

QR based Toll Collection and Vehicle Security System

Shubhangi Khetmar¹, Aditya Patki², Avdhut Deshmukh³, Krishna Gundewar⁴

^{1,2,3,4}Student, Department of Computer Engineering, Sinhgad Academy of Engineering, Kondhwa, India

Abstract: Countries under evolution similar India are in need of a massive development for infrastructure like Roads and Highways. Being a costly project it cannot be funded by the government organizations. Normally Public sector undertaking companies, sometimes private firms are made to construct such huge schemes. The money spent on these schemes can be regained by gathering toll from the travellers who use the roads. The toll collection system, particularly in India faces some difficulties such as long queue lines, escaping from toll plazas etc. Being able to service only a specific small number of vehicles on an hourly basis, there is a system of congestion and jams blocking the server of plaza as well as the local access. With the increase in the amount of vehicles on road, there has been a clear increase in the number of crimes connecting vehicle theft. Despite several stringent laws and safety measures taken by car manufacturers, thieves still find a way to continue one step ahead and vehicle theft is still between one of the most described crimes worldwide. Due to the exclusive nature of motor vehicles, there is ample motivation for petty thieves to attempt thefts. Therefore, to solve the problems of jams and theft, we propose a QR Based toll collection and security system. The code is being generated at the toll system during time of first visit to any of the system. At the Toll Plaza itself, the operator would come to know about the status of authenticity of vehicles.

Keywords: Crimes, QR Code, Authenticity

1. Introduction

Consider driving a long distance and need to get to the destination in time as soon as possible, the best possible way for an average person is to travel by interstates or roads that allow us to travel earlier and fewer stops, if any. Certain types of roads have occasional stops where you have to pay money to transportable on the road called toll roads also known to general public as toll ways. A specific amount of travel fees, called toll needs to be paid to travel on these roads. Occasionally you have to stop every so often to pay additional tolls to continue travelling on the toll road. These have been built by the government, state or local help with the money raised from the taxes the only difference is that toll are like a tax that needs to be paid only to the users of the toll road. Toll infrastructures allow new roads to be built and kept without raising taxes on the general public. A toll road doesn't always break a toll road forever, though. Sometimes tolls are uninvolved on roads once the cost of building has been recovered from the tolls collected.

A toll plaza is a gated area where you have to measure down

or stop to pay a toll. There are typically many available lanes at a particular toll plaza to keep the road running smoothly during busy hours also as quickly as possible. Some lanes may have people working the toll stands, so as to pay the toll amount in cash. The speed of these lanes is usually inversely proportional to the amount of traffic and theft crimes. Due to enormous increment in traffic, these lanes are becoming slower and slower day by day.

Modern day problems require modern day solutions. Use of QR-Code (Quick Response Code) can solve the problem of manually collecting toll and can also be employed in terms of security. They could be used to take of piece of transitory media and put it in our mobile phones. We might be able to see QR-Codes in magazine advertisement as well, billboards, WebPages or even t-shirts worn by people giving details around that commercial or particulars about someone, show and access URL or some vouchers also. The reason of them being more efficient and useful than a standard barcode is the amount of information (digital) that can be stored including regular data, URL's geo-coordinates and texts.

2. Literature survey

A review on Automated Toll Collection Systems and their Involvement

Automated toll collection system using GPS and GPRS,
Author: Sudheer Kumar Nagothu

There is a significant importance and improvement of infrastructure like roads and interstates in developing countries like India but being a non-cost efficient process, it cannot be undertaken by a single authority and hence such mega projects are collaborated by Public-Private Firm. The investment made in these projects is recovered by passengers travelling in the form of toll. Toll collection in India or many countries faces long queues engaging hours, toll theft by avoiding the plaza. Being able to service a fixed number of vehicles an hour (approx. 300) causes a situation of jams if the traffic increases on that specific patch suddenly. To avoid all these, there is a suggestion of creating eco-friendly, geo-fences using GPS by providing latitudinal and longitudinal of the corner. By comparing the position of vehicle using built in Gps and toll, the user would be charged according to the distance travelled and position of the vehicle.

Automated toll collection with complex security system,

Author: P. Kamalakannan; M. Balaji; A. Avinash; S. Keerthana; R. Mangayarkarasi

The below given work is concerned with automated toll collection system using the active RFID tags where vehicles are made to pass through a sensor system embedded on highway or mounted on highway to read the tags. The smart system will electronically classify the vehicle and calculate the amount to be transacted from the owner, ensuring no pilferage of the amount. The frequent passers have a prepaid smartcard, deducing the amount using smart card reader, a micro-controller with powerful CPU and GPU tightly coupled with memory (RAM, ROM, EPROM), I/O features such as serial ports, parallel ports, timers/counters, interrupt controller, data acquisition interfaces such as analog to digital converter (ADC), digital to analog converter (DAC) integrated to a single silicon chip connected with personal computer through RS232 data adapter.

Automated fault detection in violation enforcement cameras within Electronic Toll Collection systems, Author: Anurag Ganguli; Ajay Raghavan; Vladimir Kozitsky; Aaron Burry

Electronic Toll Collection facilities offer travellers the ability to pay toll electronically, most commonly via Radio Frequency Identification (RFID) transponders placed within the vehicle. ETCs are complex systems comprising of a multitude of sensing and electronics equipment. To prevent violation, photo enforcement cameras are used to capture license plate images of the violating vehicle. To ensure adequate image quality and integrity of these cameras, as per the standard maintenance and review policy these are checked manually on a periodic basis. Being an expensive and error prone it may involve only a fraction of images that are actually captured. This problem could be addressed some algorithmic tools are proposed that could automatically review images and detect any potential faults reducing human efforts and increase maintenance efficiency. Hence use no-reference or reduced-reference approaches for fault detection is generally employed wherever possible.

