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Automatic Fastag Toll System Using RFID And Raspberry Pi

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Abstract: A short-range communication technology is currently applied in al- most all electronic toll collection. An automated toll system is implemented and the amount of transaction is sent to the driver's mobiles through GSM modem. This technology is novel aimed at easy toll collection systems especially in ex- pressways. The objective of this study is to construct a model which can be used for automatic identification of the registration number of the approaching vehicle along with time. If it is an authorized person's vehicle then the gate will open by itself and toll tax will be debited from the user's account. In case of entering without permission, then it will be recorded and warning signals will be given. An RFIDtag containing the vehicle specific identification number will be present in all vehicles. The amount will be debited and the remaining amount will be updated as the vehicle passes through the toll gate. An update of negative balance will be provided in case of inadequate amount in the prepaid account. All details are shared between the FASTag holders and the authorized toll collection per- sonnel, so that there can be an effective toll collection and simultaneously avoid- ing long queue of vehicles and chances for human error. FASTag is a user- friendly, reloadable tag that helps in deducting toll charges automatically. This system allows you to cross the toll booth without having a need to wait for cash transaction. FASTag is connected to a prepaid account from which the certain toll amount is deducted when the vehicle passes through the toll gate. The pro- posed system makes use of Radio-Frequency Identification (RFID) tag, which is affixed on the windscreen of the vehicle. FASTag is the right solution for a prob- lem-free trip on national highways. However, in the existing system, when other users use the FASTag, it cannot be identified whether it belongs to a particular person or not and the amount is also deduced. In the proposed system the Image Processing technique Optical Character Recognition (OCR) algorithm is used to sense the number plate of a vehicle and then it is matched with a database to provide correct information, and the amount transaction is done consistently.

Keywords: FASTag, Image Processing, RFID reader, OCR, IR sensors, Cam- era.

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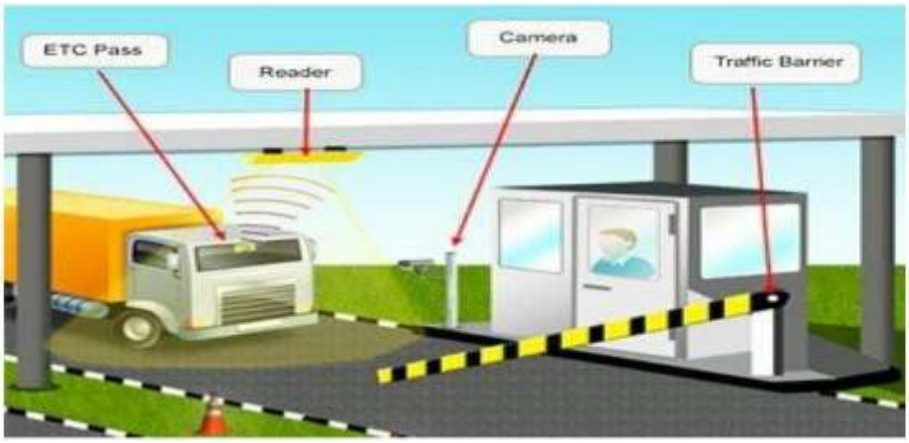
1. INTRODUCTION

RFID technology along with load cell provides a cash free transaction that saves dura- tion spent on tolls. Prime objective of our project "Automatic Toll Plaza" is automation. In this part let's take an outline of the meaning of automation. The word automation represents replacement of human being with machines to run a task. That is whatever the work being performed by the humans will be done by machines from now on. Let's see how the toll plaza have been working previously. Previously the toll plaza was operated by manual methods. A total of 4 people was involved in the operation of toll i.e., 2 for gate operation and 2 for handling money and maintaining records. By 1995, when express-highway were started with the introduction of computerized data storage and automatic gate functions, 2 persons were sufficient for toll booth maintenance. In our study let's see a fully automated toll plaza. A technology that enabled electronic system for collection is tolls known as Electronic toll collection (ETC). To improve the speed of toll collection and decrease the traffic, this system has been applied to toll both in express highway, currently manual transaction is used for toll collection where the vehicles stops at the gate for transaction. This causes congestion, increasing pollutants in air also waste of valuable time of the vehicles. The ETC avoids congestion near the toll. A RFIDTag attached to all motor is provided with memory for reading and writing. When the vehicle comes near the gate, the automated units placed receives the signal and provides the value to be deducted and deducts the same with the account linked. While driving from one location to another, we need to wait at the toll gates for a long time to pay the toll charges. This may lead to a heavy traffic jam at the toll gates and is a wastage of time. The work flow of the toll collection is given in figure 1.

