Automatic Toll Collection System using IOT

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Abstract- **The use of automated toll collection system in many metropolitan cities would be an efficient step towards the overcrowding of the city highways in heavy congestion of traffic. As we all know, transportation is the strength of our country's economy. There are various implementations, protocols in wireless sensor network such as leach-c and components such as RFID, NFC thus enabling reduction in operation costs and motivating cashless transactions. In case of manual toll collection system time consumption is much far worse as well as fuel depletion and most important is the environment, the amount of air pollution that is created at the toll booth site is at high level, so our developed system will reduce time wastage and not only reduce air pollution but also conserve fuel. The sole purpose of this paper is to reduce the hardships caused by manual toll collection system and pass the subject's vehicle through toll barrier in a matter of few seconds without halt.**

Index Terms- **Congestion, Digital India, Internet of Things (IoT), RFID, Stolen vehicle.**

I. INTRODUCTION

Each and every day more and more vehicles are increasing rapidly and the graph of the rate of buying vehicles is exponential, which has become a major problem at the site of toll booths due to heavy traffic causing endless number of problems such as high petrol/diesel consumption leading to depletion of hydrocarbon deposits below earth's crust and also death casualties due to heavy traffic. The sole purpose of this paper is to motivate cashless transactions by installing automated e-toll collection system and the technology that we used is the use of RFID readers/tags.

II. NEED OF UPGRADATION

There are many reasons behind the need for an up gradation in the manual toll collection system. Some of them are:

1. Manual toll collection system is slow as it ceases the vehicle flow as each vehicle approaches the toll booth for cash transfer and entry into the database. This leads to various issues like fuel wastage, time wastage and air pollution.
2. Manual toll collection system is often found guilty of embezzlement as the toll booth operators who are in charge of the same are involved in the theft of toll books and cash. This and other cases lead to this type of collection system not secure in terms of money.
3. The manned systems often see themselves vulnerable to harassment by the vehicle owners. Mostly in India, where such cases have been found that the toll operators are physically harassed and beaten for they have done nothing wrong. The use of ETC can curb this problem single handed.
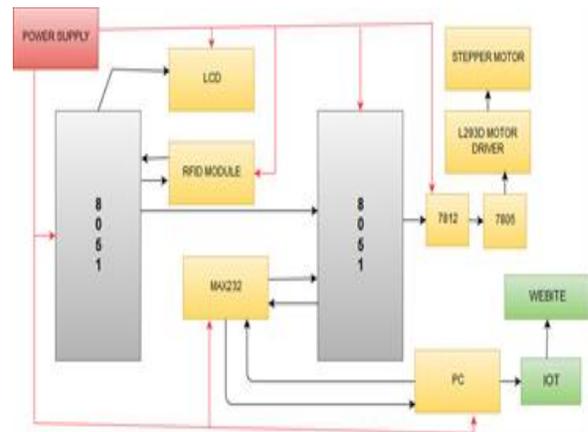
III. HARDWARE ARCHITECTURE

Fig 1: Hardware Architecture

1. The Block diagram consist of RFID module, 8051 microcontroller ,LCD display,MAX232 IC,78xx voltage convertor,L293D motor driver, stepper motor and IOT module.
2. The user places the RFID tag within relatively short range so that the radio freq. signals can be detected. Once this tag enters the required range,

it can be detected by the reader module and it receives the signal of activation. Once the RFID tag has been identified by the reader then the tag can read and write information to the reader .Then the tag can transmit the information to the RFID reader and then it can be sent to the microcontroller.

3. This corresponding data can be then transmitted via the Wi-Fi module to the online cloud database. For the prototype system, a dummy Government registration database is utilized for the verification purpose.

4. If user is identified, process goes to next level. Corresponding amount is deducted (A reference amount is taken for demonstration purpose) and the operation of the toll booth is complete. On completion of operation, the microcontroller then drives the motor to operate the toll gate. Entire operation is performed using the microcontroller.

5. IoT has been implemented for online application of the system. It has been connected to the cloud server and entire data of the transaction and remaining balance amount in the account is available online for users. As a result entire operation is recorded on the server and information can be accessed remotely. Hence entire operation can be made devoid of human intervention.

6. According to it if the user is authorized mandatory balance is deducted from their account, the message is send to the user using IOT and thus gate of toll opens.

7. This information is updated on website.

8. If the user is unauthorized then the message is send to the RTO and the user is directed to manual collection toll lane.

9. If the vehicle data matches with the data of the stolen vehicle message is send to the police station and according action is taken.

10. All this information and data and all collection is updated on website and it is access able to the respective admin.

IV. SOFTWARE ARCHITECTURE

This diagram gives the overall design view of the system and how the components are
connected and different modules in it.

Modules in the system can access the data from the database. Our system contain different hardware module as follow:

- Microcontroller
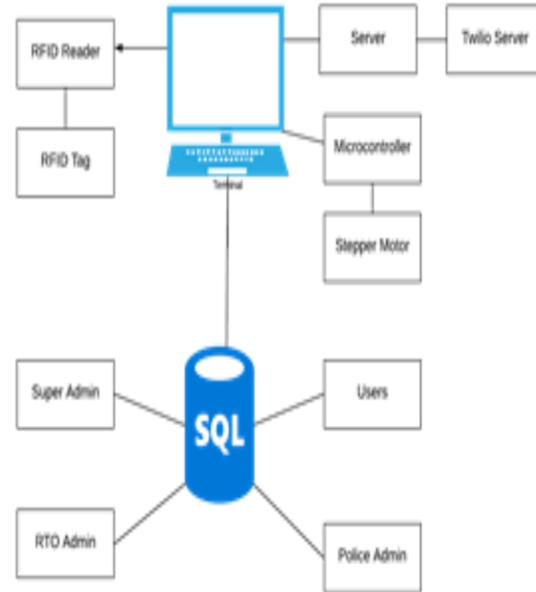- RFID reader and Tags
- Stepper motor

Fig 2: Software Architecture

Above modules are operated with programming done in different Software Modules as follow:

- Super Admin
- RTO Admin
- Police Admin
- User

1. First user has to create a new account through web page. User should enter exact and precise values of vehicle number and unique chassis number so as to identify uniquely.

