

Electronic Toll Collection System using OCR and SNMP Technology

Sonali Pandhure¹ Mrunmayee Patane² Vrishali Patil³ Shweta Walunj⁴ Prof. Biradar N.P.⁵

⁵Professor & Guide

^{1,2,3,4,5}Department of Computer Engineering

^{1,2,3,4,5}Zeal Education Society's Dnyanganga College of Engineering And Research Sr.No.39, Narhe, Pune 411041

Abstract— every day, there are huge amount of vehicles passing through Toll Gate Stations. The payment is done automatically. This system uses camera for capturing the images of the vehicles number plate. SNMP technology is used for converting the captured image into the text and the toll would be cut from the user's account and then the gate is opened. The system is divided into the design of three modules, Vehicle Module and the Central Database Module, Tollgate station. The three modules communicate via SNMP Technology. The information of the vehicles is already stored on the database, using this information vehicles are identified. Data information is also easily exchanged between the motorists and toll authorities, thereby enabling a more efficient toll collection by reducing traffic.

Key words: OCR, SNMP

I. INTRODUCTION

It has been studied by researchers and applied in various highways, bridges, and tunnels requiring such a process. This system is a technology enabling the automated collection of toll payments from the user. The purpose of this system is collecting the toll according to vehicles and builds the real time application which recognizes vehicles licenses, number plate at entry gate. This system is more efficient, reliable, and safe and environment friendly. In the past, customer would have to wait at the toll booth to pay the collector, creating traffic congestion, pollution and of course of a lot of frustration. Now Electronic toll collection successfully removes unnecessary traffic delays; keep track of on any car that might not be correctly registered. The advantage of this technology is the opportunity to eliminate traffic congestion in toll station. Thus the system works very fast and efficiently with the best results.

II. EXISTING SYSTEM

All components is centralized with FPGA Circuits. Every vehicle must have a unique RFID Tag. To recognize RFID Tag there is RFID reader. The tax collection is manual and not automated. There is no security features for finding a stolen vehicle etc. The existing system consists of a microcontroller, stepper motor, and bill printer. Then here billing system can be used after the billing process then only the gate is opened by using the stepper motor earlier. The Existing system having all components is centralized with SNMP Technology.

III. PROPOSED SYSTEM

The proposed system makes sure that the traffic at the toll gates is streamlined and security is also present. Every vehicle must have a unique formatted number plate (eg.MH 12 GQ 1234). The proposed system consists of a microcontroller, High resolution Camera, stepper motor,

and bill printer. The OCR captures the vehicle number plate and SNMP Technology retrieves the user details and identifies the vehicle. Through this system we can also identify stolen vehicles. Automatic Number Plate Recognition is very much useful in applications like, automated traffic surveillance and tracking system, automated highway/parking toll collection systems, travelling time monitoring.

Optical Character Recognition (OCR) is used to capture images of number plates by using the cameras. Systems commonly use infrared lighting to allow the camera to take the picture at any time of the day. OCR technology tends to be region-specific, owing to plate variation from place to place. Some license plate arrangements use variations in font sizes and positioning OCR systems must be able to cope with such differences in order to be truly effective.

The cameras used can include existing road-rule enforcement or closed-circuit television cameras. Some systems use infrared cameras to take a clearer image of the plates.

IV. OCR (OPTICAL CHARACTER RECOGNITION)

OCR(Optical character Recognition) Optical character recognition, usually abbreviated to OCR, is the mechanical or electronic conversion of scanned or photographed images of typewritten or printed text into machine-encoded/computer-readable text. It is widely used as a form of data entry from some sort of original paper data source, whether passport documents, invoices, bank statement, receipts, business card, mail, or any number of printed records. It is a common method of digitizing printed texts so that they can be electronically edited, searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation, text-to-speech, key data extraction and text mining. OCR is a field of research in pattern recognition, artificial intelligence and computer vision. Early versions needed to be programmed with images of each character, and worked on one font at a time. "Intelligent" systems with a high degree of recognition accuracy for most fonts are now common. Some commercial systems are capable of reproducing formatted output that closely approximates the original scanned page including images, columns and other non-textual components. The conversion of image to text provides a very high compression ratio. An image file containing the same information would be of the size of a few hundred kilo bytes but the text file containing the same information will be only of a few bites and hence can be much easily transferred to a remote location. The text file is appended every time such that the record of the previous transactions is maintained. The Character in the number plate are recognized and the syntax checking process is

carried out. It checks the recognized character according to the syntax rule HSRP which can have unique symbol and character based on the Indian number plate rules. Then the syntax rules similar to the recognized image and the number plate image are stored in the database with the appropriate user details for the verification. rule HSRP which can have unique symbol and character based on the Indian number plate rules. Then the syntax rules similar to the recognized image and the number plate image are stored in the database with the appropriate user details for the verification.

