



IoT Based Advanced Automatic Toll Collection and Vehicle Detection System

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ABSTRACT

In this project we address the problems faced at toll plaza & also introduce identification system for vehicles against which stolen and accident cases are registered using RFID. The owner has to create an account through mobile application & register his RFID tag. When vehicle passes through Toll Collection Unit (TCU) it is classified as passenger or goods carrying vehicle based on its Unique Identification Number (UIN). A goods vehicle is weighed at TCU & if it is overloaded then charged with extra tax. UIN is passed to Central Server Unit (CSU) where the balance gets deducted from account. Once the balance is deducted at CSU it will indicate TCS to open the barricade and vehicle is allowed to pass. If vehicle is detected to be stolen at CSU it will indicate TSC not to open the barricade. Also to overcome the problem of hit & run cases collision detection mechanism is implemented using vibration sensor in vehicle to identify RFID of collided vehicles. When vehicle is collided IOT module activated and sends data to server. These details can be used for further action.

Keywords: RFID Reader, GSM, RFID Tag, Arduino Uno, LCD display

1. INTRODUCTION

In our daily life we often visit toll plaza. At toll plaza we face the problems like congestion, wastage of time and fuel. To overcome the above problems, it is necessary to speed up the process at toll plaza. Hence to overcome the problems faced at toll plaza we use RFID based toll collection system. The processing time require for RFID Toll Collection System is much less than manual toll collection system. Manual toll collection system also leads to human errors which may lead to incorrect toll collection. We also often get to hear that the

number of hit and run cases is increasing day by day. It may even lead to loss of life. It is difficult to apprehend the culprit in hit and run case. It is observed that when the vehicle is stolen it is very difficult to track the vehicle. It is very necessary to control these above problems. So, the system also has an additional feature of detecting the vehicles against which stolen and accident cases are registered. It is observed that overloading the vehicles may lead to accident and also damage the roads. This problem is also address in system by weighing goods carrying vehicle and charge them with extra toll if it is

overloaded so that they will not overload again. System also makes payment system easy by making all transaction online using mobile application.

Research in field of application of RFID system is increasing on huge scale. The main reason for such a huge appeal for RFID is low cost and low maintenance of RFID system. Some of the existing applications of RFID system are logistic and supply chain visibility, item level inventory tracking, manufacturing, access control, animal tagging, library system, real time location system, etc. The RFID system is also used in toll collection system following systems gives detailed scenario. In the system comprises of toll collection unit, when vehicle arrives at toll plaza a RFID number of tag is detected and toll amount is deducted from corresponding user account then the vehicle is allowed to pass. In the system comprises of toll collection unit, when vehicle arrives at toll plaza the RFID number of tag is extracted and balance is deducted from corresponding user account. Once the balance is deducted the information of transaction and balance left in account is sent on user mobile using GSM module, so that user has a valid proof of transaction. In system comprises of toll collection unit and stolen vehicle detection mechanism. In this system when vehicle arrives at toll plaza it checked whether vehicle is stolen or not. If it is found to be stolen information is forwarded to owner. Otherwise balance is deducted from user account and vehicle is allowed to pass. In the automation of toll plaza has been done based on image processing. ANPR (Automatic Number Plate Recognition) system has been employed for detection of vehicle. When vehicle arrives at toll plaza a camera is used to capture the image of number plate of vehicle. Once the image is captured ANPR system is use to extract the number of vehicles. When the number is extracted a toll amount is deducted from corresponding user account. In this system RFID is not required, but system requires high installation cost..

2. EXISTING SYSTEM

Designed a programming board to program the PIC microcontroller that consists of JTAG in SpyBi Wire mode. When the power supply is connected with fuse blow protection additionally the port pins were attached with a single pole single thrown (SPST) switch and LED for testing the code visually [4]. The IR transmitter/LED is a device that used to emit infrared light outside the visible spectrum. The device that is used to detect or

receive, the IR light is called infrared sensor which sense aspects of its surroundings. In our example, the IR sensor is used to detect arriving vehicles. The SE555P Timer by Texas Instruments is used in the monostable mode. When IR radiation is received (“no vehicle” condition) triggering occurs, resulting in a high output. When a vehicle arrives at a toll plaza, the IR rays are blocked by the vehicle, and the output of the timer to toggle to low. The change in output of the timer is sensed by the microcontroller, which is programmed to turn on the IR transmitter.

