ISSN: 2395-7549

Enhanced Mass Vehicle Surveillance System

Prakash J.
Assistant Professor
Department of Computer Science & Engineering
PSG College of Technology, India

Abstract

Mass surveillance is the close supervision of an entire or a large part of an area, which is applicable in various applications like parking lots, garbage door opening, security control of restricted areas, automatic toll collection, traffic law enforcement, etc. Now a day with the increasing population the usage of vehicles has increased, therefore the controlling of vehicles is becoming a big issue to solve as large amount of vehicles are parked in the common places. In such places a mass surveillance is required, so in those cases we can use automatic license plate recognition (ALPR) technique. Which have difficulties like an illumination in the image, uneven illumination, dim light and foggy conditions make the task of image enhancement even more difficult and recognition of ambiguous like (B-8), (O-0), (I-1), (A-4), (C-G), (D-O), (K-X), and broken characters makes the character recognition challenging. An ALPR system is developed that will overcome these issues and provide an effective and efficient mass surveillance system.
Keywords: Mass Surveillance, Automatic License Plate Recognition (ALPR), License Plate Extraction, License Plate Segmentation, Character Recognition

---

I. Introduction

Mass surveillance is the prevalent surveillance of a substantial fraction or an entire of population. The surveillance is typically carried out by governments, often surreptitiously, but may also be done by corporations at the behest of governments or at their own initiative. It may or may not be legal and may or may not require authorization from a court or other independent agency [1]. Mass surveillance systems are useful in various applications like parking lots, Boarder Crossing Control, Identification of stolen vehicles, Red light camera, etc. The Automatic license plate recognition system recognizes a vehicle's license plate number from an image and processes it using various techniques like Image Acquisition (IA), License Plate Extraction (LPE), License Plate Segmentation (LPS) and Character Recognition (CR).

The Automatic license plate recognition system that extracts a license plate number from a given image can be composed of various stages as shown in the Fig.1.1. The first stage is to acquire the car image using a camera. The camera parameters, such as the light, shutter speed, camera resolution; camera type and orientation need to be considered. The second stage is extracting the license plate from the image based on some features, such as the boundary, the color, or the characters existence. The next phase is to segment the license plate and extract the characters by projecting their color information, or matching their positions or labeling them with templates. The final phase is to recognize the characters extracted using classifiers or by template matching, such as neural networks and fuzzy classifiers.

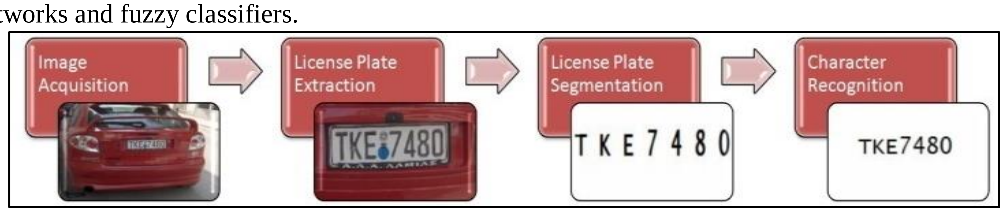

Fig. 1.1: Stages of ALPR

In this paper the illumination problem is been controlled. Uneven illumination and poor contrast in the digital images are the common problems associated with digital image processing. The presence of illumination in the image will make it look too bright or too dull. This illumination problem affects the accuracy and effectiveness of the system. Where the illumination problem is that will affect the image and make it to visible in different colour which is influenced by light. Illumination problem will make the image extraction more complex and the success rate reduces. To overcome that a methodology is proposed which will take the acquired image and enhance it by eliminating the illumination problem.

The recognised character can be an ambiguous character (i.e. B-8, o-0, I-1, a-4, c-G, D-o, k-X) which could affect the recognition rate of the system. To overcome this ambiguity problem a methodology is been proposed.

The remainder of this paper is organized as follows. In Section II, The related work is discussed. The proposed methodology is described in section III. Section IV demonstrates experimental results and Section V and VI discuss conclusion and areas for future research

II. RELATED WORK

Although license plate detection is been existing for many years, it is still a challenging task to detect license plates from different angles, partial occlusion, or multiple instances.

In [2], license plate recognition methods are :(1) Image Acquisition: By digital camera (2) License Plate Extraction: vertical edge detection by sobel algorithm, filtering by seed filling algorithm, vertical edge matching (3) Segmentation: (4) Character Recognition: Normalization, Template matching using hamming distance approach. by this paper referenced getting the result like: License Plate Extraction: 587/610, 96.22% License Plate Segmentation: 574/610, 94.04% License Plate Recognition: 581/610, 95.24%, and overall system efficiency: 95%. This approach having some problem in extracting the plate, diplomatic cars and military vehicles, are not addressed since they are rarely seen also it detects only white, black, red, and green color plate or numbers.