V. SNMP (SIMPLE NETWORK MANAGEMENT PROTOCOL)

The Simple Network Management Protocol (SNMP) is a component of the Transmission Control Protocol/Internet Protocol (TCP/IP) protocol suite as defined by the Internet Engineering Task Force (IETF). It is a UDP-based network protocol. As an application layer protocol, it is used widely in network management systems to facilitate the exchange of management information between different network-attached devices. It also helps the network administrators to monitor the conditions of network devices for attention. SNMP is based on the manager/agent model. An SNMP managed network has four key components: an SNMP manager, managed SNMP devices, an SNMP agent, a database of management information (MIB), and the network management protocol [6].

- The SNMP manager acts as an interface between the network administrator and the management system.
- The managed SNMP device is a network node that can be any type of hardware device such as computer hosts, routers, access servers, and printers that are connected to network.
- The SNMP agent is a network-management software module that resides on a managed device. It provides the interface between the manager and the physical managed device(s). It collects and stores management information received by the managed devices.
- The SNMP MIB is a collection of managed objects residing in a virtual database used to manage the devices in a communication network. The database is organized in a tree structure and entries are addressed through object identifiers (OID).

VI. MODULES

A. Administration Module:

Administrative module is provided for the sake of administrators to manage the site and update the database at regular intervals. Once Passenger registered with RTO he can use this system number of times. The major operations included in this module are:

- Check Registration.
- Click Image.
- Apply OCR.
- Recognize Number
- Send transaction request to server.

B. Server Module:

- Receive transaction request from administrator.
- Check availability of user balance.

- Deduct balance from user's account if not available then take payment by cash.
- Transaction successful.
- Transaction successful.

C. User Module:

- Register personal information (PI), vehicle number (VN) & other info.
- Recharge the pre-paid account.
- If balance is insufficient then give payment by cash.

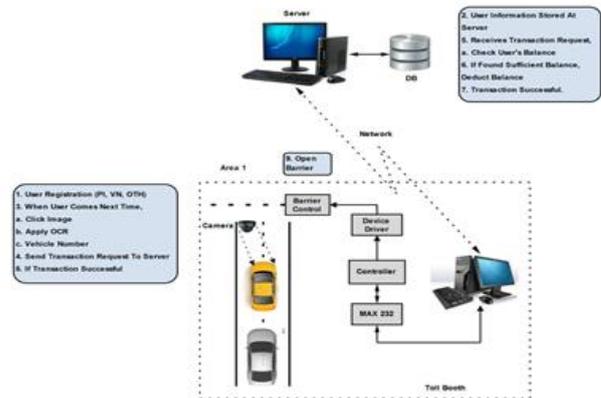


Fig. 1: module wise design of the system

VII. STRUCTURE OF SYSTEM

The System design can be highly reliable and the system architecture can record the image and recognize it. And the OTP module can be capable of using the login session with security for the toll operators. And the toll operating software uses the TTV for high security.

A. System Architecture:

The process starts when a sensor detects the entrance of a vehicle and signals the camera to capture an image of the vehicle. The image is passed on to a computer where software running, on the computer extracts the license plate number from the image. LPN [1] (License plate number) can then be verified in a central database. If number valid for this system then LPN recorded in a database with other information such as vehicle number, time, balance, personal details. The license number is used to open the toll gate.

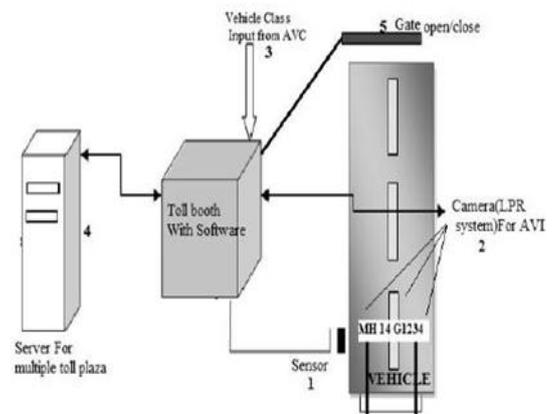


Fig. 2: Structure of the system

B. High Resolution Camera:

It captures the license plates flawlessly in any weather condition in even the dark night and up to speeds of 120 mph.



