

Vehicle License Plate Recognition for Electronic Toll Collection: Android Approach

Deshmukh Rohit Sunil¹, Satpute Mainawati Tukaram²

¹Assistant Professor, Dept. of Electronics and Tele-Communication Engineering, JSPM'S BIT, Barshi, India

²Student, Dept. of Electronics and Tele-Communication Engineering, JSPM'S BIT, Barshi, India

Abstract: The Electronic Toll Collection aims to eliminate the delay on toll roads by cashless tolling and it is rapidly becoming the most innovative technology for the commuters who pass through the toll plaza. Unlimited increase of vehicle and transportation system, population growth and human request the usage of vehicle increasing. Which make it is impossible fully managed and monitored by human. This paper focuses on Electronic Toll Collection system using Automated license Plate Recognition technology. The developed android application helps to recharge the account and deduce money. The Automated license Plate is used for detecting crime through intelligence monitoring. In our paper, we presented a system which is utilized to detect and identify the license plate of a particular vehicle and store the data into text form.

Keywords: Electronic Toll Collection, optical character recognition, Real time license plate, Image processing, Registration Number recognition, verification.

1. Introduction

The Automatic license Plate Recognition was invented in 1976 at the Police Scientific Development Branch in the United Kingdom. To design a vehicle License Plate Recognition System Using Raspberry Pi3 model in the application of the Image processing. Electronic toll collection is a technology enabling the electronic collection of toll payments. It has been studied by researchers and applied in various highways, bridges, and tunnels requiring such a process. This system is capable of determining if the vehicle is registered or not, and then informing the authorities of toll payment violations, debits, and participating accounts. In a sense, the automatic number plate recognition with Optical Character Recognition is a combination of integrated hardware and software that will read vehicle license plates without the need of humans to do it. The purpose of this paper is to develop and implement a smart system for optimum use of information and communication technology. The concept of the system is to identify properly and locate the vehicle they are looking for. The main designing of a system which captures the image of the number plate automatically by using digital camera and these vehicle detail was verified and predefined using Raspberry pi processor for authentication.

Main useful for following applications,

- Access Control based management of Vehicles.

- Parking Management Solutions.
- Shopping centers, auto repair shops, and carwash areas.
- Vehicle Monitoring through automated real time alerts for Unauthorized / Barred / Stolen vehicles.
- Airports
- Vehicle monitoring at toll collection.



Fig. 1. ANPR system

A. Scope of this paper

As it is not possible to judge which approach is better, different papers, are surveyed and categorized based on the methodologies in each approach. For each approach whenever available parameters like speed, accuracy, performance, image size and platform are reported. Electronic Toll Collection the new era of intelligent transportation systems has been started. Many toll authorities have searched for ways to improve the toll collection process. The proposed license plate recognition system will provide the better solutions to the toll collection and will deal with the problems arising due to traditional toll collection methods. When vehicle passes through toll automatically, it also sends notification to the registered user via SMS and E-mail which provides best security. Since Automatic License plate recognition are fast, easy and reliable it can recognize the number plates of vehicle up to 200km/hr. This terminology is used to detect and disrupt criminality at Local, Force, Regional and National level including tackling travelling criminals, Organized crime groups and Terrorists.

B. Proposed system

Elements of typical License Plate Recognition systems:

License Plate Recognition systems normally consist of the following units:

Camera(s) - that take the images of the car (front or rear side)

Illumination - a controlled light that can bright up the plate, and allow day and night operation. In most cases the illumination is Infra-Red which is invisible to the driver.

Computer - normally a Personal Computer running Windows or Linux. It runs the License Plate Recognition application which controls the system, reads the images, analyzes and identifies the plate, and interfaces with other applications and systems.

Software -The application and the recognition package. Usually the recognition package is supplied as a (Dynamic Link Library).

