

A Survey on Automatic Toll Collection and Detection of Stolen Vehicle

Swati Londhe¹, Khushabu Turkar², Dnyaneshwar Nagre³,
Mithun Urade⁴, Khushabu Gabhane⁵, Priyanka Shende⁶

^{1,2,3,4,5,6}Department of Computer Engineering, Bapurao Deshmukh College of Engineering, Sewagram

Abstract: The Automatic Number Plate Recognition is image processing technology that identifies vehicle without direct human intervention. On any tollbooth, vehicle has to stop for paying the toll. We are trying to develop a system that would pay the toll automatically and reduce queue at the toll. ANPR consist of 4 phases: Pre-processing, number plate extraction, character segmentation and character recognition. Moreover in our system if a vehicle is stolen and an entry is being made in central database by the police then if the vehicle passes through the tollbooth then silent alarm would buzz which indicate the operator at the tollbooth that the vehicle is a stolen vehicle. The information of vehicle is already stored in the central database.

Keywords: ANPR, OTP, SVM, IPTB, SMS Based System, Sobel Filter.

I. INTRODUCTION

ANPR is a system that captures the image of vehicles and recognizes their license number. It is a real time application which is aimed at making toll taxation more efficient, reliable, and safe and environment friendly. In general case, customer would have to wait at toll booth to pay the toll and creating traffic congestion, pollution and a lot of frustration. Today, automated toll collection is fast becoming a globally accepted toll collection. IPTB system is used as a system for fast and efficient collection of toll at the toll plaza.

- Automatic Vehicle Classification (AVC) automatically verifies the classification of vehicles. Because vehicle had been already classified at the time of registration.
- Central Server: For more security and to maintain record of each toll and customers, central server is required. A central server stores the data which comes from different toll plaza. A local computer of every toll plaza is connected to a central server through internet. The consumer/owner has to register in a central server and deposit money in their accounts. AVI and AVC totally depend on vehicle licence number plate.

II. LITERATURE SURVEY

Shyang-Lih Chang, Li-Shien Chen, Yun-Chung Chung, and Sei-Wan Chen proposed the LPR algorithm consisting of two modules: one for locating the license plates and one for identifying the license numbers. Although, the proposed algorithm was concerned with the license plates of one specific country, many parts in the algorithm were readily extended to use with license plates of other countries. The color edge detector introduced in the locating module was readily adapted to other color schemes by replacing the color parameters embedded in the detector. Since numerals and roman letters were commonly used to form license numbers, the proposed SO OCR technique was applied to any similarly constituted license plates. [1]

M. M. Shidore, S.P.Narote focused on ANPR algorithm for vehicle number plate extraction, Character segmentation and recognition were presented. The experimental results had showed that, number plates were extracted faithfully based on vertical edge detection and connected component algorithm, with the success rate of 85%. Character segmentation phase using connected component analysis and vertical projection analysis worked well with the success rate of 80%. The success rate achieved for character recognition was 79.84%. [2]

Author Allam Mousa proposed an edge-detection method to enable a Plate Recognition System through practical situations. Image processing tools were used to scan the plate area, resize it, and convert it towards a gray scale prior to filtering the image in order to remove small objects. The obtained objects were identified such that the numbers object is recognized. The details of the obtained image were controlled through the standard deviation of the Gaussian filter (sigma). [3]

Amninder Kaur and Sonika Jindal proposed the Automatic License Plate Recognition (ALPR) system for vehicles. It had considered the "Indian Number Plates", where rear followed the number plate standards. This system consist of few algorithms like "Feature Based Number Plate Localization" for locating the number plate, "Image Scissoring"

algorithm for character segmentation and proposed algorithm for character recognition using “Support Vector Machine” (SVM). [4]

Asif Ali Laghari, M. Sulleman Memon and Agha Sheraz Pathan proposed the vehicle equipped with a radio frequency (RF) tag detected RF Reader located in toll plaza. The amount then automatically deducted from the bank account. [5]