Fig. 3: High resolution camera

The Fig 3 [1] illustrate the high resolution camera which can capable of take an image even in rainy dark night and the clarity are high compared to normal cameras.

C. Toll Operating Software:

When vehicle enter in the toll booth then toll software automatically start its process first by using the sensor. This application firstly recognizes vehicle license plate number then check if number is valid then using TOS[1] (toll operating system) read the vehicle number on screen. Also check the balance in customer account and at the same time check license number in police database to identify the vehicle is a stolen vehicle. The TOS can read the number which has presented in the recognized number plate. It does can be done for the user's verification, of their number plate. And provide the high security feature.

VIII. WORKING OF SYSTEM

“License Number Plate Recognition for Use in Different Countries Using an Improved Segmentation” focus was given on the segmentation algorithm that was based on tagging the pixel cluster and a region growing approach. In this system OCR and SNMP Technologies are used. An image of a vehicle number plate is captured and processed using algorithms like Grayscale, Thresholding, Segmentation, Segment filtering, Cropping, Scaling, Binarisation, Pattern matching, Scoring and detection. OCR system is very much useful in applications like, automated traffic surveillance and tracking system, automated highway/parking toll collection systems, automation of petrol stations, travelling time monitoring

There are seven primary algorithms [6] that the software requires for identifying a license plate:

- 1) Plate localization – responsible for finding and isolating the plate on the picture.
- 2) Plate orientation and sizing - adjusts the dimensions to the required size.
- 3) Normalization – adjusts the brightness and contrast of the image.
- 4) Character segmentation – finds the individual characters on the plates.
- 5) Optical character recognition.

- 6) Syntactical/Geometrical analysis – check characters and positions against country specific rules.
- 7) The averaging of the recognized value over multiple fields/images to produce a more reliable or confident result. Especially since any single image may contain a reflected light flare, be partially obscured or other temporary effect.

The complexity of each of these subsections of the program determines the accuracy of the system. During the third phase (normalization), some systems use edge detection techniques to increase the picture difference between the letters and the plate backing. A median filter may also be used to reduce the visual noise on the image.

IX. WORKING OF CENTRAL SERVER

For more security and maintain records 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.

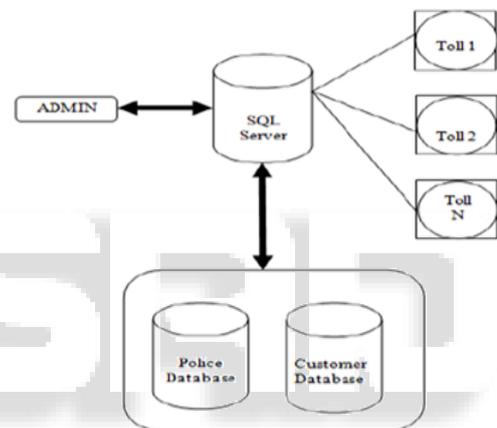


Fig. 4: Database view with multiple tolls

The central database or main database is the heart of the whole database maintenance. Admin database contains details of central database administrator and also the details of all toll station under Construction Company [1]. Centralized database consist record of all toll plazas under that specific construction company. This central database will be maintained by a central administrator. The User or the Customer has to be registered for this account to use this system. This user information is stored along with the RTO database. When the registered customer will pass through the specified toll plazas then automatically toll will deducted from customer's account. And Central database will update with this current information at a same time it includes the details of a present toll amount are added to the previous toll details. After toll amount applied to the vehicle, the customer will receive the sms using GSM United database connected to the main database or the central database of the system. United database consist of Police database and RTO database. Police database contains all stolen every process. RTO database is maintained by RTO office and it encompasses the all registered vehicles details like vehicle owner, vehicle number, license number, account ID, account balance, current charges, etc. Retrieve the vehicle information from RTO Database and during recognition of a vehicles number plate it will match with customer database

and police database. If the vehicle number plate is valid and also find it's an original vehicle of an owner not a stolen one, then automatically the toll is deducted from user's account and the sms intimation is carried out for the user verification. All these user's records are maintained at appropriate toll station and main database of toll construction Company. And these details can be seen by the toll operator by using the account ID, Customers name or number of the vehicle. All toll station records stored at central server and these details could be seen and will be printed at any time based on the user needs.

