtering technique which is the basis of noise reduction.

C. Noise Reduction:

We used median filtering technique to reduce the paper and salt noise. We have used 3x 3 masks to get eight neighbors of a pixel and their corresponding gray value. After applying the median filtering technique we erode the image by a structural element in the form of any shape. We go on to find the morphological gradient for edge enhancement, then we convert the class to double for brightening the edges and perform the convolution of the double image. Figure 4 shows the convoluted image.

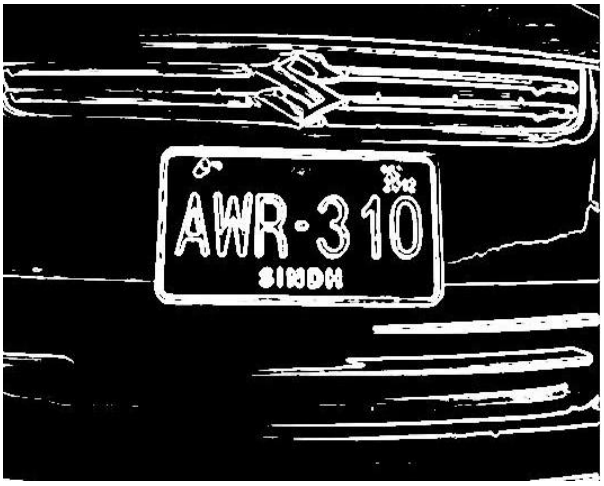

Fig.4. Convolution of the image for brightening the edges

D. Contrast enhancement using histogram equalization

Using histogram equalization technique the contrast of each image is being enhanced.

E. Plate Localization

The basic step in recognition of vehicle number plate is to detect the plate size. In general number plates are rectangular in shape. Hence we have to detect the edges of the rectangular plate.Mathematical morphology will be used to detect that region. Using Sobel edgedetector we used to high lightregions with a high edge magnitude andhigh edgevariance are identified. Depending upon the threshold value edge will be detected from the input image.

F. Character Segmentation:

Matlab toolbox function provides a function called regionprops(). It measures a set of properties for each labeled region in the label matrix. We use boundingbox to measure the properties of the image region. After labeling the connecting components, the region will be extracting from the input image.

IV. LITERATURE SURVEY

S.Roy, A. Choudhury, J. Mukherjee. [1]The proposed a system to localization of number plate mainly for the vehicles in West Bengal (India) and segmented the numbers as to identify each number separately. This paper presents an approach based on simple and efficient morphological operation and sobel edge detection method. He also presents a simple approach to segmented all the letters and numbers used in the number plate. After reducing noise from the input image we try to enhance the contrast of the binarized image using histogram equalization. We mainly concentrate on two steps; one is to locate the number plate and second is to

segment all the number and letters to identify each number separately.

S. Du, M. Shehata, W. Badawy [2] Describe a comprehensive survey on existing (Automatic License Plate Recognition) ALPR Techniques by categorizing them according to the features used in each stage. Comparisons of them in the terms of Pros, Cons, Recognition results, & Processing speeds were addressed. A future forecast for ALPR was also given at the end. The future research of ALPR should concentrate on multi-style plate recognition, video-based ALPR using temporal information, multi-plates processing, high - definition plate image processing, ambiguous -character recognition.

P. anishiya, prof. S. Mary Joans [3] focused a number plate localization and recognition system for vehicles in Tamilnadu(India) is proposed. This system is developed based on digital images and can be easily applied to commercial car park systems for the use of documenting access of parking services ,secure usage of parking houses and also to prevent car theft issues. The proposed algorithm is based on a combination of morphological operation with area criteria tests for number plate localization.

D. Jiang,T. M. Mekonnen,T. E. Merkebu,A Gebrehiwot.[5] Discussed paper presents about car plate recognition system.it describes, design algorism and future of implementation. The system has color image inputs of a car and the output has the registration number of that car. The system has three main steps to get the desired information. Those are plate localization, character segmentation and character recognition. First, the number of plate is extracted from the original image, then the characters from it are isolated, and finally each character is recognized. The algorithms were developed using a set of training images. The final program is capable of extracting the desired information in a high percentage of the test images.

