International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 58-61 June 2018-Dec 2018 www.csjournals.com

Implementation of Vehicle Authorization at the Toll Collection Using Raspberry Pi

[1]Nageswara Rao Regulagadda, [2]P. Sumana
[1]Assistant Professor, [2]M.Tech. Scholar
Vidhya Jyothi Institute of Technology, Hyderabad, Telangana-500075, INDIA

Abstract: In this project we address the problems faced attoll plaza & also introduce identification system for vehiclesagainst which stolen and accident cases are registered usingRFID. The owner has to create an account through mobileapplication & register his RFID tag. When vehicle passesthrough Toll Collection Unit (TCU) it is classified as passengeror goods carrying vehicle based on its Unique IdentificationNumber (UIN). A goods vehicle is weighed at TCU & if it isoverloaded then charged with extra tax. UIN is passed toCentral Server Unit (CSU) where the balance gets deductedfrom account. Once the balance is deducted at CSU it willindicate TCS to open the barricade and vehicle is allowed topass. If vehicle is detected to be stolen at CSU it will indicateTSC not to open the barricade. Also to overcome the problemof hit & run cases collision detection mechanism isimplemented using piezoelectric sensor in vehicle to identifyRFID of collided vehicles. These details can be used for furtheraction.
Keywords:RFID, IR Sensor, Weighing Sensor, PiezoelectricSensor.

I. INTRODUCTION

In our daily life we often visit toll plaza. At toll plazawe face the problems like congestion, wastage of time andfuel. To overcome the above problems it is necessary tospeed up the process at toll plaza. Hence to overcome theproblems faced at toll plaza we use RFID based tollcollection system. The processing time require for RFIDToll Collection System is much less than manual tollcollection system. Manual toll collection system also leadsto human errors which may lead to incorrect toll collection.We also often get to hear that the number of hit and runcases is increasing day by day. It may even leads to loss oflife. It is difficult to apprehend the culprit in hit and runcase. It is observed that when the vehicle is stolen it is verydifficult to track the vehicle. It is very necessary to controlthese above problems. So, the system also has an additionalfeature of detecting the vehicles against which stolen andaccident cases are registered. It is observed that overloadingthe vehicles may lead to accident and also damage the roads.This problem is also address in system by weighing goodscarrying vehicle and charge them with extra toll if it isoverloaded so that they will not overload again. System alsomakes payment system easy by making all transactiononline using mobile application. In this paper weaccomplish work of vehicle identification during collisionby exchanging RFID numbers, which will help to find theculprit in hit and run cases.

This paper is organized as follows. Section II consistsof literature survey. In this field III, components to be usedare specified. Section IV describes system model anddetailed working of system. In Section V, we have shownexperimental result to evaluate our proposed system.Section VI provides conclusion. Section VII givesinformation of future work.

II. LITERATURE SURVEY

A research in field of application of RFID system isincreasing on huge scale. The main reason for such a hugeappeal for RFID is low cost and low maintenance of RFIDsystem. Some of the existing applications of RFID systemare logistic and supply chain visibility, item level inventorytracking, manufacturing, access control, animal tagging,library system, real time location system, etc. The RFIDsystem is also used in toll collection system followingsystems gives detailed scenario. In [5] the system comprises
of toll collection unit, when vehicle arrives at toll plaza aRFID number of tag is detected and toll amount is deducted
from corresponding user account then the vehicle is allowed
to pass. In [4] 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 oftransaction and balance left in account is sent on usermobile using GSM module, so that user has a valid proof of
transaction. In [1] system comprises of toll collection unitand stolen vehicle detection mechanism. In this systemwhen vehicle arrives at toll plaza it checked whether vehicleis stolen or not. If it is found to be stolen information isforwarded to owner. Otherwise balance is deducted fromuser account and vehicle is allowed to pass. In [3] theautomation of toll plaza has been done based on imageprocessing.

ANPR (Automatic Number Plate Recognition)system has been employed for detection of vehicle. Whenvehicle arrives at toll plaza a camera is used to capture theimage of number plate of vehicle. Once the image iscaptured ANPR system is use to extract the number ofvehicle. When the number is extracted a toll amount isdeducted from corresponding user account. In this systemRFID is not required, but system requires high installationcost.A number of automobile

International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 58-61 June 2018-Dec 2018 www.csjournals.com

companies are working todevelop efficient vehicle identification during collisionmechanism to detect the culprit in hit and run cases.Implementation of existing vehicle collision detectionsystem is expensive. Hence it is provided only for luxuryvehicles. In [7] the system use GPS and Zigbee module forvehicle identification during collision. When collisionoccurs vibration sensor placed in front of these vehiclessenses the vibration and gives alert to traffic police viaZigbee. In this case if culprit tries to escape withoutstopping, then vibration sensor in vehicle sendcorresponding location to traffic cops server via Zigbee.

