International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

COPY RIGHT

IJIEMR Transactions, online available on 26th MAY 2018. Link :http://www.ijiemr.org/downloads.php?vol=Volume-07&issue=ISSUE-05

Title: **A ROBUST AND EFFICIENT APPROACH TO LICENSE PLATE DETECTION**

Volume 07, Issue 05, Pages: 109–119.

Paper Authors

N KRISHNAVENI , D BULLIBABU
vignan's nirula institute of technology & science for women,Guntur, AP, India.

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

A ROBUST AND EFFICIENT APPROACH TO LICENSE PLATE DETECTION

N KRISHNAVENI[1] , D BULLIBABU[2]
[1]PG Scholar, Digital Electronics and Communication Systems, vignan's nirula institute of technology & science for women,Guntur, AP, India
[2]Assistant Professor, Digital Electronics and Communication Systems, vignan's nirula institute of technology & science for women,Guntur, AP, India

ABSTRACT
This Paper presents a robust and efficient method for license plate detection with the purpose of accurately localizing vehicle license plates from complex scenes in real time. A simple yet effective image downscaling method is first proposed to substantially accelerate license plate localization without sacrificing detection performance compared with that achieved using the original image. Furthermore, a novel line density filter approach is proposed to extract candidate regions, thereby significantly reducing the area to be analyzed for license plate localization. Moreover, a cascaded license plate classifier based on linear SVMs using color saliency features is introduced to identify the true license plate from among the candidate regions. For performance evaluation, a dataset consisting of different images captured from diverse scenes under different conditions is also presented. Extensive experiments on the widely used Caltech license plate dataset and our newly introduced dataset demonstrate that the proposed approach substantially outperforms state ofthe art methods in terms of both detection accuracy and run-time efficiency. The proposed system applied in tollgate applicationfor access control.

Keywords: Image Processing, license plate detection,tollgate, SVM Classification

1. Introduction:

A Robust and Efficient Approach to License Plate Detection plays an important role in numerous real-life applications, such as automatic toll collection, traffic law enforcement, parking lot access control, highway surveillance, urban logistics and road traffic monitoring.ALPR recognizes a vehicle's license plate number from animage or images taken by either a color, black and white, or infrared camera. It is fulfilled by the combination of a lot of techniques, such as object detection, image processing, and pattern recognition. Automatic license plate recognition (ALPR) is also known as automatic vehicle identification, car plate recognition, automatic number plate recognition, and optical character recognition (OCR).License Plate Character Recognition is an important phase in Indian vehicle license plate recognition of Intelligent Transport Systems. Plate Character Recognition stage of the Indian LPR yields a sequence of ASCII characters which has to be tested with the stored database on Live License Plate Numbers if

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

such a sequence of ASCII Characters will indeed is a valid plate number. License Plate Character Recognition (LPCR) methods are broadly classified into Template Matching, Neural Networks, and Fuzzy and so on. This class of algorithms in the thesis describes a set of LPCR methods which work effectively for a specific set of image conditions suitable for Indian License Plates. The performance of the proposed classes of algorithms has been tested on many live field images and the analysis given are based on the experimental results; our algorithms are robust and show superior results over may existing algorithms for Indian License Plates.

Need for License Plate Recognition for Indian Plates

License Plate Recognition systems have been implemented in many countries like United States of America, Australia, Korea and few others. Strict implementation of license plate standards in these countries has helped the early development of License Plate Recognition systems. These systems use standard features of the license plates such as: dimensions of plate, border for the plate, color and font of characters, etc. help to localize the number plate easily and identify the license number of the vehicle. In India, number plate standards are rarely followed. Wide variations are found in terms of font types, script, size, placement and color of the number plates. In few cases, other unwanted decorations are present on the number plate. Also, unlike other countries, no special features are available on Indian number plates to ease their recognition process. To design a deployable working system for Indian License Plate Recognition which is a challenging task since there is no uniformity in the Indian License Plates, as each state has adopted its own style and structure. In addition to the problems faced by the General License Plate Recognition Algorithms, there are some set of specific problems needs to be solved by the Indian License Plate Recognition algorithms.As there is inadequacy in the Indian Transportation Engineering and Infrastructure, the road rules are violated and by the lack of monitoring capability, the number of accidents gets increased. The primary need is to identify the vehicles using their license plates. But there prevails a non-uniformity in the Indian License plates and infrastructure.The License plates may not be positioned in the correct position, according to the class of vehicles. This will lead to the misclassification of plate image in the vehicle and the vehicles. Presence of Unusual Characters in the License Plate may be misclassified as License Plate Characters.