Hardware - various input/output boards used to interface the external world (such as control boards and networking boards) This system provides benefits to the clients as well as to the Toll Collection. Here the payment is done automatically using Android Application and car license plate number is recognized by License Plate Recognition. The system also contains some additional facilities where one can edit the details if necessary. Mobile phones have become the preferred mode of transaction for the younger generation, and younger people use digital wallets more than traditional banking. It also helps to find out a vehicle number of times it passes through the toll gate in a day. Through this process of toll collection, it will save time, effort and man power.

2. Electronic toll Collection

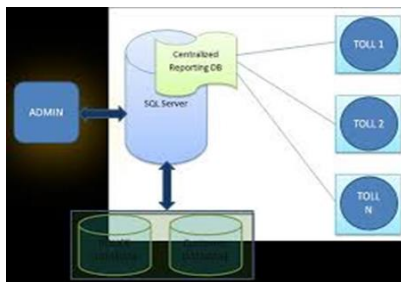


Fig. 2. Toll system

Electronic Toll Collection is the latest method for collecting tolls since it improves the speed and efficiency of traffic flow and save drivers time. Most Electronic Toll Collection lanes are less expensive to build and operate than traditional toll collection methods. The mobile application proposed here deals with the Toll collection management system and the users in a user friendly manner. The users can download and sign up the application by creating an account. They can register their trip by entering the travel details which includes source, destination, date of journey, vehicle number plate (which is taken as their unique id) etc. This helps to maintain clear information about the travel details of the user. Payments can be done by using the Mobile wallet that can be recharged through online transaction systems. Once this information is submitted, they get stored in the toll database. When the user approaches the toll booth the

License Plate Recognition recognizes the license plate and checks the details about the vehicle stored in the database and the availability of the amount in the wallet and the money is deducted from the mobile wallet automatically. The unregistered users are not allowed to pass through the toll boom where the maintained database doesn't match with the Automatic license Plate Recognition recognized vehicle.

A. Current trends and future directions

Although significant progress of License Plate Recognition techniques has been made in the last few decades, there is still a lot of work to be done since a robust system should work effectively under a variety of environmental conditions and plate conditions. An effective Automatic License Plate Recognition System should have the ability to deal with multistyle plates, e.g., different national plates with different fonts and different syntax. Little existing research has addressed this issue, but still has some constraints

3. System model

Generally, an automatic license plate recognition system is made up of four modules; Plate Detection, Character Segmentation, Plate Recognition, Optical Character Recognition modules shows (Fig. 3).

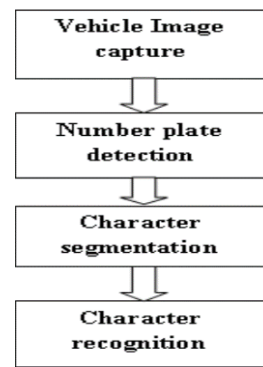


Fig. 3. System model

Number plate recognition basically consists of three concrete steps namely:

- Firstly, License Plate localization from plate images.
- Secondly, Character segmentation from localized license plate.
- Finally, optical character recognition of extracted characters.

A. Input image

This is the initial phase of acquiring a image. In the given system, use of the advanced camera of the16-megapixel camera is made the original image. Input image is captured by digital camera.

B. Plate Detection

We have to detect all the plates in the current camera frame. The basic step in recognition of vehicle number plate is to detect

the plate size. In general number plates are rectangular in shape. Hence we have to detect the edges of the rectangular plate. To detect vehicle number plate following factors should be considered:

- *Plate size:* a plate can be of different size in a vehicle image.
- *Plate location:* a plate can be located anywhere in the vehicle.
- *Plate background:* A plate can have different background colors based on vehicle type. For example, a government vehicle number plate might have different background than other public vehicles.
- *Screw:* A plate may have screw and that could be considered as a character.