Z. Xu, H. Zhu.[6] Presented an efficient and robust method of locating license plate is presented. The method makes use of the rich corner information in the plate area and the edge information of license plates. It can deal with more difficult location problems, especially with a license plate existing in a complicated background.

V. APPLICATION

The ALPR system has wide ranged applications such as traffic surveillance for criminal detect, toll booth collection, parking management, distance travel management etc.

[14]The ANPR system for traffic surveillance could be installed on a bridge to track down the entire road way and record the motion of each and every vehicle. If a suspected vehicle is detected the proposed system looks for the entries in the database provided by the concerned authority such as local RTO to immediately find the details of the suspected person and inform the local police.

In this way number of crime cases can be reduced by a great extent and also many such cases could be avoided in which the deriver runs off during an accident.

Fig.5. ALPR system installed on a bridge

Instead of a bridge an ALPR system can also be installed on tower on some height from where the entire glance at the traffic could be made. Figure 5 shows one such arrangement.

Fig.6. An ALPR system installed on a pole

Component Used:

Camera

[18]The Camera itself consists of an infrared detecting camera, a general optical color detecting camera and an infrared light emitting array of LEDs. The LED array beams infrared light in the direction of the infrared camera, which then captures the light reflected by the white background of the number plates of passing by vehicles, which appears white on the image.

The non-reflecting color of the characters and the vehicle's surface appear black. Direct sunlight enhances the infrared reflection, the LED array however is bright enough to recognize number plates in absolute darkness. The focal length of the infrared camera is adjusted to detect an overall width of one lane. The color camera with a lesser focal length generates images for overall view and alignment of the whole camera body. Both images are sent in intervals of 300ms to a Computer, where the installed software processes them. ANPR-systems can be either set up as shown in Figure 3 on a bridge construction over a carriageway or on the hard shoulder of a carriageway. In the latter case it is not possible

to detect traffic on two lanes because the further lane will not be recognizes optimally due to shadowing effects.

Fig.7. ALPR system recognizing the details of a car

VI. SUMMARY, FUTURE WORK AND CONCLUSION

A. Summary

In general, an ALPR system consists of four processing stages. In the image acquisition stage, some points have to be considered when choosing the ALPR system camera, such as the camera resolution and the shutter speed. In the license plate extraction stage, the license plate is extracted based onsome features such as the color, the boundary, or the existence of the characters. In the license plate segmentation stage, the characters are extracted by projecting their color information, by labeling them, or by matching their positions with template.

Finally, the characters are recognized in the character recognition stage by template matching, or by classifiers such as neural networks and fuzzy classifiers. Automatic license plate recognition is quite challenging due to the different license plate formats and the varying environmental conditions. There are numerous ALPR techniques that have been proposed in recent years. Issues, such as main processing procedure, experimental database, processing time, and recognition rate, are provided. However, the authors of [4] pointed out that it is inappropriate to explicitly declare which methods demonstrate the highest performance since there is a lack of uniform way to evaluate the methods.

B. Current trend and future work

The existing ALPR system has many deficiency such as inaccurate results if the image is not of proper texture for example, if the image contains blurred or tilted license plates the results are always inaccurate. So the existing algorithm could be modified to produce better results. Furthermore, the character recognition has limitations such as number of characters which varies from region to region thus there is a great need of a universal algorithm for the same.

C. Conclusion

From review of various papers we conclude that there are different techniques available for recognition of car number plate such as sobel edge detection method, Automatic license plate recognition, Novel method used for detects edge & fill holes less than 8 pixels only, categorize features in each stage, identifying & recognizing car license plate. Therefore at this stage we use improved character segmentation method to reduce effort required for recognizing vehicle license number plate.

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