Fig. 1. Toll collection



The main aim of the project is to avoid the long queue, and the traffics in the toll gates. The electronic toll plaza collection is used so that the vehicle does not need to stand in a long queue. For this process, the driver of the vehicle needs to load the data in the RTO office while buying a new car or some other item. We have automated the traditional toll gate system by introducing RFID technology and ensuring secure money transactions. This system is much more efficient than the traditional system. The trans- action for the toll gate billing is more convenient and time-saving. Under the image processing concept, we use the Optical Character Recognition (OCR) algorithm to ex- tract the number from the vehicle. The scope of the project is to avoid traffic congestion in highways. It ensures the proper transaction. It can be used to detect the false trans- actions that occur if the FASTag is replaced. The objective of this project is to avoid the unwanted amount deduction for the toll gate area

using image processing and to identify the correct user and then transfer the money in our account. The main objec- tives of the proposed system is manifolded:

- To ensure the security for transfer of money in their toll gate system. To check the currently moving vehicle number plate and RFID value, if it matches with the stored value.
- Then their vehicle is allowed otherwise not allowed.
- If in any case, the number plate information does not match, then the buzzer produces a beep sound and the toll gate will not open for that particular vehicle.
- To provide authentication for transfer money.

2. LITERATURE REVIEW

Automated Toll Collection System (ATCS) is utilized for automatic collection of tax. A radio frequency is used for identifying. An RFID tag that has specific identification number will be there in the vehicle. A reader will be placed in the tax collection centre. If a vehicle goes through the toll charges will be debited automatically from the vehicle holders account [1] .The real experiences are acquired through careful monitoring of real time purchases. This gives a conclusion which should provide them with conclu- sions about the enhancing and speeding up the activity for saving time of people also guide them about effective and meaningful shopping. This innovative research design is mainly to focus on [2].In order to understand the impact marketing and merchandiz- ing campaigns, details of the purchasing behavior is very important. The stores which sells clothes online captures the purchasing behavior of people by analysis of the streams they clicked and shopping carts. The idea is to phase read the tags linked the things can show different but stable patterns in a time-series as the user watches it, picks the needed material [3]. Unline online stores, in-store shopping some ideas to gather the consumers' behavior prior to shopping[4]. The paper represents the designing and ap- plication of in-store Customer Behaviour Identification system using a passive RFID tags, known as CBID. The 3 main aims of behavior identification is designed by con- crete problems, solving the problems with new protocols as well as algorithms. Off shelf devices are used to build a CBID model for implementing [5]. Highway and bridges are the hotspot for criminal happenings in sever underdeveloped countries. Here, the security features to prevent such incidents has been introduced. Some systems use WiFi systems for toll collection [6]. Also, overhead cameras and NFC are used to facilitate detections [7] [8]. Some of the benefits are deeply discussed in [9]. Our pro- posed system uses RFID technology for automation of toll plazas to make the collection system more-smarter.

3. PROPOSED SYSTEM- MATERIALS AND METHODS

Whenever a vehicle reaches nearer to the toll gate, the IR sensor fixed on a pole detects the appearance of an object[10]. The camera fixed at the toll gate captures the image of the number plate while the vehicle moves forward. The image is processed using OCR technique which provides an enhanced version of the number plate with distinct char- acters. The proposed system architecture is shown in figure 2.

