A Review of the Recognition System and Various Segmentation Techniques of Number Plates

Anshul[1], Anupam Garg[2]
[1]*Dept. of Computer Science, Bhai Gurdas Institute of Engineering and Technology, Sangrur*
[2]*Assistant Professer of Dept. of Computer Science, Bhai Gurdas Institute of Engineering and Technology, Sangrur*

Abstract - Vehicle Identification has become very important in today's scenario. These days' organizations are more concern about maintaining security. Many vehicles enters in and leave the organization so it is very important to maintain their record. It is used widely in highway electronic toll collection, traffic monitoring systems and parking in smart cities.The quality of the acquired images is a major factor in the success of the Automatic license plate recognition (ALPR). The paper based on a combination of thresolding, labeling, filling up the holes approach method and region props method with area criteria test for the number plate localization

Keywords - ALPR, Preprocessing, Segmentation, CCA.

I. INTRODUCTION

In the introduction section, general steps of preprocessing stage are explained. With the growing number of vehicles, finding a car park is a serious issue today for a large number of students and faculty at Educational Institutions. Most of the car parks are managed manually by security guards who do not keep a track of the number of vehicles entering and exiting the premises. A typical ALPR system consists of the following stages to recognize the number plates of different vehicles.Image Acquisition, Pre-processing, Segmentation, Feature Extraction and Recognition.

- **Image Acquisition**

In Image acquisition, recognition system obtain a scanned image as an input image. This image should have to be in specific format such as JPEG, BMT, etc. This image is acquired through a scanner, digital camera or any other suitable digital input device.[22]

- **Pre-processing**

The pre-processing is a series of operations performed on scanned input image. It enhances the image quality that is suitable for segmentation. The role of pre-processing is to segment the interesting pattern from the background .Generally noise filtering , binarlization and normalization performed in preprocessing stage.[14] The input image is converted into a grayscale image for easy analysis as it consists of only two color channels. The preliminarily preprocessing is carried out to remove noise using median filtering [26] from the input image. Median filter is a non-linear filter, which replaces the gray value of a pixel by the median of the gray values of its neighbours. A 3 × 3 mask is used to get eight neighbours of a pixel and their corresponding gray values. The gray value of the centre pixel of the mask is replaced by the median of the gray values of the pixels within the mask. This operation removes salt-and-pepper noise from the image.

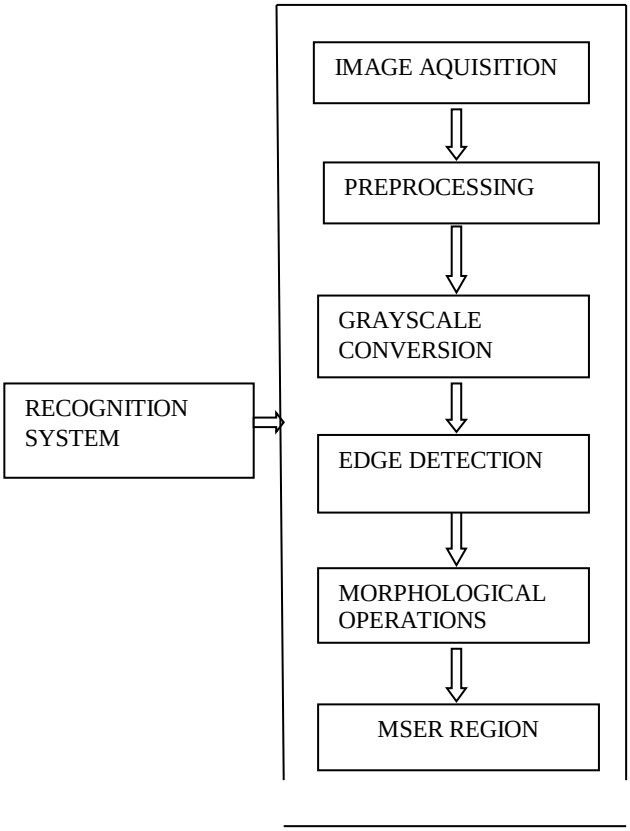

Fig.1: Number Plate Recognition System [22]

