

RFID Based Automated Toll Collection System

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Abstract— Millions of vehicles pass through tollbooth paying toll tax. Currently available toll payment system uses manual methods. In this each vehicle has to stop at the tollbooth for payment. It causes traffic congestion and time consumption. So an automated toll collection system is urgently required. Here the vehicles need not to be stop at the tollgate. There are a lot of systems available, we compare some of them and also find their future scope.

Keywords- Automated toll collection, RFID, DBSCAN Algorithm.

I. INTRODUCTION

The main idea behind implementing automated toll collection system is to automate the toll collection process and thus eliminating the long queues at tollbooths. The conventional system involves the process of stopping at the tollgate, giving toll to the tollgate staff, and take the ticket and return change(if any) only then the staff will raise the gate for the vehicle to pass through it. The entire system is very time consuming and make take a vehicle anywhere between 15mins-30mins depending upon the traffic conditions. Many people have developed automated systems to overcome these major issues. We discuss some of them that are suitable for use in such situation.

II. LITERATURE SURVEY

We now continue to analyze some of the systems developed. The first paper [1] discuss about RFID technology for automating the process of tollbooth system. RFID stands for Radio Frequency Identification. The components of the RFID System basically include RFID transmitter, a RFID receiver and some processing machine. The paper then goes on to discuss about the types of RFID tags. Types of RFID tags include Active Tags and Passive Tags. An active RFID tag is equipped with a battery. It can be used as a source of power for the tag's circuitry. It has better identification range and larger capacity. Active tag is able to send a strong signal to the reader because of the presence of battery. The major advantages of an active RFID tag are that they allows a read range of about one hundred feet and hence providing a high sensing range. It allows other sensors that can use electricity for power. The problems of an active RFID tag are that the tag

cannot function without battery power, which cause reduced lifetime of the tag. On the other hand the tag is typically more expensive. The tag is physically larger, which may limit applications. A passive tag is an RFID tag that does not contain a battery. The power is supplied by the reader. The main advantage of a passive tag is that the tag functions without a battery. Passive tags have a useful life of twenty years or more. The tag is typically much less expensive and smaller.

The paper [1] then goes on to discuss about the components of the toll collection system. An RFID reader is a device used to communicate with an RFID tag. The reader has an antenna which emits radio waves. The tag responds by sending back its data. The GSM module is used for connecting the entire system through the Internet. When the vehicle pass through the tollgate the LCD system displays the information about that vehicle. The Motor Drive controls the gate of the system. IR sensor is used to detect the presence of the vehicle. The alarm indicator indicates the illegal passing of vehicles through the tollgate.

Then the paper describes the working of the system. When vehicle cross the sensor which are fixed at some meter distance from the tollbooth, Tag will read by RFID Reader. TAG houses unique identification number. The data read by the RFID reader will be send to Microcontroller (8051). Then the microcontroller will process the data for authentication. If the user is valid, then data will send to processing unit. It then checks the account of that user from database. If sufficient amount then user is allowed to pass. If amount is not sufficient to pay toll then user must have to pay the toll manually. The system has some disadvantages because of the use of active tag. The major disadvantages are-Tag usually requires power from vehicle, Tag installation is not convenient due to large size, Moderate difficulty in duplicating tags.



The second paper [2] discusses another system which solve the problem of waiting period and payment issues in the conventional manual toll collection system. The paper proposes a system which contains transponder, Antenna, Traffic Controller System & Central Server. Transponder is the RFID tag which houses a unique identification number. It also specifies the types of tags as discussed in the paper [1]. The Traffic Controller System makes the system different from others. This system manages the distribution of vehicles incoming across a set of parallel toll gates. It uses an Lane Allocation Algorithm. This algorithm allocates the cars approaching the toll gate among the set of the toll gates. The system also employs traffic speed controller. Once the RFID tag comes into the range of the Toll Plaza, the ECU (Electronic Computer Unit) is directed to reduce the speed of the vehicle. The problem with the system is that, once the algorithm fails the entire system fails and leads to huge traffic overhead.



The third paper [3] is also based on RFID. In addition to that it uses load sensing technology. The paper first discuss about the operation of RFID. As discussed in the previous paper, The proposed RFID system uses tags that are mounted on the windshields of vehicles, through which information on the tags are read by RFID readers. In each automated toll booth we will have a RFID sensor and a load sensor. Control booth will house a computer and an operator. Then the paper discusses each operation step by step. First step is reading the card. RFID works in radio frequency. When a vehicle with TAG approaches a toll booth the RFID sensor detects it. Then it sends the detected tag id to the server through MAX232 serial communication.

