

Advance Automatic Toll Collection & Vehicle Detection During Collision using RFID

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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 piezoelectric sensor in vehicle to identify RFID of collided vehicles. These details can be used for further action.

Keywords—RFID, IR Sensor, Weighing Sensor, Piezo-electric Sensor.

I. 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 leads 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. In this paper we accomplish work of vehicle identification during collision by exchanging RFID numbers, which will help to find the culprit in hit and run cases.

This paper is organized as follows. Section II consists of literature survey. In this field III, components to be used are specified. Section IV describes system model and detailed working of system. In Section V, we have shown experimental result to evaluate our proposed system. Section VI provides conclusion. Section VII gives information of future work.

II. LITERATURE SURVEY

A 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 [5] 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 [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 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 [1] 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 [3] 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

vehicle. 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.

A number of automobile companies are working to develop efficient vehicle identification during collision mechanism to detect the culprit in hit and run cases. Implementation of existing vehicle collision detection system is expensive. Hence it is provided only for luxury vehicles. In [7] the system use GPS and Zigbee module for vehicle identification during collision. When collision occurs vibration sensor placed in front of these vehicles senses the vibration and gives alert to traffic police via Zigbee. In this case if culprit tries to escape without stopping, then vibration sensor in vehicle send corresponding location to traffic cops server via Zigbee.

III. COMPONENTS

A. RFID Tag:-

RFID tags are mainly classified as active tag and passive tag. The active tags are one with internal power supply. So it doesn't require any external source. Passive RFID tags require an external power supply. In this system we use passive RFID tags as they cost less and partly maintenance 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 automatically identify and track tags attached to objects. In this system EM-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 all processing takes place in these block. It is use for synchronization between all other components. ATmega328P microcontroller is used in this system. Arduino Uno is used as development board for this controller.

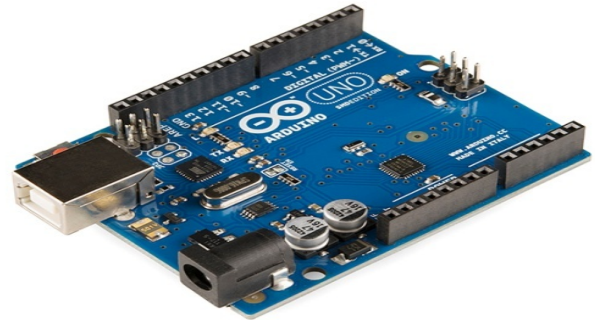


Fig. 3: Arduino Uno

IV. SYSTEM MODEL AND WORKING

The 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 as follows:-

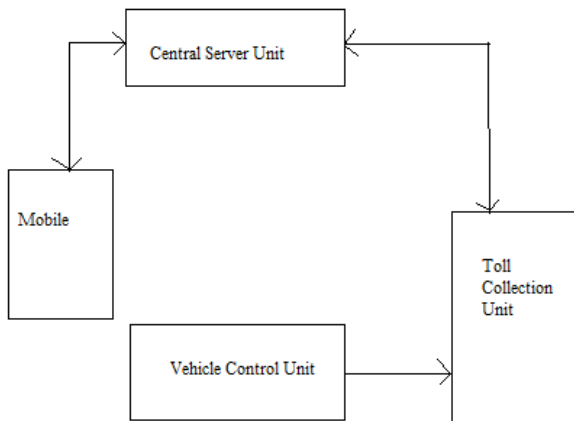


Fig. 4: System Model

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 of vehicle at toll plaza. RFID reader to read unique number from RFID tag attached on vehicle. Weighing sensors are use to weigh the goods carrying vehicle so that overloaded vehicles can be detected. Wifi module is used for internet communication between CSU and TCU. The most important element used is microcontroller for synchronization and control of other elements in TCS

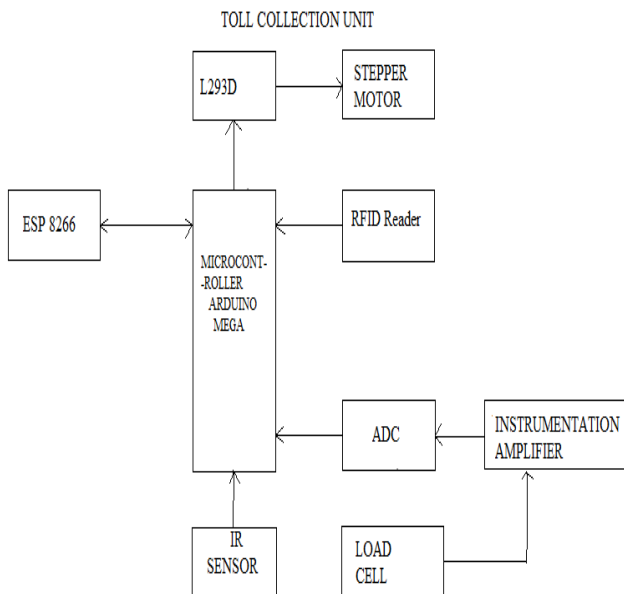


Fig. 5: Toll Collection Unit

When vehicle enters the toll plaza, the IR sensor gets activated when vehicle cuts the IR ray. The IR sensor then triggers RFID reader to read the RFID tag attached on vehicle. RFID reader sends this RFID number to microcontroller. Based on this Unique ID the vehicles are

classified as goods carrying vehicle and passenger vehicles. When goods carrying vehicle is detected it is weighed. If it is found to be overloaded then it is charged with extra tax. Once the vehicle is weighed then based whether on it is overloaded or not, the amount to be charged is decided. Further, the RFID number and amount to be deducted are sent to CSU. If vehicle is detected as passenger vehicle then it is not required to be weighed. The RFID number and amount to be deducted from account is directly 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.