III. COMPONENTS

A. RFID Tag

RFID tags are mainly classified as active tag andpassive tag. The active tags are one with internal powersupply. So it doesn't require any external source. PassiveRFID tags require an external power supply. In this systemwe use passive RFID tags as they cost less and partlymaintenance free. It is powered by using RFID readers.Here we use Class-0 Gen-1 RFID tags.

Fig. 1. RFID Tag.

B. RFID Reader

Reader uses electromagnetic fields to automaticallyidentify and track tags attached to objects. In this systemEM-18 reader module is used. It is a low cost low frequency(125 kHz) RFID reader.

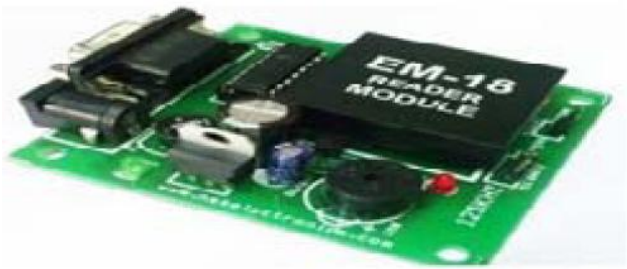

Fig. 2. RFID Reader.

C. Microcontroller

It is the most important component of our system allprocessing takes place in these block. It is use forsynchronization between all other components.ATmega328Pmicrocontroller is used in this system.Arduino Uno is used as development board for thiscontroller.

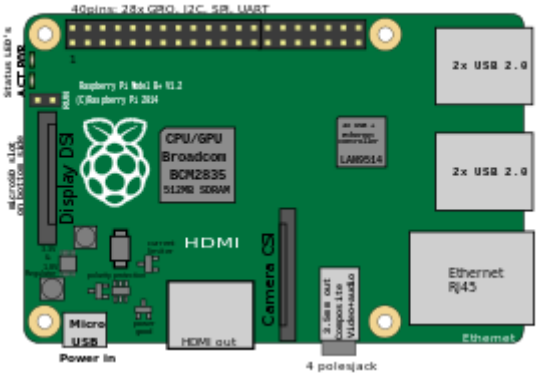

Fig. 3. Raspberry Pi.

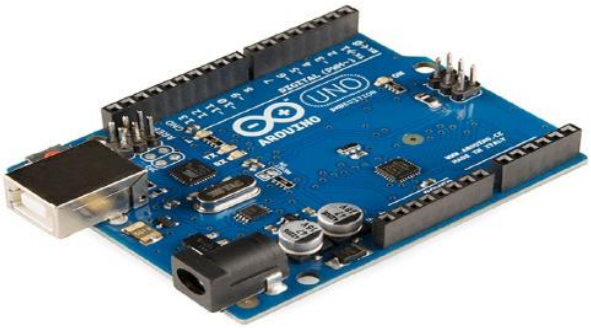

Fig. 4. Arduino Uno.

IV. SYSTEM MODEL AND WORKING

The system consists of mainly three units TCU,VCU and CSU. The TCU performs the work tollcollection and allows valid vehicles to pass. The VCUkeeps check that is only valid RFID can be used for tolltransaction. The CSU is used to keep the track oftransaction and also to declare that whether vehicle isvalid or invalid based on black list of vehicle store indata base. It is CSU which sends message to TCU thatvehicle is allowed to pass or not. Once the transactionof toll payment is completed the information is send onuser mobile application. The mobile application is useto deposit the amount in user account through onlinebanking. The whole system block diagram is asfollows

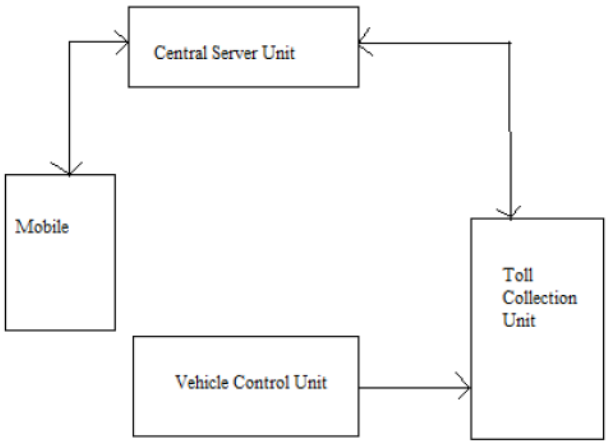

Fig. 5. System Model.