C. Character segmentation:

Segmentation is the process of dividing an image into multiple segments. This process is to simplify the image for analysis and make feature extraction easier. Its main function is to segment the characters in the selected candidate region (extracted license plate) such that each character can be sent to the optical character recognition module individually for recognition. We get individual character and number image by using, vertical and horizontal scanning Method. Characters are segmented from the number plate image which is then used for template matching.

D. Optical character recognition:

The goal of this stage is to recognize and classify the binary images that contain characters received from the previous one. Template matching method is used for Character recognition and the resulting data is then used to compare with the records on a database, so as to come up with the specific information. Segmented characters are template matched with the templates of each character and the number plate is identified as a string.

E. Flow chart

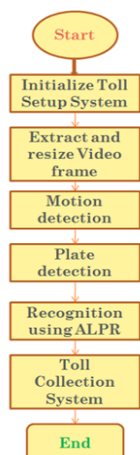


Fig. 4. Flow chart

The system must first be initialized by selecting what video source to use, whether a video file for testing or through an IP

camera for real-time video capture. After acquiring the necessary input, the system detects the presence of a moving object and determines whether the object is vehicle. In the frame. Where the car is detected, the plate number will then be localized for plate number recognition. Finally, the extracted plate number is considered as input to the registered accounts.

4. Block diagram

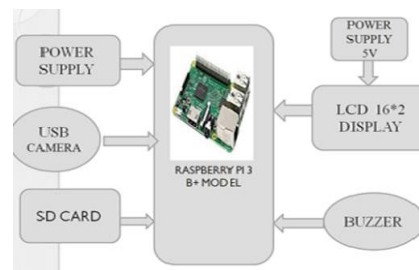


Fig. 5. Block diagram

A. Block diagram description

The onboard computer can efficiently communicate with the output and input modules which are being used. The Raspberry Pi is a credit card-sized single-board computer developed in the United Kingdom by the Raspberry Pi Foundation. we propose a Raspberry Pi based vehicle number plate recognition system that automatically recognizes vehicle number plates using image processing. The system uses a camera along with Liquid Crystal Display circuit interfaced to a Raspberry pi. The system constantly processes incoming camera footage to detect any trace of number plates. On sensing a number plate in front of the camera, it processes the camera input, extracts the number plate part from the image. Processes the extracted image using Optical Character Recognition and extracts the number plate number from it. The system then displays the extracted number on a Liquid Crystal Display. Thus we put forward a fully functional vehicle The number plate recognition system using Raspberry Pi automatically captures the image of the number plate of a vehicle and these details were verified using Raspberry Pi processor for authentication. The system also alerts the authorities when any unauthorized or crime or theft vehicle image of number plate was detected by using buzzer and also send SMS to the police.

B. Related work

1) Manual toll collection

In existing system, a manual toll collection can process near about 400 vehicles per hour in comparison to a free flow freeway lane, with huge capacity approaching 2,000 vehicles per hour significant congestion at many of these toll plazas. There are many high costs associated with this method of payment. In India, Manual toll collection is most widely used collection method. It needs a toll collector. Depend upon the vehicle type; cash toll is received by the toll collector. And the processing time of manual toll collection is highest. Electronic Toll Collection using Barcode Reader where a Barcode will be placed on the vehicle and Barcode reader will read the bar code

and the toll will be directly deducted from the prepaid account. In the technique number plate is used and includes the barcode, which in coordination with each other can be used to detect the vehicle identity.

To perform this task Raspberry Pi processor is programmed using embedded “Linux”. Linux is a Unix-like computer operating system assembled under the model of free and open source software development and distribution. The defining component of Linux is the Linux kernel, an operating system. The Linux Standard Base is a joint project by several Linux distributions and is based on the POSIX specification, the Single UNIX Specification, and several other open standards, but extends them in certain areas.