By [3], (1) Extraction of plate region: edge detection algorithms and smearing algorithms (2) segmentation of Characters: smearing algorithms, filtering and some morphological algorithms (3) recognition of plate characters: template matching. Final output it is proved to be 97.6% for the extraction of plate region, 96% for the segmentation of the characters and 98.8% for the recognition unit accurate, giving the overall system performance 92.57% recognition rate. Its having some limitation like it recognition of car license plate only, and this system is designed for the identification of Turkish license plates.

In [4], recognition steps are as follow: (1) Image Enhancement: by histogram equalization method (2) Structuring Elements: by thickening, (3) Hat transformations: which is use for contrast, enhancement (top has & bottom has) setting (4) Morphological Operations like dilation and erosion (5) Plate region confirmation (6) Character Segmentation and Recognition by neuron implementation model. By this reference 250 color images were used for testing the technique, These results report a high accuracy rate of above 95%.Although the technique is quite efficient enough to work very well in the real time environment but currently the proposed technique places more emphasis on the accuracy of the overall system, while some work is done to make the technique more efficient.

By [5], mainly focused on Edge Detection (Sobel Edge Detection) technique and then filtering of noise by Median Filter, Smoothing, Connector, Masking, and then Color Conversation is done. We can see that the detection is not that clear and proper, which we find, is due to improper light segment or varying illumination effects. And all over system result is not mention in this paper.

In the reference [6], the proposed algorithm consists of three major parts: Extraction of plate region, segmentation of characters and recognition of plate characters. For (1) extracting the Plate region, edge detection algorithm and vertical projection method are used. (2) In segmentation part filtering, thinning and vertical and horizontal projection are used. And finally, (3) chain code concept with different parameter is used for recognition of the characters. The performance of the proposed algorithm has been tested on real images. Total Vehicles Images 150(tested under sunny, cloudy, daytime, nigh time, rainy days, and atmosphere), Extracted license plates147 Unsuccessful Extraction 3 and final system Efficiency: 98%. The proposed method is mainly designed for real-time Malaysian license plate, and can be readily extended to cope with license plates of other countries, especially those using Latin characters.

By[7],involve three approaches:(1)In plate localization Noise alleviation, Changing color space, Intensity dynamic range modification, Edge detection ,Separating objects from background, Finding connected component ,Candidate selection, all above process are used (2) In segmentation part multistage model are used.(Improvement, Rotation, Binarization, Segmentation, Preparation,) (3) The recognition artificial Feed forward neural network is used. The method achieved accuracy over 91% for localizing plates. The recognition system implemented by neural networks after segmentation of characters in image plate identify alphabets and numbers separately and achieve an accuracy over 97% and 94% respectively for each. Advantage of this approach is the image database includes images of various vehicles with different background and slop under varying illumination condition and the disadvantage is detection only for English and Parisian number plate.

In[8] For the Number plate recognition first image conversion in binary and apply to neural network, and apply mpl algorithm, then detection individual symbol, by matrix mapping, and Training by this approach obtained 96.53% average recognition rate using double hidden layer and 94% using single hidden layer. The captured image 2-3 meters taken away from the cameras.

By[9] (1)Pre-processing of Image by histogram equalization (2)Extraction of plate region by edge detection algorithm(canny operator) and Plate Area Detection by various morphological operations (3)Segmentation of characters by connected component, bounding box method , Median filter. And observed final result as Extraction: 71/78 which gives 91.02% efficiency, Segmentation 69/78 which gives 88.46%efficiency. Overall accuracy of our system is 89.74%.proposed method is sensitive to the angle of view, physical appearance and environment conditions.

In[10] detection steps are :(1)Image acquisition by capturing an image of a vehicle from video (2)License plate detection extraction, by Spectral Analysis Approach and Connected Component Analysis (3)extract the region of license plate process use spectral analysis (4)Character segmentation use Connected component analysis approach and SVM feature extraction techniques. The advantage of this approach is success full recognition of a moving vehicle.

III. PROPOSED WORK

This section describes the proposed work of the ALPR system that will overcome the issues of illumination problem and ambiguity and provide an effective and efficient mass surveillance system. Fig 3.1 shows the various stages of the system.

A. Image Acquisition

Image acquisition is the process of obtaining an image from the camera. This is the first step of any Automatic License Plate Recognition systems. In our current research we acquire the images using a digital camera placed at the road side facing towards the incoming vehicles. Here our aim is to get the frontal image of vehicles which contains license plate.

