Vehicle Number Plate Extraction in Real Time using Image Processing

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Abstract*:* In current days vehicles play important role in transportation and the use of vehicles is also increasing due to population growth and human needs. Automatic Number Plate Recognition is an image processing technology and an important field of research that identifies vehicles by their number plates in which the number plate information is extracted from vehicle's image or from sequence of images without direct human intervention. ANPR consists of four phases that includes Pre-processing, Number plate extraction, Character segmentation, Character recognition. This project presents an efficient approach for number plate extraction from preprocessed vehicle input image using morphological operations, thresholding, sobel vertical edge detection and connected component analysis. The input image is firstly preprocessed using iterative bilateral filter and adaptive histogram equalization. This proposed approach for number plate extraction work well for all types of input images (jpeg, png, tiff, jpg, tif, bmp etc). The images are taken at different distances relative to camera and are of different colors and different sizes images. The proposed method works well for low contrast, noisy and low resolution input images. This project will be implemented in MATLAB 9.7. Software.

Key words: Automatic Number Plate Recognition, iterative bilateral filter, adaptive histogram equalization, number plate extraction, morphological operations, thresholding, sobel edge detection, connected component analysis.

I.INTRODUCTION

In current days vehicles play important role in transportation and the use of vehicles is also increasing due to population growth and human needs. Number plates are used for identification of vehicles all over the nations. Vehicles are identifying either manually or automatically. Automatic vehicle identification is an image processing technique of identify vehicles by their number plates. Automatic vehicle identification systems are used for the purpose of effective traffic control and security applications such as access control to restricted areas and tracking of wanted vehicles.

Number plate recognition is easier method for vehicle identification. NPR system for Indian license plate is difficult compared to the foreign license plate as there is no standard followed for the aspect ratio of license plate. The identification task is challenging because of the nature of the light. Experimentation of number plate detection has been conducted from many years, it is still a challenging task. Number plate detection system investigates an input image to identify some local patches containing license plates. Since a plate can exist anywhere in an image with various sizes, it is infeasible to check every pixel of the image to locate it.

In parking, number plates are used to calculate duration of the parking. When a vehicle enters an input gate, number plate is automatically recognized and stored in database. In NPR system spectral analysis approach is used where acquiring the image, extract the region of interest, character segmentation using SVM feature extraction techniques. The advantage of this approach is success full recognition of a moving vehicle. It is difficult to detect the boundary of the number plate from the input car images in outdoors scene due to color of characters of the number plate and background of the number plate the gradients of the original image is adopted to detect the candidate number plate

regions. There are also algorithms which are based on a combination of morphological operation, segmentation and canny edge detector.

Due to the mass integration of information technology in all aspects of modern life, there is a demand for information systems for data processing in respect of vehicles. These systems require data to be archived or by a human or by a special team which is able to recognize vehicles by their license plates in real-time environment and reflect the facts of reality in the information system. Therefore, several techniques have been developed recognition and recognition systems are license plates used today in many applications. In most cases, vehicles are identified by their license plate numbers, which are easily readable by humans but not machines. For machines, a registration number plate is just a dark spot that is within a region of an image with a certain intensity and luminosity. Because of this, it is necessary to design a robust mathematical system able to perceive and extract what we want from the captured image.

This paper is organized as follows: Section 2 describes the Literature survey.   Section 3 Proposed work. Section 4 Result and discussion. Section 5 gives the conclusion.

II.LITERATURE SURVEY

In this section, detailed literature review is done that aims to review the critical points of current works. Here the information collected about researches and innovations carried out on the related technologies have been done. This section will highlight the recent trends and innovations in the concerned technology.

