AUTOMATIC TOLL COLLECTION SYSTEM USING RFID

[1]Satyasrikanth P, [2]Mahaveer Penna, [3]Dileep Reddy Bolla

[1,2,3] Assistant Professor, Department of Electronics & Communication Engineering Sri Venkateshwara College of Engineering Bangalore

[1] satyasrikanth123@yahoo.in, [2] mahaveer6017@gmail.com, [3] dileep.bolla@gmail.com

ABSTRACT- Automatic Toll Tax systems have really helped a lot in reducing the heavy congestion caused in the metropolitan cities of today. It is one of the easiest methods used to organize the heavy flow of traffic. When the car moves through the toll gate on any road, it is indicated on the RFID reader that it has crossed the clearing. The need for manual toll based systems is completely reduced in this methods and the tolling system works through RFID. The system thus installed is quite expedient reducing the time and cost of travelers since the tag can be deciphered from a distance.

Keywords: RFID, Card, Reader, Microcontroller, LCD

I. INTRODUCTION

As we all know that transportation is the backbone of any country's economy. Improvement in transportation systems result into the good lifestyle in which we achieve extraordinary freedom for movement, immense trade in manufactured goods and services, as well as higher rate of employment levels and social mobility. In fact, the economic condition of a nation has been closely related to efficient ways of transportation. Increasing number of vehicles on the road, result into number of problems such as congestion, accident rate, air pollution and many other. All economic activities for different tasks use different methods of transportation. For this reason, increasing transportation is an immediate impact on productivity of nation and the economy. Reducing the cost of transporting resource at production sites and transport completed goods to markets is one of the important key factors in economic competition. Automatic toll collection is a technology allows the automated electronic collection of toll costs.

As it is studied by researchers and also applied in various expressways, bridges, and tunnels require such a process of Automatic Toll Plaza. ATP is capable of determining if the vehicle is registered or not, and then informing the management center about to process violations, debits, and participating accounts .The most excellent advantage of this

ATP system is that it is capable of eliminate congestion in toll plaza, especially during those seasons when traffic seems to be higher than normal.

The Benefits of this System [1] are:
- Shorter queues at toll plazas by increasing toll booth service rates.
- Faster and more efficient service
- The ability to make payments by keeping a balance on the card itself and
- The use of postpaid toll statements
- Other general advantages include minimization of fuel wastage and reduced emissions by reducing deceleration rate, waiting time of vehicles in queue, and acceleration.

For Toll Operators, the benefits include:
- Lowered toll collection costs
- Better audit control by centralized user account
- Expanded capacity without building more infrastructures

Thus, the ATP system is useful for both the motorists and toll operators, this is the reason of extended use of ATP system throughout the world.

A. PURPOSE OF THE PAPER:

The base idea behind implementing RFID Based Toll System is to automate the toll collection process and their by reducing manual operation in toll booths and the long queues at toll booths using RFID tags installed on the vehicles. In addition to we can not only help the vehicle owners and system administrators from vehicle theft detection but also can track over speeding vehicles, and crossing the signals. Here we are going to see some points regarding to purpose behind choosing this topic & what is the requirement of this type of the project in our day to day life.
- Avoid the fuel loss.
- Saving of time in collecting toll.
- Avoid financial loss.
- To monitor the traffic.

According to the survey of Karnataka Government, in Sept.2012 they have proposed to get the annual toll collection about 2500 crores/year .But in the present situation they are able to collect only 900 crores of the toll value. Means there is loss of 600 crores due to human errors. So, in this situation we have to control this leakage.

Now the present system we have with us on the high ways takes 1 minute to complete the toll collection process for one vehicle. With this automatic process, it will take just less than a minute. to complete the whole process.

As there is reduction in time for completion of the process so indirectly there will be no traffic as such & as there is no traffic so no fuel wastage takes place & the purpose of designing the highways is achieved i.e. reduction in journey time & also the money loss will be reduced.

II.   BACKGROUND OVERVIEW

A. Existing System

There are two methods of collecting tax presently used they are First is the traditional manual method where one person collects money and issues a receipt. The other one is the Smart Card method where the person needs to show the smart card to the system installed at the toll tax department to open the Gate.

B. Drawbacks of Existing System
Both the above mentioned method for collecting tax is time consuming method. Chances of escaping the payment of tax are there. It leads to queuing up of following vehicles.