- **Grayscale Conversion**

Taking climatic conditions into consideration, captured image may consist of blur factors, noise or other factors that may affect its quality and also may cause loss of information. To avoid these risks contrast adjustment, edge detection, de-blurring will be done.[19] So in this phase the image is first converted into gray-scale.And then the smoothing and sharpening is done. Nowadays the images which are acquired by cameras are in coloured format. In this stage the coloured RGB image is converted into gray scale image. Following formula is used to convert colour image into Gray Scale.[20]

$G(x,y) = 0.3R + 0.59G + 0.11B$[20]

- **Edge Detection**

Edge detection has major feature for image analysis. These features are used by advanced computer vision algorithms. Edge detection is used for object detection which serves various applications like medical image processing, biometrics etc. Edge detection is an active area of research as it facilitates higher level image analysis. There are three different types of discontinuities in the grey level like point, line and edges. Spatial masks can be used to detect all the three types of discontinuities in an image. There are many edge detection techniques in the literature for image segmentation. The most commonly used discontinuity based edge detection techniques are reviewed in this section. Those techniques are Roberts edge detection, Sobel Edge Detection, Prewitt edge detection, Kirsh edge detection, Robinson edge detection, Marr-Hildreth edge detection, LoG edge detection and Canny Edge Detection.[21]

- **Morphological Operations**

Morphology is a topological and geometrical based approach for image analysis which provides powerful tools for extracting geometrical structures and representing shapes in many applications. Steps followed in morphological operations are erosion, dilation, opening,closing, thresholding.[22]

- **MSER Region**

The MSER feature detector works well for finding text regions. It works well for text because the consistent colour and high contrast of text leads to stable intensity
Profiles [22]

Segmentation

Blob Extraction consists of three sub parts. Adjusting the input image and generating a binary image is the first part. In this part Otsu's method not working well and Niblack's method shows better result and performance than Sauvola's method so Niblack's method is used as the binarization algorithm. Analyzing blobs which is a connected set of pixels in the binary image, and removing the noisy blobs and also merging and splitting the blobs is the second part. In this step it starts with CCA, the noncharacter blobs, Plate boundaries, small dirties, and unrelated marks or bars are excluded. Correcting the rotated plate images and selecting final seven character blobs is the last part..[23]

Connected Component analysis (CCA) based on pixel connectivity the CCA scans and labels the pixels of a binarized image into components. Every pixel is labeled with a value depending on the component to which it was assigned. The connected components are then analyzed to filter out long and wide components and only left the components based on the defined values.[23]

Line scanning method

Firstly scanning done from left to right of the license plate.The process involves several steps, first the gray scale image is converted into binary image. In order to partition the text on the license plate into lines 'Lines' function which uses "clip" function is used. [23]Usually this "Clip" function crops black letter with white background. And then resizing is done. At the end same procedure is repeated on the cropped image till all the characters are segmented.

Hat Transformations can be used for contrast enhancement. There are two hat operations and are known as the top hat and bottom hat transformations. Tophat operation is actually the result of subtraction of an opened image from the original one, mathematically,

th = f – (f □ b) (1) [8]

where, f is the input image and b is the structuring element.We see that no matter of what color the number plate is, the characters (i.e., text and numerals) on the vehicle plate are usually bright colored and contrast the color of the plate. So this operation highlights the characters and suppresses the irrelevant background.

Morphological and partition based character

Segmentation stated character segmentation job is very difficult due to several factors like image noise, plate frame, rivet, and rotation and lighting variance. So in order to get a good performance of character segmentation preprocessing stage is significant. Initially, image is filtered and noises are removed.[23] During the threshold processing several small objects that directly affect the segmentation process may grow on the threshold image due to the problems of various lighting conditions, low quality camera and motion effect. So a morphological process which looks for the whole image for small connected elements and remove it. Then to separate the characters that are close with each other, dilation operator is applied to the image.

Feature extraction extract a set of features, which increase the recognition rate with the least amount of elements. In this stage, the features of the characters that are important for classifying in recognition stage are extracted. This is an important stage of ALPR as its effective functioning improves the recognition rate and reduces the misclassification.

