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# An Efficient Method for Number Plate Detection and Extraction Using White Pixel Detection (WPD) Method

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***Abstract:*** Intelligent transport systems play an important role in supporting smart cities because of their promising applications in various areas, such as electronic toll collection, highway surveillance, urban logistics and traffic management. One of the key components of intelligent transport systems is vehicle license plate recognition, which enables the identification of each vehicle by recognizing the characters on its license plate through various image processing and computer vision techniques. Vehicle license plate recognition typically consists of smoothing image using median filter, White pixel detection (WPD), and number plate extraction. In this work an efficient White pixel detection method has been describing a license plates in various luminance conditions. Mostly we will focus on vehicle number plate detection along with the white pixel detection method we will use median filters and Line density filters to increase the detection accuracy for number plate. Subjective and objective quality assessment parameters will give us robustness of proposed work compared to state of License Plate Detection(LPD) techniques.

***Key points :*** *License plate detection, Median filters, Line density filter, Extraction, detection.*

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## I. INTRODUCTION

Nowadays with increasing number of vehicles on roads, it is getting difficult to manually enforce laws and traffic rules for smooth traffic flow. Toll-gates are constructed on freeways and parking structures, where the car has to stop to pay the toll or parking fees. Also, Traffic Management systems are installed on freeways to check for vehicles moving at speeds not permitted by law. All these processes have a scope of improvement. In the center of all these systems lies a vehicle. In order to automate these processes and make them more effective, a system is required to easily identify a vehicle[1].

The important question here is how to identify a particular vehicle? The obvious answer to this question is by using the vehicle's number plate. Vehicles in each country have a unique license number was implemented by intelligent transport management system, which is written on its license plate. This number differentiate one vehicle from the other, which is useful especially when both are of same make and model. An automated system can be implemented to overcome the problems of over ruled vehicles in traffic and road transportation. this automated system can identify the license plate of a vehicle and extract the characters from the region containing a license plate. The license plate number can be utilized to recover more data about the vehicle and its owner, which can be used for further processing. Such an automated system should be small in size, and portable.

The result of the increase in vehicle traffic, many problems have appeared. For example, traffic accidents, traffic congestion, traffic induced air pollution and so on. Traffic congestion has been a significantly challenging problem. It has widely been realized that increases of preliminary transportation infrastructure, more pavements, and widened road, have not been able to relieve city congestion. As a result, many investigators have paid their attentions on intelligent transportation system (ITS), such as predict the traffic flow on the basis of monitoring the activities at traffic intersections for detecting congestions. To better understand traffic flow, an increasing reliance on traffic surveillance is in a need for better vehicle detection at a wide-area. Automatic detecting vehicles in video surveillance data is a very challenging problem in computer vision with important practical applications, such as traffic analysis and security.

### *1.1 Research Topic and Objectives:*

License Plate Recognition (LPR) is a computer vision method used to identify vehicles by their license plates. During recent years, LPR have been widely used as a core technology for security or traffic applications such as in traffic surveillance, parking lot access control, and information management [2, 3]. This thesis targets at the problem of detecting and recognizing Indian vehicle license plates from images and videos in real time. This will help us identify and register vehicles and provide the reference for further vehicle tracking and activity analysis. Our license plate detection approach has two major steps. First, we need to extract certain features which encode the images or frames from videos. Second, we need develop a detector, which is a classifier in our case, to determine whether a certain region in the images or frames is license plate.

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*1.2 Challenges*

In LPR, we need to deal with a large variety of license plates, especially in India. Each state in India has its own license plate color, pattern and formats of numbers and characters. Moreover, every few years, each state will issue new license plate patterns. Fig. 1 shows the number plates from all states in India. And in some states, the government allows vehicle owners to have personalized license plates which will further increase the difficulty of license plate detection and recognition.


Fig.1 number plate samples from all states in India.

Another challenge in LPR is that the image quality taking by camera in real time may be affected by severe weather conditions, poor lighting conditions, and low camera resolutions. The aperture time of the camera will cause the blurring effect of the moving vehicle. The third challenging issue we need to address in LPR is the large variations in camera perspectives when the license plate image is captured.

