Tollbooth Automation Using Smartcard Data


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Abstract: Tollbooth automation using smartcard data (RFID tag) echoes the technology which has strong aspects in minimizing the huge overhead as well as the inconvenience in proper collection of toll at tollgates. RFID technology is used to overcome the major issues of time consumption and vehicle congestion. By using this system, there is no need of manual transaction. A vehicle will hold an RFID tag which houses a unique Tag id (identification number). Whenever the vehicle passes the tollgate, the RFID reader mounted at the tollbooth will read the tag and automatically respective amount will be deducted from user’s account. The user comes to know about the transaction by mobile notification. So the toll transaction becomes easier.

1. Introduction

Tollgate Automation using RFID technology is implemented using passive radio frequency identification technology to detect and identify vehicles passing through the tollgate. This process alleviates the long queues and saves time during tollbooth payments. This technology has incorporated in making advancements in the field of theft detection and vehicle tracking. The manual working system currently being used, do have the drawback of inappropriate financial management accompanied by a hectic stress in tollgate traffic.

The system is a great investment in the transport industry. It reduces the common hustles in accounting for the movement of goods from point to point. An RFID tag is programmed with information in the form of an Electronic Product Code (EPC), which could be read over a considerable distance so that its contents are used to identify the vehicle and enhance a transaction to be undertaken with respect to the specific tag identity.

The advantages of the system in prior are the less overhead at tollgates, convenient toll collection, avoiding financial loss by miscalculations to a considerable level, being a limiting factor to avoid fuel loss, stolen vehicle detection and ensuring authentication of vehicles. The tollbooth automation system using smartcard data is completely based on RFID technology. All the activities in the system are carried out using a single smart card (RFID tag), thus saving the effort of carrying money and records manually.

2. RFID

RFID means Radio Frequency Identification. It uses radio frequency waves to transfer data between a reader and a movable item to identify, categorize and track. RFID is fast and reliable. It doesn’t require physical line of sight or contact between reader and the RFID tagged item. The RFID system mainly contains two components- RFID tag and RFID reader.

An RFID tag is a microchip combined with an antenna in a compact package. The packaging is designed to allow the RFID tag to be attached to an object to be tracked. The antenna emits radio signals for activating the tag. The antenna picks up signals from an RFID reader and then returns the signal with some additional data such a unique serial number or customer’s account number. The RFID tags can be either active or passive.

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.

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. RFID reader is also called interrogator because it interrogates the RFID tag. The means of interrogation is wireless and because of shorter distance. Line of sight between the reader and tags is not necessary.

4. Proposed System

The proposed automatic toll collection system uses passive RFID technology since it has long life time and cheap rate. Installation of passive tag is very easier.

4.1. 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 the amount will be deducted.

4.2. 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 believed on the toll payers.

4.3. 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.

5. Implementation

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 database. 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.

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 belong to (eg.KL02 group). Thus it makes the process of data mining vibrant in the proposed system.

6. Advantages

The main aim of tollbooth automation is to reduce the man power & to increase the accuracy and efficiency of the system. They system also offers cash free operation. Since we use smart card mechanism for the toll payment, there will be no necessity of hand to hand cash transaction. Another feature is fuel saving. That is, it minimizes huge rush at toll plaza which will cause indirectly the saving of fuel. The major advantage is reduced time for completion of process. The current system we have in consumes nearly 2-3 minutes for each vehicle to complete the process of toll payment. With our automated toll payment system we can able to reduce the time consumption nearly up to a few seconds (30-40 s).

7. Conclusion

Automation in tollgate incorporated with our salient features is sure to achieve its goal to a huge success by winning the drawbacks of the existing system especially in relation to the tightness in traffic along the tollgate and the hectic financial management. Theft detection and toll reduction has given another way for a highly distinct tollgate automation accompanied with the DBSCAN algorithm achieving a better method of data mining.

8. Future Enhancement

Achieving automation in control using RFID system for toll collection powered by Embedded System designed in such a way for easy payment of Toll Fees Using RFID and Alcohol sensor to Prevent Accidents on the Highways. Another future achievement that could be eattenated is the implementation of image processing for centralized data recording. In our present concept we are only using the RFID system for vehicle detection. So we can extend the scope of this concept in other way for centralize data recording. For that purpose we can use the IR courting at the entry gate which is followed by the Camera assistance which will continue sly capturing the images of the vehicles entering into the toll plaza and the third step to which the RFID reader collects the vehicle number. Now when the vehicle passes through the IR courting it tresses the outline of the vehicle, in the next step the camera will take the image of the vehicle & followed by the RFID to record the data related to the vehicle. The load cell weighs the vehicle and classifies it into two categories as light & heavy vehicle respectively. The whole data collected together & sent to the
centralize server which will store it for a stipulated time. This application will help in detecting the vehicles in the crime cases like terrorism and smuggling of goods & it will also reduce the load on check post.

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10. Reference