C. History of Automatic Toll Tax:
Design and development of a "RFID Based Automatic Toll Plaza" which is based on microcontroller, RFID technology and load cell to save the time at toll plaza and having cashless operation

As the name implies "RFID Based Automatic Toll Plaza" the key theme of our project is the automation. So here we will just take the overlook of what is mean by Automation. In simple words the Automation means the human being from the process with the machines.

Before going further we just take the overlook of history of the toll plazas. So before the 90's decade the toll plazas were fully manual controlled. Means there are total four people for operating the Toll gate in this two people will be used for opening & closing of the gate & another two are for reception of the money & data keeping etc.

Semi Automatic Toll plazas were launched after the introduction of Express ways in 1995, in which data is stored in computers and gate operation is automatic, only two personals are required for single booth. But here we are going to see the human less toll plaza.

Active wave Inc [2] has currently deployed a system of active tag vehicle monitoring solution. Active wave vehicle products have a range of 30 meters and operate in the 916 – 927 MHz for the transmit operations and 433 MHz for the receive link. Active wave products are currently equipped with 256 Kbits of fixed memory. The tag is powered with a replaceable 3V battery and the total weight is 14 grams. Elementary signals are shown with the help of blinking LEDs and beeping sounds. Smart key Access Control Systems [3] have a client – server model based system with an SQL server handling multiple vehicle monitoring systems. They have designed a user interface using the Microsoft .NET Framework. Smart key also operate in the 900MHz band but have a small range of 30 meters. RFID based toll collection system [1] uses active

RFID tag which uses car battery power. The implementation is divided into the design of two modules- the Vehicle Module (Active Tag) and the Base Module. The two modules communicate via RF modem connected to each module. These RF modules communicate over the ISM Frequency Range of 902 – 928 MHz.

III. PROPOSED SYSTEM

This project gives the simplified procedure to passengers to pay toll at toll booths by making them automated, vehicle theft detection, signal breaking avoidance, tracking over speed vehicles. All these activities are carried using single RFID tag thus saving the efforts of carrying money and records manually [5].

A. Automatic Toll Collection: The RFID Readers mounted at toll booth will read the prepaid RFID tags [4] fixed on vehicles' windshield and automatically respective amount will be deducted. If the tag is removed from the windshield then cameras fixed at two sites at toll plaza take snaps of the front and back number plate. Since every vehicle registration ID is linked to users account, toll can be deducted from the account bank directly.

B. Vehicle Theft Detection: When vehicle is stolen the owner registers complaint on the website with its registration ID and unique RFID tag number. Now when stolen vehicle passes by the toll plaza, the tag fixed on it is matched with the stolen vehicle's tag in the database at the toll booth.

C. Signal Breaking Avoidance: The vehicle ignoring the traffic signal will be detected by the RFID readers fixed at signal crossing and will be notified to the traffic police. This can be done efficiently and great accuracy.

D. Tracking Over speeding Vehicle: Vehicle travelling above speed limit can be tracked with 100 % accuracy.

Figure 1: The Proposed System of RFID toll tax

The following are the major advantages over current system...
- Automatic collection of toll tax.
- Free flow of traffic.
- Time saving.
- Record maintenance.
- Problems with pursuing toll evaders.

IV.   METHODOLOGY

Flow of RFID based toll tax are:
- ➢ Detection of vehicle
- ➢ Weighing of vehicle
- ➢ Display of toll
- ➢ Payment through RFID card

Whenever any person buys a vehicle, first he/she need to do her vehicle registered at the RTO office. RTO people will assign a number plate to it along with it they will give a RFID enabled tag. This card will have a unique ID feasible to use with that vehicle only. They will also create an account for that particular smart card and maintain transaction history in database. Owner of the vehicle needs to deposit some minimum amount to this account.

Every time a registered vehicle approaches the toll booth, first the Infrared sensors will detect the presence of the vehicle which   in turn activate the RFID circuit to read the RFID enable smart card fixed on the windscreen of the vehicle. Transaction will begin, depending upon the balance available toll will be deducted directly or the vehicle will be directed towards another lane to pay tax manually. The software further updates the details in the Centralized database server. It also triggers mechanism to generate the bill and will be sent to user as a text message [7].

On the other hand, whenever any vehicle owner registers a complaint at the RTO office regarding theft of the vehicle respective entry is made in the database. Now any vehicle arriving at toll booth with same ID as already present in stolen vehicle category will be easily identified as the ID assigned with it is unique.

All the toll plazas will be connected to each other along with the centralized server in the form of LAN. Updates of any sort of transaction will be immediately updated to local database and centralized server.

