

# VIRTUAL HIGHWAY TOLL COLLECTION SYSTEM USING GLOBAL POSITIONING SYSTEM

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## Abstract

As transportation is said to be the backbone of any country's economy, India has made dozens of trials in improving the same. The improvement in transportation includes the proper and dedicated source of funding for highway infrastructure. Though various models have been proposed, the very existence of the toll booth is questioned now. One of the main objectives of the Intelligent Transportation System (ITS) is maintaining traffic efficiency with constant development and economic growth. This involves traffic management that in turn improves the mobility of people on the road. The toll collection is made to compensate for the investment made on the infrastructure from the people using it. Considering the Indian scenario, the uniformity in cost collection is disrupted frequently. A system that enables road users to pay the toll fees without stopping or slowing down is proposed. The characters of the number plate are segmented by CCA and ratio analysis as well. Comparison techniques such as SVC (linear) help the system to detect well under dim light, over-exposed images and those in which the vehicle is angled. The serial monitor is used for displaying the particular authority of the vehicle and the license plate number, the GSM module is used for sending the alert messages to the particular authority. Depending upon the predicted vehicle, the amount will be deducted through a uniquely assigned RFID reader in the vehicle. When the vehicle crosses the toll zone without paying, the user is alerted immediately. In this way, the proposed system helps in a cashless and contactless payment without waiting time.

**Keywords:** GPS, GSM, Toll module, Vehicle module

## 1. Introduction

The period of Covid-19 has taught us the importance of contactless and cashless payment methods. Contactless transactions can help in this by providing quicker movement and shorter queues at the checkout. The traffic management in turn aids faster mobility of vehicles on the highways. This paper overviews the advantages of such a system that ensures the non-stop

movement of vehicles by including a speed-limiting zone inside with cashless transactions through GPS match-making. Traffic congestion mainly happens due to the manual fare collection. To eradicate this problem, this research work introduces the Digital and autonomous toll collection system using arduino based GPS technology, which helps to reduce the traffic congestion

The point is to foster a Toll Collection System on express parkways so that the client has compelling reason need to keep cash with him to pay cost and without the vehicle in any event, dialing back or stop at a cost. This framework doesn't need foundation along the street, for example, cost information assortment extensions and tollgates. The on board unit (OBU) empowers programmed utilization based cost installment. The working rule of the OBU depends on two innovations: GPS and versatile correspondence (GSM). Drivers go to the cash installment focus, register and introduce connecting equipment gadgets and apply for a pre-loaded card or post-paid card. At the point when a vehicle moves into the cost region, a connecting equipment gadget checks the ongoing vehicle's position coordinate from GPS with the virtual cost hub coordinate, kept in the capacity of the communicating equipment gadget. After calculated assurance, the interacting equipment gadget sets up a remote correspondence channel through the GSM module.

Connecting equipment gadgets send exchange messages to the control framework by the GSM module through a versatile organization. In the wake of reviewing, the control framework saves cost information and sends back exchange data to the Interfacing equipment gadget. The Interfacing equipment gadget gets and shows the exchange result then it is working appropriately. On the off chance that there is a blunder in exchange the outcome is either there is an issue in the connecting gadget or might be establishment not appropriately finished. At the point when the vehicle crosses the charging zone, assuming that the Interfacing equipment gadget has an unusual state or the vehicle doesn't introduce an Interfacing equipment gadget the infringement will be handled.

## **2. Related works**

The Indian cost door framework today depends on an operable National Electronic Toll Collection (NETC) called FASTag provided and sent by the Indian Highways Management Company Ltd. (IHMCL). FASTag is a Radio Frequency Identification (RFID) empowered sticker fastened on the windscreens of vehicles[1,2]. Radio Frequency Identification (RFID) innovation is utilized to make cost installments straightforwardly from a record, which is connected to the FASTag, while the vehicle is moving. This RFID uninvolved tag is utilized for making cost installments straightforwardly from the clients connected paid ahead of time or reserve funds/current record. It is fastened on the windscreen of the vehicle and empowers the client to pass through cost squares, with lesser holding up time at the cost court.

The cost admission is straightforwardly deducted from the connected record of the client. FASTag is likewise vehicle explicit and whenever it is joined to a vehicle, it can't be moved to another vehicle. FASTag can be bought from any of the NETC Member Banks. On the off chance that a FASTag is connected to the prepaid record, it should be re-energized/beat up according to the use of the client. On the off chance that satisfactory equilibrium isn't kept up with by the client, the FASTag gets boycotted at the cost court[3-5]. Notwithstanding, the higher coordination and

support costs related with cost administration frameworks are supposed to adversely affect the cost administration framework market.

[1,13,14] This paper uses Automated Toll assortment and Check-Post framework utilizing Radio Frequency Identification (RFID) and Global System for Mobile communication (GSM) module. The acknowledgment is prevailed with the direction of inactive radio recurrence. This task partner vehicle specific like novel ID is saved in a RFID label which is joined in the vehicle[7-9]. After every one of the particulars are really see through a PC, it very well may be saved money on an information bank for cyclic hole concerning time and date. Individual clients secure the one of a kind ID for their vehicles. At the point when the vehicle crosses the Toll-Plaza the tag and the assessment sum will be recognized from their record balance by utilizing of RFID and GSM module[10].

