

# Smart Number Plate Recognition and Toll Deduction

Omkar Bhushankar<sup>1</sup>, Soham Naik<sup>2</sup>, Akshay Athawale<sup>3</sup>, Nilay Birmole<sup>4</sup>

<sup>1</sup>Department of Electronics & Telecommunication, Mumbai University, Virar-401305

**Abstract**—The proposed paper is about use of license plate for identification of vehicle and deducts the toll from respective vehicle owner's account using an image processing technology. The objective is to design an efficient automatic vehicle identification and verification by using the vehicle's license plate. The developed system firstly detects the vehicle and then captures the vehicle's image. Vehicle number plate region is extracted using the image segmentation of an image. Template matching technique is used for character recognition. The resulting data is then used to compare with the records on a database so as to come up with the specific information like the vehicle's owner, phone number, address, account details and this information is used for online deduction of toll from respective owner. The system is implemented and simulated in MATLAB interfaced with SQLite, and its performance is tested on vehicle's image. It is observed that the developed system successfully recognizes the vehicle number plate from vehicle's images and deduces the toll accordingly.

**Keywords**— Image processing, Image segmentation, Template Matching, SQLite, Character Recognition.

## I. INTRODUCTION

Technology plays an important role in today's world. With advent in technology over the past century we have been using automation technologies for almost everything. Transportation is the vital part of today's lifestyle. In the need of enforcement of laws and traffic rules for smooth traffic flow, tollbooths are employed on freeways and highways. However, their drawbacks are long queues, escaping from toll plazas and many other malpractices. Also these toll-plazas can serve 350 vehicles per hour and if more vehicles arrive then there are chances of a severe traffic jam and many a times loss of revenue. These issues are usually dealt manually leading to longer time constraints causing inconvenience. The techniques used to improve such issues are various license plate detection algorithms, vehicles in every nation have a unique license number, which is written on its number plate. An automated system can be employed to identify the license plate of a vehicle and detect the characters from the region containing a license plate. This license plate number can be further used to retrieve more information about the vehicle and its owner, which can be used for further processing to deduct the toll amount from the respective vehicle's owner. The proposed system is inexpensive and provides faster computation than other techniques that requires great amount of training data. Along with its computability, the proposed system is designed in a way that it can be operated under real time conditions and it can detect as well as recognize any number plate under normal circumstances.

## II. DESIGN METHODOLOGY

As seen from the literature survey, faster computational speed and low cost equipment are the major reasons why automatic license plate detection algorithms are popular. The most important portion of the proposed system is the software model which makes use of various image processing technologies which are implemented in MATLAB 2018a and databases which are employed using SQLite. The proposed system can be classified into three parts accordingly,

- i. Capturing of the vehicle's image.
- ii. Detection and Recognition of the license plate in the vehicle's image using image processing.
- iii. Recognition of the respective owner details using license number and deduction of toll.

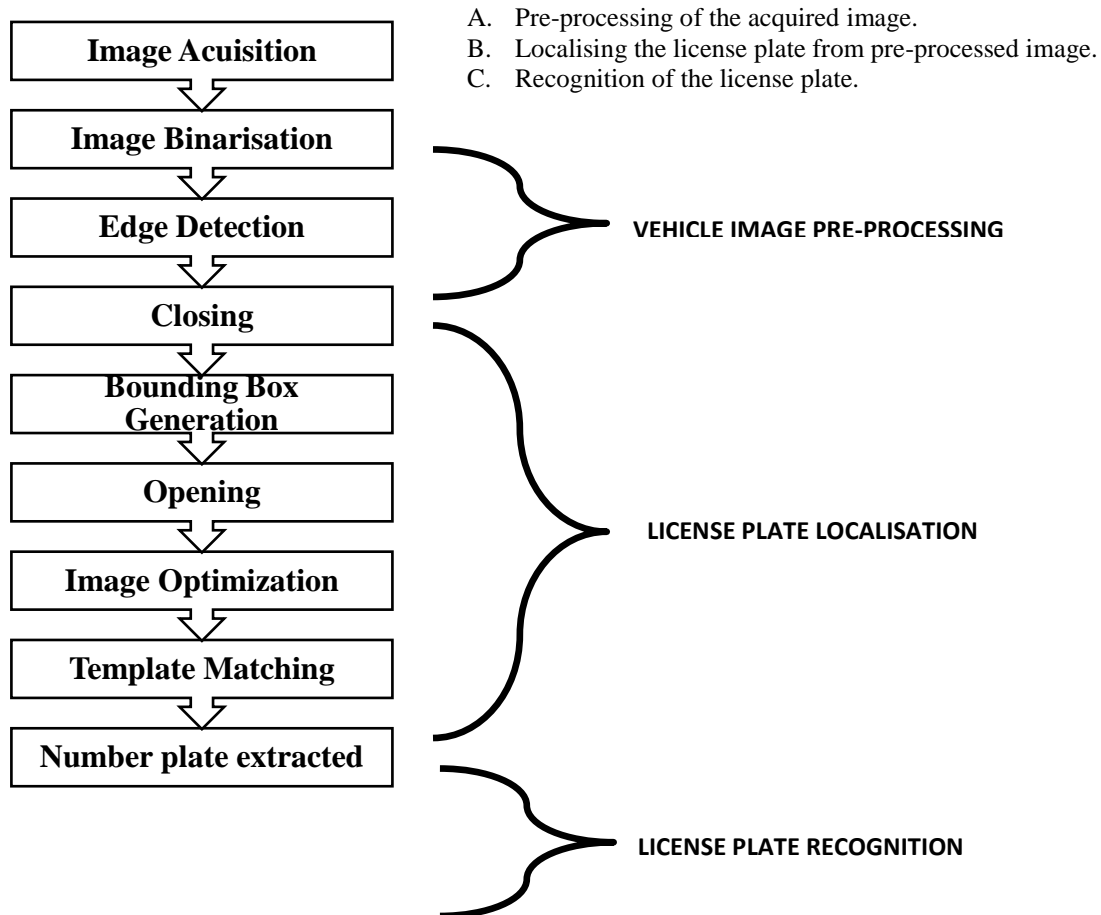
### 2.1 Capturing Of The Vehicle's Image.