3. PROPOSED SYSTEM

The proposed system consists of mainly three units TCU, VCU and CSU. The TCU performs the work toll collection and allows valid vehicles to pass. The VCU keeps check that is only valid RFID can be used for toll transaction. The CSU is used to keep the track of transaction and also to declare that whether vehicle is valid or invalid based on black list of vehicle store in data base. It is CSU which sends message to TCU that vehicle is allowed to pass or not. Once the transaction of toll payment is completed the information is send on user mobile application. The mobile application is use to deposit the amount in user account through online banking. The whole system block diagram is shown below (Figure 1).

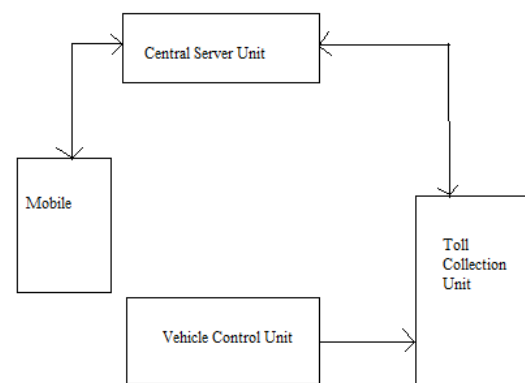


Figure 1: Proposed System Block Diagram

The detail explanation of above blocks with its working is as follows: -

3.1 Toll Collection Unit (TCU)

This unit consists of RFID reader to read unique number from RFID tag attached on vehicle. Zigbee module is used for communication between CSU and TCU. The most important element used is Arduino for synchronization and control of other elements in TCS

When vehicle enters the toll plaza, triggers RFID reader to read the RFID tag attached on vehicle. RFID reader sends this RFID number to Arduino. Based on this Unique ID the vehicles are classified as passenger vehicles. Further, the RFID number and amount to be deducted are sent to CSU. Once CSU receives RFID and amount to be deducted from TCU it checks whether any stolen or collision case is registered against that RFID. It also checks whether there is enough balance in account. If any case is registered against vehicle or if there is not sufficient balance in users account, the CSU declares it as an invalid RFID. The Central Server Unit sends message to TCU that RFID is invalid, thus not to open the barricade for vehicle to pass. If the user doesn't have a sufficient balance, then user is allowed to pay cash. If all the above cases are false then amount is directly deducted from account at CSU. When balance is deducted from user account the information about account is sent to user mobile.

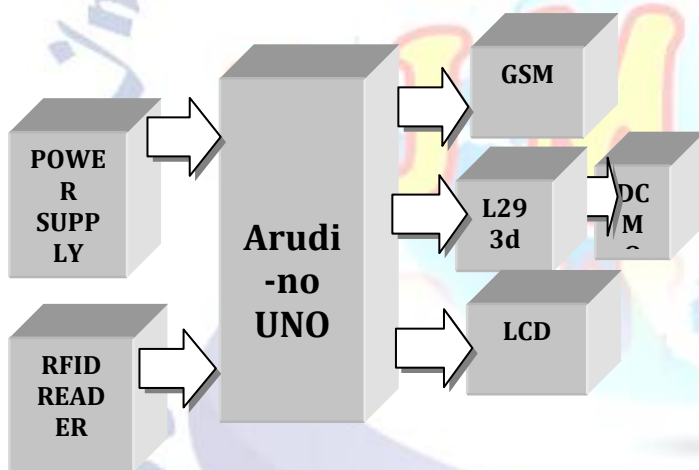


Figure 2: Toll Gate unit

3.2 Central Server Unit (CSU)

This unit consists of Central Processing Unit (CPU) which is used to store account information of user. GSM module is use to send balance deducted and remaining balance on user's cell phone. So that user has information of transaction done at toll plaza. Central Server Unit also keeps the record of stolen vehicles and also vehicles against which accident cases are registered. Central Server Unit is also use to keep the record of online bank transaction of user and payment transaction at toll plaza.

3.3 heft Detection System

The VCU consist of RFID reader and RFID card. The vehicle doesn't start until RFID reader detects valid RFID tag. If vehicle is stolen the case is registered against it, and vehicle is added to black list. When stolen vehicle which are black listed arrives at toll plaza, CSU detects it as a stolen vehicle. CSU then sends message to TCU that vehicle is invalid and don't allow vehicle to pass.

