

An RFID and Ble Based Automated Tollgate Payment System

¹M. Geetha, ²B. Sangeetha, ²J. Vidhya, ²S. Ramya and ²L.N.K. Ragavi

¹Department Of Computer Science and Engineering,
Rajalakshmi Institute of Technology, India

²UG Students, Department of Computer Science and Engineering,
Rajalakshmi Institute of Technology, India

Abstract: The automated tollgate system is designed to provide a solution for manual toll tax collection at the tollgate. The main intent of the automated system is to scale down the waiting time and the traffic volume at a peculiar point. The Automated tollgate payment makes use of two technologies. RFID technology (Radio Frequency Identification Device) is used to sense the RFID tag, which contains the vehicle number and the BLE technology (Bluetooth Low Energy version 4.1) used to establish the connection between the user and the tollgate for automated collection of tax at the tollgate. The manual toll collection leads to increase in the volume of traffic thereby increasing the length of the queue. The toll collection system used at present consumes enormous amount of time to pay the toll tax by the toll passers. In order to Overcome this problem, the Automated Tollgate Payment System is schemed in which the feasible cases are to be considered for payment. The automated system enables rapid toll tax collection as it minimizes the waiting time.

Key words: Automated toll collection • Traffic density • Quicker processing • The fare collection • RFID and BLE technology

INTRODUCTION

The manual toll collection system used at present is not efficient for the toll passers since it consumes tremendous amount of the user's time. In the manual toll tax payment the toll user's have to wait in a long queue in order to pay their toll fare which in-turn increases the traffic density at a peculiar point. Though this system is applicative for all the toll users, it seems to be quite feeble for the regular toll users or those who use the tollgate at the time of emergency. The drawback of the manual system is that it is not user friendly. The purpose of proposing this automated payment concept is to reduce the manual errors that occur in manual toll collection. The intent of designing this automated system is to reduce the traffic congestion that occurs frequently at the tollgate. The automated tollgate system makes use of two following technologies namely

- RFID technology
- BLE technology

The RFID has electromagnetic fields that are used to identify the tags that are attached to the objects. It consists of two types of tags namely passive tag and active tag. The RFID reader is used to sense the RFID tag which contains the vehicle number. The BLE technology is used to provide faster connection between the user's device and the toll device. The Bluetooth smart is the advanced version of the Bluetooth introduced by Nokia. The BLE is of low cost.

Related Works: T.ArunPrasath, M.S.Dhanapal, proposed a paper on automated toll payment system using RFID and GSM to automate the toll collection process their by decreasing the waiting time at toll booths using the RFID tags installed on the vehicle. It can help in vehicle theft revelation but also can track vehicles crossing the signal and over speeding vehicles.

Edwin's has proposed this technique in street by road side commercial store and done by user but not for public. Then on later it came into existence.

S. Nandhini, P.PremKumar has proposed an Automated Tollgate System Using Advanced RFID and GSM Technology. In this method, after scanning the number the amount will be automatically transferred to the tollgate system and that cost information will be sent through GSM modem to the mobile phone of the user. The status of the user will be displayed in LCD.

V.Sandhya, A. Pravin has proposed the paper on Automatic Toll Gate Management and Vehicle Access Intelligent Control System Based on ARM7 Microcontroller in which the information exchange is done by using RFID and the sensor is kept for tracking the vehicles.

Existing Works: In India, there is no tollgate payment system developed using BLE. The system will be useful for the regular passers, who make use of the toll way. BLE is being used in most of the innovative projects, but till date it is not implemented in the tollgate tax payment system. The main use of the BLE is to establish a faster connection between the user's device and toll device. There is no need for any networks in order to establish the connection between the devices. The major advantage of the BLE device is that it consumes low energy.

For an instance, In Smart Electronic Toll Collection System the system uses RFID tag and RFID reader which collects information of vehicle passing through the toll plaza and automatically debits the toll amount from of vehicle owner, which in return reduces the traffic congestion and human errors. The vehicle owner has to book their vehicle with prescribed RFID tag, creating a rechargeable account. When the vehicle will pass through tollgate the amount of toll will automatically be reduced from its account. The system produced is of the microcontroller based system with the c coding and thus the hardware is interfaced with java base coding [5].

