Study of Different Electronic toll Collection Systems and Proposed toll Snapping and Processing System

Apurva Hemant Kulkarni
M.E Department of Computer Science & Engineering,
G.H.R.I.E.M Jalgaon, North Maharashtra University, INDIA

Abstract— The focus of this article is to briefly describe new proposed system “Toll snapping and processing system” and study of different ETC system. The Toll collection system’s are always in news for corruptions. The person who collects amount from vehicles at toll booth, leaves vehicles by toll collection from them and don’t give them proper receipts. Also sometimes he charges them less amount than actual toll tax. Collection costs can absorb up to one-third of revenues, and revenue theft is considered to be comparatively easy. They require vehicles to stop or slow down, manual toll collection wastes time and raises vehicle operating costs. Thus to eliminate the corruption, and to keep data centralized and to make the toll automated with less human intervention we can develop “Toll snapping and processing system”.

Keywords— electronic toll collection system , SMS based toll system, TSPS, ETC, ANPR.

I. INTRODUCTION

Electronic toll collection (ETC) is a technology enabling the electronic collection of toll payments. An ETC system is able to determine if a car is registered in a toll payment program, and then informing the authorities of toll payment violations, debits, and participating accounts. The most obvious advantage of this technology is the opportunity to eliminate congestion in toll booths, especially during festive seasons when traffic tends to be heavier than normal[1]. Toll snapping and processing system (TSPS) is a proposed technology enabling the electronic collection of toll payments. By using existing infrastructure a better system can be developed with several benefits. There are many advantages TSPS. The benefits for the motorists include:

1. Less manual intervention which will decrease the chances for corruption.
2. Fewer or shorter queues at toll plazas thus saving time, fuel and avoids congestion.
3. Faster and more efficient service (no exchanging toll fees by hand) [3]
4. The use of SMS service instead of receipts (no need to request for receipts).

Meanwhile, for the toll operators, the benefits include:
5. Better audit control by centralized user accounts[3]

Thus, the TPS system has several benefits.

II. RELATED WORK

A. CANADA

The Electronic Toll Collection (ETC) system used in Canada is known as the Canada 407 Express toll route (ETR) [1]. It is one of the most sophisticated toll roads in the world[1]. The 407 uses a system of cameras and transponders to toll vehicles automatically. There are no toll booths, hence the name "Express Toll Route" (ETR). It is one of the earliest examples of a highway that exclusively uses open road tolling. Highway 407 is designed as a normal freeway with interchanges connecting directly to surface streets, without the need for toll booth intermediaries (typically via a trumpet interchange) which could otherwise take up significant land. A radio antenna detects when a vehicle with a transponder has entered and exited the highway, calculating the toll rate. For vehicles without a transponder, an automatic number plate recognition system is used. Monthly statements are mailed to users. A small electronic 'transponder' is attached to the windshield behind the rear-view mirror. The system automatically matches transactions at entry and exit ramps to form 'trips' supporting a distance-based tolling policy. The electronic sensors located on each overhead gantry log the 407 ETR entry and exit point. On exit, a green light on the transponder and four short beeps indicate the toll transaction has been successfully completed. In this system, cameras are equipped with Optical Character Recognition (OCR). The OCR cameras are used to photograph license plate numbers of vehicles that do not have transponders. The toll bill will then be sent directly to the registered address of the vehicle owners. Other than that, two laser beam scanners are placed above the roadway to detect the types of vehicles passing through the gantries. Nevertheless, this toll road bears a very high infrastructure cost, and the users are the ones who help recover the cost through increments in their toll bills[1].

The figure of Canada 407 Express toll route is given below-
B. ITALY
Telepass is the brand name for an electronic toll collection system used to collect toll on motorways in Italy.

Telepass can be used for all types of vehicles which can travel on Italian motorways. Telepass consists of an On-Board Unit (OBU) mounted at the top of the vehicle's windscreen. The OBU is battery-powered. The OBUs communicate with the electronic toll booths by dedicated short-range communications. Telepass is used on motorways in the open and the closed systems. In both systems, the toll varies according to the type of vehicle (car, bus, lorry etc.) and to the upkeep for the motorway. Telepass users travel no faster than 30 km/h when in the Telepass lane. Once the OBU has been identified and verified, the OBU emits a single high beep, and the barrier blocking the lane is lifted. When the user exits the toll lane, the OBU emits a second single high beep. The number plate is then photographed, and the vehicle is allowed to continue. The vehicle is subsequently identified by its number plate, and the owner is sent a bill for the toll which could not be collected automatically.