In the first step, the video clip of the vehicle is captured by a camera which is connected to the system network. The frame is extracted from the avid clip recorded with the help of camera and is in the coloured format which is processed further to enhance and prepare it for next phases.

### 2.2 Detection And Recognition Of The License Plate In The Vehicle's Image Using Image Processing

In the second step, various morphological operations and image processing techniques are utilized so as to enhance, detect and recognize various characters on the number plate. The following flowchart gives a detailed description of the techniques used for recognition and detection of number plate.

The license plate detection and recognition mechanism is a convolutional process with a series of techniques involved in it. The techniques involved are classified into three parts namely;



**FIG. 1. Flowchart for Recognition and Detection of Number Plate**

### 2.2.1 Pre-processing of the acquired image

Pre-processing helps in maintaining the quality of the image that are obtained from the video/camera and for enhancing the contrast initially the coloured image is converted in a grayscale format. The main purpose of grayscale conversion is to reduce the number of conversion and processing of RGB planes at every phase. This grayscale image is now converted into binary image using matlab function and resized to a specific size for better and faster computation.

### 2.2.2 Localising the license plate from pre-processed image

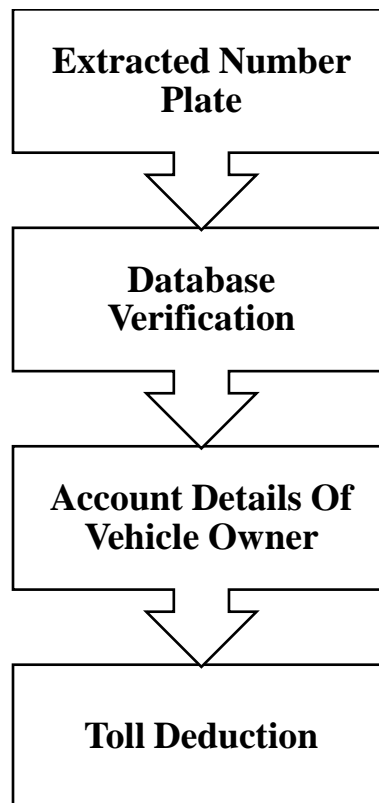
With certain noise removal filters and basic morphological operations, unnecessary objects in the image are removed and the area of interest. (I.e. The number plate of the vehicle) is detected. Filtering helps to remove unwanted noise occurred during capturing the image of the vehicle or due to climatic conditions. Sobel operator is used for noise reduction mechanism and also for edge detection for determining vertical edges in the image.

The next step in localisation of number plate is performing dilation operation on the edge detected image. Now bounding boxes are generated across the elements with greater pixel values across the image followed by morphological opening and eroding operations for filling the gaps or holes formed due to removal of noise elements from the image. Lastly the image is optimized to the region of interest and all the other elements in the image are cropped to obtain only the region having the license plate, thereby giving us the detected license plate for further processing.

### 2.2.3 Recognition of License Plate

After detecting the license plate area, the areas containing highest number of pixels are taken into consideration for extraction of number plate. These areas are taken as an input symbols for recognition of license plate. The number plate is extracted using template matching algorithm in which there is a fixed matrix models of the predefined symbols which are correlated with the symbols generated from detected number plate. These symbols are compared with these pre-defined symbols depending on their rows and columns of the matrix. Symbols having higher correlation with the pre-existing templates is given as an output thereby extracting the number plate as the output.