- Non Uniformity in License Plates depends on the Class of vehicles
- Single / Multi Line Characters in the License Plate
- Dust / Unwanted Materials in the License Plate
- Non Uniformity in the Font Styles, Font Size and Color

The problems that are to be borne by the above specification needs to be addressed by an efficient system. The primary component of ITS applications is LP. For example, to get theft vehicles details, LP is required by which the vehicle can easily be traced out.

In highway toll collection booths, the vehicles are queuing up for long hours and it becomes worst in peak hours to get the fee paid and pass on the gates. By using LP, automatically the fee can be collected from the owners account and no manual process in required in toll gates. The accidents are getting increased due to speed violation and disobeying the traffic rules. These kinds of violations can easily be monitored by LPR and the driver can be punished. So, LPR helps to get the best value from the road and rail systems and it also helps in traffic flow more smoothly, reducing delays, fuel consumption, and air and noise pollution.

In general, a single ALPDR (Automatic License Plate Detection and Recognition) System is ableto examine the License Plates only of a particular country, since the geometrical arrangement of the License Plate along with the scripts, the font color, the font size, syntax and the direction, etc. are generally realm specific. If devoid of the prior awareness and information in respect to the License Plate geometry, i.e. the character allocation, the spacing between the characters, the dimension ratios, etc., the ALPDR System software would be unable to predict the License Plate in the image acquired or captured.

License Plates are available in a wide range all around the world. These include:

1. White Script on Black or a light background
2. Black Script on White or a dark background
3. Single Row License Plates
4. Multiple Row License Plates

PROPOSED METHOD

3.1 Introduction

In this the proposed algorithm is based on extraction of plate region, segmentation of plate characters, recognition of characters and compare the number with database and display the vehicle authorized and status details.

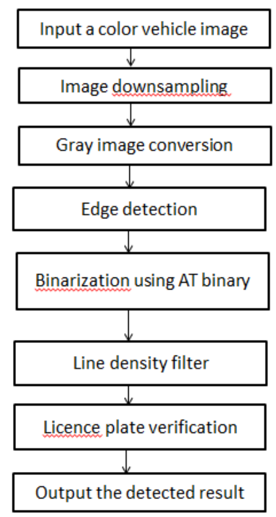


Figure 3.1: The proposed license plate detection approach block diagram.

This section presents our proposed approach to license plate detection, which consists of image preprocessing, candidate extraction and license plate verification. As illustrated in Fig. the original color image is downscaled and converted into a gray scale image by the preprocessing procedure. Then, a set of candidate regions is extracted via edge density detection, adaptive thresholding for the detected edges and line density filtering. Finally, the license plate is located by verifying each of the candidate regions.

3.2 Image preprocessing

The original color images for license plate detection and recognition are generally captured at a high resolution (e.g.,1082×728), which ensures that the small license plates and the even smaller characters on them can be processed and recognized using computer vision algorithms. However, this high resolution also imposes a high computational cost for detecting the license plate in an image. To address this issue, one suggestion might be to downscale the input image for license plate detection. Unfortunately, the downscaling operation mayresult in a loss of information and lead to a decrease in licenseplate detection performance; for this reason, most previously developed methods do not perform image downscaling as part of the license plate detection task. Thus, a fundamental problem to be addressed is "how to balance detection accuracy and run-time efficiency for license plate detection". In this, we propose a novel image downscaling method for license plate detection that can substantially reduce the image size without incurring an obvious decrease in performance compared with that achieved when using the original image. This method is based on the following observations.First, the width of a license plate is obviously greater than its height. Second, the characters on a license plate are printed in the horizontal direction. Thus, we define different scalefactors for the vertical and horizontal directions to downscale the original image, i.e.,

