



# International Journal of Innovative Research in Computer and Communication Engineering

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## GPS Based Automatic Toll Collection System

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**ABSTRACT:** Transportation has emerged as a dominant part of India. Toll plazas play a crucial role in maintaining the road transportation. At present, manual toll collection is most widely used collection method in India. It significantly requires a toll collector or attendant. Due to manual intervention, the processing time at toll plazas is highest. The paper proposes a design for the automation in toll tax payment using GPS and GSM Technology. Automation of toll plaza has been experimented using combination of Microcontroller, RFID, Global positioning system, Global system for Mobile. Implementation of automation in toll plaza enhances the monitoring of vehicles that are travelling in predestined routes. The paper aims in designing a system, which automatically identifies the vehicle that advance towards the toll plazas and observes the vehicle number and the time of arrival. If matches exist between vehicle data and GPS data, then predetermined amount is automatically taken from the user account at the destination toll before user exit. It passes this information to avoid the Traffic congestion at toll plazas and helps in consuming less amount of fuel.

**KEYWORDS:** ATC, GSM, GPS, RFID, Toll Unit

### I. INTRODUCTION

Automation means to reduce the activities of human labor. This means the process handled by the humans will be carried out by the machines once it is programmed such a way that it reduces more amount of time and it decreases the possibility of risk factor. Overview of the toll booth system in late 90s is, the toll plazas were controlled manually. Those systems require two people for opening and closing of the gate and another two are for reception of the money and also data keeping etc. Later on, in the year of 1995 the development of Express Highway Systems introduced semi-automatic toll plazas were constructed in which data is stored in computers and operation of gate is automatic. Two persons are required for single toll plaza. Later on, the upcoming project aims in developing the human less toll plazas. The notable advantage of this technology is the opportunity to reduce the traffic congestion in toll plaza during festive seasons. Also, this is a method by which to control complaints from motorists relevant to the inconveniences associated with manually making payments at the toll booths. Another obvious advantage, the method recognizes the benefit of the toll booth operators. In the paper, the microcontroller will be placed in vehicle unit and also has a GPS receiver and GSM unit [7].

Global positioning system (GPS)[9] technology has become the new trend for road charging system, which implements ETC system based on positioning and Global System for Mobile communication (GSM) technologies. It is used to find the position of the vehicle accurately. When driver enters toll gate mp3 module will give voice information about private toll gate or a message is sent to the user. When the destination toll is near to the user, an alert message is sent or voice output is given whether to quit toll or continue. The predetermined amount is deducted automatically from user account when he exits from the toll gate. Automatic Toll Collection lanes improve the speed and efficiency of traffic flow, save drivers time and also results of better flow, congestion is reduced, fuel economy is improved and pollution is reduced.



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## II. EXISTING SYSTEM

Since from decades, cost of construction, extension, and maintenance of roads, bridges and tunnels were collected through tolls for Revenue Generation. In previous method RFID technology was used. A radio-frequency identification system uses tags, or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response. RFID tags can be either passive or active or battery-assisted passive. RFID tags contain at least two parts: an integrated circuit for storing and processing information. It also includes either fixed or programmable logic for processing the transmission and sensor data, respectively. In this system sensors were placed above roads and vehicles get charged, sensors identifies the chassis number & number plates of vehicle through sensors and the details were sent to server, after that server further processed and toll is collected. But this technology has some risks. RFID technology is based on image processing technique in which number plates and chassis numbers are scanned as a image, afterwards further processing on that image is done and remaining task get finished regarding toll collection of particular vehicle. But problem with this system is that, if due to mud or any other reason number plate or chassis number of vehicle get covered and not visible properly then sensors cannot detect it properly so it rises a problem while identifying the vehicle and obvious toll collection cannot be completed. In this paper we eliminate the problem by using GPS technology.

Disadvantages:

1. Image processing technique cannot detect the vehicle number plate if it is covered due to mud or any other reason.
2. Toll collection cannot be completed normally since vehicle number is not visible.
3. This technology leads to traffic congestion which consumes more time and fuel.

## III. PROPOSED SYSTEM

The functional concept of a manual toll system is simple. The motorist takes a ticket at the entrance of the motorway and presents it at the tollbooth at the exit. Ticketing and toll barriers can also be placed on each section of motorway. With progress in technology, these systems have evolved towards electronic toll collection, allowing traffic to flow more smoothly and improving service to both users and operators. System consists of Automatic Toll Collection Centre, control gates and on-board units.

This system is based on an innovative combination of mobile telecommunications technologies GSM and the satellite-based Global Positioning System (GPS). The main element of the automatic log-on system is the On-Board Unit (OBU). With the use of GPS satellite signals and other positioning sensors, the OBU automatically determines how many kilometers have already been driven on the toll route, calculates the toll based on the vehicle and toll rate information that has been entered and transmits this information to the ATCS computer centre for further processing. Software will be in support with the electronic road maps and data of users registered in as well as data charges of highways and expressways. Amount counting will be started after toll entrance gate and finished after toll exit gate. Data on vehicle position will be additionally approved by GPS system and delivered to ATCC by GSM net. The toll amount is based on the truck's emission category and number of axles, as well as on the length of the toll route.

Advantages:

1. Avoid the fuel loss.
2. Saving of time in toll collection.
3. To monitor the traffic flow smoothly.
4. Minimizes the operating cost.
5. Minimizes human resources.

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## IV. SYSTEM DESIGN

System design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. Design must be set by the project management to coordinate the collective efforts of the team. System design includes System Architecture. System architecture is the conceptual model that defines the structure, behaviour, and more views of a system.