Christos-Nikolaos E. Anagnostopoulos [1] in 2014 states that we present a brief tutorial on the well-studied, but not fully solved, problem of LPR(license plate recognition). The main goal is to provide the young researcher with sufficient information about this topic and possible solutions giving emphasis on image processing techniques. In 2013, Shan Du,Mahmoud [2] described that the Automatic license plate recognition (ALPR) is the extraction of vehicle license plate information from an image or a sequence of images. The extracted information can be used with or without a database in many applications, such as electronic payment systems (toll payment, parking fee payment), and freeway and arterial monitoring systems for traffic surveillance. The ALPR uses either a color, black and white, or infrared camera to take images. The quality of the acquired images is a major factor in the success of the ALPR. ALPR as a real-life application has to quickly and successfully process license plates under different environmental conditions, such as indoors, outdoors, day or night time

Sahil Shaikh [3] stated that this innovative method is proposed for number plate recognition. It uses series of image manipulations to recognize number plates. It uses 4-6 algorithms in order to do the same. For plate localization, several traditional images processing techniques are used. Techniques such as image enhancement, unsharp masking, edge detection, filtering and component analysis each plays a role in the extraction process. For character segmentation, connected components are extracted as individual number plate characters. Template Matching is in charge of the Optical Character Recognition.

Norizam Sulaiman [4] states that the development of automatic vehicle plate detection system using image processing technique. The famous name for this system is Automatic Number Plate Recognition (ANPR). Automatic vehicle plate detection system is commonly used in field of safety and security systems especially in car parking area. Beside the safety aspect, this system is applied to monitor road traffic such as the speed of vehicle and identification of the vehicle's owner. This system is designed to assist the authorities in identifying the stolen vehicle not only for car but motorcycle as well. In this system, the Optical Character Recognition (OCR) technique was the prominent technique employed by researchers to analyse image of vehicle plate. The limitation of this technique was the incapability of the technique to convert text or data accurately. Besides, the characters, the background and the size of the vehicle plate are varied from one country to other

country. Hence, this project proposes a combination of image processing technique and OCR to obtain the accurate vehicle plate recognition for vehicle in Malaysia. The outcome of this study is the system capable to detect characters and numbers of vehicle plate in different backgrounds (black and white) accurately. This study also involves the development of Graphical User Interface (GUI) to ease user in recognizing the characters and numbers in the vehicle or license plates.

Reza Azad and Hamid Reza Shayegh [5] License Plate recognition plays an important role on the traffic monitoring and parking management systems. In this paper, a fast and real time method has been proposed which has an appropriate application to find tilt and poor quality plates. In the proposed method, at the beginning, the image is converted into binary mode using adaptive threshold. Then, by using some edge detection and morphology operations, plate number location has been specified. Finally, if the plat has tilt, its tilt is removed away. This method has been tested on another paper data set that has different images of the background, considering distance, and angel of view so that the correct extraction rate of plate reached at 98.66%. In the year 2013 Ronak P Patel [6] Automatic license plate recognition (LPR) plays an important role in numerous applications and a number of techniques have been proposed. However, most of them worked under restricted conditions, such as fixed illumination, limited vehicle speed, designated routes, and stationary backgrounds. In this study, as few constraints as possible on the working environment are considered.

Najeem Owamoyo [7] introduced a Automatic Number Plate extraction, character segmentation and recognition for Nigerian vehicles. In Nigeria, number plate models are not followed strictly. Characters on plate are in different in terms of States within Nigeria, as well as local government in each state. Due to variations in the representation of number plates, vehicle number plate extraction, character segmentation and recognition are crucial. Sourav Roy and Joydeep Mukherjee [8] Vehicle number plate recognition is the most interesting and challenging research topic from past few years, presents an approach based on simple and efficient morphological operation and sobel edge detection method. We 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. Divya gilly and Dr. Kumudha Raimond [9] introduced LPR system and is mainly used in parking lots, tolling booths and nowadays in the signal system in order to identify the vehicle that crosses the line before the indication of green signal. This paper presents an efficient method for LPR. This method utilizes a template matching technique. Isack Bulugu [10] proposes an algorithm to increase readability of the plate number, part of the image was enhanced, noise removal and smoothing median filter is used due to easy development.