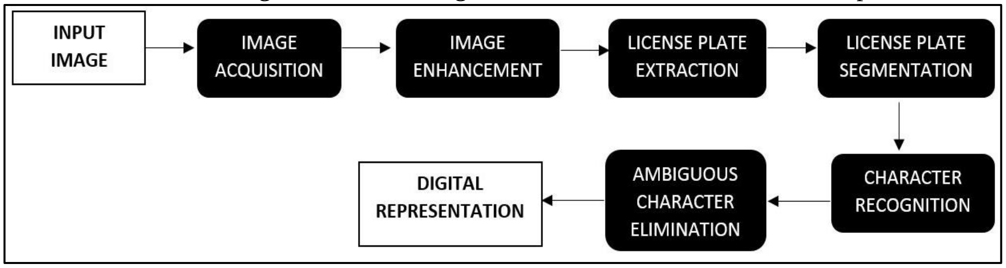

Fig. 3.1: Proposed ALPR Stages

B. Image Enhancement

In this stage of image enhancement the acquired image is obtained and that image is processed by eliminating the illumination problem and enhanced. The captured image is normalized, eliminating noise, and improving contrast. A new graphic file is obtained with an enhanced image.

In image enhancement, First, we converts RGB values to gray scale values by forming a weighted sum of the R, G, and B components, with 8 bits per pixel, which allows 256 different intensities.
The effective luminance of a pixel is calculated by the Eq.

$$Y\ 0.2989*R = +\ 0.5870*G + 0.1140*B \quad (1)$$

Second, we adjust old intensity values of gray scale image to new values, the image is weighted toward lower (darker) output values. For intensity images, the n bins of the histogram are each half-open intervals of width $A/(n-1)$ the p_{th} bin is the half-open interval.

$$\frac{A(p-1.5)}{(n-1)} - 32678 \le \frac{A(p-0.5)}{(n-1)} - 32678 \quad (2)$$

Where x is the intensity value, the scale factor A is 255, because the intensity image of class uint8. Third, we convert to binary image use Otsu Method, the image converted by Eq.2

$$g(x, y) = \begin{cases} 1 \text{ if}(x, y) \ge T \\ 0 \text{ otherwise} \end{cases} \quad (3)$$

where, T is some global threshold, which defined by Otsu's method, computing a global threshold (level) that can be used to convert an intensity image to a binary image, level is a normalized intensity value that lies in the range [0, 1], which chooses the threshold to minimize the intra class variance of the black and white pixels.

C. License Plate Extraction

In license plate extraction input to this stage is the enhanced image, and the output is a portion of the image containing the portion license plate.

The license plate can exist anywhere in the image, Instead of processing every pixel in the image, which increases the processing time, the license plate can be identified by its features, and therefore the system processes only the pixels that have these features. The features are derived from the license plate format and the characters organizing it. License plate color is one of the features since some authorities (i.e., countries, states, or provinces) have certain colors for their license plates. The rectangular shape of the license plate boundary is another feature that is used to extract the license plate. The color change between the characters and the license plate background, known as the texture, is used to extract the license plate region from the image. The presence of the characters can be used as a feature to identify the region of the license plate. Here more features are combined to identify the license plate.

Assuming that the character pattern is an H _W image f(i, j),where (i, j) is the pixel at i^{th} row and j^{th} column ($1 \le i \le H, 1 \le j \le W$), then the construction of an $N \times M$ mesh ($N \le H, M \le W$) can be described as follows. First, the horizontal and vertical projection profiles, h(i) and v(j), are computed using

$$h(i) = \sum_{k=1}^{W} f(i, k), 1 \le i \le H, \quad (4)$$

$$v(j) = \sum_{k=1}^{H} f(k, j), 1 \le j \le W, \quad (5)$$

D. License Plate Segmentation

The extracted license plate is then segmented to extract the characters for recognition. An extracted license plate from the previous stage may have some problems, such as tilt, noise and non-uniform brightness. These problems are overcome using this segmentation algorithm.

The first step in the segmentation is contrast stretching where the contrast of the extracted image is improved. Then the contrast stretched image may contain noise that is removed by using median filtering. Now the obtained noise free image is been converted from RBG to GRAY. The obtained gray image is segmented by using Sobel Edge Detection to find the edges of the image.

E. Character Recognition

Character Recognition is the mechanical or electronic translation of images of handwritten or typewritten text (usually captured by a scanner) into machine-editable text. The procedure consists of two important steps, training and recognition.