C. SINGAPORE
The Electronic Road Pricing (ERP) system is an electronic toll collection scheme adopted in Singapore to manage traffic by way of road pricing. The gantry system is actually a system of sensors on 2 gantries, one in front of the other. Cameras are also attached to the gantries to capture the rear license plate numbers of vehicles. A device known as an In-vehicle Unit (IU) is affixed on the lower right corner of the front windscreen within sight of the driver, in which a stored-value card, the CashCard, is inserted for payment of the road usage charges. When a vehicle equipped with an IU passes under an ERP gantry, a road usage charge is deducted from the CashCard in the IU. Sensors installed on the gantries communicate with the IU via a dedicated short-range communication system, and the deducted amount is displayed to the driver on an LCD screen of the IU.

D. US
EZ TAG is an electronic toll collection system in Houston, Texas, United States that allows motorists to pay tolls without stopping at toll booths. To participate, drivers sign up through the EZ TAG website, via telephone, or at one of the store locations. Next, the customers receive a small, white radio frequency transponder which must be affixed to the insides of their windshields behind their rear view mirrors. Finally, when passing through a toll plaza, drivers choose lanes specially equipped with sensors that can read EZ TAG transmitters and deduct the appropriate amount from their accounts.
E. POLAND
The ETC system used in Poland has been proposed by the Motor Transport Institute along with the University of Technology in Warsaw and Dublin. This system is called the National Automatic Toll Collection System (NATCS), and consists of the National Automatic Toll Collection Center (NATCC), control gates, and on-board units (OBU). The NATCS uses a combination of mobile telecommunication technology (GSM) with satellite-based Global Positioning System (GPS). Using GPS technology, the OBUs determine the kilometers that have been driven, calculate the toll fees and rates, and then transmit the information to the NATCS computer center. Each vehicle will be charged from the highway entrance up until the end of the highway. In order to identify the plate numbers of trucks, the system has control gates equipped with digital short range communication (DSRC) detection equipment and high resolution cameras. Due to the technical specifications, this system incurs a high cost for motorists.

F. PROPOSED TSPS SYSTEM
The main objective behind this proposal is to create a suitable TSPS system to be implemented in India. TSPS can be implemented by using camera, ANPR automatic number plate recognition using OCR, SMS service, and server i.e. centralized database. Centralized database will comprise information about all vehicles in India. Regional Transport office’s (RTO) are connected to state road transport ministry which is connected to ministry of transport high government of India which is connected to our database so our database will comprise information about all vehicles in India. Details of all vehicles will be maintained at one central database. At the time of registration of vehicle each user has to create an account and deposit some money. At toll booth there would be on camera installed at one fixed position, when some vehicle enters toll booth camera will capture photo of its license number plate. Our application installed at toll booth’s computer will get its number from this captured image and get details of this vehicle from centralised database. According to vehicle type system will automatically generate toll charge and SMS will be sent on owner’s mobile. In case, if the owner does not have account, the barrier will not lift up and he will have to pay manually and receipt will be issued. If number plate is in some regional language or not readable then the toll booth operator can also enter number of this vehicle and the system will automatically generate receipt for it.

Working of system:

Step I: Capturing number plate through cameras.
Step II: Automatic Number Plate Recognition (ANPR) using OCR
Step III: Comparing and searching license number in server and accessing information about the number.
Step IV: When we get proper information about the number then Toll Charges are deducted from vehicle owner’s account.
Step V: Acknowledgement of money deduction through SMS to vehicle’s owner instead of receipt.

System can also generate different reports required for accounting and tracking such as:
1. Daily/ weekly/ monthly toll collection report
   1. RTO office wise vehicle report
   2. State wise vehicle report Etc.

Using this system, all problems related to manual toll fee collection will be minimized, thereby achieving a higher efficiency rate per transaction. This is because this system requires less human interactions that could lead to cheating and human errors. In addition, compared with the existing system, this system can keep watch over the vehicles and can keep track of license number plate and total amount of money collected. Most importantly this application will also show following details of each Toll booth online to prevent corruption:
   1. date of allotment
   2. amount to be recovered
   3. collection till date and
   4. Likely period of operation of toll collection

The advantages of this proposed system is summarized as follows:
1. Higher efficiency in toll collection;
2. Cheaper cost;
3. Smaller in size compared with the existing system.
4. Reduce traffic congestion.

After complete recovery of amount from public some toll booths continues to exist we can create a system which will stop working after a recovery of amount from public by not giving access to central database.

III. CONCLUSION
In this article, the we have discussed various toll’s systems applied in some countries. The proposed TSPS system discussed in this work applies OCR technology. By doing so, increased efficiency will be guaranteed. With the less intervention of human in the entire toll collection process, we can create a better TSPS system to be implemented in India and thus can significantly reduce corruption. It can also significantly improve the efficiency of toll stations and the
traffic abilities. The TPS is a Future work which can be implemented if all the conditions regarding this system are fulfilled.

REFERENCES