X. TYPES OF PAYMENT

There are two types of toll payment are as follows:

- Prepaid payment
- Postpaid payment

A. Prepaid Payment:

The vehicle owner or driver has to pay the amount in advance by using their account id and the RTO office can keep track of this user details and the central database can maintain the account deduction and balance of every user.

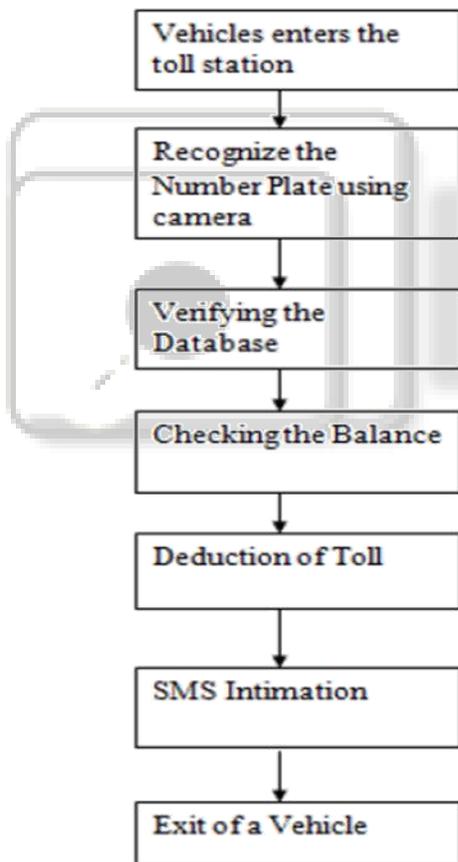


Fig. 5: Flow chart of prepaid payments

The Fig 5 illustrates that the vehicle are identified first and the number plate are recognized using the high resolution camera [1] then the recognized number are verified in the central database then the user balance are verified and the toll are deducted from their account and the sms are intimated which have the current toll details and also the remaining balance.

B. Postpaid Payment:

The vehicle owner or driver has to pay the amount after instead of before. The payment details are received through the sms and mail then the customer has to pay the bill. These details are also maintained by the central database.

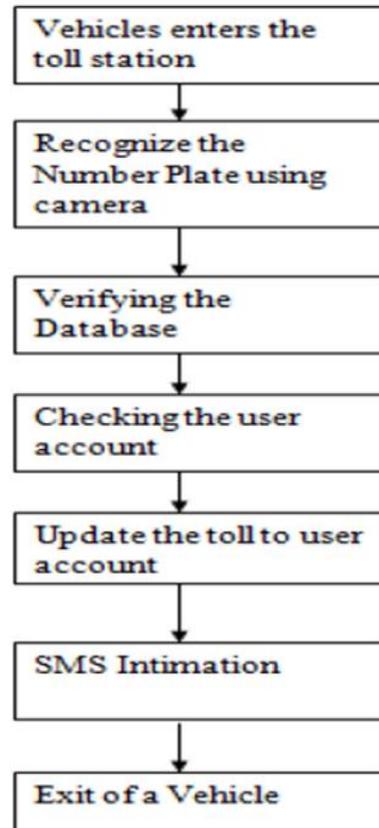


Fig. 6: Flow chart of postpaid payments

The Fig 6 illustrate the vehicle are identified first and the number plate are recognized (ANPR) using the high resolution camera [1] then the recognized number are verified in the central database then the user details are verified and the toll are updated to their account and the sms are intimated which have the current toll details and also the remaining balance amount which have to be paid by the user.