Secured short time automated toll fee collection for private group transportation, Author: Jayapriyaa CT; Y. Bevish Jinila

Automated toll fee collection on Indian road has been widely anticipated and has been a challenge because of cost and efficiency of these systems. This paper presents automated toll fee collection system in more efficient, faster, low cost and in very secure manner. Normal cameras are used to capture vehicle number plates and vehicle numbers are retrieved. The vehicular ID provides the details of bank details of owner linked from the database. The fee being paid from the account if available or is manually paid. If there is cluster of vehicles belonging to a particular organisation is present nearby toll booth then these are grouped and billed together to reduce the number of transactions. One of the vehicles is appointed as head representing all the members of the cluster and ID based multi signature scheme is used for the purpose of checking authenticity. On an experimental basis, it has been proven that

cluster based scheme performs far better than non-cluster based approach.

Open road tolling in India by pattern recognition, Author: Dipti Jadhav; Manoj Sabnis

Basic requirements and characteristics of modern services are modern amenities, faster data transfer and minimum delay which are applicable for transport services as well. One such service offered to transport system is toll collection. Initially it was a manual process but now due to development in various fields it is slowly migrated towards automation. The system discussed in this paper is a full automated toll collection system. These days, Number plate recognition (NCR) is used for automatic toll collection, secure parking and law enforcement. Open Road Tolling(ORT) uses video evidence to identify vehicle usage of a toll facility without the use of toll booths for toll collection without having to stop or even slow down to pay the toll. The application utilizes image processing and pattern recognition methods for Open Road Tolling. This paper presents Open Road Tolling (ORT) using number plate recognition. The proposed Number Plate Recognition (NPR) techniques consist of two modules: histogram based number plate localization and number plate recognition using template matching. Being a simple and faster approach, it has been implemented in foreign countries as well on a major scale.

A. Problem statement

There lies a problem in every situation. Traditional toll collection system is able to service a comparatively less number of vehicles and there is no methodology proposed to check their authenticity for the sake that weather it is stolen or having any criminal record as well.

3. Proposed system

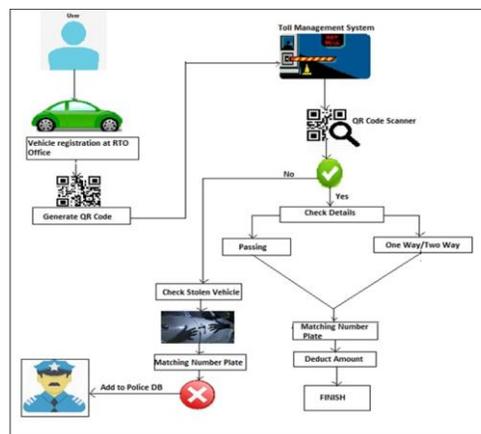


Fig. 1. System architecture

A. QR-code

Initial step being the generation of QR-Code from the user information during the vehicle registration or during its initial visit to a toll plaza.

QR-Code is the most efficient and effective way of storing and transfer of data via an image in an encrypted format.

Generation of code is handled by the term called image steganography and the data stored in code is in encrypted format with more or less security.

B. Toll management system

Toll management system is an interactive user interface developed as a web application for the toll collector. On a broad notice, it consists of various features which will facilitate the collection of toll, generation of passes and verification of QR-Codes by the operator for the security purpose.

C. Processing

The codes when scanned, will give the detail information of the corresponding vehicle, whether it be owner details, registration type, pass or non-pass user and whether that vehicle is stolen or not. If in case there is a complaint registered with the police station for vehicle theft, the code will flash an alert for the operator to inform the vehicle to the nearest police station and further embedding and integrating other sensors, live movement of a particular vehicle could also be tracked.

Here AES algorithm has been used to encrypt user data to the code and technique employed for the same is known as image steganography.

4. Algorithms and techniques used

A. AES

The advanced encryption standard (AES algorithm) is asymmetric key cryptographic algorithm published by National Institute of Standards and Technology (NIST) in December 2001. The algorithm was proposed by Rijndael and hence the reason behind known as Rijndael algorithm. It is a replacement for data encryption standard (DES Algorithm).

Being a block cipher, it operates on an input block of data and generates output of block of data of same size along with an input key for AES algorithm. It being a symmetric key algorithm, importantly allows data length of 128,192,256 bits supporting three different key lengths, 128,192,256 bits. It contains multiple rounds for processing different key bits. The general encryption process in AES is divided into two namely the encryption process itself (Encryption Process) and key generation process (key expansion or key schedule) or round key. In the process, AES-128 works as follows:

1. Add_Round_key. Perform XOR between initial state with cipher key.
2. Round as much as Nr-1 times (nine rounds on AES-128). The process for each round being:
 - a) SubBytes: bytes substitution by using

substitution table.

- b) ShiftRows: Shifting state array rows any wrapping.
 - c) MixColumns: scrambles the data in each state array column.
 - d) AddRoundKey: Performs XOR between the current state and round key.
3. Final round process for the last round:
 - a) SubBytes
 - b) ShiftRows
 - c) AddRoundKey

5. Results

Development of a reliable system which can be employed on a mass scale for the tracking of vehicle security purpose along with an added functionality of toll collection based on general algorithms which are having medium level security standard.

6. Conclusion

QR-Code is effective way to store information also effective way to handle stored data. We propose effective and transparent toll collection system. Toll collector just need to scan QR-Code; all other operations are done automatically. Automation toll collection reduce the time required for toll collection. Also the proposed system will track whether the vehicle that is currently passing from the booth is stolen or not and would be a stepping stone in restoring public faith back in the police force in terms of finding of theft vehicles.

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