In order to decrease this passing time, we decided to automate the process of toll system by doing technology enablement of Internet of Things (IoT). [6,11,12] This paper describes, in order to decrease this passing time, we decided to automate the process of toll system by doing technology enablement of Internet of Things (IoT). Each vehicle is labeled with a RFID tag, which has vehicle's enrollment number in it, which can be detected by RFID present at tollbooth .RFID will send this data to IoT regulator (Arduino). Detected enrollment number can thoroughly searched in to cloud data set for getting wallet balance and in the event that adequate equilibrium is there, and cost charges can be deducted consequently. While rider can appreciate stop complementary lift and will be hinted about his outing allowance charges. For collaboration of client a versatile application will likewise be planned with which client can follow all logs of installments and can add cash in wallet utilizing the application. The sole motivation behind this paper is to decrease the difficulties brought about by manual cost assortment framework and it guarantees efficient, fuel preservation and contributing in setting aside of cash by making process programmed[16-22].

### **3. Virtual highway toll collection system using global positioning system**

In this paper, we are intended to achieve non-stop travel on highway. Vehicle should stop at toll plaza for to payment transaction, but here we proposed a system to provide non-stop movement of vehicle. In figure1, it elaborates the flow of our project

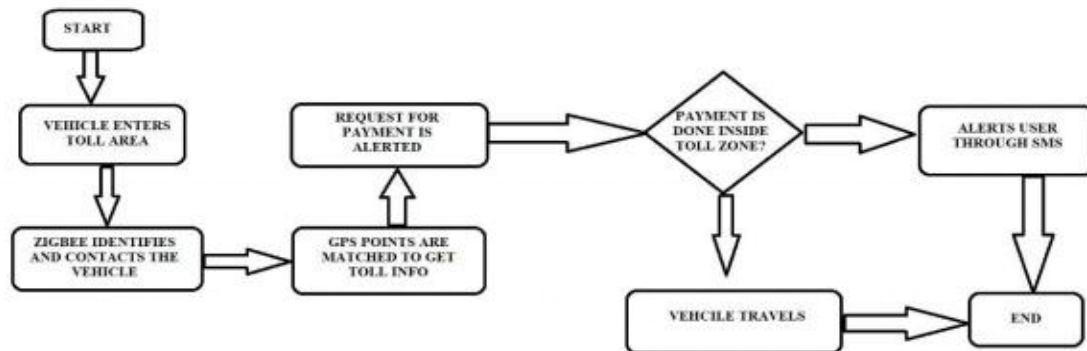


Figure 1 Flow Chart

### 3.1 Modules

In our proposed framework, we fostered Two module,

- Toll module
- Vehicle module

### 3.2 Module Description

#### Toll Module

In our proposed system, the toll module sends data to the vehicle module when it comes to the range and the user has to complete the payment using a reader module (RFID Reader) in the car module. Whenever a vehicle crosses, it checks for the vehicle number plate. Whenever the unpaid vehicle crosses the tollgate, it sends an alert message to the owner of the vehicle. When the payment is completed, the zigbee module sends data to the toll module, and when the payment is not processed, it doesn't send data to the toll module. Firstly, the toll gate system gets the information of the vehicle that enters the toll gate through ANPR system and then the toll system gets the payment history and calculates the toll using highway usage with GPS tracker. Vehicle module consists of GPS for location tracking, GSM for mobile communication and RFID reader for e-payment process. The whole system is incorporated in arduino UNO coded with embedded C software. ANPR system is done in MATLAB, where a vehicle number plate is given as input.

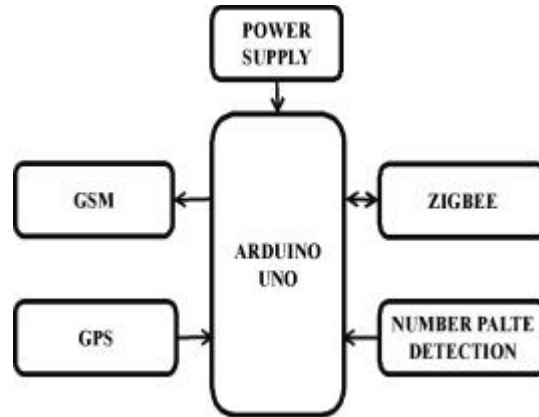


Figure 2 Toll Module

### Vehicle Module

The vehicle module has a GPS module, zigbee, and e-installment segment. The GPS module sends an area to the cost module at whatever point the e-installment is finished from the vehicle module. In the cost segment, at whatever point the GPS esteem is gotten it checks for the vehicle number plate and in the event that the individual paid the sum it will permit them to pass the cost or probably it sends an admonition. By utilizing a virtual cost assortment framework, drivers of vehicles need not to stop at a window or and sit around holding up in a long line to pay their cost. This decreases the utilization of fuel; lessens blockage, increments street wellbeing. Motivation behind the proposed framework is to do the undertakings somewhat on the client machine through the server.

