ELECTRONIC TOLL COLLECTION SYSTEM USING BARCODE LASER TECHNOLOGY

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ABSTRACT: This paper focuses on an electronic toll collection (ETC) system using barcode laser technology. The proposed barcode laser system uses tags (barcode) that are mounted on the number plate of vehicles, through which information embedded on the barcode are read by barcode readers, the proposed system eliminates toll authorities to manually perform ticket payments and toll fee collections, respectively. Data information are also easily exchanged between the motorists and toll authorities, thereby enabling a more efficient toll collection by reducing traffic and eliminating possible human errors.

Keywords: Electronic toll collection, Barcode, Laser light, Motorists, Toll Authorities.

1. Introduction

Million of drivers/consumer passes through toll booths paying toll tax. In past toll payment system was manually and drivers are using manual system using coin or cash by hand to cross the toll plaza gate. Manual process is too much time consuming and drivers have to wait in row for long time for crossing the toll plaza. In waiting time oil of vehicle is also consuming. Now a days this manual toll deduction system is changed to automated system. Where driver no wait for pay cash or get token to cross the toll plaza. This automatic system used the barcode laser technology. This new automated system works very fast with best results. This system is capable of determining that the car is registered or not and then informing the authorities of toll payment violation and to inform the owner about the location and the deducted toll cost of vehicle via SMS /Email. The major objective behind this technology is to eliminate congestion in tollbooths. This also helps the government to maintain proper record of toll collection. Tag can be installed on the front number plate of vehicle. This system depends on four devices.

- Tag: Barcode
- Bar Code Reader : Laser
- Traffic controller system:
  Traffic controller system is computer system which manages the traffic in single row or line by using traffic signals.
- Central Server: Central server stores the data which comes from different toll plaza. A local computer of every toll plaza is connected to central server through Internet.

Every barcode contains the following details of owner other than RC (Registered Challan):
- Account number
- Mobile number
- Email address

Some benefits of the proposed system are:
1. The proposed system does not require vehicles to stop whereas manual toll collection wastes time and raises vehicle operating costs;
2. The proposed toll system reduces congestion on the road system and reduces wastage of time;
3. The ability to make payments without using cash manually;
4. By tracking the vehicle’s location and receiving a verified message, the owner feels comfortable and secure; and
5. Better security is provided as when someone disobeys the rules of toll plaza (breaks or touches the barrier), the alarm will be generated.

2. Related work

Toll roads have existed for at least the last 2,700 years, as tolls had to be paid by travelers using the Susa–Babylon highway under the regime of Ashurbanipal, who reigned in the 7th century BC. Many modern European roads were originally constructed as toll roads in order to recoup the costs of construction, maintenance and as a source of tax money that is paid primarily by someone other than the local residents [6]. In 14th-century England, some of the most heavily used roads were repaired with money raised from tolls by pavage grants. In the 20th century, road tolls were introduced in Europe to finance the construction of motorway networks and specific transport infrastructure such as bridges and tunnels. Italy [7] was the first European country to charge motorway tolls, on a 50 km motorway section near Milan in 1924.

The ETC system used in Poland is called national automatic toll collection system (NATCS). It consists of national automatic toll collection center, control gates and onboard units (OBI). NATCS uses a combination of global system for mobile communication (GSM) with satellite-based Global Positioning System (GPS). Using GPS technology, the OBUs calculate the toll fees, and then transmit the information to the NATCS computer center. 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 [1]. Due to the technical specifications, this system incurs a high cost for motorists.
The ETC system used in Philippines is called as the E-PASS system. It uses transcore technology where electronic transponders are embedded in the front of vehicle’s rear view mirror. Each time a vehicle enters the toll booth, the tag is read by the receiver, automatically identifying the account and debiting the toll fee amount from the corresponding account. Once the amount has been debited, the control gate will lift and the vehicle is allowed to pass through[2].