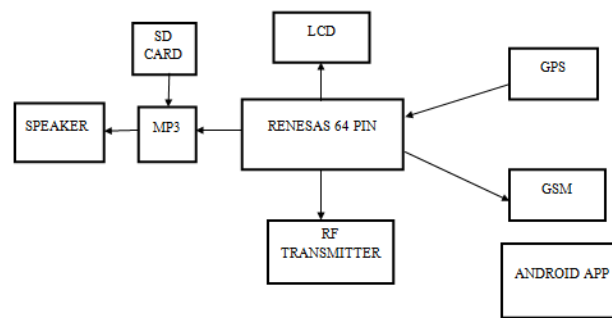


Fig. 1. Block Diagram of Toll Collection System

In the Fig. 1. Renesas 64 pin microcontroller takes the input location of the vehicle from GPS. GPS is the navigation system which is used for specific purpose such as a car based or hand held device or a smart phone application. GPS Technology works in almost any condition and is accurate to within 3-15 meters. The position of the vehicles in the range of mobile tower, will be compared with the position of the toll plaza, when it is near to the toll, the vehicle database is updated, i.e. vehicle information is added to the database. LCD is used to view the vehicle details and other selection texts on on-board unit to users. MP3 is used to give the voice output to the user when the vehicle is near the toll. This information is sent to the android device through the GSM module. Once the toll unit confirms the vehicle is registered user, the RF transmitter sends the signal to the toll unit to open the toll gate.

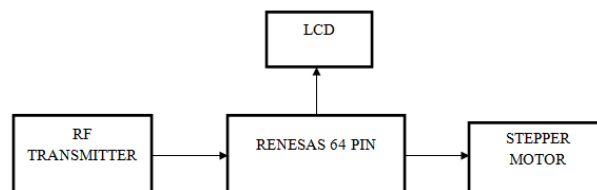


Fig. 2. Block Diagram of Toll Unit

When the distance between vehicle and toll plaza is less than 5 meters from the destination toll, user gets an option to select either to quit the toll plaza or to continue. If user selects to continue in the toll then the toll gate is opened from the signals it receives from the RF transmitter. If user selects to quit, then the amount will debited from the account of the vehicle owner, which will be acknowledged with a SMS to the customer. This information is also sent to the toll unit using the RF transmitter in the toll collection system and the toll gate is opened. If there is no balance in the account of a customer, the bill can be sent to the vehicle owner home with fine, which should be paid immediately or else the vehicle may be seized.

The sequence flow of the automatic toll collection is shown in Fig.3 which represents how toll collection works. The Hardware unit is installed inside the vehicle; it gives the information to the toll that the vehicle is near to toll. Then the user will receive the voice output in the android device through GSM module which is sent by the toll. The received

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message in the android app is saved in the database and acknowledgement is sent to the hardware. These steps take place in seconds.

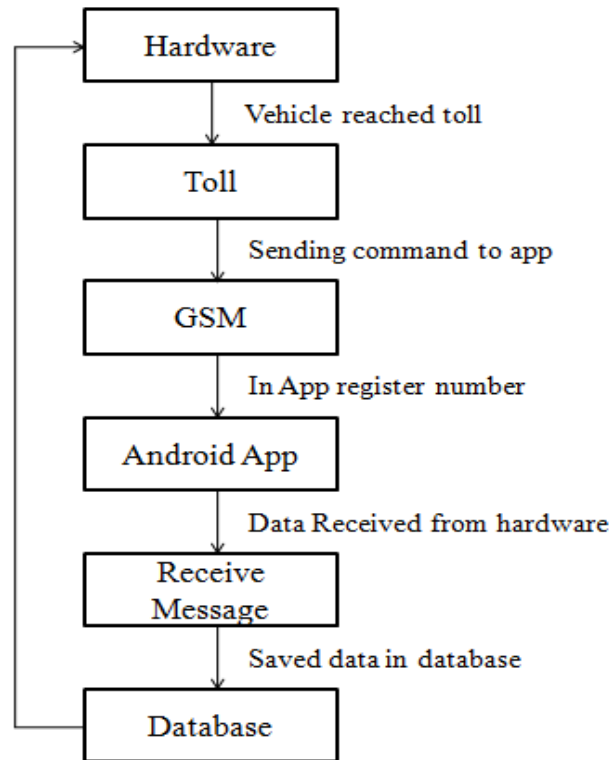


Fig. 3. Sequence flow of System design

Applications of the Proposed System:

1. Can be used in check posts for toll collection.
2. Applicable to nice road toll collection.
3. Can be installed in malls for vehicle parking.

## V. CONCLUSION

A method has been proposed to collect toll fee from the owners of the vehicle. Wastage of time and fuel because of the large traffic jams has been solved by implementing toll collection using GPS. Each vehicle is identified uniquely by the GPS, and the amount is debited from the respective account of the vehicle's owner, which is acknowledged by the SMS/ Email to owner of the vehicle. Since everything is computerized, the under charge or over charge collection of toll by private agencies is solved. A uniform fare can be collected throughout the country. The above mentioned technologies are future electronic toll collect systems and have different attributes. The proposed system based on a combination of mobile communication technology (GSM) and a satellite based global positioning system (GPS). An innovative log on unit OBU, which automatically calculate the amount of charge due and take in to account, depends on the type of the vehicle. It will also act like a platform for vehicle identification and prove effective in tracking stolen vehicles. With regard to future expansion and development, the satellite-based toll collection system will be a better solution, especially with regard to flexibility when it comes to extending toll collection to every road category and in terms of cost efficiency in an implementation operation. For this system to work well, the vehicle which is fitted with



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this system must be represented separately, for e.g., by providing separate colour for number plate of the car, and providing separate lane for this type of car at the toll plaza to get serviced at a fast rate.

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