Next is measuring weight. After the detection of ID of a vehicle, It have to go through a platform where load-sensor is pre-installed. Load cell plate weighs the vehicle accurately. Then gives the analog signal to the first microcontroller which

then displays the respective amount of the toll value in the LCD display. These details are sent to the server by serial communication. When a vehicle with both TAG and weight appears then two pins of the second microcontroller becomes high and green light appears. Then the vehicle is ready to go through the tollbooth. Stepper motor manages the locking and unlocking of the gate. When an unregistered vehicle approaches the toll plaza, Stepper motor will close the gate. So the vehicle driver has to pay the toll manually.



Final step is sending SMS. The system notifies the vehicle owners about the transaction via SMS. These SMS are sent automatically from the system using a GSM modem. .NET serial communication and universal AT-Commands is used to send these SMS. The major disadvantage in this paper is that the load sensing for long length vehicles become crucial.

III. PROPOSED SYSTEM

The proposed automatic toll collection system uses passive RFID technology (passive tag). A passive tag is an RFID tag that does not contain a battery. The power is supplied by the reader. The main advantage of a passive tag is that the tag functions without a battery. Passive tags have a useful life of twenty years or more. The tag is typically much less expensive and smaller. The proposed system features are as follows.

A. Automatic toll collection

When the vehicle is going to enter into the toll plaza, the first aim is to detect the type & no. of the vehicle. Then we have here the RFID system. In this system the tag which is stickled at the front glass of the vehicle is detected by the RFID reader & the data is matched with the data base provided at every toll booth. Since every vehicle ID is linked to users account (toll account), automatically respective amount will be deducted.

B. Reduction in toll

Whenever a vehicle pass a tollgate through a tollgate twice the same day (both entry and exit), a reduction in the amount to be paid at the tollbooth is reduced. The time of entry and exit is fed on to the database whenever the action takes place and meanwhile the checking is simultaneously done to see whether the event has taken place within 24 hours and hence the rates

are diminished accordingly. For example, When moving on to the destination it takes Rs 5 and to come back from the destination it takes another 5. In our proposed system when both the above events do occur on the same day (within 24 hrs) the second toll is reduced to half (Rs 2.5) and an amount of Rs 7.5 will only be levied on the toll payers.

C. Theft detection

Our database maintains the whole list of vehicle owners as the vehicle registration could only become successful after fixing the RFID tag on the vehicles according our proposed scenario. Thus when an unauthorized vehicle does pass through the tollgate it could be easily detected. The vehicle owner could report the vehicle theft to the company staff who handover the particular vehicles tag id to the tollbooth user who is authorized to view the vehicle details on the monitor and could prevent the vehicle from getting passed through the tollgate and catch the theft red-handed.

D. DBSCAN Algorithm Implementation

The central processing of the proposed system is the DBSCAN algorithm and its implementation has given way for a new era of data mining. Let's see how the DBSCAN algorithm is implemented. Consider a vehicle that do enter the tollgate with the vehicle number beginning with KL02 (first four characters).There proceeds the process of adding the vehicle number to the table vehicle (KL02 table).First it is checked to see whether such a tale exists and if it is so, the vehicle number is appended to it (string vehicle).while in the absence of such a table then a new table is created and then the vehicle number is added into it. During the process of searching since the vehicle numbers are added hence it makes the process much simpler and also could be checked in the clusters to see to which category of number pattern they belongs to (eg.KL02 group) .Thus it makes the process of data mining vibrant in the proposed system.

The implementation of the proposed system is described as follows. Whenever any person buys a vehicle from a company showroom, a company staff first needs to do is to get his or her vehicle registered at the database. They will provide a RFID enabled tag. This card contains unique ID to use with that vehicle only. They will also create an account for the use of that particular tag and maintain transaction history in database. User has to deposit some minimum amount to this account. When a registered vehicle approaches the toll booth, tag which is stickled at the front glass of the vehicle is detected by the RFID reader. Then the data is matched with the data in the data base. Transaction will begin, depending upon the balance available. If amount is not sufficient to pay toll the user have to pay the toll manually. If sufficient amount then user is allowed to pass. The software further updates the details in the database. It also triggers a mechanism to generate the bill and will be sent to the user as a text message.

On the other hand, whenever a vehicle owner registers a complaint to the respective officials regarding a theft the respective entry is made in the database. Now any vehicle passing through the toll booth with same tag id as already present in stolen vehicle list (theft list) will be easily identified as the tag id assigned with it is unique. Updates of any sort of transaction will be immediately updated to the database.

IV. CONCLUSION

We have tried to analyze some of the current RFID toll collection systems and their practicality. All the system tries to reduce the traffic overheads at toll plaza. These systems include benefits to both toll authorities and facility users, in terms of time and cost saving, improved security and high capacity.

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