Rupali Kate [11] proposed that Automatic Number Plate Recognition (ANPR) is a real time embedded system which identifies the characters directly from the image of the license plate. It is an active area of research. Vehicle number plate recognition (VNPR) has been intensively studied in many countries. P.Kumaresan and Dr.S.A.K.Jil [12] has proposed the Real time vehicle license plate identification system develops how the license number plate is extracted from the image and how characters are isolated for recognition. Image processing and pattern recognition is suggested for this simplified RTVLPIS.

Hadi Sharifi Kolou [13] evaluate some most important LPD algorithms and compared them in terms of accuracy, performance, complexity, and their usefulness in different environmental condition. This evaluation gives views to the developers or end-users to choose the most appropriate technique for their applications. Our study and investigation show that the dynamic programming algorithm is the fastest and the Gabor transform is the most accuracy algorithm compared to other algorithms. Kumar Parasuraman and P.Vasantha Kumar [14], stated that License plate location is an important phase in vehicle license plate recognition for intelligent transport systems. The objective of this work is to design and implement an efficient method for License plate recognition of Indian license plates. This

presents a robust method of License plate location, Segmentation and Recognization of the characters present in the located plate.

S. Hamidreza Kasaei, S. Mohammadreza Kasaei and S. AlirezaKasaei, [15] estimated the Persian License Plate Detection and Recognition System is an image-processing technique used to identify a vehicle by its license plate. In fact this system is one kind of automatic inspection of transport, traffic and security systems and is of considerable interest because of its potential applications to areas such as automatic toll collection, traffic law enforcement and security control of restricted areas. License plate location is an important stage in vehicle license plate recognition for automated transport system. This paper presents a real time and robust method of license plate detection and recognition based on the morphology and template matching. In this system main stage is the isolation of the license plate, from the digital image of the car obtained by a digital camera under different circumstances such as illumination, slop, distance, and angle.

Lekhana G.C, R.Srikantaswamy., [16] researched on a smart and simple algorithm is presented for a vehicle license plate recognition system. Based on pattern matching, this algorithm can be applied for real time detection of license plates for collecting data for surveying or for some application specific purposes. The proposed system has been prototyped using C++ and the experimental results have been shown for recognition of Alberta license plates.

In 2013, Chen Chunyu, Wang Fucheng and Zhang Chen, proposed that at present, the traffic engineering and automation have developed, and the vehicle license plate recognition technology need get a corresponding improvement also. In case of identifying a car license picture, the principle of automatic license plate recognition is illustrated in this paper, and the processing is described in detail which includes the pre-processing, the edge extraction, the license plate location, the character segmentation, the character recognition [17]. In April 2013, Suhan Lee, proposed vehicle model recognition from images is one of challenging fields for supporting intelligence transport system. Existing methods only deal with vehicle in fixed view. However, in video rotation is occurred and it decreases performance of recognition. To overcome this problem, rectification method about skew though rotated view is needed [18]. In 2012, Khalid W. Maglad,, described that Automatic vehicle license plate detection and recognition is a key technique in most of traffic related applications and is an active research topic in the image processing domain. Different methods, techniques and algorithms have been developed for license plate detection and recognitions [19].

Lukadev Meher [20] (2013) proposed a full-featured vehicle detection, tracking and licence plate recognition system. It consists of vehicle detection, licence plate extraction and a character recognition module. Here first foreground estimation is done by Gaussian mixture model then proposing a real time and robust method of license plate extraction based on block variance technique. License plate extraction is an important stage in license plate recognition for automated transport system. The Extracted license plates are segmented into individual characters by using a region-based approach. The method is invariant to illumination and is robust to character size and thickness, skew and small character breaks. The major advantages of our system are its real-time capability and that it does not require any additional sensor input (e.g. from infrared sensors) except a video stream.

