Automatic tollgate payment system using Hybrid Mechanism

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ABTRACT
        The Electronic Toll Collection (ETC) systems around the world are mostly implemented by RFID (Radio Frequency Identification device) and GPS technology. The concept proposed is of automatic toll tax payment system in which the solution for automatic toll collection is obtained. The main purpose of the automatic system is to reduce the waiting time and to avoid traffic density in a particular point. In Automatic toll system, we make use of RFID technology (Radio Frequency Identification Device) to sense the RFID tag, which is an ID system that uses small RFID for identification and tracking purpose. BLE (Bluetooth Low Energy version 4.1) technology used to connect user and the tollgate for automatic toll collection. At present, the toll payment is processed through manual collection that results in heavy traffic density. The volume of traffic in recent years has been steadily increasing due to the ever-increasing number of vehicles passing through tollgate. In this scenario, the manual collection consumes tremendous amount of time for toll passers. To overcome this problem, the Automatic Tollgate Payment System using Hybrid Mechanism is proposed in which the possible cases are to be considered. It enhances faster processing of toll fare collection and lessens the traffic volume at a particular point. The Automatic toll payment system makes high speed tolling as the toll passers do not have to stop and make the tax payments.

KEY WORDS: Automatic toll collection, traffic volumes, faster processing, the collected fares, RFID and BLE technology.

1. INTRODUCTION

        The tollgate system used at present consumes our time and it is not efficient for easy movement of vehicles. Now a day's people prefer automatic technology to meet their needs. The amount of traffic in recent years has been steadily increasing due to the ever increasing number of vehicles. From the very past, the construction, extension, maintenance and costs of Highways, roads, bridges and tunnels were clustered directly or indirectly. In the direct method, the toll users have to wait in a Queue for a long time to pay the tax. However this system is applicable to all passers-by, it seems to be inefficient for the regular toll users. The drawback of the direct system is that, it is not suitable at the time of emergency due to over congestion. The purpose of proposing this automatic concept is to reduce the human need in tollgates, which was an leading requirement in direct method. At present secured access is budding in various fields with the advancement in technology. The automated tollgate system makes use of two following technologies namely

- RFID technology
- BLE technology

        The RFID technology is widely used because of its efficiency and low cost. These aspects are the fundamental reasons for rapidly growing RFID based authentication system. Today, several wireless technologies are used for building wireless networks. The wireless technology BLE (Bluetooth low energy) is the advanced version of Bluetooth.

Related Works: A paper on automated toll payment system using RFID and GSM to robotize the toll collection process their by lessening the long queues at toll booths using the RFID tags installed on the vehicle. Supplement to this, it can not only help in vehicle theft detection but also can trace the vehicles crossing the signal and also the over speeding vehicles with their vehicle name plate.

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

        Nandhini and Prem Kumar (2014), 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.

        A 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 tollgate and automatically accounts the toll tax from the

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. The vehicle will pass over the tollgate and the amount of toll tax will automatically be reduced from the user account. The system produced is of the microcontroller based system with the c coding, and thus the hardware is interfaced with java base coding (Ganesh, 2015).

An adequate utilization of the link of communication between RF Modems over a wireless channel to facilitate the monitoring and the authentication of vehicles 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 tax in bigger 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 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 the user-specific details associated with the user 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 activities in the 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.

Technologies 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 the decreased consumption of power and cost while maintaining a similar communication range.

Figure.1. BLE device

Rfid reader: RFID reader is a network connected device 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 Work: 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.
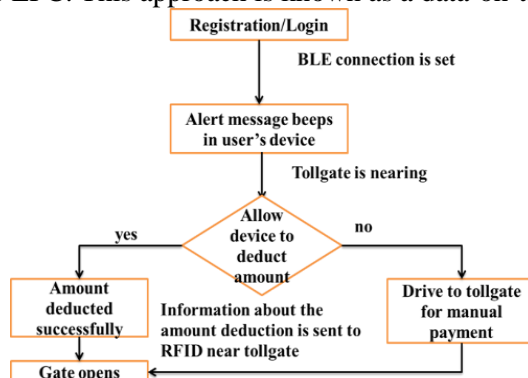

Figure.2. Flow of proposed system

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 needed 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.
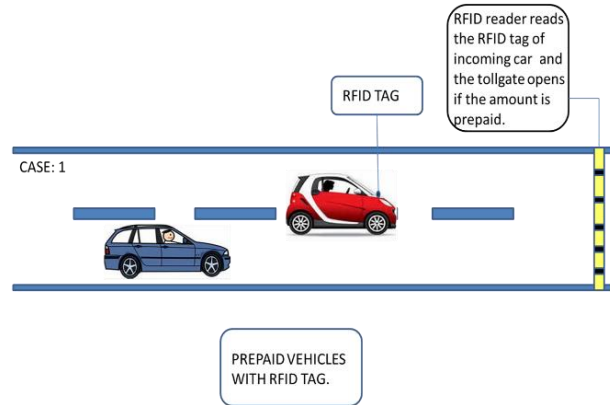
Figure.3. Pre-payment of toll tax

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.
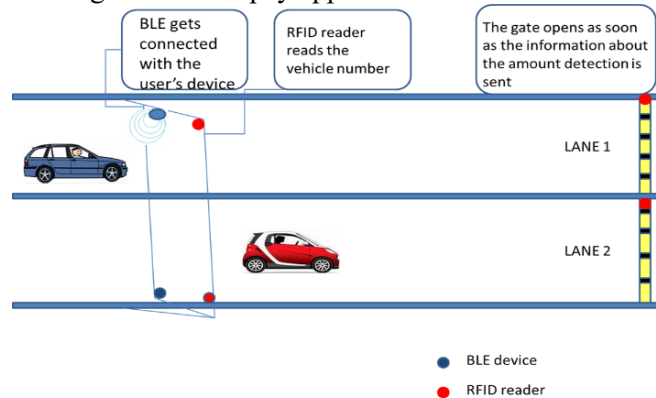

Figure.4. Payment while travelling

Once the application is installed, it enters into the registration phase where the user has to provide the necessary data such as the 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).
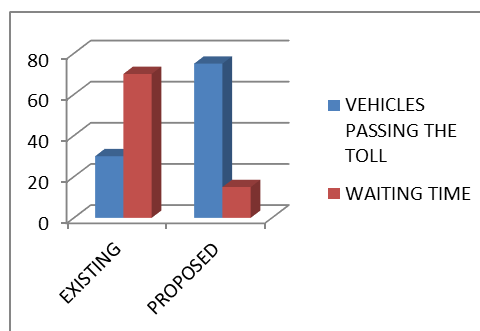

Figure.5. Analysis of proposed system

3. 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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