ws = wi/dw

hs = hi/dh

wherewi and hi denote the width and height, respectively,of the original image, whereas wsandhsrepresentthe corresponding downscaled dimensions, and dw and dh (s.t. dh <dw) are the downscaling factors for width and height, respectively. Note that a larger scale factor dwshouldbe assigned to downscale the original image in the horizontal direction for the following two reasons. First, we can compress more image data in the horizontal direction because the width of a license plate is obviously greater than its height. Second, a larger scale factor in the horizontal direction makes the characters on the license plate more compact, which allows the subsequently applied candidate region extraction methodto group all characters into a single region. In our experiments,dw and dh were set to 3 and 2, respectively. Using these well-defined scale factors, we exploit bilinear interpolation for image downscaling, in which each output pixel value is computed as a weighted average of the nearest pixels in a 2×2 neighborhood.

3.3 Candidate extraction using a line density filter

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. As illustrated in Fig.3.1, an extension of the Sobel operator is used to detect the boundaries of objects in the image. Then, AT is exploited to eliminate weak edges and generate a binary edge image. Finally, a line density filter (LDF) method is proposed to connect the high-density regions in the binary edge image along the horizontal and vertical directions. Several examples of the results generated by each component of the candidate detection method are shown in

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Fig. 6. The following subsections describe the details of the proposed candidate extraction method.

3.4 Edge detection and density enhancement:

For edgedetection, we propose a simple extension of the Sobeloperatorfor edge density enhancement. As illustrated in Fig.3.2, p0denotes the current pixel, and p1, p2, p3, and p4 are the nearestneighbor pixels of p0. The edge intensity e0 for pixel p0is defined as follows:

$$e_0 = \begin{cases} \gamma & \text{if } d_0 \geq \gamma \\ d_0 & \text{else } d_0 < \gamma \end{cases}$$

	P_3	P_1	P_0	P_2	P_4	

Figure 3.2. The edge intensity for the current pixel $p_0$is computed from the nearest-neighbor pixels p_1, p_2, p_3 and p_4.

(a) Input Image (b) Grayscale Image

(c)Edge detection by sobel operator

Figure 3.3. Edge detection results generated by the Sobel operator and byour proposedmethod: (a) Input image, (b) Grayscale Image(c) edge detection by Sobel operator.

whereγ is a defined threshold value and d0 is computed as

$$d_0 = |p1 + p_2 - 2 \times p_0| + |p_3 + p_4 - 2 \times p_0|$$

Compared with the typical Sobel operator, which uses a pair of 1×3 (or 3×3) convolution masks to estimate the gradient in the vertical and horizontal directions, we use a single 1×5 mask to estimate the gradient in the vertical direction only. Experimentally, we have found that a 1×5 convolution mask is more robust for edge detection than a 1×3 mask. The threshold value γ was set to 48 in our experiments to avoid overflow in the hardware implementation of the subsequent adaptive thresholding operation. An example of the edge detection results generated by the Sobel operator and by our proposed method is presented for visual comparison in Fig 3.3.

3.4 Adaptive thresholding

To further enhance the estimated edges and generate a binary edge image E_b, we perform adaptive thresholding (AT) on the previously generatedgrayscale edge image Eg. Given E_g, the AT method generates an integral image E_i by summing all pixel values from the upper left corner for each pixel in E_g. Then, a binary edge image E_b is generated by thresholding each pixel p(x, y) in the integral image E_i using a threshold that is adaptively computed from a local window inE_i. Specifically, $E_b(x, y)$ is computed as follows:

$$E_b(x, y) = \begin{cases} 255 & \text{if } E_i(x, y) \geq \beta\varpi(x, y) \\ 0 & \text{else } E_i(x, y) < \beta\varpi(x, y) \end{cases}$$

Whereβ is the coefficient used to control the threshold and$\varpi(x, y)$ is the average of all

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

pixel values within the local hw× hwwindow surrounding pixel p(x, y)

3.5 Line density filer

Given the edge image generated via AT, we attempt to highlight the license plate area and remove noise in the binary image. The morphology technique istypically used as a mathematical tool to address such problems in image processing. Wu et al. presented an impressive morphology gradient method for detecting license plates. Baiet al. introduced a hybrid method using edge statistics and morphology to extract license plate regions. However, the conventional morphology filter is very time-consuming because its template usually contains several pixels, which increases the computational cost. Thus, this filter may not be appropriate for applications that require real-time processing. Therefore, we propose an efficient line density filter (LDF) to highlight the character region.