International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 10 • Issue 2 pp. 58-61 June 2018-Dec 2018 www.csjournals.com

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

A. Toll Collection Unit(TCU)

This unit consists of IR sensor to detect the entrance ofvehicle at toll plaza. RFID reader to read unique numberfrom RFID tag attached on vehicle. Weighing sensors areuse to weigh the goods carrying vehicle so that overloadedvehicles can be detected. Wifi module is used for internetcommunication between CSU and TCU. The mostimportant element used is microcontroller forsynchronization and control of other elements in TCS.

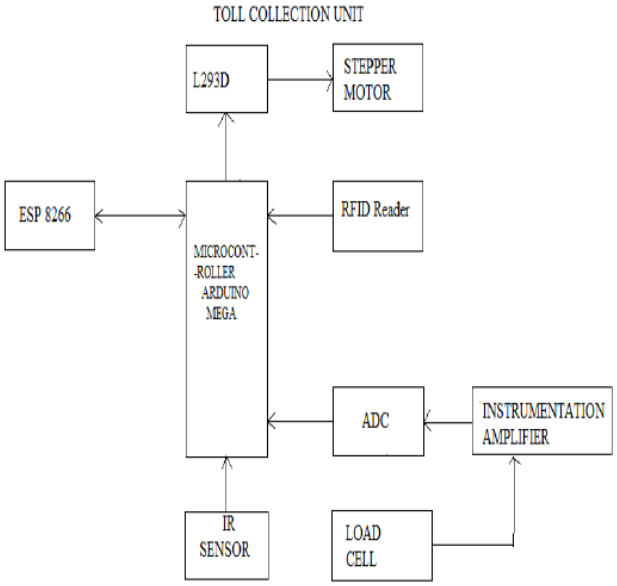

Fig. 6: Toll Collection Unit.

When vehicle enters the toll plaza, the IR sensor getsactivated when vehicle cuts the IR ray. The IR sensor thentriggers RFID reader to read the RFID tag attached onvehicle. RFID reader sends this RFID number tomicrocontroller. Based on this Unique ID the vehicles areclassified as goods carrying vehicle and passenger vehicles.When goods carrying vehicle is detected it is weighed. If itis found to be overloaded then it is charged with extra tax.Once the vehicle is weighed then based whether on it isoverloaded or not, the amount to be charged is decided.Further, the RFID number and amount to be deducted aresent to CSU. If vehicle is detected as passenger vehicle thenit is not required to be weighed. The RFID number andamount to be deducted from account is directly sent to CSU.

Once CSU receives RFID and amount to be deducted fromTCU it checks whether any stolen or collision case isregistered against that RFID. It also checks whether there isenough balance in account. If any case is registered againstvehicle or if there is not sufficient balance in users account,the CSU declares it as an invalid RFID. When balance is deductedfrom user account the information about account is sent touser mobile.

B. Vehicle Control Unit (VCU)

This unit consists of RFID reader and RFID card foreach vehicle to provide unique RFID number to eachvehicle. The system also consists of collision detectionsensor for sensing vibration during collision.

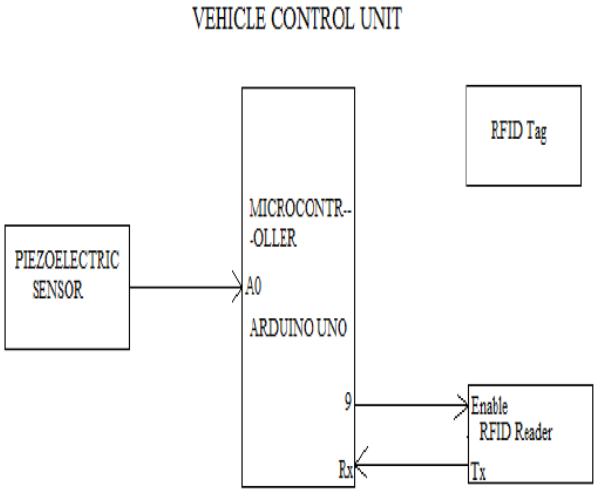

Fig. 7. Vehicle Control Unit.

Piezoelectric sensors are attached on the front part ofvehicle to detect vibration during collision. When collisionoccur two vehicles strikes collision sensors of oppositevehicles. This collision produce electrical signal inpiezoelectric sensors.

RFID reader. RFID reader reads the RFID of oppositevehicle. Hence both the vehicles exchange RFID numbersand store in controller. This information can be used byvehicle owner to register the case if required. Once the caseis registered, the vehicle is black listed in CSU. So thatwhenever culprit arrives at toll plaza central server unitsends message to TCU do not allow vehicle to pass.

C. Central Server Unit (CSU)

This unit consists of Central Processing Unit (CPU)which is use to store account information of user. GSMmodule is use to send balance deducted and remainingbalance on user's cell phone. So that user has information oftransaction done at toll plaza. Central Server Unit also keepsthe record of stolen vehicles and also vehicles against whichaccident cases are registered. Central Server Unit is also useto keep the record of online bank transaction of user andpayment transaction at toll plaza.