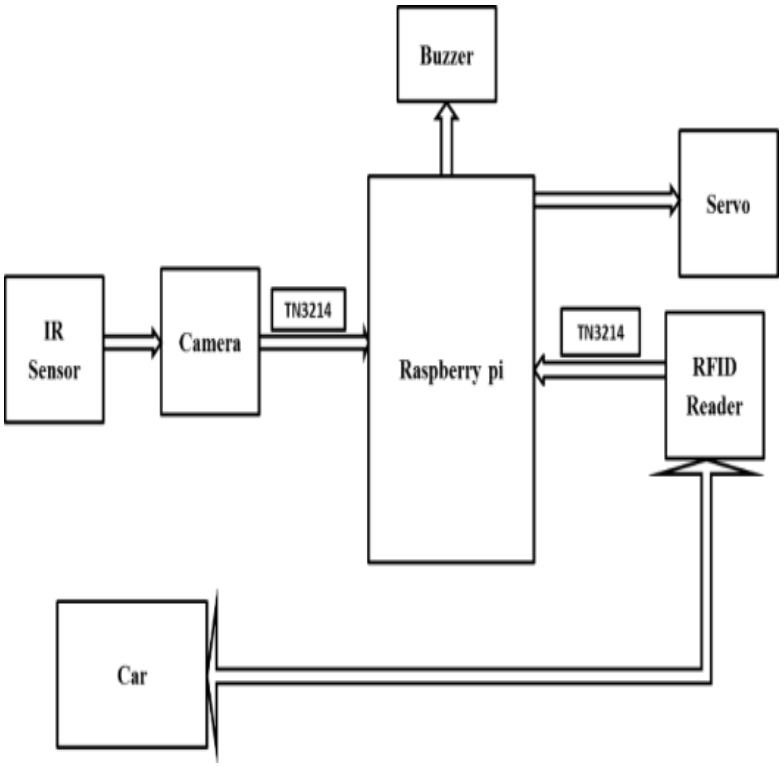


Fig. 2. Architecture of the Proposed System

The outcome of this process is stored in Raspberry Pi. The FASTag affixed to the automobile is read using RFID reader at the toll gates. The FASTag details are already stored in the database during the registration of the FASTag. So, the number of plate information is retrieved from the database and is mapped with the current number plate by the Raspberry Pi. If both the number plates match, then the payment of toll charges takes place through the registered bank account. If the transaction is successful, then the servo motor attached to the toll gate rotates causing the gate to open. The vehicle can then move forward after this process. If at any case, the number plate information does not match, then the buzzer produces a beep sound, and the toll gate will not open for that particular vehicle. Hence, the proposed system reduces traffic congestion at the toll gates and saves time. When the vehicle reaches nearer to the toll gate, the IR sensor fixed on a pole detects the appearance of an object. The object in the toll gates System produces the output is 0. The workflow is summarized below:

a. The camera fixed at the toll gate captures the image of the number plate while the vehicle moves forward. Radio-Frequency Identification (RFID) device is similar to a bar code or a magnetic strip present on the backside of credit card or ATM card which gives specific identification for the objects.

b. Similar to the credit/atm cards which are scanned to provide the details, the RFID is scanned to give the users' details RFID tags are interrogated with an RFID reader. This interrogation happens wireless and since the distance is very short; there is no need for line of sight to interrogate the tags.

c. An RF module is present in the reader which transmits and receives the RF signals. In the transmitter, a carrier frequency is created by oscillator; data commands are impinged by a modulator upon this carrier frequency; finally, the signals are strengthened enough to awaken the tag by amplifier.

d. A demodulator extracts the returned data and an amplifier to strengthen the

signal for processing in receiving phase. A device which connects the tag data as well as the enterprise system software which requires the information is an RFID reader otherwise known as interrogator.

e. The reader and tag establish communication inside the operating region, doing numerous works that include simple continuous inventorying, filtering (iden- tifying the suitable tags), writing (or encoding) to choose tags and so on. The data from the tags are captured by the antenna connected to the reader. It then goes through system for processing. Similar to RFID tags there are RFID read- ers of varying size and type. The pin diagram of connecting R-Pi with the RFID is shown in figure 3.