*1.3 Background and Related Work*

In most cases, License Plate Detection is a necessary procedure before LPR. Some pre-processing techniques to locate the number plate region in images or videos from previous literature three pre-processing can be grouped into the following categories: Binary Image Processing, Gray-Level Processing, Color Processing and Classifiers [3]. Character segmentation is also a very important step before character recognition. The methods for character segmentation can be grouped into Binary Image Processing, Gray-Level Processing and Classifiers. To identify the segmented characters, some number of algorithms using the pattern/template matching or learning based classification have been developed [4-6].

*1.3.1 License Plate Detection*

Block Diagram

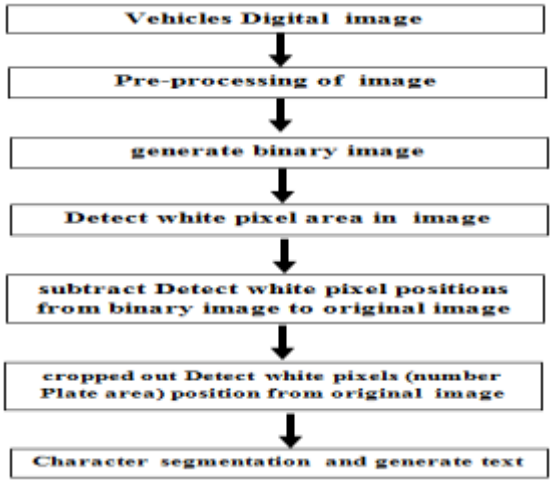


Fig.2. Framework of the proposed number plate detection approach.

*A. Binary Image Processing :*

To extract number plate locations from background images, techniques based on combinations of edge measurements and morphology can achieve good results. In [7], they applied edge operators on a gray image after smoothing and normalization to extract horizontal and vertical edge maps. Statistical analysis of edges was then performed to detect the rectangle of license plate. The procedure was performed in a hierarchical manner at different scales. Several license plate regions were left after the rule-based fusion. The final decision was made based on the connected component analysis (CCA). Many other license plate detection algorithms [8,9] also follow similar procedures. However, those methods are typically based on a hypothesis that the edges of the number plate frames are clear and horizontal. If the license plate images were not clear or they had some affine noise on image, these algorithms may not produce reliable results.

*B. Gray-Level Processing :*

The large contrast between the characters and the background is exploited in [10] to detect license plates with black characters over white backgrounds. While some other algorithms assumed that the density of edges in the license plate region is larger than other regions if the contrast of the character and the license plate is sufficiently large. For example scanned the vehicle images with N-row distance to count the existent edges. Regions with high edge density will likely have the license plate inside.

Similarly, a block-based method was proposed, and blocks with high edge magnitude and variance are considered as the license plate region. Image transformation methods based on Hough transform, Gabor filters and wavelet transform have been applied in license plate detection. Hough transform is a classic algorithm to detect straight lines. Since the shape of license plate can be defined

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by lines, [4] used the Hough transform to detect the boundary of a license plate.

This method is practical only when the background of the image is simple. Another disadvantage of this method is that the computational complexity of Hough transform is very high. Gabor filters are often used to analyze textures as they are sensitive to textures with different directions and scales. F. Kahraman et al.[15]. proposed Gabor filters to recognize vehicle number plate and tested the algorithm with images acquired in a fixed angle and achieved a very good performance. Vector quantization (VQ) has also been used as a feature to encode images for number plate detection. In this method, vehicle images was divided into blocks and coded into strips.

If a certain block contains high contrast region or details, it will split into four sub-blocks. In this case, the area of license plates with high contrast and five complex texture will be represented by small blocks.

*C. Color Processing*

In the world many countries or regions, the format of number plates are strictly implemented. The color of the text and background is fixed, so that many algorithms use color information to detect license plates. However, if the lighting conditions change, the shade of the number plate will fluctuate. So the license plate detection algorithms that only rely on the color information may not achieve high detection rates.

*D. Classifiers*

In generally an idea is to use a classifier to group the candidate features segmented from the vehicle images into positive class (license plate region) or negative class (non license plate region). A number of computational intelligence architectures, such as artificial neural networks (ANNs), genetic programming (GP), and genetic algorithms (GAs), were implemented for license plates detection. However, such algorithms usually need many predefined parameters. And if the parameters were not tuned properly, they may not produce satisfied results. Recently, adaptive boosting (AdaBoost) and support vector machine (SVM) strategies have been generally utilized for number plate detection as they do not need a large number of parameters to obtain a decent classification performance.