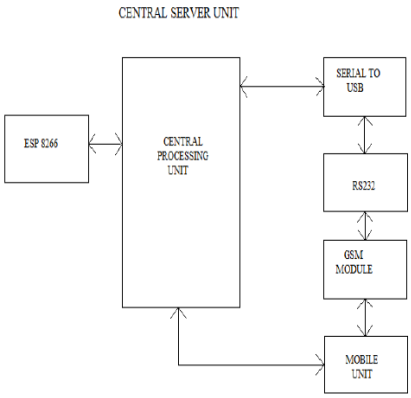

Fig. 8. Central Server Unit.

D. Theft Detection System

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

V. IMPLEMENTATION AND RESULTS

When vehicle with tag T1 (RFID Number-3E00677FAC8A) collides with vehicle with tag T2 (RFIDNumber-3E0067807DA4), the piezoelectric sensors of boththe vehicles will generate the voltage signal. This voltagesignal is sent on analog pin A0 of Arduino Uno. The voltagesignal received on analog pin of Arduino is read usingcommand "analogRead". This command activates ADC onArduino to give digital input to microcontrollerATmega328P. The threshold value of voltage signal is set to1Volt. If voltage exceeds this threshold value, themicrocontroller sets enable pin of RFID Reader high. Theenable pin of reader is connected to PWM pin 9 of Arduino.When A0 pin exceeds the threshold value, themicrocontroller will set duty cycle of PWM pin 9 to 100%(i.e. it gives +5V signal to enable pin of reader).

After collision vehicle with tag T1 stores the RFID ofvehicle with tag T2. Similarly aftercollision vehicle with tag T2 stores the RFID of vehicle withtag T1. Thus both the vehicles exchange RFID.

VI. CONCLUSION

"Vehicle detection during collision using RFID" part ofsystem implemented and tested. The RFIDs of vehicles areexchanged and stored in memory of VCU placed in the
vehicle. Hence it is easy to detect culprit in hit and runcases.

VII. FUTURE PLANS

In order to reduce the congestion and time wastage attoll plaza, the toll collection system is to be implemented.The theft detection system is to be implemented fordetection and tracking of stolen vehicles when it arrives attoll plaza. In order to make payment mode easy and also tokeep record of account on user side mobile applicationneeds to be develop.

VIII. REFERENCES

[1] N. Jeevagan, P. Santosh, R. Berlia, S. Kandoi, "RFID Based VehicleIdentification DuringCollisions" IEEE Global HumanitarianTechnology Conference 2014

[2] R. Kalantri, A. Parekar, A. Mohite, R. Kankapurkar, "RFID based tollcollection system," International Journal of Computer Science andInformation Technologies, Vol. 5 (2) 2014

[3] R.B. Takbhate,S.D. Chavan "Automated Toll Booth System,"International Journal of Research Studies in Computer Science andEngineering, Vol. 1 (3), July2014

[4] T.Aphale, R. Chaudhari, J. Bansod "Automated Toll Plaza UsingRFID and GSM" International Journal on Recent and InnovationTrends in Computing and Communication Volume: 2 Issue: 9,September 2014

[5] G.K. Andurkar, V.R. Ramteke,"Smart Highway Electronic TollCollection System," International Journal of Innovative Research inComputer and Communication EngineeringVol. 3, Issue 5, May 2015

[6] M.Rajeswari ,S.Chandana,D.VPruthvi, SarithaS.P,Ramya "CollisionDetection And Avoidance Using Intelligent Vehicle CommunicationProtocol," National Conference on Recent Advances in Information
& Communication Engineering (NCRAICE-2016)

[7] R.Aishvarya, S.Poornima, K.Pradeepa, T.Subashini4, K.P.Lavanya"Automatic and Effective Tracking of Hit & Run Misbehavior Driverwith Emergency Ambulance Support,"International Journal ofAdvanced Research in Electrical, Electronics and InstrumentationEngineering Vol. 5, Issue 3, March 2016.

GUIDE'S PROFILE:

Mr.NageswaraRaoRegulagadda. He has pursued her M.Tech in Embedded Systems. He is presently working as Assistant Professor of ECE DepartmentatVidhyaJyothi Institute of Technology. His areas of interest are mostly related to robotic arm, wireless surveillance protocols.

AUTHOR'S PROFILE:

Ms.P.Sumana has completed herB.Tech (ECE) from JoginpallyM.N.RaoWomens Engineering College, JNTU University,and Hyderabad. And she pursuing her Masters in Embedded Systems (ECE) from VidhyaJyothi Institute of Technology, Hyderabad. Herareas of interest are Robot Surveillance, Robotic Arm controlling, Wireless protocols.