2. Then at the RTO admin side, the newly created user will be assigned a unique RFID card by which he/she can perform transactions.

3. This RFID assignment is done by the RTO admin on windows application which is RTO admin's personal computer.

4. The next step is to setup a toll booth. This is done by the super admin. Super admin creates a toll booth for a particular highway, assigns a username and password to the toll admin and tax for every type of vehicle. For example different taxes for three wheeler, four wheeler, heavy vehicles etc. are assigned.
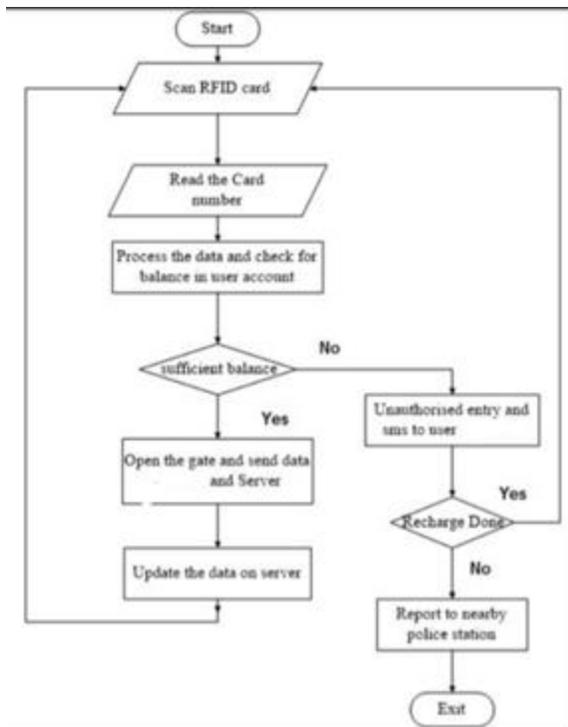
Fig 3: Flowchart of Software Model

5. At toll booth, a toll admin is logged in. Toll booth system is responsible for valid or invalid transactions. Toll admin is given access to the transaction history and logs. But the admin is not able to change the logs, it can only be altered by super admin.

6. At toll booth when a vehicle arrives, the unique RFID tag attached to the vehicle is red by the RFID reader placed at the toll booth. When a reader reads the tag attached to a vehicle it automatically detects the vehicle and the corresponding toll tax is deducted from the users E-wallet. After the successful transaction the barrier at the toll booth will open and an IR sensor placed after the barrier will sense the presence of vehicle after crossing the barrier and then the barrier will be lowered down.

7. In case of government vehicle (police) or emergency vehicle (ambulance) then that vehicle will be registered as VIP during the vehicle registration by the RTO admin. Whenever a VIP vehicle arrives at the toll booth it will not be charged and will be allowed to pass through without disruption.

8. If the user doesn't have sufficient balance then negative amount till ₹ -300 is added to the user's wallet. If the amount goes beyond ₹ -300 then

the vehicle is not allowed to pass through the barrier until he refills his wallet. On successful transaction, user will get a notification on his registered mobile number. Our system also comprises of stolen vehicle detection. If any user has registered his vehicle as stolen at police admin, then during the transaction at the toll booth that vehicle will be detected as stolen and the barrier will not open for that vehicle and hence it will be stopped. A record of vehicles passed daily from every registered toll booth is maintained on daily basis. This record gives precise values like which vehicle at what time on which day of the year passes through a particular toll booth. Another attribute, which shows if that vehicle is returned to that same toll booth within 24 hours, if yes then accordingly the amount will be deducted. This report is only accessible to the super admin. The main purpose of doing so is to avoid the intermediate alterations done by the corrupt government or private bodies. This super user authentication can be used to calculate the yearly tax collected.

V. RESULTS

A. Database

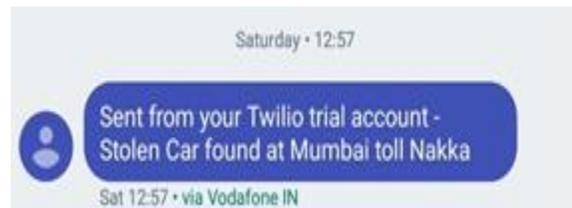Fig 4: Super Admin database

B. SMS

Fig 5: SMS Alert to Police admin for stolen vehicle

VII. CONCLUSION

The concept of IOT for automatic toll collection is demonstrated here .This paper is based on 8051 microcontroller, RFID module.

By doing automation of toll plaza we can have the best solution over money loss at toll plaza by reducing the man power required for collection of money and also can reduce the traffic indirectly resulting in reduction of time at toll plaza .In our project we have introduced the techniques such as Radio Frequency Identification .This technique will include the RFID tag & reader which in coordination with each other can be used to detect the vehicle identity.

IoT has been implemented for online application of the system. It has been connected to the cloud server and entire data of the transaction and remaining balance amount in the account is available online for users. As a result entire operation is recorded on the server and information can be accessed remotely. Hence entire operation can be made devoid of human intervention.

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