To recognize the characters were feature extraction is performed which is the basic concept to recognize the character. The feature extraction is a process of conversion of data from a bitmap representation into a form of descriptors, which are more suitable for computers. The recognition of character should be invariant towards the user font type, or distortions caused by a skew. Also, all instances of the same character should have a similar description. A description of the character is a vector of numeral values, so called descriptors or patterns.

The image obtained after segmentation is Grayscale. The first step is the character training, the template for each character is created by inserting value 1 for every white pixel and 0 for every black pixel. It is done similarly for each character and calculate the weight to get the template.

The matching score of the segmented character from the templates of the character stored is calculated. The pixel values of the matrix of segmented character and the template matrix is compared, and for every match we add 1 to the matching score and for every mismatch we decrement 1. This is done for all 225 pixels. The match score is generated for every template and the one which gives the highest score is taken to be the recognized character.

IV. EXPERIMENTAL RESULTS

Experiments have been performed to test the result of the proposed Automatic License Plate Recognition System. The performance of the system is identified by measuring the success rate of the in each stage of the system.Fig.4.1. Shows the graphical representation of the comparison of the existing four stages ALPR system and the proposed enhanced mass surveillance system from the analysis it is clear that the enhanced mass surveillance system provides better outcome and is more effective than the existing four stage ALPR systems and Fig.4.2. Shows the graphical representation of the comparison of the processing time of the systems which shows the enhanced mass surveillance system is much effective.

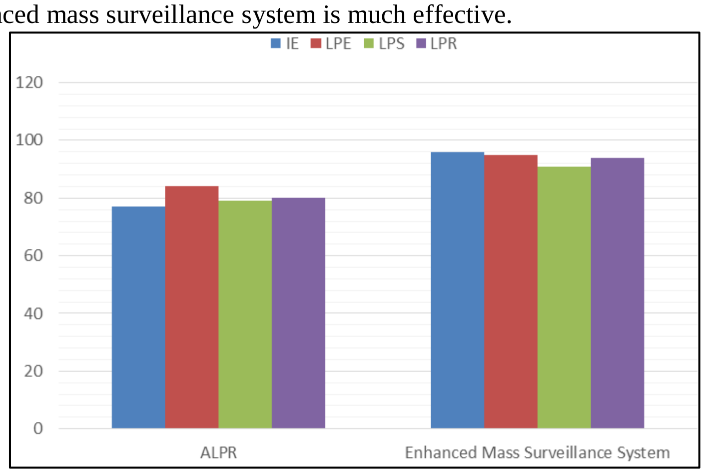

Fig. 4.1 Overall Performance of System

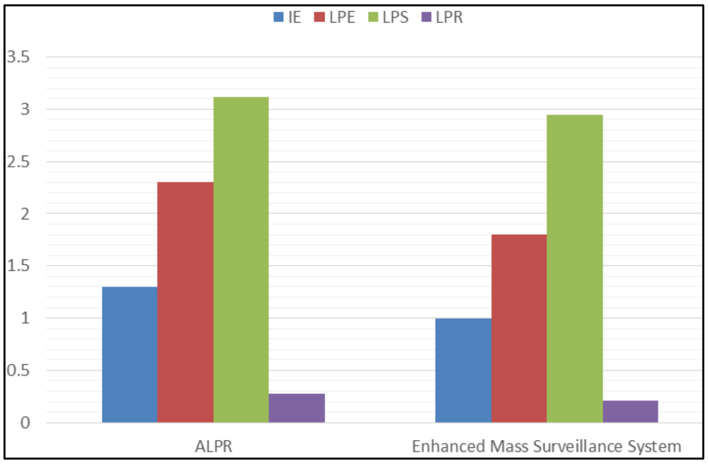

Fig. 4.2: Comparison of Processing Time of System

V. CONCLUSION

This paper provides an enhanced mass surveillance system which takes the vehicle image as the input and processes it and recognizes the number plate present in it and displays it to the users. The experimental result shows that the enhanced mass surveillance system is more effective than the existing ALPR systems. The future direction includes video based ALPR system, which need to extract the frames of passing car. The correct frame has been extracted from the frames of passing car, which has clear vehicle plate image. This could be challenge, especially when the image is taken when car speed is very fast.

REFERENCES

[1] Automatic License Plate Recognition (ALPR): A State-of-the-Art Review Shan Du, Member, Ieee, Mahmoud Ibrahim, Mohamed Shehata, Senior Member, Ieee, And WaelBadawy, Senior Member, Ieee, Ieee Transactions On Circuits And Systems For Video Technology, Vol. 23, No. 2, February 2013.