B. Vehicle Control Unit (VCU): -

This unit consists of RFID reader and RFID card for each vehicle to provide unique RFID number to each vehicle. The system also consists of collision detection sensor for sensing vibration during collision.

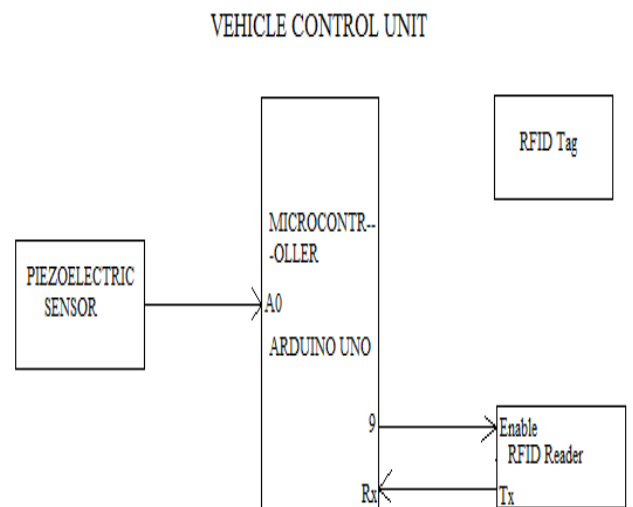


Fig. 6: Vehicle Control Unit

Piezoelectric sensors are attached on the front part of vehicle to detect vibration during collision. When collision occur two vehicles strikes collision sensors of opposite vehicles. This collision produce electrical signal in piezoelectric sensors. The piezoelectric sensor gives input to Arduino Uno on its analog pin. The Arduino then enable RFID reader. RFID reader reads the RFID of opposite

vehicle. Hence both the vehicles exchange RFID numbers and store in controller. This information can be used by vehicle owner to register the case if required. Once the case is registered, the vehicle is black listed in CSU. So that whenever culprit arrives at toll plaza central server unit sends 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. 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.

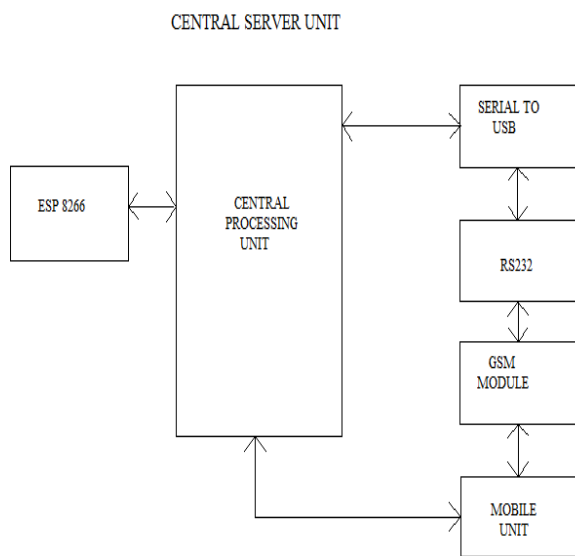


Fig. 7: Central Server Unit

D. Theft 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.

V. IMPLEMENTATION AND RESULTS

When vehicle with tag T1 (RFID Number-3E00677FAC8A) collides with vehicle with tag T2 (RFID Number-3E0067807DA4), the piezoelectric sensors of both the vehicles will generate the voltage signal. This voltage signal is sent on analog pin A0 of Arduino Uno. The voltage signal received on analog pin of Arduino is read using command “analogRead”. This command activates ADC on

Arduino to give digital input to microcontroller ATmega328P. The threshold value of voltage signal is set to 1Volt. If voltage exceeds this threshold value, the microcontroller sets enable pin of RFID Reader high. The enable pin of reader is connected to PWM pin 9 of Arduino. When A0 pin exceeds the threshold value, the microcontroller will set duty cycle of PWM pin 9 to 100% (i.e. it gives +5V signal to enable pin of reader).

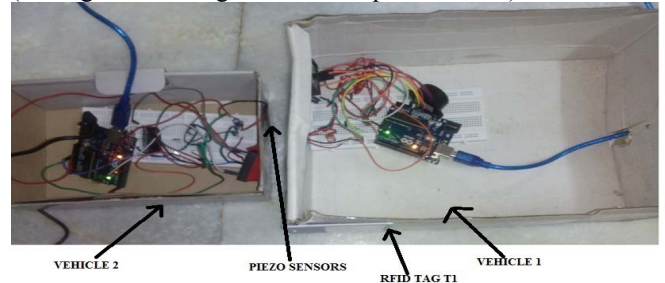


Fig. 8: Implementation of Vehicle identification during collision



Fig. 9: RFID stored in vehicle 1 after collision



Fig. 10: RFID stored in vehicle 2 after collision

When A0 pin does not exceed the threshold, microcontroller sets duty cycle of PWM pin 9 to 0% (i.e. it gives 0V signal to enable pin of reader). When enable pin of RFID reader is high reader gets activated and reads the RFID of opposite vehicle.

So, when collision occurs between vehicles with tag T1 and T2, RFID of both the vehicles are exchanged. As shown in Fig. 9, after collision vehicle with tag T1 stores the RFID of vehicle with tag T2. Similarly as shown in Fig. 10, after collision vehicle with tag T2 stores the RFID of vehicle with tag T1. Thus both the vehicles exchange RFID.

VI. CONCLUSION

“Vehicle detection during collision using RFID” part of system implemented and tested. The RFIDs of vehicles are exchanged and stored in memory of VCU placed in the vehicle. Hence it is easy to detect culprit in hit and run cases.

VII. FUTURE PLANS

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

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