V.   BLOCK DIAGRAM

The following are the brief explanations of the working principle of the various major blocks or sections used in the system
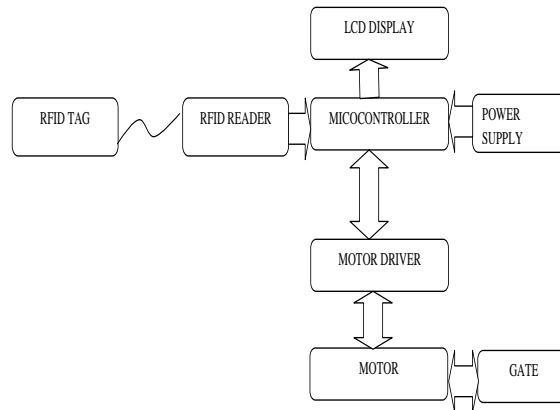

Figure 2: Block Diagram of RFID toll tax

- **RFID card:** This is one of the most important part of the project. RFID cards are used for applications as access control in security system, cashless payment etc.

- **RFID reader:** A RFID reader is a device which is used to interrogate an RFID tag. It reads the unique number from the RFID cards and sends it to the microcontroller.

- **Microcontroller:** The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 4K bytes of In System Programmable Flash memory. The device is manufactured using Atmel's high-density nonvolatile

memory technology and is compatible with the industry- standard 80C51 instruction set and pin out. Microcontroller is the heart of the complete system. It is actually responsible for all the process being executed. It will monitor & control all the peripheral devices or components connected in the system. In short we can say that the complete intelligence of the project resides in the software code embedded in the Microcontroller. The controller here user will be of 8051 family. This unit requires +5VDC for it proper operation. Microcontroller is the CPU of our project. The various functions of microcontroller are:

➢ Reading the RFID card number from the RFID reader.
➢ Sending this data to the LCD so that the person operating this project should read various informative messages.
➢ Sending the data to the motor or buzzer depending upon the RFID card number and balance inside the car.

• **LCD:** It is called Liquid Crystal Display. We are going to use 16x2 character LCD. This will be connected to microcontroller. The job of LCD will be to display all the system generated messages coming from the controller. LCD will provide interactive user interface. This unit requires +5VDC for it proper operation. This module is used for display the present status of the system.

• **Power Supply:** This unit will supply the various voltage requirements of each unit. This will be consists of transformer, rectifier, filter and regulator. The rectifier used here will be Bridge Rectifier. It will convert 230VAC into desired 5V/12V DC.

• **Motor driver:** Motor driver is an IC which is used to drive the motor.

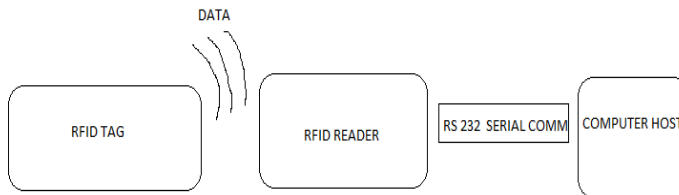• **DC Motor:** Motor is used to open the gate.

VI.   IMPLEMENTATION

Figure 3: Hardware Assembly

EM-18 RFID CHIP

Figure 4: EM-18 RFID Reader Module

Table 1: features of RFID chip EM-18

RF transmit frequency	125KHz
Supported standards	EM4001 64-bit RFID tag compatible
Communications Interface	TTL Serial Interface, Weigand
output Communications Protocol	Specific ASCII

Communications Parameter	9600 bps,8,N,1
Power Supply	4.6V-5.5V DC +/- 10% regulated
Current Consumption	50mA<10mA at power down mode
Reading	Distance Up to 100mm , depending on tag
Antenna Integrated Size(L*W*H)	32*32*8mm

RFID based toll collection system is used as a technology for fast and efficient collection of toll at the toll booths. This is possible for the vehicles passing through the toll plaza need not stop to pay toll and the payment automatically is deducted from the account of the driver. The electronic toll lanes are setup with special antennas that will send out signals continuously. These signals are used to identify the vehicles that travel through them. To use the electronic toll facility the drivers need to setup an electronic transponder (tag) fixed in the vehicle. These transponders (tags) are fitted on the windshield of the vehicle [6]. The tags have all the information regarding the users account. The antennas continuously send   radio frequency pulses which returns only when hits a tag. These pulses are returned back from the tag and are received by the antenna. These reflected pulses from the tags contain information about the driver number, drivers account, balance etc. After encrypting the contents of this pulse the unit uses cellular modems or wireless transmitters to send it off to a central location where computers use the unique identification number to identify the account from which the cost of the toll should be deducted.