Our proposed LDF approach is motivated by the following observations:

1) License plates generally exhibit a relatively high edge density.

2) The characters on a license plate are printed in a horizontal orientation, and the height of each character is nearly identical.

3) If an image contains multiple license plates, some spatialdistance will exist between each of them.

3.6 Candidate extraction via CCL

Once the candidate regions have been obtained using the LDF method, we need to further distinguish the true license plate region(s) from other regions. We use a two-step approach to verify these candidate regions. First, connected-component labeling (CCL) is applied to find candidates and remove areas that obviously do not exhibit the geometrical characteristics of a license plate, which are defined as 1) $24 < w < 256$, 2) $6 < h < 32$, 3) $256 < w * h < 4096$, and 4) $w/h < 6$, where w and h represent the width and height, respectively, of the labeled rectangle. These parameters were chosen based on the minimum and maximum widths and heights of a wide range of possible license plates to cover the potential characteristics of most scenes, and they can be modified to be suitable for license plates in different countries or administrative regions.

3.7 Verification via a CLPC based on color saliency

The final step of LPD is to identify the real license plates from among the detected candidate regions. Li et al. constructed a conditional random field model (CRF) to find the final license plates. In, a cascade AdaBoost classifier was proposed to verify candidates. Other methods for license plate verification include principal visual word discovery and CNNs. In, a neural network (NN) was trained based on the HSL color space to determine whether each pixel belonged to a license plate region. Wang et al. proposed a fuzzy logic method for license plate recognition. Considering that a license plate usually consists of two dominant colors, we propose a cascaded license plate classifier (CLPC) based on linear SVMs using color saliency features to verify license plate candidates, inspired by. The feature vector is extracted from both the HSV and RGB color spaces to ensure the effectiveness of the CLPC. To eliminate the

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

negative impact of illuminate variations and decrease the computational complexity of license plate verification, a quantization scheme for color feature representation.

3.9 System Working

The algorithm proposed in this paper is designed to recognize license plates of vehicles automatically. Input of the system is the image of a vehicle captured by a camera. The captured image taken is processed through the license plate extractor with giving its output to segmentation part. Segmentation part separates the characters individually. And finally recognition part recognizes the characters giving the result as the plate number.Here the cameras used for number plate capturing. We will have database of registered number plate, Character database (0-9 and A toZ).When vehicle comes, its size will be detected through blob detection. Then Number plate will be detected using Genetic Algorithm and verified if is registered or not. Then will have red, green and blue indicators simulation. If red signal is active and vehicle is passed then its number plate, fine and date, time will be stored in database.

3.10 optical character recognition

Optical character recognition belongs to the family of techniques performing automatic identification. The traditional way of entering data into a computer is through the keyboard. However, this is not always the best nor the most efficient solution. In many cases automatic identification may be an alternative. Various technologies for automatic identification exist, and they cover needs for different areas of application. Optical character recognition is needed when the information should be readable both to humans and to a machine and alternative inputs cannot be predefined. In comparison with the other techniques for automatic identification, optical character recognition is unique in that it does not require control of the process that produces the information.OCR reduces time for processing for processing data from large number of forms. If done manually, may lead to human error and takes up much of thetime. Recognition of cursive text is an active area of research, withrecognition rates even lower than that of hand-printed text. Higher rates of recognition of general cursive script will likely not be possible without theuse of contextual or grammatical information.