An adequate utilization of the link of communication between RF Modems over a wireless channel to facilitate vehicle monitoring, vehicle authentication and automated toll collection on the highways is proposed. The system is enforced to the automatic registering of the vehicles getting on or off a motorway or highway, cutting the amount of time for paying toll in large queues. The detailed information about the monthly bills will be directed to the customer at the end of the each month. The customers could register and have a transmitter module and thereafter would not have the compulsion to stop at toll booth. The implementation is divided into the design of two modules- the Vehicle Module (Active Tag) and the Base Module. The following two modules

communicate via RF modem connected to each module. The RF modules communicate through the ISM Frequency Range of 902 - 928 MHz. The module of the vehicle revolves around the microcontroller (8051). This module contains the panel called LCD. The Microcontroller contains user-specific data associated with vehicle, such as the Registration Number, Engine Number and the owner's information along with the address of billing. The base module comes with a user-interface that allows the administrator to monitor the current activities in the range, including the vehicles in range, their status and the detailed information about any registered vehicle. Moreover the following base and vehicle module can communicate with each other through the conversation session.

Components Used

BLE: Bluetooth low energy is a technology designed area network marketed by special applications of Bluetooth. Bluetooth Smart which is the advanced version of Bluetooth is expected to provide greatly reduced power consumption and cost while maintaining a similar communication range.



Fig. 1: BLE device

RFID Reader: RFID reader is a network-connected device (Fixed/Mobile) with an antenna that sends the data and mandates to the tags. A device provides the connection between the data and the system software that needs the information. The reader uses an attached antenna to capture data from tags. Readers can also be embedded in electronic equipment and in vehicles.

RFID Tag: RFID tag serves the same purpose as a bar code or a magnetic strip on the rearward of a ATM card or credit card.

Proposed Works: The proposed method is to provide a fast environment for toll tax payment and to automatically control the movement of vehicles. The RFID reader, which

is placed at a distance of 1 km before the tollgate is used to sense the vehicle number with the help of the RFID tag, which are mainly used for identification of physical objects and store an ID called an Electronic Product Code (EPC) in the tag. RFID tags come with additional memory apart from that used for storing the EPC. This approach is known as a data-on-tag approach.

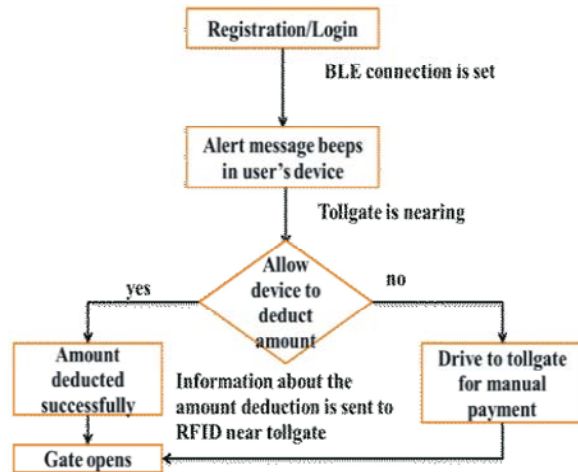


Fig. 2: Flow of proposed system

Case 1: In this case, RFID tag and RFID reader is used in which RFID tag is scanned using the RFID reader. In this process the toll passers can make use of the application in order to pay the toll tax in advance. Once the source and the destination are entered by the user, the number of tollgates gets displayed and the required amount for reaching the destination is displayed. On entering the account number, the required amount will be detected from your account. Only when the process has been completed the toll users are allowed to pass the tollgate.