The discrete-time cellular neural networks (DTCNNs) was applied for number plate detection in [9]. They extract two features of "grayness" and "texture" from the vehicle image, and used the DTCNNs to indentify the pixels in the images with gray value in certain range and certain type of histogram after applying the Sobel operator. Their system identified more than 85% license plates. The pulse-coupled neural network (PCNN) was a novel neural network algorithm and was widely used in signal and image processing fields. pulse-coupled neural network (PCNN) was applied to segment number plate candidates from vehicle images, before the Fourier transform and a statistic process to locate license plate area [10]. This method achieved a detection rate of 85%. The time-delay neural network (TDNN) was implemented by Kim for license plate detection and achieved remarkable result. A TDNN is a multilayer feed forward network whose hidden neurons and output neurons are replicated across time. authors utilized two TDNNs as horizontal and vertical filters to analysis the color and texture information of the vehicle images.

Another impressive license plate detection method was implemented based on the convolutional neural network (CNN) [11]. CNN have been widely used for optical character recognition (OCR) purpose. In this article, they used the convolutional subsampling to extract feature map, and a hierarchical approach to search the text candidate in license plate. This method achieved a detection rate of 98%. AdaBoost was successfully used with Haar-like features in a "cascade" for face detection. Using the cascade framework, the background region can be excluded to a great extent from further training. It was capable of processing images very fast with high detection rates.

The idea of AdaBoost algorithm is to combine a collection of weak classifiers to form a stronger classifier. It was demonstrated that the training error of the strong classifier approaches zero exponentially with the number of iterations. In the above method was applied for license plate detection, and a detection rate of 93.6% was achieved. As they used the Haar-like features, their result was invariant to color, light, size and position of the license plates. So this algorithm can be applied with complex background. Xiangrong et al. extracted three set of informative features for text and used AdaBoost to detect text from natural scenes. Their algorithm can detect 97.2% of the visible text from their test set, many of which are blurred. SVM has also been widely applied for object detection recently. SVM is a pattern classification algorithm which minimizes an upper bound on the generalization error, while other classifiers are trying to minimize the training error. And it was tested that SVM can work well even in high dimensional space. Author Kim adopted SVM to classify the color texture features followed by a continuously adaptive mean shift (CAMShift) algorithm in order to detect license plate region. The detection rate of their system is 92.7% with a miss rate of 3.7%.

*1.3.1 Character Segmentation*

As some LPR algorithms require the single character input, after license plate detection, the preprocessing to segment the whole license plate into patches containing single characters is often needed. Any error made during this process will also affect the final LPR result.


(a) original color image

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(b) gray scale image


(c) convert to binary based on threshold


(d)mark position of license plate (white pixel area)


(e)differentiate number plate on given image


(f)extract number plate from given image

*1.3.3 License Plate Recognition*

*A. Classifiers*

Various multilayered neural networks have been used for license plate recognition. In [4], they authors used a discrete-time cellular neural networks (DTCNN's) to extract four different features (horizontal projection, vertical projection, horizontal connected component count and vertical connected component count) and an ordinary multi-layer perception network (MLP) to do the classification. A 98.5% recognition rate was reported using this method. Chang et al. proposed a LPR method using self-organizing neural networks which was able to handle noisy, deformed, broken or incomplete characters in license plates . The topological features of the input characters were first calculated and compared with the pre-stored character templates, which will be performed by the self-organizing character recognition procedure. An impressive 95.6% recognition rate was achieved over a large data set. 10 Probabilistic neural networks (PNN) were widely applied in LPR. As these types of networks can be designed and trained fast.

A remarkable recognition rate of 99.5% was published in 2005. SVM-based LPR algorithms have been very popular recent years. Kim et al. used a SVM classifier to do LPR for Korean license plates and reported an average character recognition rate of 97.2%.

## II. PATTERN/TEMPLATE MATCHING

Template matching technique was successfully implemented for LPR. They calculated the distance of the patch from plate image and the template, and used classifier to find the minimum distance to make a decision. The template matching method was often combined with other methods to do LPR.

*2.1 Designers interpretation of the users requirements*

In the previous chapter the problem and the user requirements for the system was briefly described. The requirements are now being revisited and possible solutions for each problem are provided.