4. Software Configuration:

Operating system : Windows XP

Developing Environment : MATLAB

5. Hardware Configuration:

- Arduino-Nano
- Servo motor
- Buzzer

5.1 Arduino-Nano:

- The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (ArduinoNano 3.0) or ATmega168 (Arduino Nano 2.x).
- It has more or less the same functionality of the ArduinoDuemilanove, but in a different package.
- It lacks only a DC power jack, and works with a Mini-B USB cableinstead of a standard one.

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

It is a 30 Pin configuration

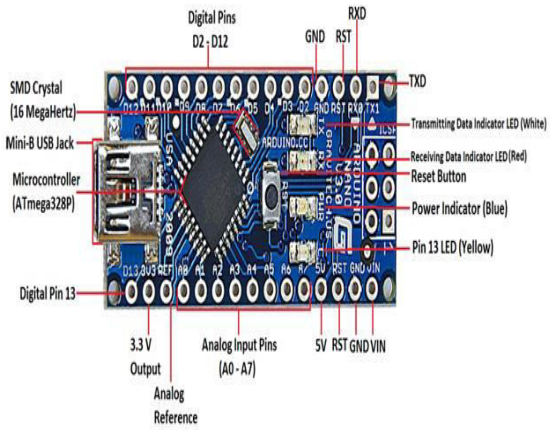


Figure 5.1 Arduino Nano

5.2 Servo Motor:

- The servo motor is most commonly used for high technology devices in the industrial application like automation technology.
- It is a self-contained electrical device that rotates parts of a machine with high efficiency and great precision.
- The output shaft of this motor can be moved to a particular angle.

Servo motors are mainly used in home electronics, toys, cars, airplanes,

Figure 5.2 Servo Motor

5.3 Buzzer:

A buzzer is an electrical device that is used to make a buzzing sound for example, to attract someone's attention.

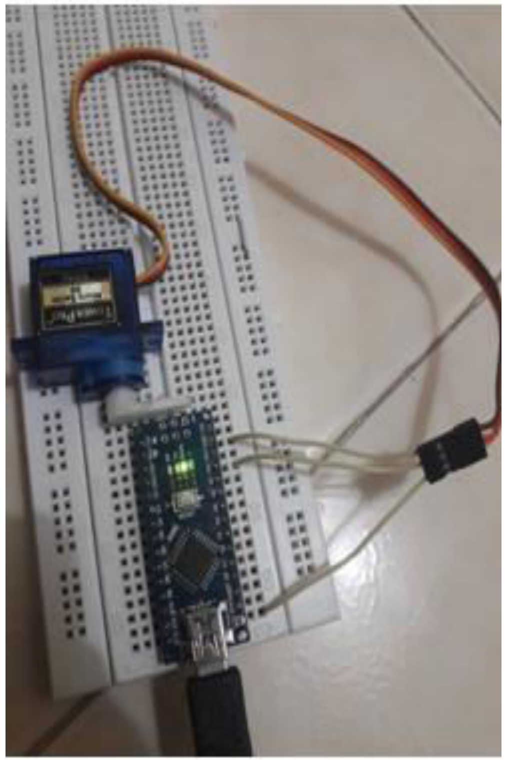
- A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric.

Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke

Figure 5.3 Buzzer

6. Experimental Results

At firstly connect the Arduino Nano, Servo motor and Buzzer to PC by USB cable.



- Taking the input Image from camera as captured frame-1

Figure 6.1:Input Image

- Then the image License Plate region is Filtered.

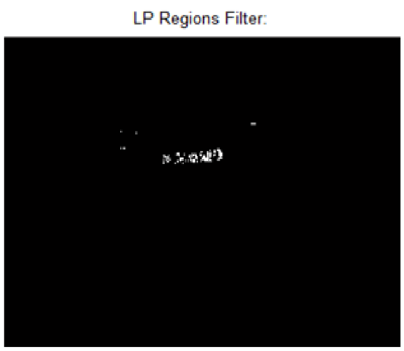


Figure 6.2: LP Region Filtered

- Then the License Plate region is taken.