Aditya Acharya, and Sukadev Meher [21] proposed that most of the existing interpolation techniques available in the literature produce a blurring effect while converting a low resolution video to its high resolution counterpart. The blurring results in the loss of fine details and critical edge information of a video intra frame. In order to resolve this problem, an efficient, no reference, hybrid interpolation technique proposed here. The proposed method makes use of a combination of anticipatory, spatial domain, region adaptive unsharp masking operation withth discrete cosine transform based interpolation technique for retaining some of the fine details and critical edge information in the reconstructed video frame.
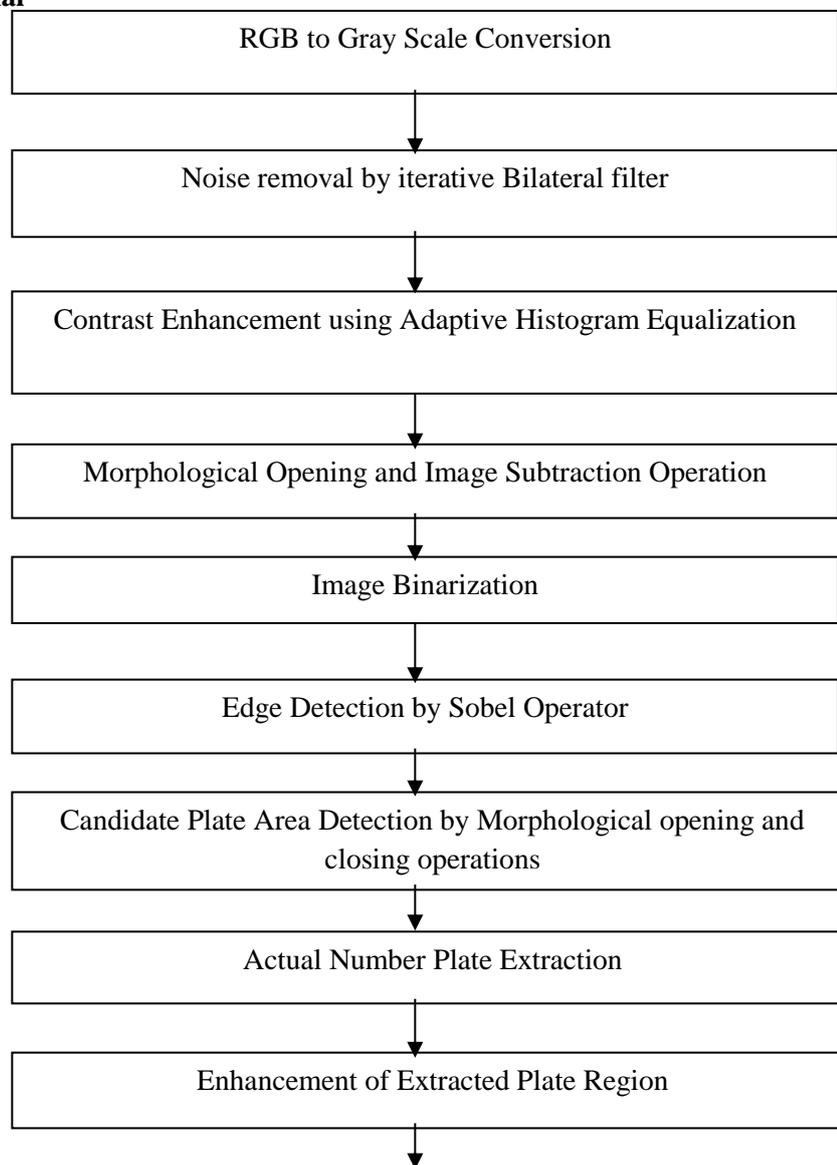
Manuel Vargas [22] proposes a new background subtraction algorithm based on the sigma-delta filter, which is intended to be used in urban traffic scenes. The original sigma-delta algorithm is a very interesting alternative due to its high computational efficiency. However, the background model quickly degrades in complex urban scenes because it is easily "contaminated" by slow-moving or temporarily stopped vehicles. Then, subsequent foreground validation steps are needed to refine the foreground detection mask. Instead of requiring any subsequent processing steps or resorting to algorithms with higher computational cost, the proposed algorithm tries to achieve a more stable background model by introducing a confidence measurement for each pixel. This confidence measurement assists in a selective background-model updating mechanism at the pixel level. Experimental comparative tests and a quantitative performance evaluation over typical urban traffic sequences corroborate the benefits of the proposed algorithm.