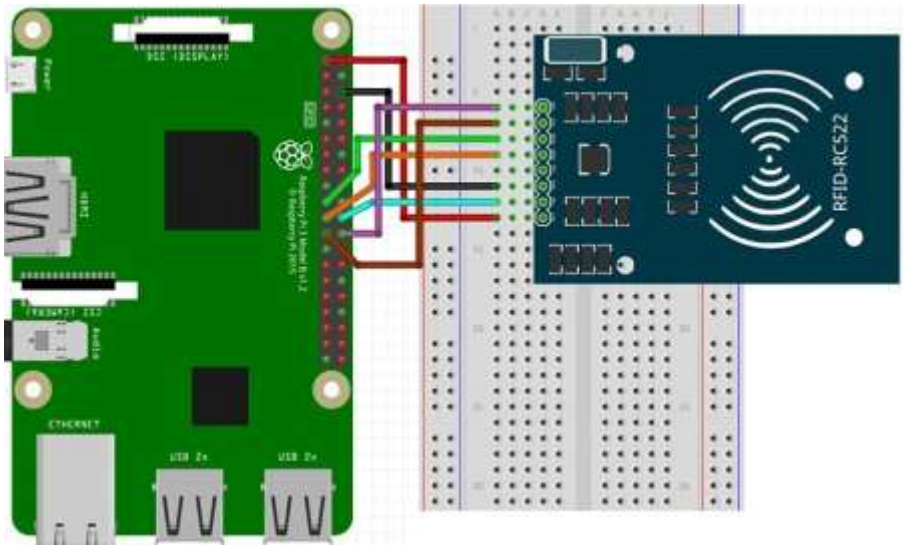


Fig. 3. Interfacing RFID with Raspberry-Pi

Readers can be attached in a fixed place in a shop or industry, or merged into a mobile device like movable scanner that can be held on hand. It can also be placed in electronic devices as well as automobiles. The RFID reader then reads the FASTag affixed to the vehicle at the toll gates. The system produces the results as a number plate image. Moreover, read the RFID value. The FASTag details are already stored in the database during the registration of the FASTag. The working of RFID is illustrated in figure 4.

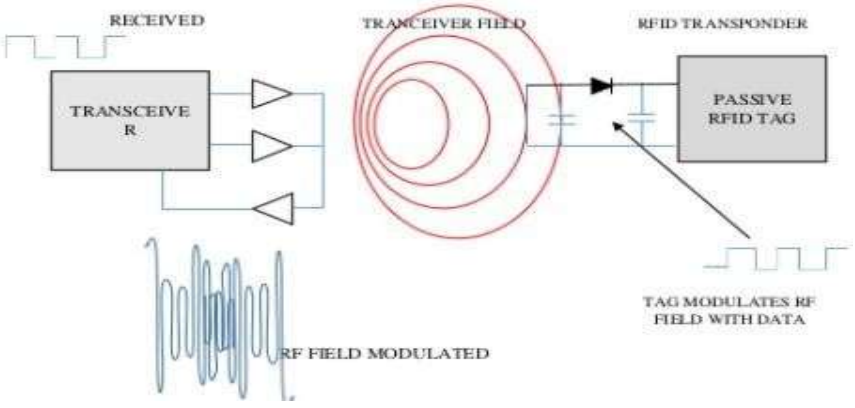


Fig. 4. Working of RFID

So, the number of plate information is retrieved from the database and is mapped with the current number plate by the Raspberry Pi. If both the number plates match, then the payment of toll charges takes place through the registered bank account. If the transaction is successful, then the servo motor attached to the toll gate rotates causing the gate to open. The system produces the result is a gate open.If at any case, the number plate information does not match, then the buzzer produces a beep sound, and the toll gate will not open for that particular vehicle. The system produces the result is beep sound.

4. IMPLEMENTATION RESULTS

The experimental setup and dash board are illustrated in figure 5 and figure 6.

Fig. 5. Experimental setup

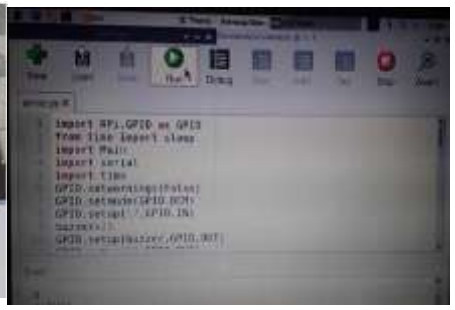


Fig. 6. Dash board

5. CONCLUSION AND FUTURE WORK

The proposed technique is a toll plaza which has been made automatic. This has an game-changing technique to reduce traffic in toll booths to a huge extent. This allows easy toll collection on expressways. It is cost-effective, secure method to use the tech- nology in decreasing congestion and simultaneously reducing the chances for human error. By using the automation technology as the main principle, the requirement of manpower to collect toll charges is reduced to a great extent. The RFID technology applied here also provides added benefits like tracking the automobiles, automated toll gate charges and avoids the need to break the speed, and the transaction will be done using FASTag. In future, we can use the QUALCOMM mobile processor, which is used to track the vehicle and the user details world-wide.

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