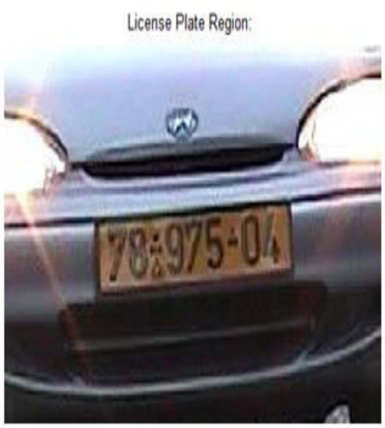


Figure 6.3: LP Region

- The License Plate region is Extracted from our input image and angle is determined by using radon transform.

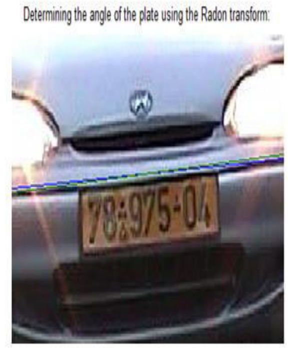


Figure 6.4: Determining the angle of LP Region

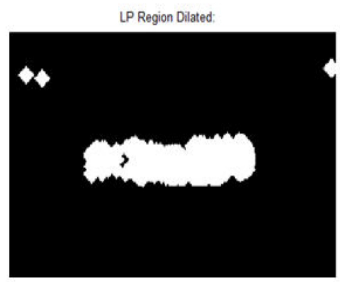


Figure 6.5: LP Region Dilated

- License Plate is cropped from our input image by edge detection.

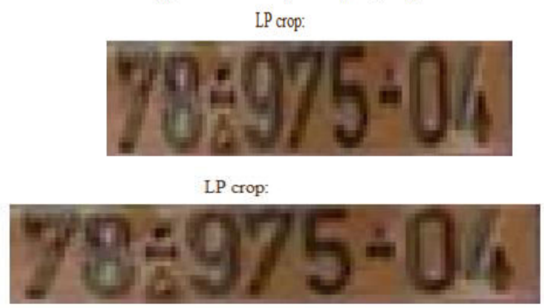


Figure 6.6: LP Region Cropped

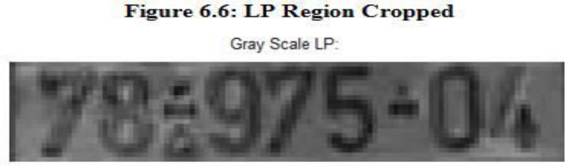


Figure 6.7: Gray Scale LP Region

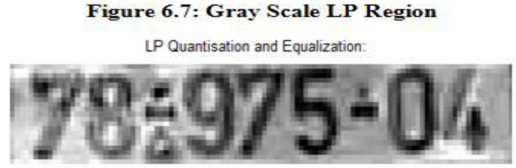


Figure 6.8: LP Quantization and Equalization

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Figure 6.9: BinariesLP

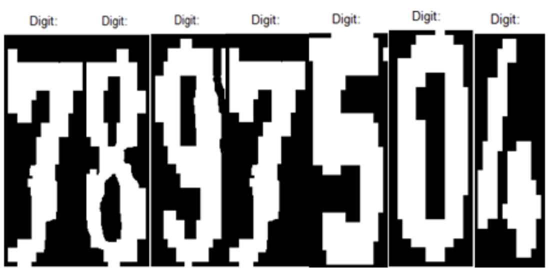


Figure 6.10: Individual Digits of LP

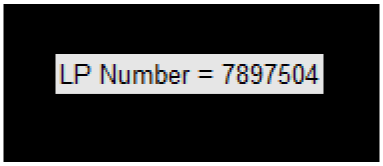


Figure 6.11: Detected LP Region

14

• The Number Plate is cheek either it is authorized and any emergency vehicle then the gate will opens otherwise it gives the buzzer sound of indicating it is an unauthorized vehicle.