II. RELATED WORK

As we have studied various segmentation techniques. It is intended to improve the overall efficiency of the system so as to make it computationally more effective. Most of the ANPR focus on processing one vehicle number plate but in real-time there can be more than one vehicle number plates while the images are being captured.. This paper reviewed various paper that define basic segmentation techniques that can be used in ANPR systems.

According to **Chao Gou et.al [1]** vehicle license plate recognition method is based on character-specific extremal regions (ERs) and hybrid discriminative restricted

Boltzmann machines (HDRBMs). Firstly, a sequence of morphological operations is applied to find plate candidates with dense vertical edges. Then the character-specific ERs are extracted and selected as character regions in color space. The recognition step is achieved by an effective classifier named HDRBM.

According to **Jingyu Dun et.al [2]** License plate recognition (LPR) is an important component of an intelligent transportation system. It can be used to supervise vehicle behavior, monitor traffic condition, and so on. Traffic videos from surveillance cameras are a principal source of traffic data. Such videos usually cover multiple lanes, and the background varies with time and location. Given the large proportion and the importance of this kind of video, efficiently processing such videos can benefit the intelligent transportation. Concominent colors are also used in this paper. LPR algorithms are generally composed of the following three processing steps:

1) location of the license plate (LP) region;

2) segmentation of the plate characters; and

3) recognition of each character

According to **C. Anantha Reddy et.al [3]** Automatic License Plate Recognition (ALPR) System plays an important role in various real time applications like toll payment, electronic payment systems and parking fee payment, border crossing control systems, identification of stolen vehicles etc. This is possible, only because License Plate Numbers uniquely identifies a vehicle. This ALPR follows two steps localization of license plate and identifying characters. This paper proposes the implement of the genetic algorithm in multiple levels for localizing more than one license plate in the single image. Thus any number of license plates in a single image can be localized. By using Multi-level genetic procedure the localization of the symbols on a two dimensional compound objects can be done with high accuracy rates compared to the existing one. The extensive experiments conducted depicted the higher accuracy with lesser computation times.

According to **Abdul Mutholib et.al [4]** ANPR was designed and implemented on Android mobile phone platform. First ,graphical user interface for capturing image using built in camera was developed to acquire car plate number in Malaysia. Second, the preprocessing of raw image was done using contrast enhancement, filtering and straighetning . Next , an optical character recognition (OCR) using neural network was utilized to extract texts and numbers .

B.Leelarani1 et.al [5] proposed a new technique which finds the both fixed parameter and scale invariant license plate image. It achieved by using Connected Component Analysis (CCA) and Hit and Miss Algorithms. By using these algorithms we can improve the lighting, remove the shadows, and camera position and orientation can be done. The system is implemented using MATLAB and the result of number plate images is successfully detected.

J. Layolin sobiya et.al [6] presented a novel methodology to solve the problem of car license plate recognition. The stage of plate detection is solved using two methods: rectangle detection and model pattern comparison. The stage of character detection is solved using an adaptive thresholding method and horizontal and vertical projections. The characters detected are resized in order to obtain always the same size of a character. Finally the problem of recognition was solved using a fuzzy three layer neural network. The results obtained show that the system performs well even when the images were taken on uncontrolled environment and using three different kinds of plates.

Musab Mohammed Bagabir et.al [7]presented a new framework for Sudanese VLPR system. The proposed framework uses Multi Objective Particle Swarm Optimization (MOPSO) and Connected Component Analysis (CCA) to extract the license plate. Horizontal and vertical projection will be used for character segmentation and the final recognition stage is based on the Artificial Immune System (AIS). A new dataset that contains samples for the current shape of Sudanese license plates will be used for training and testing the proposes framework.

Humayun K.Sulehria et.al[8]presents a methodology for extraction of the vehicle number plates from the vehicle images using hybrid mathematical morphology techniques. The main advantage of the technique that they propose is the high accuracy of the technique that works irrespective of the color, size, location, and angle of the number plates. Future work is intended to improve the overall efficiency of the system so as to make it computationally more effective.