M. M. Rashid, A. Musa, M. Ataur Rahman, and N. Farahana, A. Farhana proposed that automatic parking system and electronic parking fee collection based on vehicle number plate recognition. This paper presented an algorithm technology based method for license plate extraction from car images followed by the segmentation of characters and recognized and also developed electronics parking fee collection system based on number plate information. [6]

Ronak P Patel, Narendra M Patel, Keyur proposed the Smart Vehicle Screening System, which installed into a tollbooth for automated recognition of vehicle license plate information using a photograph of a vehicle. It contained new algorithm for recognition of number plate using morphological operation, thresholding operation, edge detection, bounding box analysis for number plate extraction, character separation using segmentation and character recognition using template method and feature extraction. [7]

S. R. Jog, S.D. Chavan, Rama Takbhate proposed that the image & the respective information processed based toll collection system and made more efficient and perfect. In this system camera was used for capturing the image of the vehicle number plate. The captured image converted into the text using ANPR and the toll was cut from the customer's account and then opened the gate. For the identification of the vehicles, the information of the vehicles was already stored on the central database. So captured number sent to the server received at the toll. [8]

Rong-Choi Lee, King-Chu Hung proposed that Automated Toll System no needed to stop vehicle at toll plaza, it detected the RFID tag, which is mounted on vehicle. An RFID tag is installed on each vehicle with read/write memory. The entire system was developed as an embedded system using micro-controller and associated devices. The system was connected to a PC using the RS232C interface in the embedded system. This allowed the system to read and write data from/to a database that was from the account. [9]

Manisha Shirvoikar, Jairam Parab, Vinay Mirashi, Ramesh Kudaskar, described the method in which in pre-processing, the sobel operator is used for detecting horizontal and vertical edges. The result showed that, number plate was extracted successfully with success rate of 89%. Character Segmentation was done using Thin Window Scanning method. Character Recognition was carried out using Artificial Neural Network (ANN). [10]

Amina Khatra described that the vehicle's no. plate identification system should be capable of identifying the texts written in any style and at any angular position. [11]

Kuldeepak, Monika kaushik and Munish Vashishath described that the design of algorithms used for extracting the license plate from a single image, isolating the characters of the plate and identifying the individual characters. [12]

Divya Gilly and Kumudha Raimond proposed that a good success rate of 93.7% was obtained by the combination of fuzzy logic for license plate detection and Self Organizing (SO) neural network for character recognition. [13]

Lekhana G.C and R. Srikantaswamy proposed that License plate recognition (LPR) algorithms in images or videos are generally composed of four processing steps, namely, Image acquisition, License plate detection and extraction, Character segmentation, was done through fusion of spectral analysis and connected component analysis, and Character recognition was done using support vector machines. [14]

Vincent O. R. Olayiwola, O. E and Kosemani O.O proposed an automated procedure for monitoring traffic at toll gates to give the best compromise among the conflicting objectives of payment, security and good services. [15]

Divya gilly and Dr. Kumudha raimond proposed LPR system that can only be practical on the front view and rear view orientation of the license plates. The license plates that was successfully located and segmented as 80% and 87.5% respectively. [16]

Shridhar Allagi, Sharada H N proposed the system that helps for parking toll collection automatically without much human intervention or human interaction. The automated system had been integrated with a camera that was placed near entry and exit gates, automatically detects number plate and collect necessary information and processes it and automatically calculates the toll fee based on the duration the vehicle was in the campus. The data had been stored in a database that helps to surveillance the campus regarding the unknown vehicles in organization campus or public parking lots. [17]

Ch. Rama Krishna Reddy, M. Padmaja, Dr. K. Sri Rama Krishna, K.Prasuna described that in Electronic Toll Collection System (ETC) the violation enforcement team should get an image of traveler's number plate from Toll Plaza point for tracking the traveler's information to inform travelers about their toll fee. [18]