*2.1.1 Requirements*

• Stolen vehicles.
• Compute parking cost or fee.
• Identify owner violated traffic laws. – Speed limit on road.

*2.1.2 Solutions*

A solution to all of the problems or requirements listed above will be by using the Number plate recognition system. Number plate recognition system can also play a good role or can be helpful on stolen vehicles by matching the current license plate to the one that's stolen, by doing so if they match then you found the stolen car or vehicle. For computing the parking cost, number [6 7] plate recognition system can be useful here as well since it will recognize the vehicle entering and living the environment and calculates the difference in between for calculating the hours or total cost.

This system can be helpful in finding the vehicles that violates traffic laws for example vehicles that go over limit, this number plate system can be used as to identify the vehicle so they can apply fines to it. This system can be helpful for traffic management as to identify the vehicle easily.

This system could be very useful to the University of Wales Cardiff ( UWC) university in granting access, it will not be manipulated like their current system being used where it only accept the student card and does not even check if the person trying to grant access is the right person or is a student, all it does if student card is placed it grand access.

The carelessly of this system could lead to problem of student stealing each others vehicles and still it will not be able to identify automatically and all what will happen the

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vehicle will be reported and securities have to deal with the matter themselves. But the proposed system that is number plate recognition will help solve all the problems listed about University of Wales, Cardiff ( UWC).

## III. PROBLEM STATEMENT

The main purpose of this project is to detect a license plate from an image provided by a camera. White pixel detection method is developed to detect a license plate in various luminance conditions. It uses median filters and line density filters, that extracts the license plate data from an image next detected license plate will process in three steps first white pixel detection, second License Plate Detection(LPD) and finally extract number plate. This project can work as a base for future improvements in the field of image processing, especially in license plate extraction and plate number recognition.

### *3.1 Existing System*

Most of these methods perform well only under certain predefined conditions such as fixed illumination, license plates with little blur or distortion from viewpoint changes, relatively simple backgrounds and the presence of only a single license plate in an image, high computational complexity. Horizontal Line Density Filter for license plate detection that is able to accurately localize one or multiple vehicle license plate(s) with diverse variations from complex backgrounds. To speed up the detection algorithm overall, we first investigate how to reduce the size of the original high resolution image without decreasing license plate detection performance. Because of the negative effects that are generally introduced by the down sampling method that is commonly used in image processing, most previously developed methods perform license plate detection using the original image. Then, we analyze the common characteristics among diverse license plates and their major differences with respect to background regions to serve as a basis for designing a region filter to exclude irrelevant regions in the image. Finally, a cascaded license plate classifier (CLPC), which is trained using color saliency features, is proposed to detect the true license plate(s) from among the candidate regions by cascading multiple linear support vector machines to localize. Challenges in above existed system are: Less efficiency , Statistical Guarantee , Universality , Nonlinearity

## IV. PROPOSED METHOD

To overcome the above challenges an efficient algorithm called white pixel detection method is proposed for license plate detection that is able to accurately localize one or multiple vehicle license plate(s) with diverse variations from complex backgrounds. To speed up the detection algorithm , first investigate how to reduce the size of the original high resolution image without decreasing license plate detection performance. Because of the negative effects that are generally introduced by the down sampling method that is commonly used in image processing, most previously developed methods perform license plate detection using the original image. Then, we analyze the common characteristics among diverse license plates and their major differences with respect to background regions to serve as a basis for designing a region filter to exclude irrelevant regions in the image. Finally, a cascaded license plate classifier (CLPC), which is trained using color saliency features, is proposed to detect the true license plate(s) from among the candidate regions by cascading multiple linear support vector machines to localize.

1. The system involves constructing a base matrix whose columns represent features of the LPD images, referring the matrix dictionary whose columns are called atoms; for a given whole LPD, divide it into small blocks called patches whose number of pixels are equal to the dimension of the atoms; use the method of sparse representation to obtain the coefficients; then, quantize the coefficients; last, encode the coefficients and other related information using lossless coding methods.
2. In most instances, the evaluation of compression performance of the algorithms is restricted to Peak Signal to Noise Ratio (PSNR) computation with respect to localization construction.
3. Performance Differences can be highlighted in an LPD Application Prototype.

The input color vehicle image is first processed via image down sampling and grayscale conversion. Then, a set of candidate regions for the target license plate is extracted through edge detection, binarization and line density filtering. Finally, the license plate is located by verifying the candidate regions using a cascaded license plate classifier.