According to Chirag Patel et.al[9]traffic control and vehicle owner identification has become major problem in every country. Sometimes it becomes difficult to identify vehicle owner who violates traffic rules and drives too fast. Therefore, it is not possible to catch and punish those kinds of people because the traffic personal might not be able to retrieve vehicle number from the moving vehicle because of the speed of the vehicle. Therefore, there is a need to develop Automatic Number Plate Recognition (ANPR) system as a one of the solutions to this problem.

According to Cosmo H.Munuo et.al[10]The vehicle number plate is a numeric or alphanumeric code that uniquely identifies the vehicle within the issuing country database. It is a metal or plastic plate attached at the front and /or rear of a motor vehicle. The main goal of this research is to study, analyze and design an efficient and optimized algorithm for detection and recognition of Tanzanian cars by their plate numbers. The algorithm will provide accurate and timely alphanumeric recognition performance. The application of the algorithm will facilitate

automation capturing and recognition of vehicle plate number.

III. CONCULSION

Over the past years ALPR become the vital area of development. This paper has attempted to review a significant number of papers to define ALPR and to cover the development in the field of number plate recognition algorithms. Present study reveals that new algorithm has to evolve for the images capture in uneven illumination and blurred images so that recognition rate can be improved much more.

IV. ACKNOWLEDGMENTS

I would like to thank all experts and authors whose work helped me a lot. I am also thankful to my professors for their support.

V. REFERENCES

[1]. Gou, Chao., Wang, Kunfeng., Yao, Yanjie. and Li, Zhengxi. (2015),“ Vehicle License Plate Recognition Based on Extrenal Regions and Restricted Boltzmann Machines”, IEEE transactions on intelligent transportation systems, pp.1524-9050.

[2]. Dun, Jingyu., Zhang, Sanyuan., Ye, Xiuzi.and Zhang, Yin .(2015), “ Chinese License Plate Localization in Multi-Lane with Complex Background Based on Concomitant Colors”, IEEE Intelligent transportation systems magazine.

[3]. Reddy, C. Anantha.and Bindu, C. Shoba .(2015),“ Multi-Level Genetic Algorithm for Recognizing Multiple License Plates in a Single Image”,International Journal of Emerging Technology and Advanced Engineering, Vol.No. 4(2),ISSN. 2278-0947.

[4]. Mutholib, Abdul ., Surya Gunawan, Teddy .and Kartiwi, Mira.(2012),”Design and Implementation of Automatic Number Plate Recognition on Android Platform”,International Conference on Computer and Communication Engineering.

[5]. Leelarani, B.andRameshnaidu,B.(2015),” Recognition of License Plate Numbers using Connected Component Analysis”, International Journal of Engineering Development and Research, Vol.No. 3, Issue.No. 3, ISSN.2321-9939.

[6]. sobiya, J. Layolin.and priya,P.Angelin.(2014),” Automatic multistyle licensed plate detection by using fuzzy logic classifier”, International Journal of Advanced Research in Computer Engineering & Technology Vol.No. 3 Issue.No. 4.

[7]. Mohammed Bagabir,Musab.,Mariyam Shamsuddin, Siti., Elhafiz,Mohammed.and Ahmed, Ali.(2015), “Multi Objective Segmentation for Vehicle License Plate Detection with Immune-based Classifier: A General Framework”,International Journal of Computer Applications Technology and Research,Vol.No. 4, Issue.No.4,ppn.322-326, ISSN. 2319–8656.

[8]. Sulehria, Humayun K. Zhang, Ye. and Irfan, Danish.(2007),” Mathematical Morphology Methodology for Extraction of Vehicle Number Plates”, International Journal of Computers, Vol.No. 1, Issue.No.3, ppn.69-73.

[9]. Patel, Chirag. Shah, Dipti. and Patel, Atul .(2013),”Automatic Number Plate Recognition System (ANPR): A Survey”, International Journal of Computer Applications, Vol.No. 6, Issue. No.9, ppn. 21-33.

[10]. H.Munuo, Cosmo. and Kisangiri, Dr Michael.(2014),”Vehicle Number Plates Detection and Recognition using improved Algorithms: A Review with Tanzanian Case study”, International Journal Of Engineering And Computer Science, Vol.No. 3, Issue.No. 5, ppn. 5828-5832, ISSN:2319-7242.