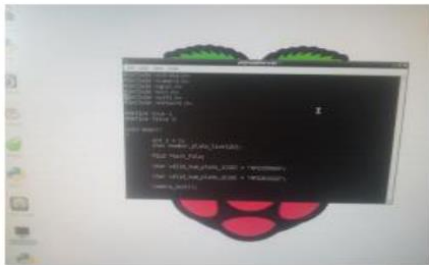


Fig. 6. Embedded Linux programming

The main core of the system can be executed under Windows and Linux operating systems. For the high-security and high-sensitivity projects where Windows cannot provide the required security, the Linux-based LPR version can be used for more improved reliability. The received data can be sent using wireless communication system to a defined server.

2) *Raspberry pi processor:*

This paper makes use of a single board computer, which is commonly termed as Raspberry Pi3 processor. It acts as heart of the project. The device which is able to perform the task is a Raspberry Pi3 processor. In the Proposed ALPR system, we used the Raspberry Pi is a credit-card-sized single-board computer. The Raspberry Pi has Broadcom BCM2837 64bit ARMv7 Quad Core Processor powered Single Board Computer running at 1.2GHz, 1GB RAM BCM43143 Wi-Fi on board. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and long-term storage.



Fig. 7. Raspberry pi3 processor

C. *USB camera*

A webcam or Universal Synchronous Bus camera is a video camera that feeds its image in real time to a computer or

computer network. Unlike an IP camera which uses a direct connection using Ethernet or Wi-Fi, a USB camera is generally connected by a USB cable, FireWire cable, or similar cable. The common use as a video camera for the World Wide Web gave the webcam its name. Other popular uses include security surveillance, computer vision, video broadcasting, and for recording social videos. Webcams are known for their low manufacturing cost and flexibility, making them the lowest cost form of video telephony. It is often necessary to have a conventional color image of the vehicle especially where prosecution or congestion charging is the application. This would be a separate color camera mounted alongside or just below the License Plate Recognition camera. Saving the overview image is triggered by the License Plate Recognition camera registering a number plate. This then adds a color image to the same file for future reference.



Fig. 8. USB Camera

D. *Buzzer*

The paper related to license plate based toll system uses a buzzer module for audible alerts. The buzzer or beeper is an audio based signaling device. It is mainly designed as mechanical, electromechanical, or piezoelectric. There are many typical uses of buzzers and beepers which include alarm devices, timers and also based on confirmation plate is detected or not.



Fig. 9. Buzzer

5. Conclusion

In License Plate Recognition system, the image of vehicle number plate is taken with the image capturing system and the license number of the vehicle is perceived with the goal that the data and information of the vehicle owner can be obtained. The automatic vehicle identification plays an important role in detecting security threat. The system use series of image processing technique for identifying vehicle from the database stored on pc. and also implemented in android and its

performance is tested on real image. With the help of this License Plate Recognition we can reduce the human interaction in the entire toll collection process and improves the security level of the system. This technology will be used in different toll booths across the country where the traffic can be controlled easily and management of time can be effectively handled. It helps in the digitization technique and serves to be user friendly.

References

- [1] B. D. Acosta, Experiments in image segmentation for automatic US license plate recognition M.Sc. thesis, Department of Computer Science, Faculty of the Virginia Polytechnic Institute and State University (2004).
- [2] Bai Hongliang and Liu Changping, "A hybrid license plate extraction method based on edge statistics and morphology," *Proceedings of the 17th International Conference on Pattern Recognition, 2004. ICPR 2004.*, Cambridge, 2004, pp. 831-834 Vol.2.
- [3] Hwajeong Lee, Daehwan Kim, Daijin Kim and Sung Yang Bang, "Real-time automatic vehicle management system using vehicle tracking and car plate number identification," *2003 International Conference on Multimedia and Expo. ICME '03. Proceedings (Cat. No.03TH8698)*, Baltimore, MD, USA, 2003, pp. II-353.
- [4] Prathamesh Kulkarni, Ashish Khatri, Prateek Banga, and Kushal Shah, "Automatic Number Plate Recognition (ANPR)," in *Radio Elektronika. 19th International Conference, 2009.*