



Automatic Toll Collection using Global Navigation Satellite System

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ABSTRACT

The handed down method for collecting the toll is manually done where there are lot of disadvantages like time, fuel and energy consumption and also there may be a problem with respect to management of cash to the chauffer's, in order to avoid this damage a new method was introduced wherein RFID chips were placed on the vehicles and in the toll booths but this method to had lot of disadvantages like connectivity, scalability, disclosing of data etc. to over these disadvantages a new technology was introduced which is called as automatic toll collection using global satellite navigation system where the location of the vehicle will be continuously updated to the system and also simultaneously matches with the toll center and when the vehicle nears to the toll center the match is made based on the system[1] database and also specific amount is deducted and the proposed system also provides these information on the dashboard of the vehicle before nearing to the toll booths and the chauffer can select the plan well in advance and can pass the toll without stopping in the toll booths and the user can send the location to the cloud where all the necessary calculations are done and updated in the database in advance

Key words: Satellite system, navigation, automatic, toll collection, secured payment

1. INTRODUCTION

Toll roads are existing in a way back time where taxes were collected by the citizens for the maintenance and building of new roads there were two methods of collecting the taxes one was deducting it from salaries, or finding other ways to collect the taxes from all the citizens of the country and the other way was collecting the taxes from the vehicles passing through that streets or roads through

Toll booth system and it as lot of advantages like generation of capital, avoiding traffic jam problem and firm request management.

Collecting the toll taxes from the passing vehicles varies usually from vehicle to vehicle like fees varies to that of from car and lorry and these taxes are collected at the points known as toll booths or centers etc., nowadays a unmanned toll booths exist which use RFID's to identify and deduct the correct toll tax from each vehicles and apart from this toll tunnels, bridges are do exist this days[12].

The tax collected at the toll roads are utilized by the government for the improvements of the roads, infrastructures and also the purpose of maintenance of roads

2. LITERATURE SURVEY

The concept of toll roads existed ton way back of 2700 years the best known example is the travelers use to pay toll taxes while using the Susa-Babylon highway under the regime of Ashurbanipal who ruled in 7th century BC, tolls do existed in INDIA before 4th century BC as mentioned in Arthasastra notes, and tolls do existed in roman empire in 14th and 15th century.

Turnpike trusts were found in England and Wales in about 1706 in order to improve the quality and maintenance of roads and more than 8000 toll booths were formed for over 48000kms and the roads were maintained by the trusts and also toll taxes collected were the source for the revenue for the government.

The main objectives of collecting the road tolls were as follows [3]:

- Generation of finance/revenue: to maintain, improve the conditions of the roads
- Management of demand: to reduce the demand of the transportation system and to encourage public transport and carpooling

- Management of congestion: the amount of toll taxes increases with the increase in congestion. In order to avoid this this process is very much important. [11]

There are different charging methods as follows:

- Access fees and charges based on time: where the traveler will pay only for the particular period of time and he can use that infrastructures.
- Motorway and other infrastructure tolling: this method is used for tolling well defined infrastructures like tunnels, mountain passes, bridges etc.,

There is a different toll collection method that exists as follows:

- Collection of toll manually: where a toll collector and a attendant is required
- Automatic toll collection: automated coin machine is used to collect the toll and it reduces the time and cost of operation
- Electronic toll collection: here an electronic tag is used to identify the vehicle and the amount to be paid in the toll is deducted from the registered account of the chauffer's

Therefore to summarize in general in the toll booths every vehicle has to wait for some time to pay the money and there should be a person to collect the money and to verify the vehicles in the database as this process is time consuming and there are possibilities of human errors and congestion this traditional system has got lots of disadvantages [4].

3. IMPLEMENTATION

The functional requirements of the system describe about the services that the proposed system is going to provide and the functionalities are as follows [Figure 1]:

- **Toll head is notified** : system should intimate about the upcoming users to the toll
- **Operation in the toll must be seen:** Various kinds of option services must be shown to the user in the platform in which he is working
- **An alert message** must be sent to the user if there is no proper account balance to the users
- **Send an acknowledgement** message to the user once the toll tax is paid
- **Log detail** of the same needs to be maintained

The nonfunctional requirements for the proposed system are as follows [13]:

- **Scalability**
- **Availability**
- **Performance**
- **Recoverability**
- **Maintainability**
- **Interoperability**
- **Security**

The functioning of the system is explained below[4]:

- **On board unit:** a device which will place on the vehicle which consists of sensor and interfacing units.
- **Location sensor unit:** this device will sense the location of the vehicle on earth and send the regular updates to the system
- **Interfacing device:** a device that makes the gateway for the interaction of humans with the system, here it helps the user to know about the plans for toll taxes, balance in his account etc [2].
- **Control unit:** the control unit manages the whole system, it continually gets the location co-ordinates from the location sensor in the onboard unit and matches with the location of the toll plazas. When there is match with the location it sends further interaction using the interfacing device
- **Database:** it retains the data about the user and toll booths. It stores the user related information like the number, type account balance etc., toll booths information like location, catalog for various types of vehicle etc.,
- **Transaction management unit:** keeps the records of the transactions happened over in the system
- **Enforcement unit:** Highway patrol is created for the need to monitor the toll rules and policies, traffic safety and these things are necessarily done by the nearest police stations or temporarily given to monitoring agencies.
- **Money payment center:** Chauffer's identifies the money payment center and registers himself and installs hardware of interfacing that applies for prepaid or postpaid cards.

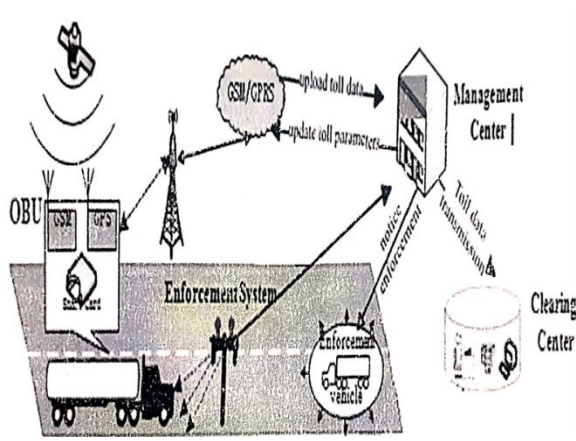


Figure 1: System Architecture

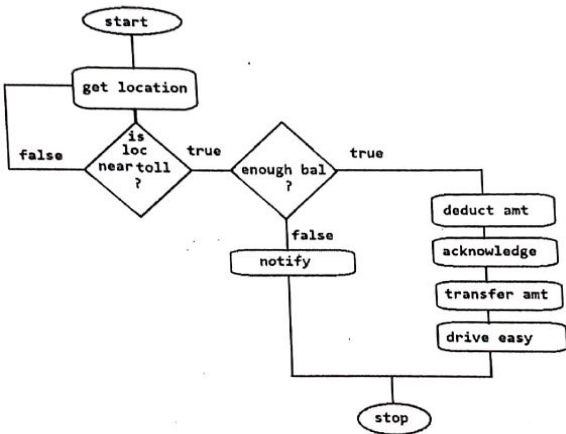


Figure 2: Flow chart of the implemented system

The working mechanism is has follows[figure 2]:

The positioning of the vehicle is taken from the system and the location of the plaza is compared and when there is a match found then the second step is to be brought to practice where the balance is verified on the users account and then if there is no proper balance in the chauffeurs account then system notifies and goes to appropriate payment gateway, otherwise if there is sufficient balance then the system deducts the amount and acknowledgements the user and transfers the money to the toll plaza account and it has two modules as follows:

- Client module
- Cloud module(server Module)

Client Module: it acts the interface between system and users and is further divided into the following modules[figure 3 & 4)