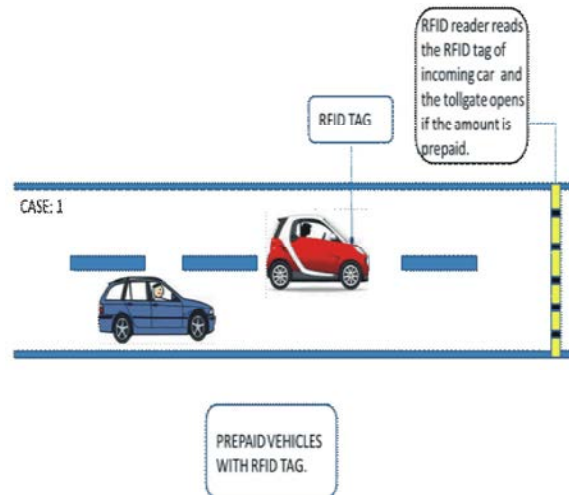


Fig. 3: Pre-payment of toll tax.

Case 2: The BLE device in users' automatic phones gets automatically connected with another BLE device placed near the RFID reader at the difference of 1km from the tollgate. The above used BLE device is designed with the use of a chip and a battery. Once the connection is established between two devices, an alert message will be displayed on the user's mobile through automatic pay application that has been installed.

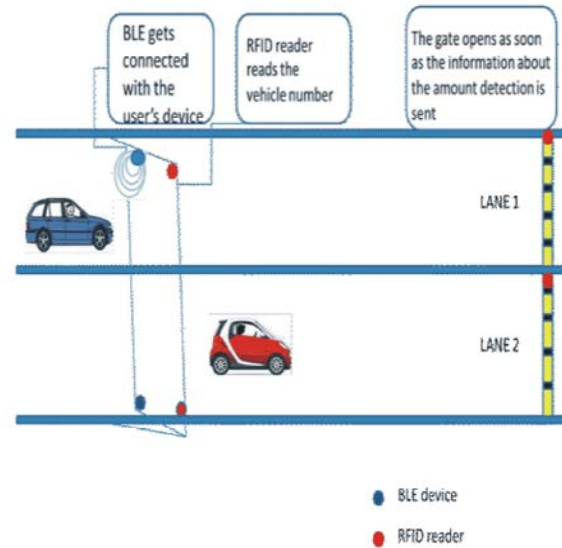


Fig. 4: Payment while travelling

Once the application is installed, it enters into the registration phase where the user has to provide the necessary details (users name, vehicle number, users account number, phone number, mail id). Click->Register. The 4 digit verification code will be sent to your mobile via text message and to your mail id. Type the verification code in the next page and Click->Finish.

The alert message with the YES or NO option is provided.

On clicking YES, the required amount will be detected depending upon the vehicle from the account number that has been provided. On clicking NO, the alert message disappears.

Case 3: Electronic Toll Collection becomes the only option for the toll users those who do not prefer the above cases. In the direct method, the users have to wait in a queue to pay the amount. After receiving the receipt the gate opens and then they are allowed to pass.

Experimental Analysis: From the analysis, it is evident that on implementing this project the waiting time of the vehicles to pass the toll can be reduced largely but not

completely as at least 10 percent of the people passing through the toll also the number of vehicles passing the toll will be increased when compared to the existing system. It is important to recognize that throughput increases if delay at the tollgate is reduced (*i.e.*, if the tollbooth can serve more vehicles per hour).

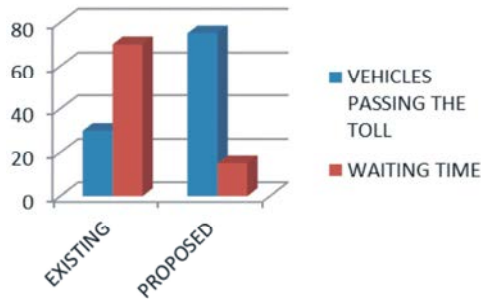


Fig. 5: Analysis of proposed system

CONCLUSION

The automatic toll payment system is one of the best methods for toll tax collection as it reduces queuing and waiting time at a higher rate. In this project the RFID reader is used for identification of vehicle number and the BLE device is used through which amount transaction is done. By effectively using the above techniques in the automatic toll payment system it reduces the processing time and thereby resulting in effective toll collection.

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