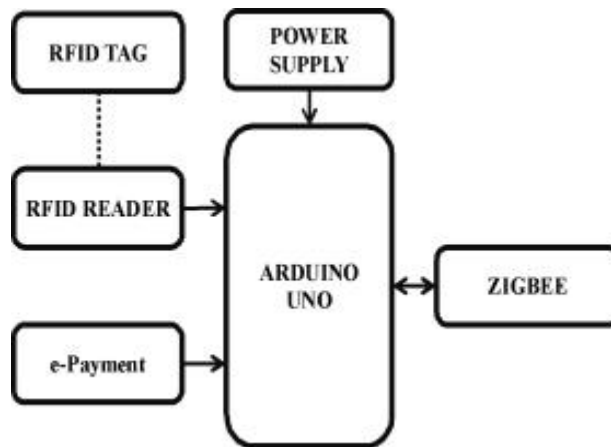


Figure 3 Vehicle module

## 4. Results and discussion

Here in the system, the ANPR (Automatic number plate recognition) is used for deduction of vehicles that are crossing through the speed limiting zone. Here in our demo model, the templates of two cars are taken and the unique vehicle number is identified through MATLAB.



Figure 4 Vehicle Number Detection Output

When the vehicle is understood to be inside the toll zone by matching the GPS points of the toll gantry and the vehicle, the zigbee transmits the signal by alerting the vehicle user for payment and also the central system about the vehicle that a vehicle has entered along with its number.

```
Entered into Toll Area  
  
R  
Entered into Toll Area  
2500D4A69FC8  
C  
Amount Debited
```

Figure 5 Serial Monitor output when payment is done

```
Entered into Toll Area  
2500D4E09A8B  
please recharge your card  
  
R  
Entered into Toll Area
```

Figure 6 Serial Monitor output when user not paid

Now the user is triggered to pay the toll payment, the user is attached with a RFID reader. The user can pay when alerted, by using any of their cards with a tap payment. This ensures a non- stop travel and safe, secure and contactless transaction.

Once the vehicle module enters the specific range of zigbee, the vehicle module will receive the comment A. If it is received ,payment process will be proceeded.

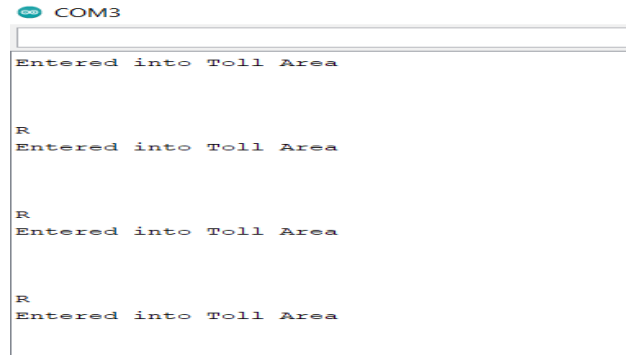


Figure 6 Communication from zigbee

When the user crosses the zone without payment, the user is warned through an SMS. The message will be from the SIM that is in the GSM of toll module. In this message, the GPS points of the current location is mentioned.

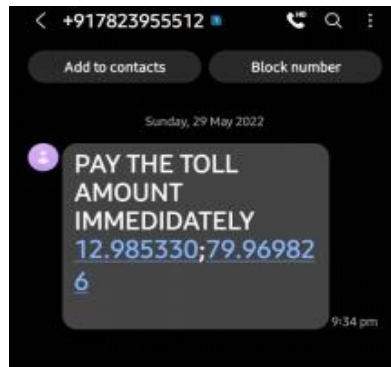


Figure 7 Received message

**Comparison Table**

SPECIFICATIONS	EXISTING SYSTEM	PROPOSED SYSTEM
Unique Capabilities	RFID based	GPS based
Waiting time	Near Non-Stop travel	Non-stop travel
Toll Collection	Manual and Fastag.	Uniquely attached RFID reader inside car.

Payment method	Digital Wallet scheme through recharged RFID tag.	Tap payment through any of the available user credit/debit cards.
Vehicle Entry and exit	Stops at toll plaza.	Pays within toll zone

**5. Conclusion**

Through this system payment transaction is between the vehicle owner and the toll management, no man power is required. Thus the system proposed here can help in cashless contactless payment method, and provide non-stop travel on highways. Depending upon the predicted vehicle, the amount will be deducted through a uniquely assigned RFID reader in the vehicle. When the vehicle crosses the toll zone without paying, the user is alerted immediately. Database can be maintained for further use and vehicle can be tracked any time. The toll tax is being collected using manual system and RFID based fastag system. Our proposed system is attached with a GPS module that tracks the vehicle but not the personal number of the user. This can help in identifying thefts using GPS.

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