Location sensing modules

- Plaza comparison module
- Communication module
- Data fetching module

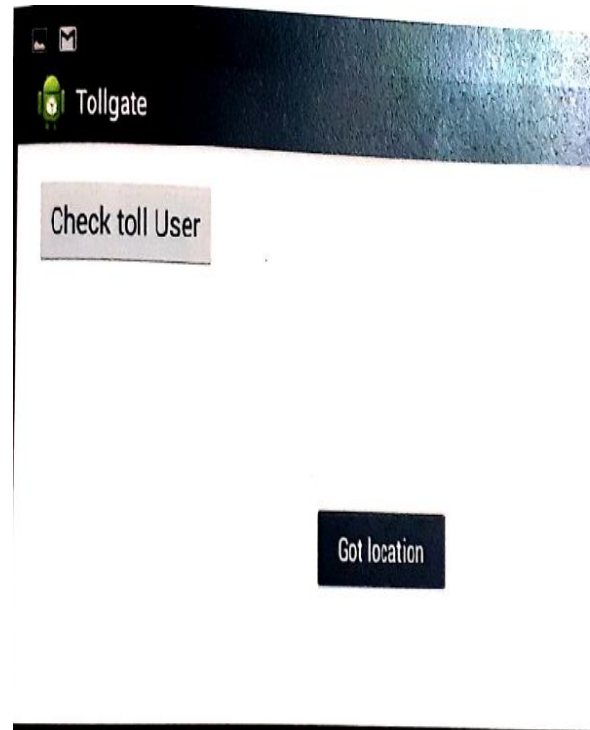


Figure 3: User Display screen snapshot

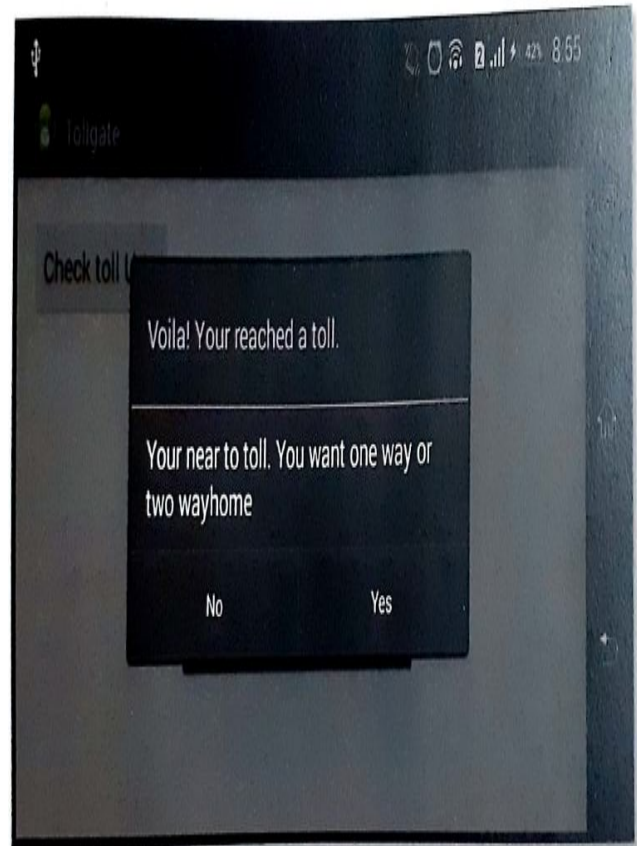


Figure 4: Acknowledgement Screen snapshot

ID	TimeStamp	User	Amount	...
1	04/10/2015 12:10	874150	2529000000000	Apr 10, 2015, 09:40
2	04/10/2015 12:10	970352	3529000000000	Apr 10, 2015, 09:40
3	04/10/2015 12:10	997353	3529000000000	Apr 10, 2015, 09:30
4	04/10/2015 12:40	825571	3529000000000	Apr 10, 2015, 09:30
5	04/10/2015 12:40	922701	3529000000000	Apr 10, 2015, 09:30
6	04/10/2015 09:30	217707	35105300021000	Apr 10, 2015, 10:00
7	04/10/2015 09:30	901200	35105300021000	Apr 10, 2015, 10:00
8	04/10/2015 09:30	417051	35105300021000	Apr 10, 2015, 10:00
9	04/10/2015 09:30	970552	35105300021000	Apr 10, 2015, 10:00
10	04/10/2015 09:30	970731	35105300021000	Apr 10, 2015, 10:00
11	04/10/2015 09:30	30005	35105300021000	Apr 10, 2015, 10:00
12	04/10/2015 09:30	30100	35105300021000	Apr 10, 2015, 10:50
13	04/10/2015 09:30	34202	35105300021000	Apr 10, 2015, 10:50
14	04/10/2015 09:30	136054	35105300021000	Apr 10, 2015, 10:50
15	04/10/2015 09:30	984107	35105300021000	Apr 10, 2015, 10:50
16	04/10/2015 09:30	302044	35105300021000	Apr 10, 2015, 10:50
17	04/10/2015 09:30	952003	35105300021000	Apr 10, 2015, 10:50

Figure 5: Cloud data display snapshot

Cloud Module: The cloud module stores the data and information of the users and the toll plaza it is the central database on which the other modules act upon. This is achieved on the parse.com it provides the Hardware as a service (HaaS) to make the backend of the software. Here the database is stored which contains the information of the user toll plaza and the transaction details[figure 5]

4.CONCLUSION

In above mentioned system is used to reduce overhead both user side and plaza side and the system is more advantageous when compared to manual toll collection system and it also reduces traffic congestion, reduced waiting time, save fuel, reduce wear and tear of the vehicles and increase highway capacity and is more flexible than any other existing toll collection systems Quick drain in power of phones because of the lot of process in background

5. FUTURE ENHANCEMENTS

The system can be further enhanced by linking the application of the user with the vehicle number and also cameras can be used to detect the registered vehicles and also can be utilized in traffic management and to the intelligent management system.

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