III.PROPOSED WORK

The proposed approach for number plate extraction is represented in this section. Input to this system is vehicle image that is acquired through digital camera and output is the actual number plate portion. Images are acquired in different background. The flowchart of proposed method is shown in the following steps:

- Image Acquisition
- RGB to Gray scale conversion
- Noise removal by Iterative Bilateral Filtering
- Contrast Enhancement by using Adaptive Histogram Equalization
- Morphological opening and image subtraction operation
- Image Binarization
- Edge detection by sobel operator
- Candidate plate area detection by morphological opening and closing operations
- Actual number plate area extraction
- Enhancement of Extracted plate region.

The purpose of this paper is to build a real time application, which recognizes the license plate from cars at gate. For example at the entrance of the parking area, the system based on regular PC with in camera takes pictures of license plate of the car and process them. Once a license plate is detected and extracted its characters are then isolated. The focus is on recognition characters of the license palate this process is called optical recognition. The recognized characters are then displayed on GUI and checked with the database. Thus the focus is on the design of algorithms used for extracting the license plate from a single image isolating the characters of the plate and identifying the individual character. The process flow representation is shown in figure.

RGB to Gray Scale Conversion

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Noise removal by iterative Bilateral filter

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Contrast Enhancement using Adaptive Histogram Equalization

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Morphological Opening and Image Subtraction Operation

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Image Binarization

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Edge Detection by Sobel Operator

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Candidate Plate Area Detection by Morphological opening and closing operations

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Actual Number Plate Extraction

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Enhancement of Extracted Plate Region

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Figure 1: Flowchart of Proposed Approach

Properties of Number plate extraction:

I.   Aspect Ratio
II.   Width of Number plate
III.   Total number of pixels.

Image Acquisition:

The first step is to acquire the input image of vehicle. Image is acquired by digital camera. Images are taken in different illumination conditions and at various distances from the camera.

Pre-processing:

In basic aim of pre-processing is to improve the contrast of the input image, to reduce the noise in the image, hence to enhance the processing speed. In pre-processing RGB image is converted into gray level image and then into binary image.

Morphological opening and Image subtraction operations:

Morphological opening operation is performed on the contrast enhanced gray scale image by using disc shaped structuring element. In image subtraction the morphological opened image is subtracted from contrast enhanced gray scale image.

Image Binarization:

In this operation the subtracted gray scale image is converted into binary image.

Edge detection by sobel operator:

Vertical edge is detected by sobel operator and result of applying sobel operator to binarized image.

Candidate plate area detection by morphological opening and closing operations:

With morphological operations the unwanted objects in the image are removed. In detection of candidate plate area, firstly dilation operation is applied on sobel edge detected image and after this holes are filled by using MATLAB *imfill* function.

Actual Number plate area extraction:

After the detection of number plate area that area is extracted from the image. Firstly the row and column indices of plate area plate area are found by connected component analysis.

Extracted plate region Enhancement:

The extracted number plate may consist of various noise or unwanted holes. So enhancement of plate region is done.

.IV.RESULTS AND DISCUSSION

This proposed approach for number plate extraction work well for all types of input images. Total 70 vehicle images are tested. Images are taken in different illumination conditions. The images are taken at different distances relative to camera and are of different colors and different sizes images. The proposed method works well for low contrast, noisy and low resolution images. The result of proposed approach for number plate extraction is shown in table.

TABLE 1: Result of Proposed Number Plate Extraction Approach

Total Vehicles Images	Successfully Extracted Number Plates	Success Rate (%)
120	118	118/120=98.33%

Output location plate

TX0615XB

C·0266 XX

Output location plate

CO266XX

V.CONCLUSION

In this paper, an efficient approach for vehicle number plate extraction is presented on this project. The proposed method is mainly designed for real-time Indian vehicles number plate but it also works well for foreign number plates. This extraction process works well for low resolution, noisy, and low contrast images. This method is tested for number of vehicle images under different weather illumination conditions i.e. daytime, night time, sunny, cloudy, rainy days etc and success rate achieved by using this method is 97.14%.

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