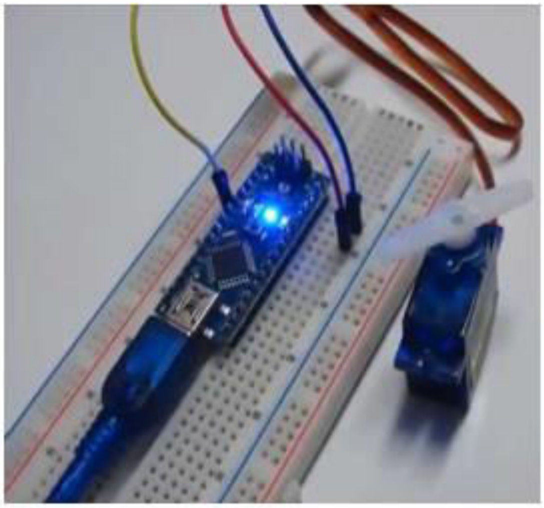


Figure 6.12 Result

• It displays in Command Window of vehicle either it is Autorised,Emergency vehicle and also theft/unauthorized vehicle based on Number Plate detected.

Figure 6.13 displayin the condition in cammand window

It can be applicable for toll collection,parking slot allocation and check post,etc..,

7. Conclusion

This presented a comprehensive survey on existing ALPR techniques by categorizing them according to the features used in each stage. Comparisons of them in terms of pros, cons, recognition results, and processing speed were addressed. A future forecast for ALPR was also given atthe end. The future research of ALPR should concentrate onmultistyle plate recognition, video-based ALPR using temporalinformation, multiplates processing, high definition plateimage processing, ambiguous-character recognition, and so on.

REFERENCES

1. S. Wang, H. Lee, "Detection and recognition of license plate characters with different appearences," in Proc. IEEE Conf. Intell. Transp. Syst.(ITSC), vol.2,pp.979-984, (2003).

2. R. E. Fan, K. W. Chang, C. J. hsieh, X. R. Wang, C. J. Lin, "LIBLINEAR: A Library for Large Linear Classification," Journal of Machine Learning Research, vol.9, pp.1871-1874, (2008).

3. A. Rosenfeld, J. Pfaltz, "Sequential operations in digital picture processing," J. ACM, vol. 13, no. 4, pp. 471-494, (1996).

4. B. Li, B. Tian, Y. Li, D. Wen, "Component-based license plate detectionusing conditional random field model," IEEE Trans. Intell. Transp. Syst.,vol.14, no.4, pp.1690-1699, (2013).

5. H. H. Wu, H. H. Chen, R. J. Wu, D. F. Shen, "License plate extracioninlow resolution video," in Proc. IEEE Int. Conf. Pattern Recognit. (ICPR), Hong Kong, pp.824-827, (2006).

6. Y. Zhao, Y. L. Yuan, S. B. Bai, K. Liu, W. Fang, "Voting-based licenseplaste location," in Proc. IEEE Conf. Intell. Transp. Syst. (ITSC), pp.314-317, (2011).

7. D. Zheng, Y. Zhao and J. Wang, "An efficient method of license plaetlocation," Pattern Recognit. Lett., vol.26, no.15, pp.2431-2438, (2005).

8. V. Shapiro, G. Gluhchev, D. Dimov, "Towards a multinational car licene plate recognition system," Mach. Vis. Appl., vol.17, pp.173-183, (2006).

9. C. N. E. Anagnostopoulos; I. E. Anagnostopoulos; I. D. Psoroulas; V. Loumos; E. Kayafas, "License Plate Recognition From Still Images and Video Sequences: A Survey," IEEE Trans. Intell. Transp. Syst., vol.9, iss.3 pp.377-391, (2008).

10. O. Chum, M. Urban, and T. Pajdla, "Robust wide baseline stereo form maximally stable extremal regions", Image Vis. Comput., vol.22, no.10, pp.761-767, (2004).

11. M. Donoser, C. Arth, H. Bischof, "Detecting, tracking and recognizing license plates," In Proc. Aisian Conf. Comput. Vis. (ACCV), pp.447-456, Springer, (2007).

12. A.M. Al.Ghaili, S. Mashohor, A. R. Ramli, A. Ismail, "Vertical-Edge- Based Car-License-Plate Detection Method," IEEE trans. veh. technol., vol.62, no.1, (2013).