4. RESULTS& DISCUSSION

In this section results and working of the proposed system is presented. Here, when a vehicle comes, the RFID reader reads the information on the tag in the vehicle. Microcontroller processes it and the transaction takes place. The details will be displayed on the LCD as well as it is sent to the user's mobile. When person enters the toll plaza with an invalid card, with a card having no balance or without any card the microcontroller intimates the motor to close the gate. By this way we can control the trespassing in the toll plaza. By introducing this method, we can avoid the inconveniences experiencing in the toll plaza and we can also have a more convenient and new generation toll plazas.



Figure 3: Automatic Toll Collection System using RFID & GSM Technology

Proteus software is used for simulation. Here RFID reader connected to 0 pin of Arduino three color LED is connected to 2, 3, 4 pin of Arduino. LCD display (RS,EN,D4,D5,D6,D7) connected to Arduino uno. Figure 4 shows the connection diagram of the proposed Automatic Toll Collection system using RFID & GSM technologies.

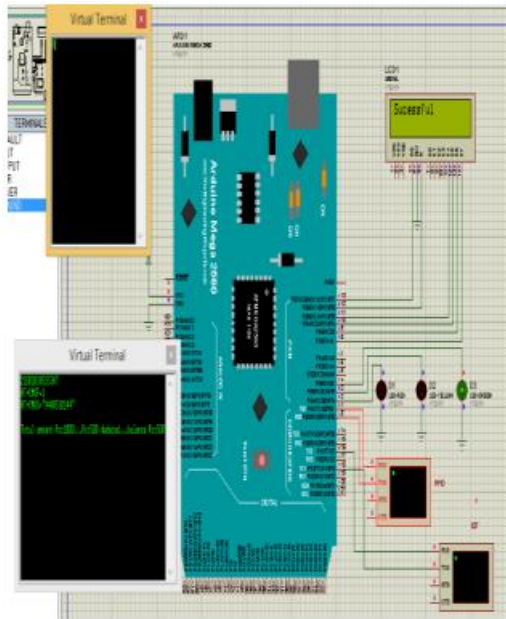


Figure 4: Connection diagram of the Proposed Automatic Toll Collection System

When the RFID reader reads the signal, from the Tag the respective toll amount will be deducted from the recharged amount, when the amount is deducted the system sends the message to the users registered mobile number about payment details. When vehicle approaches near the toll plaza, the user has to display the RFID tag to the RFID reader, which reads the information from the card. The amount will be deducted and the vehicle will be allowed to pass.

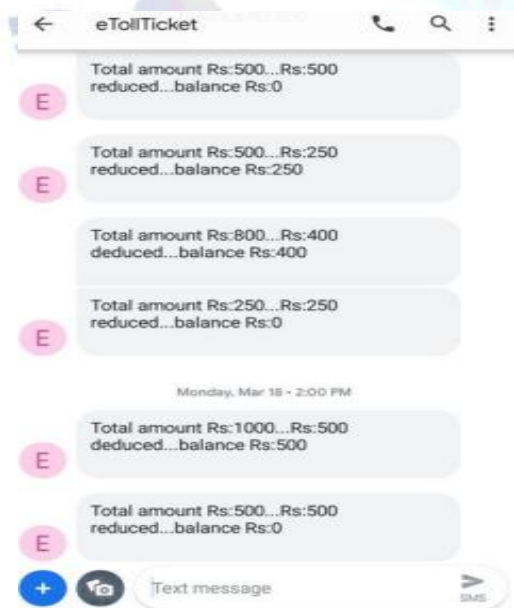


Figure 5: Message sent to the users registered

Designed a system to give complete solution for traffic and transport related problems such as Toll gate control, traffic signal control, traffic rules violation control, parking Management and special zone alert using the latest RFID technology. It is proposed as a low cost optimized solution using RFID and GSM mobile technology. At the toll plaza, there will be a large LCD screen for displaying details of the transaction.

5. CONCLUSIONS

Here we have tried to analyze some of the current RFID and GSM technology, toll collection systems and their practicality. All system tries to reduce the traffic overheads at toll plaza. This system includes some of the benefits to both toll authorities and facility users in terms of time and cost saving improved security and high capacity. Today transportation is the major contributor to the nation's economy. IoT Toll Collection systems are aimed at automating the toll plazas so as to maintain fairness in the transactions during toll collections. Every industry has its different method of transportation to reduce excessive costs spent on transportation. thus, providing good quality transportation will significantly contribute to better economy and productivity.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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