Sarmad Majeed Malik, and Rehan Hafiz proposed that to design an efficient algorithm which had high efficiency. A camera first detects and captures the snap of the vehicle and then the algorithm searches for the license plate. The system was implemented on MATLAB. [19]

Afaz Uddin Ahmed, Taufiq Mahmud Masum, Mohammad Mahbubur Rahman proposed a design of an automated secure garage system featuring LPR process. A study of templates matching approach by using Optical Character Recognition (OCR) was implemented to carry out the LPR method. The system allows only a predefined enlisted cars or vehicles to enter the garage while blocking the others along with a central-alarm feature. [20]

Table 1: Literature Review

Title	Author	Year	Description
Effective method of license plate localization and Segmentation of vehicles	ManishaShirvoikar, JairamParab	2013	LPLS system overcomes the Difficulty in tracking vehicles for the purpose of parking admission, traffic management and law enforcement.
Automated tollplaza system using RFID	Sachin Bhosale	2013	It is proposed as a low cost optimized solution using RFID and GSM mobile technology.
Automated toll booth and tracking system for theft vehicle	S. R. Jog; S.D. Chavan, Rama Takbhate	2013	The captured image converted into the text using ANPR and toll would be cut from the customer's account.
License Plate Recognition Using Support Vector Machine	AmninderKaur, Sonika Jindal	2012	(ALPR) system is used. Algorithm used "Feature based number plate Localization" for locating the number plate, "Image Scissoring".
RFID Based Toll Deduction System	Asif Ali Laghari, M. Sulleman Memon	2012	RF tag detect RF Reader Located on toll plaza and the amount automatically deduct from the bank account.
Number Plate Recognition for Indian Vehicles	M. M. Shidore, S. P. Narote	2011	Number plate extraction and Character Segmentation is done. segmentation accuracy is 80% and Recognition rate is 79.84 %.
Automatic Number Plate Recognition (ANPR) system for Indian conditions using Support Vector Machine (SVM)	Shriram Waghmare, A. K. Gulve	2006	proposed model pre-processing and number plate localization is performed by using "Ostu's methods" and "feature based localization Methods". Restriction like speed of vehicle, Script on the number plate and skew in image.

III. EXISTING APPROACH

Indian number plates can have single row or double row. Few types of variations found in Indian Number plates. There are number of algorithms proposed for number plate localization such as multiple interlacing and transform domain filtering. In case of multiple interlacing algorithm, horizontal edge detection and vertical edge detection is performed separately on input vehicle image. Then horizontal and vertical edge detected images are added to get an image which avails co-ordinates of number plate. This approach cannot be employed for Indian number plates because they do not necessarily have a border which is mandatory for this algorithm. Transform domain filtering is another approach in which high frequency area of input image is taken out as number plate. The algorithm is also not suitable for Indian conditions because of the presence of other characters or character like structures in input image.