XI. SCREEN LAYOUTS

A. To Add New Toll Booth:

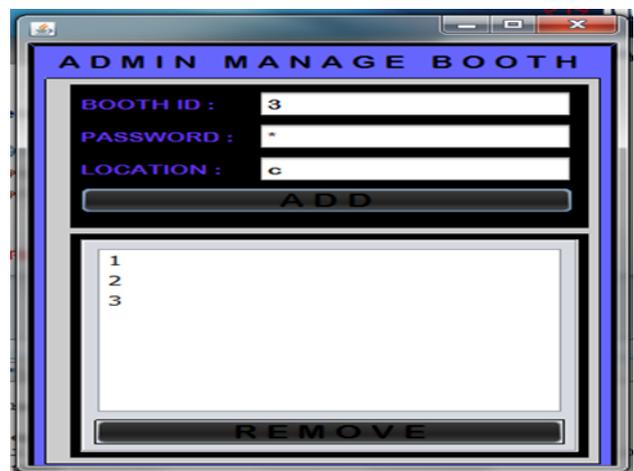


Fig. 7: Admin Manage Booth

B. For Authentication, There Is Login Window To Enter Username And Password:



Fig. 8: Opening Window

C. Main Form to Select Option for Process:



Fig. 9: Main Form

D. To Add New Vehicle in Database:



Fig. 10: Admin Manage Booth

E. To Recharge Account:

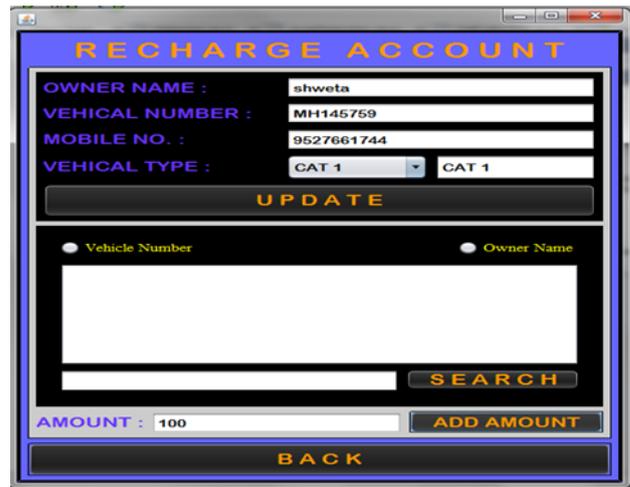


Fig. 11: Recharge Account

F. Vehicle Passing:

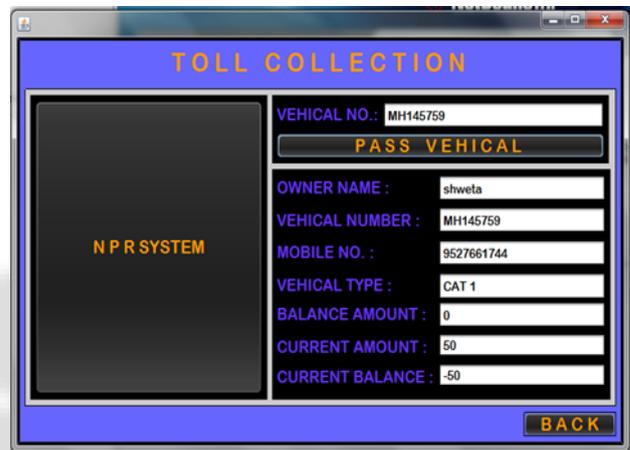


Fig. 12: Vehicle Passing

XII. BENEFITS OF THE ELECTRONIC TOLL SYSTEM

Electronic toll systems, like conventional toll systems, generate funds for building and maintaining roads. They also offer a number of additional advantages. For example, they improve traffic flow by significantly reducing delays at the toll booth. In one hour, an electronic system allows 500 vehicles per lane to pass (1,800 in free flow) compared with just 200 for conventional systems. In addition, the transaction is much simpler for the user because it is entirely automatic. Electronic toll collection systems used today are very reliable: they have an error rate of less than 0.01%. By making traffic more fluid and avoiding bottlenecks, electronic toll collection helps reduce the number of accidents and improves the environmental impact. It also eliminates risks inherent in transferring funds because no cash is involved. Fewer amounts of queues at the toll station. Quick and more efficient service. The ability to make payments by keeping a balance on the register account. The use of prepaid as well as postpaid toll payments. Cheaper toll costs. Avoidance of traffic congestion. Time Saving.

XIII. CONCLUSION

Thus a system for Electronic Toll Collection system for efficient traffic control system using OCR [1] based on

Indian Condition which is highly reliable and also achieves high security. And this system can remove the traffic congestion by analysing the traffic prior, and it can be used to remove all drawbacks with doesn't require any tag only required best quality camera and fixed font number plate. Thus implementation of this technology will dramatically decrease the traffic at Toll junction. System based on Indian Condition which reliable. It achieves high security. It can be used to remove all drawbacks of existing System.

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