[11]. L.Amatya, Mrutyunjay. and Sarvanan, K, N.(2017),”The state of the art – Vehicle Number Plate Identification – a complete Survey”, International Research Journal of Engineering and Technology, Vol.No. 04, Issue. No. 02, ppn. 785-792, e-ISSN. 2395 -0056, p-ISSN. 2395-0072.

[12]. Kumar, Kiran,K. Sailaja, V. Khadheer, S. and Viswajith, K.(2017),” Automatic Number Plate Recognition System”, Indian Journal of Science and Technology, Vol.No. 10(4), ppn. 1-4, ISSN. 0974-6846.

[13]. Miah, Alam, Badrul, Mohammad. Akter , Sharmin .and Bonik, Chitra.(2015),”Automatic Bangladeshi Vehicle Number Plate Recognition System using Neural Network”, American International Journal of Research in Science, Technology, Engineering & Mathematics,Vol.No.9(1), pp. 62-66, ISSN (Print). 2328-3491, ISSN (Online). 2328-3580, ISSN (CD-ROM). 2328-3629.

[14]. M, N, Veena. S, J, Shruthi. and T, Vasudev.(2015),” Detection of Skew and Mirror Images in Vehicle Number Plates using Radon Transform and Geometric Moments”, International Journal of New Innovations in Engineering and Technology, Vol.No.3, Issue.No. 2, ppn. 6-11, ISSN. 2319-6319.

[15]. Gondkar, Surekha, R. Mala, C, S. George, Susan, Alina. Pandey, Beauty. and H,V, Megha.(2015),” Extraction and Recognition of Alphanumeric Characters from Vehicle Number Plate”, International Journal of Innovative Research in Computer and Communication Engineering, Vol.No. 3, Issue.No. 5,ppn. 4766-4771, ISSN(Online): 2320-9801, ISSN (Print): 2320-9798.

[16]. Jain, Sumatilal, Anand . and Kundargi, Jayshree, M.(2015),” Automatic Number Plate Recognition Using Artificial Neural Network”, International Research Journal of Engineering and Technology , Vol.No. 02, Issue.No. 04, ppn. 107-1078, e-ISSN. 2395-0056, p-ISSN. 2395-0072.

[17]. Arora, Neha. Jain, Lalit. and Gour, Puran.(2015),” Highly Adaptive Indian High Security Vehicle Number Plate Recognition”, International Journal of Computer Applications, Vol.No.130 – No.16, ppn. 28-33, ISSN. 0975 – 8887.

[18]. Hajare, Tai. Harmale, Priyanka. Jadhav, Neha. and Mali, Kanchan.(2015),” E_ License Plate”, International Journal of Advanced Research in Computer Science and Software Engineering, Vol.No. 5, Issue.No. 3, ppn. 1046-1050, ISSN: 2277 128X.

[19]. R, Jadhav, Ganesh. and J, Karande, Kailash.(2015),” Automatic Vehicle Number Plate Recognition For Vehicle Parking Management System”, International Journal of Industrial Electronics and Electrical Engineering, Vol.No.3, Issue.No.1,ppn. 37-39, ISSN. 2347-6982.

[20]. K, S, Selvanayaki. and SomaSundaram, Rm.(2015),” Hybrid Approach for Detection and Recognition of Vehicles”, Journal of Computer Science, Vol.No.11(2), ppn. 304-314.

[21]. R, Muthukrishnan. And Radha, M.(2011),” Edge Detection Techniques For Image Segmentation”, International Journal Of Computer Science & Information Technology (IJCSIT), Vol,No. 3, Issue.No. 6, ppn.259-267.

[22]. Agrawal, Kumar, Upendra. and Kumar Narendra.(2016),” MSER region based Number plate recognition

system",International Journal of Advanced Research in Computer Engineering & Technology, Vol.No. 5, Issue.No. 9, ppn. 2371-2373, ISSN. 2278 – 1323.

[23]. Karthikeyan,V. Sindhu, R. Anusha, K. and Vijith, D, S.(2013)," Vehicle License Plate Character Segmentation – A Study", International Journal Of Computer And Electronics Research ,Vol.No. 2, Issue.No. 1,ppn. 47-54, ISSN: 2278-5795.