IV. PROPOSED APPROACH

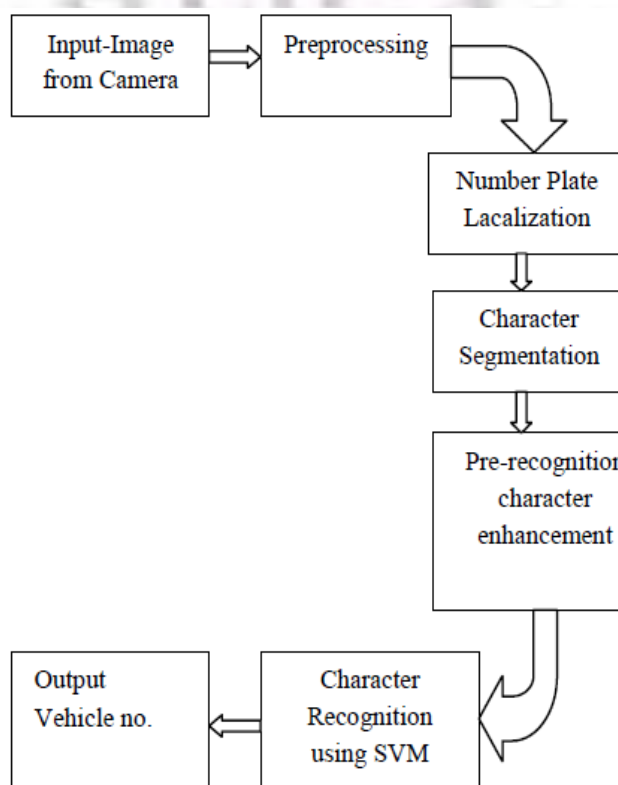


Fig1: Proposed ANPR System

In this proposed approach consist from various fields (Fig.1), such as input image from camera, pre-processing, Number Plate Localization, character segmentation, character recognition using SVM.

V. RELATED WORK

The basic model of automatic number plate recognition system consists of 4 main phases: 1) Image Acquisition and Pre-processing phase 2) Number Plate Extraction 3) Character Segmentation 4) Character Recognition phase. The basic working of ANPR system is shown in Fig1. In the first phase image is acquired and some pre-processing operations are performed on it to make better quality of input image. In the second phase the exact location of number plate is detected from whole vehicle image and then extracted that portion of image. In the third phase, the segmentation of characters from the extracted plate area is done. The last phase is character Recognition in which segmented characters are recognized and output is license plate number.

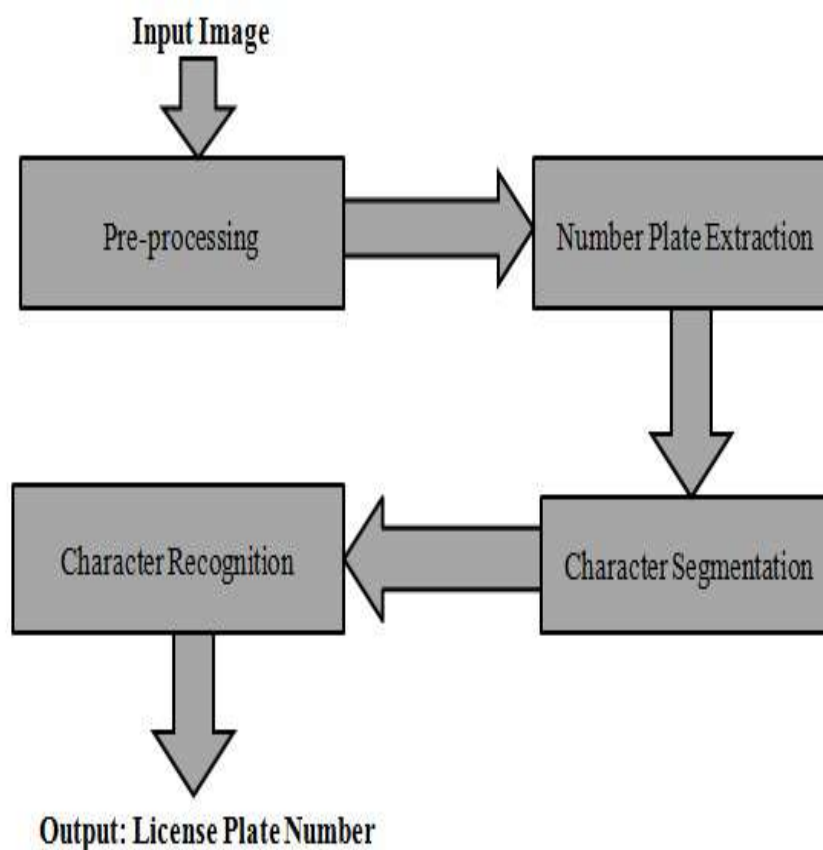


Fig 2: Basic working of ANPR system

Number plate extraction phase is the most important phase in ANPR system because all others phases depends on exact extraction of number plate area. The extraction of number plate is difficult and directly influences the accuracy of ANPR because all further steps depend on accurate extraction of number plate. Many difficulties occur during the detection and extraction of number plate due to the following reasons:

1. The efficiency of extraction is affected by scene complexity.
2. Different vehicles have plates located on different position.
3. Noise can occur during camera capture.
4. The weather conditions responsible for noise arrival.
5. Time of day affects lighting thus resulting into contrast Problems.
6. Unwanted characters, frames and screws introduce confusion.
7. Wrong camera or plate position result into distortion that affect efficiency of plate extraction.
8. Low or uneven illumination, blurred image, low resolution input image, reflection, shadow affect the efficiency of number plate area extraction.

VI. SYSTEM ARCHITECTURE

The process starts when there is presence of a vehicle and signal the system camera to record an image of the passing vehicle. The image is then passed on to a computer where software running, on the computer extract the license plate number from the image. LPN (License Plate Number) can then be verified in central database if number valid for this system then LPN recorded in database with other information such as vehicle number, time, balance, personal details. License plate number can also be further process and be used to control other systems.

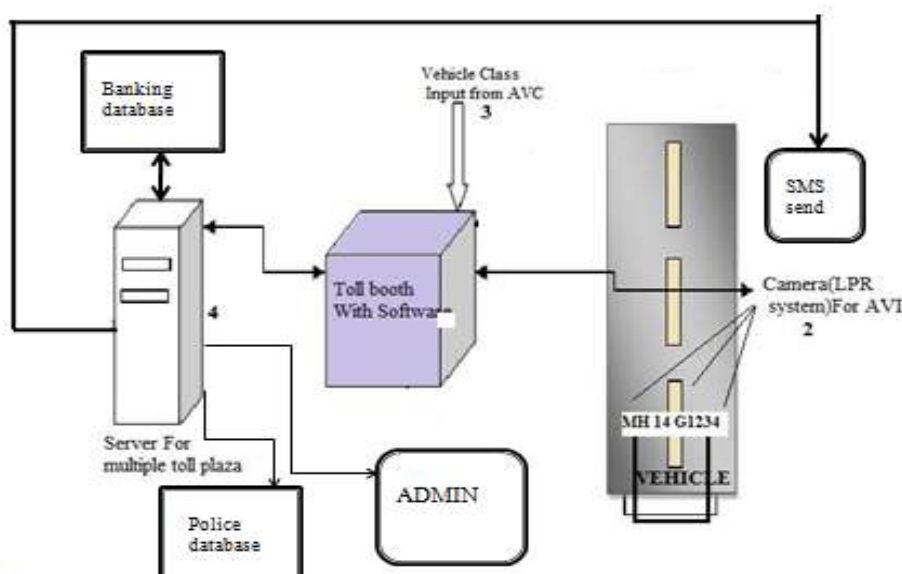


Fig 3: Structure of the system

Now, centralised database check for the validation of License Plate Number and if the number is found to be valid then the respected amount will be deducted from users account and this information will be received by user through SMS via GSM modem. If a vehicle is stolen and an entry is being made in the central database by the police then if the vehicle passes through the toll booth then silent alarm would buzz which would indicate the operator at the toll booth that the vehicle is a stolen vehicle.

A. ANPR System

The algorithm proposed in 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 from 4-5meters away is processed through the license plate extractor with giving its output to segmentation part. The segmentation part separates the characters individually. And finally recognition part recognizes the characters giving the result as the plate number. For better performance of image to text conversion high resolution camera is required.

