

Electronic Toll Collection Using Automatic Number Plate Detection System

Pranjal Deshmukh¹, Prafull Shiromany², Deepak Kumar Ray³

^{1,2}B.Tech Student, Department of Electronics & Telecommunication, Bharati Vidyapeeth (Deemed to be) University College of Engineering Pune, India

³ Professor, Department of Electronics & Telecommunication, Bharati Vidyapeeth (Deemed to be) University College of Engineering, Pune, India

ABSTRACT

Electronic toll collection using automatic number plate recognition (ANPR) system is designed for collection of toll fare on toll booths without manual assistance using digital image processing. We are aware of the drastic increase in number of vehicles recently, hence it is necessary to digitalize the information record of these vehicles. The electronic toll detection system other than its primary goal, makes it possible. We propose a system which performs various digital image processing algorithms on the image of vehicle and segments the license plate into individual characters. The proposed system takes a picture of license plate and extracts the number plate. The extracted number plate is then compared with already stored database of vehicle and its type. Accordingly, the fair is displayed. The system does so using the combination of suitable algorithms in accordance with the application, hence proves to be highly efficient and fast. We perform character extraction, character segmentation and recognition work, using English characters and numbers in MATLAB software.

Keywords: Pre-processing, Edge detection, Segmentation, Character recognition

I. INTRODUCTION

The Electronic Toll Collection(ETC) aims to eliminate the delay on toll roads by electronic tolling. This project focuses on ETC system using Automated Number Plate Recognition(ANPR) technology. The Automated Number Plate detection system is used for detecting crime through intelligence monitoring. This technology has many advantages such as automatic toll collection, improvement in highway efficiency, Low fuel consumption, highly reliable, modular architecture and it compares with records on database so as to come up with specific information like vehicles owner, address etc. It successfully detects and recognize the vehicle number plate on real images using Optical Character Recognition(OCR) method.

The electronic automatic number plate recognition system is a tool that we are using to digitalize the record of information related to vehicles. Since the number plate of a vehicle can be considered a primary key for its unique identification , it proves to be an efficient technique to target each and every vehicle. The number plate of a vehicle is easily readable for a human but not for machines. For a machine a number plate is as good as an image with white and black patches. To make it meaningful to machines, we need a robust system to detect and extract desirable information from captured image. There are five main processes which are required to be implemented using suitable algorithms in order to obtain fastest results. They are:

- A. Pre-processing
- B. Edge Detection

- C. Segmentation
- D. Object Recognition

A. Pre-processing

The captured image is first subjected to a few processes which make it compatible for further processing. These processes fall under the category of pre-processing. Pre-processing includes the following processes:

- Greyscale conversion:

Algorithm used: luminance

In luminance, the conversion is done in accordance with the human eye. It takes into consideration, the perception of different colors by the human eye. Humans sense green colour more strongly than red and red more than blue. Hence the most accurate formula used in this algorithm is:

$$\text{Grey} = (\text{Red} * 0.299 + \text{Green} * 0.587 + \text{Blue} * 0.114)$$

Due to the obvious advantage we use luminance algorithm for our application.

- Noise reduction:

Algorithm used: Median filtering

Noise is defined as a non-patterned change in intensity of image. It makes its appearance as granular disturbance. It could occur in the image as consequence of basic photon nature of light or thermal energy of heat inside the image sensors. It mostly occurs while the picture is been taken or sent. Noise means, the pixels in the image show different intensity values instead of true pixel values that are obtained from image. Noise removal algorithms are a mathematical step wise procedure to reduce it in any way possible. The noise removal algorithms reduce or remove the visibility of noise by smoothing the entire image leaving areas near contrast boundaries. But these methods can blur the boundary of the image.

Here are a few algorithms that can be used to reduce noise in digital image processing:

Median filtering: In median filtering the corrected value is not the average of the values of the

neighboring pixels but it's the median of those values. It's a harsh filtering hence, blurring effect is successfully avoided. Since it provides sharper results, we use this technique in our project.