### 2.3 Recognition of the Respective Owner Details Using License Number and Deduction Of Toll.



**FIG. 2. Flowchart for Toll Deduction from Extracted Number Plate**

In the third step, the number plate that is being recognized and extracted is compared with the database which contains entries of various vehicle's license plate and their respective owner's information such as address, account information, contact and so on. This is done with the help of SQLite software in which the extracted number plate is compared with the existing entries in the database and if the match is found then the respective license plate holder's information is taken and money is deducted from the registered account.

### III. SIMULATION RESULTS

Following are the results of simulation for the developed system. The proposed system are tested under various weather conditions and license plates. The camera is interfaced with MATLAB 2018a. The video clip of the vehicle is captured and hence a frame or an image is extracted from the clip and further process of image processing is followed as shown in figure.



FIG 3: Vehicle Input Image



FIG 4: Grayscale Image

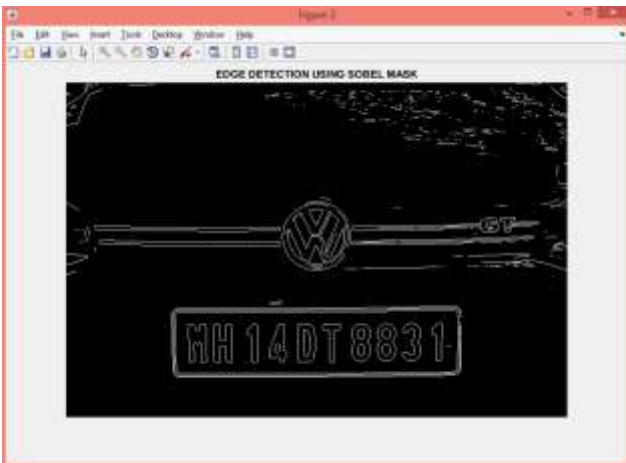


FIG 5: Edge Detected Image

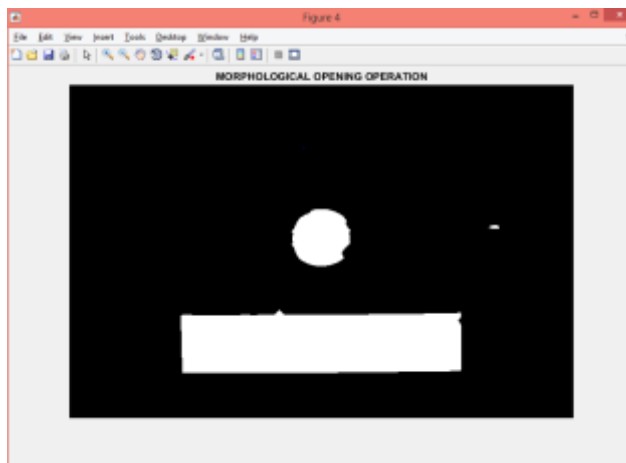
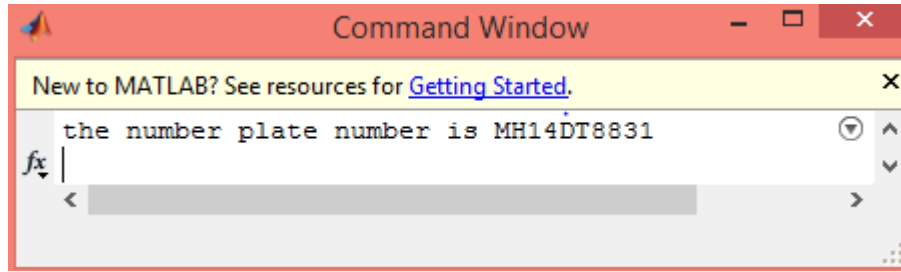


FIG6: Opening Operation



FIG 7: Detected Number Plate



**FIG 8: Extracted Number Plate**

PLATE_NO	NAME	MODEL_NAME	CITATIONS	INITIAL_BALANCE	CURRENT_BALANCE
'MH14DT8831'	'CAROLINA CANNON'	'WOLKSWAGON 3T'	'NO CITATIONS'	356	326

**FIG. 9: Extracted Number Plate detected in database and toll deducted**

#### IV. RESULTS AND DISCUSSIONS

Though the resulting algorithm is very efficient and robust and has a high success rate, it does have a few limitations as well. Here we have stated a number of limitations that we faced, along with the solutions we came up with:

##### 4.1 Recognizes only specified font

The algorithm extracts characters from an image by comparing them to a pre-existing database. Therefore, if a license plate uses a font that is drastically different from the fonts present in the database, chances are they would be recognized incorrectly, or won't be recognized at all.