The main system components are as follows:
1) RFID tagged vehicle
 2) Toll booth equipped with RFID scanners
 3) Vehicle registration plate
 4) Centralized database
5) Cameras
6) Laser transponders

These components of the RFID based toll collection system technology work as follows:

1. Automatic Vehicle Identification -- The automatic vehicle identification (AVI) component of this system refers to the technologies that determine the identification or ownership of the vehicle so that the toll will be charged to the corresponding customer.

2. Automatic Vehicle Classification -- Vehicle type and class may have differentiated toll amount. The vehicle type may include light vehicles like the passenger car or heavy vehicles like recreational vehicles. A vehicle's class can be determined by the physical attributes of the vehicle, the number of occupants in the vehicle, the number of axles in the vehicles and the purpose for which the vehicle is being used at the time of classification

3. Video Enforcement Systems -- When used for electronic toll collection, the video enforcement system (VES) captures images of the license plates of vehicles that pass through an electronic tollbooth without a valid electronic tag. Although the deployment of these technologies makes the initial cost of installation very high, but there exits huge benefits accompanied with such high investment. These benefits are discussed in the upcoming section [7].

Flowchart1: Working of the RFID based toll collection system
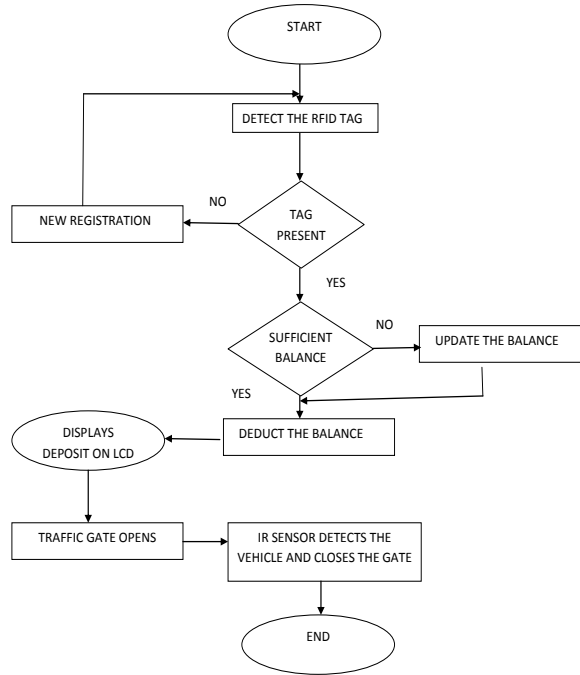
VII.   CONCLUSION

The Electronic Toll Collection system in expressway based on RFID, a design scheme was put forward. It is low cost, high security, far communication and efficiency, etc. It not improve the passage ability of expressway but also improve the technology level of charge. Electronic toll collection system using RFID is an effective measure to reduce management costs and fees, at the same time, greatly reduce noise and pollutant emission of toll station. In the design of the proposed Electronic toll collection (ETC) system, real time toll collection and anti-theft solution system have been designed. This reduces the manual labour and delays that often occur on roads. This system of collecting tolls is eco-friendly and also results in increased toll lane capacity. Also an anti-theft solution system module which prevents passing of any defaulter vehicle is implemented, thus assuring security on the roadways.

REFERENCES

[1] RFID based toll collection system 2011 IEEE third international Conference

[2] ActiveWaveInc. http://www.activewaveinc.com

[3]Smart key Access Control System http://www.smartkey-rfid.com

[4] D. M. Grimes and T. O. Jones, ―Automotive radar: A brief review, Proc. IEEE, vol. 62, no. 6, pp. 804–822, Jun. 1974.

[5] D. M. Grimes and T. O. Jones, ―Automotive radar: A brief review, Proc. IEEE, vol. 62, no. 6, pp. 804–822, Jun. 1974.

[6] Liu Bin, Lu Xiaobo and Gao Chaohui. ―Comparing and testing of ETC modes in Chinese freeway. ‖ Journal of Transportation Engineering and Information, 5(2), 2007, pp.31-35.

[7] A Novel Chipless RFID System Based on Planar Multiresonators for Barcode Replacement Stevan Preradovic, Isaac Balbin, Nemai C. Karmakar and Gerry Swiegers2008