### 4.2 Segmentation:

The next step is to find all the regions in an image that has high probability of containing a license plate. Co-ordinates of all such probable regions are stored in an array. The output image displaying the probable license plate Characters.

**Algorithm:** Detect candidate regions

**INPUT:** Color image(I)
**OUTPUT:** I, C.
Where **I** is color image and
**C** is detected License Plate
$B_i$ = converted binary image
$G_r$ = White pixel group
n = max($G_r$)
// number of white pixel groups
for i = 1 to n
// iterations i.e., how many white pixel groups
{
[row col] =find($G_r$ == i)
// check group white pixels are not
height= (maximum_row) - minimum_row);
// white pixels in row iteration
length= (maximum_col) - (minimum_col);
// white pixels in column iteration
mark = [height length];
}
C = I- mark ;
// separate detected candidate from input image

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*a. Region of Interest Extraction:*

Initially, to remove salt and pepper noise from an image using an averaging filter and a median filter to allow comparison of the results. These two types of filtering both set the value of the output pixel to the average of the pixel values in the neighborhood around the corresponding input pixel. However, with median filtering, the value of an output pixel is determined by the median of the neighborhood pixels, rather than the mean. The median is much less sensitive than the mean to extreme values (called outliers). Median filtering is therefore better able to remove these outliers without reducing the sharpness of the image.

Note: Median filtering is a specific case of order-statistic filtering, also known as rank filtering.

The output of segmentation process is all the regions that have maximum probability of containing a license plate. Out of these regions, the one with the maximum Peak Signal to Noise Ratio (PSNR) value is considered as the most probable candidate for number plate. All the regions are processed row-wise and column-wise to find a common region having maximum horizontal and vertical Peak Signal to Noise Ratio (PSNR) value. This is the region having highest probability of containing a license plate. The image detected license plate is shown in algorithm: This algorithm was verified using several input images having resolution varying from 680 * 480 to 1600 * 1200. The images contained vehicles of different colors and varying intensity of light. With all such images, the algorithm correctly recognized the number plate. This algorithm was also tried on images having number plate aligned at certain angle (approximately 8-10 degree) to horizontal axis. Even with such images, the number plates were detected successfully.

*B. Candidate extraction using a white pixel detect:*

In this section, we propose a novel scheme for extracting license plate candidates. The candidate extraction method consists of edge detection, edge image binarization via adaptive thresholding (AT) and the proposed novel line density filter. At image preprocessing stage original image(I) manipulate to generate binary image($B_i$) while image consist of pixel values only 1's and 0's. in the binary image side-by-side white pixels are consider as a group($G_r$) and do n number of iterations for count the number of white groups

i.e., n=max($G_r$)

for i = 1:n

after marking the white group pixels and separate all white pixel group($G_r$) from the original image

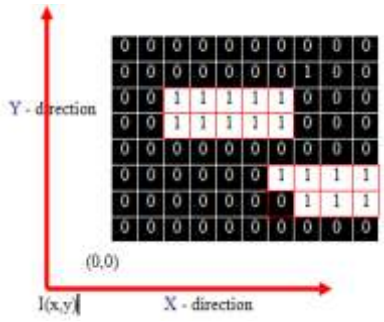
result = (I - mark)

Finally, white pixel detect (WPD) method is proposed to connect the white regions in the binary image along the horizontal and vertical directions. Several examples of the results generated by each component of the candidate detection method are shown in Fig. 6. The following subsections describe the details of the proposed candidate extraction method.

Image can be represented as I(x, y).

Where, 'I' is intensity values at (x, y)

(x, y) be the pixel position




The black and white image is having only two possible pixel values (0/1)

1 ⟶ White

0 ⟶ Black

As it contain two (0/1) pixel values so called Binary image.

1 pixel = 1 bit (0/1)

As each pixel contain only one colour (either black or white) so called Monochrome.

## V. Conclusion

In this work white pixel detection method has been proposed to detect license plates easily and accurately. White pixel detection method useful in detect license plates in the given image, mostly of the license plates in white color, the white color pixels detect on given image and to mark all white pixels group position and the same white pixels group position extract from given original image White pixel detection(WPD) method uses the median filter and line density filter for detecting the boundaries of objects in the image.

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