The solution of this problem is simply increasing the size of the database used for comparison. The more the number of different fonts present in the database, greater is the success rate of the algorithm.

##### 4.2 Character ambiguity

As some of the letter and number looks alike (B and 8, I and 1, O and 0, Z and 2 etc.), there is always a chance that one of these characters will be mis-interpreted by the algorithm.

The solution of this problem is While comparing the candidates with the database, we keep in mind that a license plate has a specific format (in India, for example, it is LLNNLNNNN, where L stands for a letter from the English alphabet, and N stands for a decimal digit). Therefore, while scanning a picture, we also calculate the position of a candidate in a string, and accordingly compare it only to the alphabet set, or to the number set, but not both at the same time.

##### 4.3 Variable Lighting Conditions

This is one serious problem and there is no perfect solution available to overcome the situation. Though the algorithm does incorporate noise-removing as well as contrast-enhancing algorithm, they only improve the success rate by a factor – they can't eliminate the problem completely.

#### V. CONCLUSION AND FUTURE SCOPE

An efficient way for toll deduction using automatic number plate recognition is presented in this paper. In the proposed project, it mainly deals with real-time processing with all types of number plates. It also works well for low quality images with less resolution and contrast. The proposed system can also have applications in red light violation systems, border crossing systems, and private parking systems. The project was designed keeping in mind the automation of the number plate detection system for security reason that could replace the current system of manual entry.

## REFERENCES

- [1] Abolghasemi V, Ahmadyfard A. A fast algorithm for license plate detection. In International Conference on Advances in Visual Information Systems 2007 Jun 28 (pp. 468-477). Springer, Berlin, Heidelberg.
- [2] Kaur, Sarbjit, and Sukhvir Kaur. "An efficient approach for number plate extraction from vehicles image under image processing." *International Journal of Computer Science and Information Technologies* 5, no. 3 (2014): 2954-2959..
- [3] Guanglin, He, and Guo Yali. "A simple and fast method of recognizing license plate number." *Information Technology and Applications (IFITA), 2010 International Forum on*. Vol. 2. IEEE, 2010..
- [4] Pruthi, Y.M. and Anuradha, S.G., 2014. Morphological image processing approach of vehicle detection for real-time traffic analysis. *Int. J. Eng. Res. Technol*, 3(5), pp.2278-0181..
- [5] Soomro, S.R., Javed, M.A. and Memon, F.A., 2012, October. Vehicle number recognition system for automatic toll tax collection. In *Robotics and Artificial Intelligence (ICRAI), 2012 International Conference on* (pp. 125-129). IEEE..
- [6] Rani, Kusum, and Reecha Sharma. "Study of different image fusion algorithm." *International journal of Emerging Technology and advanced Engineering* 3.5 (2013): 288-291..
- [7] Nagothu SK. Automated toll collection system using GPS and GPRS. In Communication and Signal Processing (ICCCSP), 2016 International Conference on 2016 Apr 6 (pp. 0651-0653). IEEE..
- [8] JCSN International Journal of Computer Science and Network, Volume 5, Issue 2, April 2016 ISSN (Online) : 2277-5420 www.IJCSN.org Vehicle Counting and Automated Toll Collection System using Image Processing.
- [9] Qadri, Muhammad Tahir, and Muhammad Asif. "Automatic number plate recognition system for vehicle identification using optical character recognition." In *Education Technology and Computer, 2009. ICETC'09. International Conference on*, pp. 335-338. IEEE, 2009..
- [10] Khalil M. Quick Techniques for Template-Matching-Based Cross-Correlation. *World Applied Sciences Journal (WASJ)*. 2015;33(3):430-6..
- [11] Liu, Na, and Jianfei Zhou. "The Research and Application of a Big Data Storage Model." *International Journal of Database Theory and Application* 8.4 (2015): 319-330.
- [12] Sibiriyakov, Alexander. "Fast and high-performance template matching method." (2011): 1417-1424..
- [13] Prabhakar, Priyanka, P. Anupama, and S. R. Resmi. "Automatic vehicle number plate detection and recognition." *Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2014 International Conference on*. IEEE, 2014..
- [14] Anumol Sasi, Swapnil Sharma, Alice N. Cheeran, "Automatic car number plate recognition", *Innovations in Information Embedded and Communication Systems (ICIIECS) 2017 International Conference on*, pp. 1-6, 2017.
- [15] Kulkarni, Prathamesh, et al. "Automatic number plate recognition (ANPR) system for indian conditions." *Radioelektronika, 2009. RADIOELEKTRONIKA'09. 19th International Conference*. IEEE, 2009..