B. Edge detection

Algorithm used: Laplacian of Gaussian (LoG) algorithm

Edge is defined as distinction between two regions in a picture which have somewhat different characteristics. For the system to recognize a number plate, we need it to detect edges in the captured image. It is easy for a human being to detect an edge but for a machine there has to be an algorithm. The algorithms for edge detection work on a simple logic based on pixel density. It detects the discontinuity in the pixel density and the discontinuity is considered to be an edge.

Laplacian of Gaussian (LoG) algorithm:

The LoG method is found to be the most efficient method of all for edge detection. The reason behind this is that it calculates the first derivative, which gives us the curve for values of input image pixels. This curve is then subjected to thresholding. A threshold value is set and the part of curve that crosses the threshold is considered to be the edge. After thresholding, the edge becomes thicker. To normalize the edge, this technique provides a solution. The first derivative is now subjected to second derivative. Giving the accurate results for edge detection.

C. Segmentation

Algorithm used: Otsu algorithm

The thresholding is one of the simplest segmentation algorithms. This technique consists of filter the pixels that form the image so that if they exceed a threshold is set to 0. Otherwise set to 1 or not change. The greatest difficulty lies in choosing the threshold. A variety of techniques have been proposed in this regard. We have limited our thresholding to a pixel

limit of minimum 100 for segmentation of the characters.

D. Character recognition

Algorithm used: Template matching

Template matching is one of the most suitable algorithm for the implementation number plate detection, in which it compares the image with its already stored character templates and matches them accordingly with the help of a suitable code. It is simple and henceforth really fast for this particular application.

II. RESULTS

In this section, few sample images of Indian vehicle number plates are fed to the program as input. The response of the system is then recorded. The recorded samples are presented below:

SAMPLE 1

The image named SAMPLE 1 of number plate of a vehicle is captured by the system. The image is then saved in the database and then given as an input to the program. Shown below is SAMPLE 1.



Figure 1. Sample picture- SAMPLE 1

Image processing is performed and a notepad file is created of the number of the vehicle. The notepad file of sample picture shown below.

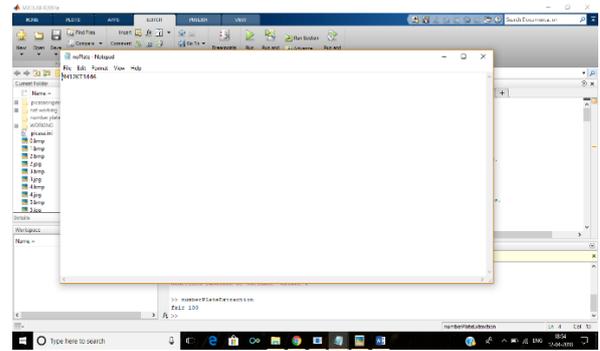


Figure 2. Notepad file of SAMPLE 1

This number is then compared with the already saved database of vehicles. The pre-embedded database contains information about vehicles and toll fare of that vehicle category. The notepad file of license plate is matched with the database and the fair for vehicles category-wise is displayed on the command window. The sample fair output is shown in the image below.

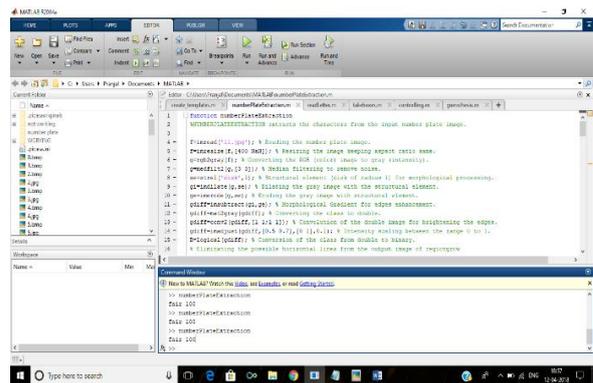


Figure 3. The sample fair output of car

SAMPLE 2

The image of number plate of a vehicle is captured by the system. The image is then saved in the database and then given as an input to the program. Shown below is a sample of tampered number plate.