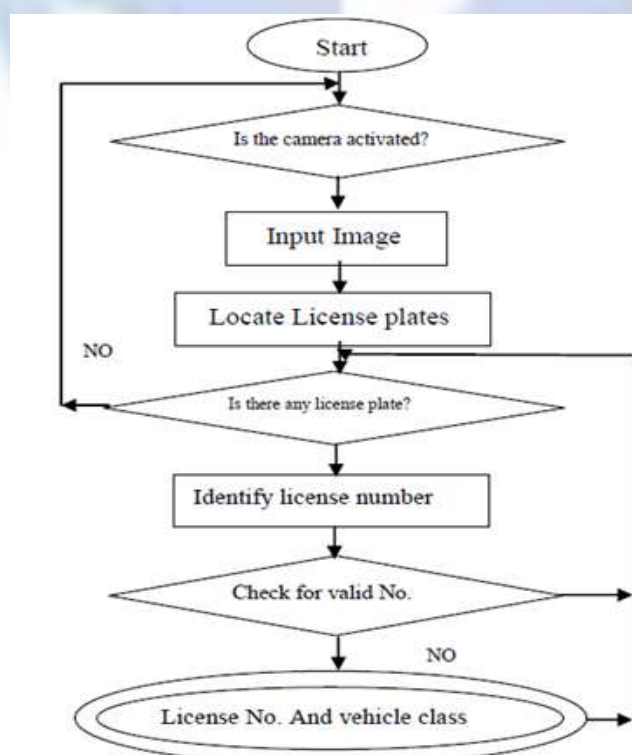


Fig 4: ANPR Flow

B. Template Matching Rule

The Indian number plates following the new format can be of lengths 8, 9 or 10. Format of the registration is as shown below.

AA 11 BB 1111

Where AA is the two letter state code; 11 is the two digit district code; 1111 is the unique license plate number and BB are the optional alphabets if the 9999 numbers are used up [1]. Using Validation and assumptions in string checking improves the accuracy of template matching. For example vehicle number is "OR 11 XX 1111". If O matches with 0 (zero) but in predefined format first two fields are fixed for the character. Hence zero is replaced by O, similarly for B and 8, 2 and Z.

VII. SOFTWARE AND SECURITY

a) Login with OTP (one time password) security:

In proposed system as toll operator point of view provide OTP system. OTP is a password that is valid for only one login session. OTP generation algorithms typically make use of randomness. Any toll worker knows ID and password but when enter the private details for login then generate OTP and send to the toll operator register mobile and then login with OTP, ID and password. If all the details match then operator can login to the toll system.

b) Toll Operating Software:

When vehicle enters the toll plaza then toll software automatically starts. Shows in fig in these application firstly get vehicle license plate number then check if number is valid for these system then using TTV(text to voice) read number in a speaker for driver confirmation. Also check the balance in customer account and same time check license number in stolen vehicle database.

CONCLUSION

In this paper, we presented application software designed for the recognition of license plate. Firstly we extracted the plate location, and then we separated the plate characters individually by segmentation and finally applied template matching with the use of correlation for recognition of plate characters. Image processing based automatic toll booth in Indian condition can be used to remove all drawbacks with current system such as time and human efforts.