[2] Muhammad Sarfraz, Mohammed Jameel Ahmed, and Syed A. Ghazi ,“Saudi arebian licence plate recognition system”, International Conference on Geometric Modeling and Graphics (GMAG’03), 2003.

[3] SerkanOzbay, and Ergun Ercelebi,” Automatic Vehicle Identification by Plate Recognition”, Processing of world academy of science engineering and technology vol9, ISSN 1307-6884, november 2005.International Journal of Computer Science and Technology, ISSN : 2229 – 4333, IJCST Vol. 1, Issue 2, December 2010.

[4] Kumar Parasuraman, Member, IEEE and P.Vasantha Kumar, “An Efficient Method for Indian Vehicle License Plate Extraction and Character Segmentation”, IEEE International Conference on Computational Intelligence and Computing Research, 2010.

[5] Muhammad H Dashtban, Zahra Dashtban, Hassan Bevrani, “A Novel Approach for Vehicle License Plate Localization and Recognition”, International Journal of Computer Applications (0975 – 8887), Volume 26– No.11, July 2011.

[6] HumayunKarimSulehria, Ye Zhang, Danish Irfan, AtifKarimSulehria,” Vehicle Number Plate Recognition Using Mathematical Morphology and Neural Networks”, Wseas Transactions On Computers, Volume 7, and ISSN: 1109-2750, Issue 6, June 2008.

[7] Dr. P.K.Suri, Dr. EktaWalia, Er. AmitVerma,” Vehicle Number Plate Detection using Sobel Edge Detection Technique”,

[8] StutiAsthana, Niresh Sharma, Rajdeep Singh, “Vehicle number plate recognition using multiple layer back propagation neural networks”, International Journal of Computer Technology and Electronics Engineering (IJCTEE), Volume 1, Issue 1, July 10, 2011.

[9] Chetan Sharma1 and Amandeep Kaur2, “Indian Vehicle License Plate Extraction and Segmentation”, International Journal of Computer Science and Communication, Vol. 2, No. 2, pp. 593-599, July-December 2011.

[10] Lekhana G.C, M.Tech; R.Srikantaswamy, Professor,“Real time license plate recognition system”, International Journal of Advanced Technology & Engineering Research (IJATER) National Conference on Emerging Trends in Technology (NCET-Tech) ISSN, Volume 2, Issue 4, ISSN No: 2250-3536, July 2012.

[11] Mohan Prasanth R, “Enhanced Automatic License plate recognition” [IJRAT] International journal of Research and advent technology, Volume-2, Issue-5, E-ISSN: 2321-9637, May 2014.

[12] P.Sandhya Rani1, VaraPrasad,“License plate character segmentation based on pixel distribution density”, [IJESAT] International journal of engineering science and advanced technology, Volume-2, Issue-5, 1539 – 1542, Sep-Oct 2012.

[13] S.Kranthi, K.Pranathi, A.Srisaila “Automatic Number PlateRecognition”,International Journal of Advancements in Technology http://ijict.org/ ISSN 0976-4860

[14] Rinkusolanki, Naitikkapadia, Viralpatel,”The Review on Automatic License Plate Recognition”, Ijret | Feb 2013, ISSN: 2319 - 1163 Volume: 2 Issue: 2 178 – 183.

[15] C.-N. E. Anagnostopoulos, I. E. Anagnostopoulos, I. D. Psoroulas, V.Loumos, and E. Kayafas," License plate recognition from still images and video sequences: A survey “IEEE Trans. Intell. Transp. Syst., vol.9, no. 3, pp. 377 391, Sep.2008.

[16] Runmin Wang∗, Nong Sang, Rui Huang, Yuehuan Wang, " License plate detection using gradient informationand cascade detectors "0030-4026/$ – see front matter ©2013 Elsevier GmbH. All rights reserved. http://dx.doi.org/10.1016/j.ijleo.2013.06.008

[17] Yang, Xing, Xiao-Li Hao, and Gang Zhao. "License plate location based on trichromatic imaging and color-discrete characteristic." Optik-International Journal for Light and Electron Optics 123, no. 16 (2012): 1486-1491.

[18] Lalimi, MahmoodAshoori, SedighehGhofrani, and Des McLernon. "A vehicle license plate detection method using region and edge based methods." Computers & Electrical Engineering 39, no. 3 (2013): 834-845.

[19] Zheng, Lihong, Xiangjian He, BijanSamali, and Laurence T. Yang. "An algorithm for accuracy enhancement of license plate recognition." Journal of Computer and System Sciences 79, no. 2 (2013): 245-255.

[20] Yao, Zhenjie, and Weidong Yi. "License plate detection based on multistage information fusion." Information Fusion 18 (2014): 78-85.