3. Proposed work
In this paper our focus on automatic toll deduction system with more features for owner convenience and time saving. The vehicle will be equipped with barcode tag, which will be detected by Barcode Reader, located on the barrier of toll plaza. The amount will be automatically deducted from the bank account [3] of the owner and this information is sent to owner’s mobile number including location of toll plaza and the phone number of next toll booth. If owner’s vehicle is stolen then he/she can contact to the toll free number and can complaint to police about the same. Speed of vehicle can be controlled by speed breaker.

The barcode basically contains the following information:
1. Registered Challan –
   1.1. Vehicle number
   1.2. Vehicle type
   1.3. Owners name
   1.4. Owners address
   1.5. Date of purchase
2. Account number
3. Mobile number
4. Email id

4. Working
When the vehicle enters the toll plaza, the embedded laser in the barrier reads the barcode and it retrieves information and deducts the toll amount from owners account. If the balance is not enough in the owners account, the barrier will still be lifted, but a warning email or an SMS will be sent to the owner otherwise the deducted amount is sent to the owner via email or SMS along with location and the next toll booth number. Before lifting the barrier, the server checks whether the vehicle is registered as well as valid or not. The registered owners have the barcode embedded in their vehicles and any complaint of the stolen vehicle is sent to the police using toll server database which makes the vehicle invalid. Thus a valid vehicle is the one which does not have any complaint against them. If the vehicle is both registered and valid, then the barrier is lifted otherwise alarm is generated to make the police alert and police will contact.

The barcode reader is placed on the barrier and it is connected to Central Server (backend database) [4]. Software connects barcode reader and the Central server [4] and the data coming from the tags stored in backend database. The software provides the flow of information between the reader and backend database of Central server. It is connected to reader which is placed in the barrier. Central server is also connected to LAN (local area network). All computer system of LAN is connected to a central Database via a WAN (wide area network) [5]. The whole Record of toll deduction will be stored at the central server and monthly transaction will be sent to the owner from the Central server [4].

Using this system, all problems related to manual toll fee collection will be eliminated, thereby achieving a higher efficiency rate per transaction. This is because this system requires no human interactions that could lead to cheating and human errors. If anyone tries to break or touches the barrier, then an alarm will be generated and police will contact them and the information will send to next toll booth so that high alertness is maintained and police can easily catch the culprit.
5. Vehicle speed control through speed breaker

When any vehicle enters the toll booth its speed is slowed down with a speed breaker so that laser light embedded in the barrier can easily send the signal to the barcode to retrieve the information from barcode. The vehicle will adjust its speed to obey the stretch of road which include speed breaker. The vehicle should be slowed down through a speed breaker so that from the initial to last breakers, all communication can take place easily from sending the signal to barcode and retrieving the information from barcode.

5.1 Reducing vehicle theft

Barcode laser detection can provide an efficient way to catch the culprit of vehicle. When a vehicle pass through a toll plaza, a deduction message along with location and next toll booth number is sent to owner via SMS/email. It can provide an effective deterrent against vehicle theft. Vehicle owner can contact to the next toll booth and file a complaint to police. This will lead the police to detect the vehicle and the culprit.

An application for this is automotive antitheft immobilization. In this commercially deployed solution, an embedded barcode inside number plate becomes activated and when a barrier is lifted a verified message is sent to owner’s number in which location of a vehicle along with the succeeding toll booth number is present and a culprit can easily be caught.

6. Comparison with previous mechanism

In the previous work, manual systems are automated by using the technology of RFID (radio frequency identification detector), but in RFID a vehicle is to be restricted with certain speed limit such that if a motorist does not obey the speed limit as mentioned, then a vehicle can cross the toll booth without paying the toll tax. As the proposed system contains the barrier the speed is controlled automatically using speed breaker. Originally the toll tax was deducted manually which is very time consuming and ineffective.

For future perspective, the police department should also be provided with Laser Barcode technology system to deduct the various fine including challan, alcoholic motorist, non helmet wearer, no seat belts put, high speed motorist.

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References


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