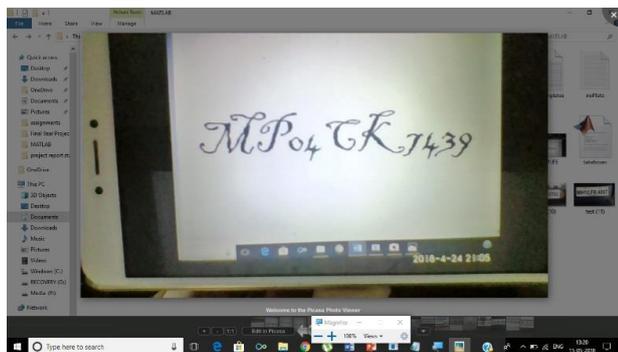


Figure 4. Sample picture- SAMPLE 2

Image processing is attempted but has failed since the number plate is in tampered condition. In this condition no notepad file is formed.

The message suitable for such condition is displayed in the command window.

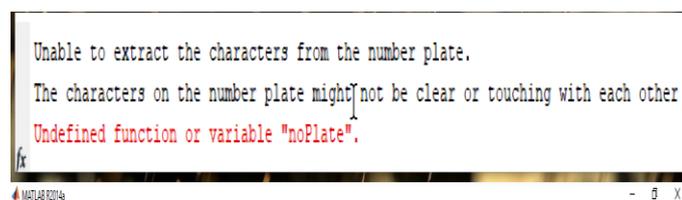


Figure 5. The output for tampered input image

III. CONCLUSION

The objective of this paper was to study the prospects of all applicable algorithms for automatic number plate recognition and prepare a combination that gives out fastest results for the specific application. In the previous section, we weighed the advantages and disadvantages of all applicable techniques. For greyscale conversion, luminance algorithm is used. The formula used in luminance algorithm takes in consideration the sensitivity of the human eye. Hence, proves to be the most suitable alternative. Among both the noise removal techniques, median filtering keeps the image sharper. Hence used. For edge detection, smooth edges are preferable for our application. This requirement is fulfilled by Laplacian of Gaussian (LoG) technique. Otsu algorithm is adopted for segmentation procedure,

since Otsu algorithm's histogram approach is better. Also, small object area is not a concern for License plate recognition. ANPR is rather a basic implementation of image recognition and also the objects to be recognized are not complex in any manner. Hence, the simpler approach of template matching is used. It spares us time and complexity. Algorithm which don't need any computational complexity like LMS algorithm.

IV. REFERENCES

- [1] Ms.Sushama H.Bailmare*, Prof.A.B.Gadicha** (International Journal of Scientific and Research Publications, Volume 3, Issue 12, December 2013). "A Review paper on Vehicle Number Plate Recognition (VNPR) Using Improved Character Segmentation Method". * Student of M. E. Computer Science & Engineering, Department of Computer Science & Engineering, P.R.Patil College of Engg & Technology, Amravatinot
- [2] Guowei Yang, Fengchang Xu* (Procedia Engineering, Volume 15, 2011). "Research and analysis of Image edge detection algorithm Based on the MATLAB". School of Information Engineering, Nanchang Hangkong University, Nanchang 330063, China
- [3] E.R.Lee, P.K.Kim, H.J.Kim (1994). "Automatic Recognition of a car licence plate". Austin, TX, USA.
- [4] Abdalla Mohamed Hambal, Dr. Zhijun Pei, Faustini Libent Ishabailu (International Journal of Science and Research (IJSR), 2015). "Image Noise Reduction and Filtering Techniques". Tianjin University of Technology and Education, Department of Electrical and Electronics Hexi District Tianjin, China.
- [5] Mr. Deepak Ray* , Mr. Prafull Shiromany**, Ms. Pranjal Deshmukh*** (International Journal of Industrial Electronics and Electrical Engineering, Volume-6, issue-3, March 2018) "Automatic Number Plate Detection system". Pune, Maharashtra, India.