REFERENCES

- [1]. Shyang-Lih Chang, Li-Shien Chen, Yun-Chung Chung, and Sei-Wan Chen, Senior Member, IEEE, "Automatic License Plate Recognition", in Transactions on intelligent transportation systems, Vol. 5, No. 1, MARCH 2004
- [2]. M. Shidore, S. P. Narot, "Number Plate Recognition for Indian Vehicles", in IJCSNS, Vol 11 No.2, Feb. 2011 .
- [3]. Allam Mousa , "Canny Edge-Detection Based Vehicle Plate Recognition", International Journal of Signal Processing, Image Processing and Pattern Recognition Vol. 5, No. 3, September, 2012
- [4]. Amninder Kaur, Sonika Jindal, "License Plate Recognition Using Support Vector Machine" , International Journal of Advanced Research in Computer Science and Software Engineering , Volume 2, Issue 7, July 2012.
- [5]. Asif Ali Laghari, M. Sulleman Memon and Agha Sheraz Pathan, "RFID Based Toll Deduction System", IJ. Information Technology and Computer Science, 2012, 4, 40-46 Published Online April 2012 in MECS (<http://www.mecspress.org/>) DOI: 10.5815/ijitcs.2012.04.06
- [6]. M. M. Rashid, A. Musa, M. Ataur Rahman, and N. Farahana, A. Farhana, "Automatic Parking Management System and Parking Fee", International Journal of Machine Learning and Computing, Vol. 2, No. 2, April 2012.
- [7]. Mohamed El-Adawi, Hesham Abdel Moneim Keshk, Mona Mahmoud H Saragi, "Automatic License Plate Recognition" ,IEEE Transactions on Intelligent Transport Systems, vol. 5, pp. 42- 53, March 2013.
- [8]. S. R. Jog, S.D. Chavan, Rama Takbhate, "Automated Toll Booth And Tracking System For Theft Vehicle" , ISSN (Online): 2347-2820, Volume -1, Issue-2, 2013.
- [9]. Rong-Choi Lee, King-Chu Hung, "An Automatic Vehicle License Plate Recognition Based on Prewitt Edge Detection and Artificial Neural Network", Vol.1, issue 5, Page 79-90, 2013, ISSN (e): 2321-7 545
- [10]. Manisha Shirvoikar, Jairam Parab, Vinay Mirashi, Ramesh Kudaskar, "Effective Method Of License Plate Localization And Segmentation Of Vehicles", International Journal of Advances in Engineering & Technology, May 2013.
- [11]. Amina Khatra, "Vehicle's RC Plate Tracking based on Image Processing Applications" , International Journal of Scientific Engineering and Research (IJSER) ISSN (Online): 2347-3878 Volume 1 Issue 4, December 2013.
- [12]. Kuldeepak, Monika Kaushik, Munish Vashishath, "License Plate Recognition System based on Image Processing Using Labview", International Journal of Electronics Communication and Computer Technology (IJECCCT) Volume 2 Issue 4 (July 2012).

- [13]. Divya Gilly, Kumudha Raimond, "License Plate Recognition Systems", International Journal of Computer Applications (0975 - 8887) Volume 61,pg. No.6, January 2013.
- [14]. Lekhana G.C, M.Tech; R.Srikantaswamy, Professor, "REAL TIME LICENSE PLATE RECOGNITION SYSTEM", International Journal of Advanced Technology & Engineering Research (IJATER) National Conference on Emerging Trends in Technology (NCET-Tech).
- [15]. Vincent O. R, Olayiwola O. E. , Kosemani O. O., "Estimating Traffic Intensity at Toll Gates Using Queueing Networks", (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 5, No. 4, 2014.
- [16]. Divya gilly, Dr. Kumudha raimond, "License Plate Recognition- A Template Matching Method", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 ,Vol. 3, Issue 2, March -April 2013, pp.1240-1245.
- [17]. SHRIDHAR ALLAGI, SHARADA H N, "AUTOMATIC LICENSE PLATE DETECTION FOR TOLL COLLECTION AND SURVEILLANCE", Proceedings of 07th IRF International Conference, 22nd June-2014, Bengaluru, India, ISBN: 978-93-84209-29-2.
- [18]. Ch. Rama Krishna Reddy, M.Padmaja, Dr. K.Sri Rama Krishna, K.Prasuna, "Image Transmission Using Adaptive Channel Coding for Electronic Toll Collection System", IJECT,vol 2, Issue 2, June 2011 ISSN : 2230-7109.
- [19]. Sarmad Majeed Malik, and Rehan Hafiz, "Automatic Number Plate Recognition Based On Connected Component Analysis Technique", 2nd International Conference on Emerging Trends in Engineering and Technology (ICETET2014), May 30-31, 2014 London (UK).
- [20]. Afaz Uddin Ahmed , Taufiq Mahmud Masum , Mohammad Mahbubur Rahman , "Design of an Automated Secure Garage System Using License Plate Recognition Technique", I.J. Intelligent Systems and Applications, 2014, 02, 22-28 Published Online January 2014 in MECS (<http://www.mecspress.org/>) DOI: 10.5815/ijisa.2014.02.03.

