

# Electronic Toll Collection System Based on ARM

Amol A. Chapate, D.D. Nawgaje

**Abstract-** *The traditional manual toll collection is not efficient over highway transportation in modern road network thus to collecting the toll and traffic management we introduce a new system with advance technology is electronic toll collection(ETC). In this paper a system uses the radio frequency identification technology (RFID), GSM, ARM7 LPC2148 and computer host. The RFID is used to access the vehicle information, RFID tag with a unique id is mounted on each vehicle, information contain on the tag is read by RFID reader placed at toll gate. If the vehicle belongs to the authorized person or registered, a predetermined amount is automatically deducted from its account, message will send to register mobile number and automatically opens the toll gate. All vehicle information that passing the toll booth store in database for future reference. It also consist stolen vehicle directory if that match with incoming vehicle then and message will send to registered police station. The proposed system eliminate the manual cash handling, increase efficient toll collection by reduce traffic congestion at toll plaza and help in lower fuel consumption.*

**Keyword-** *Electronic toll collection, RFID, GSM.*

## I. INTRODUCTION

Now a day's highway plays a vital role in social and economical development, with a development of economy the growth of highway becoming faster. Number of vehicle passing through the toll plaza, a manual system is time consuming thus there is a long queue of vehicle to pass the toll plaza. To overcome the problem of manual toll system we propose an electronic toll collection system. It is a technology for collection of toll should be such as to ensure smooth flow of traffic in efficient and faster way.

Electronic Toll is an element of Intelligent Traffic System which allows nonstop toll collection as well as continuous monitoring of traffic. Electronic toll system utilizes vehicles equipped with electronic tags, wireless communication, inroad/ roadside sensors and a computerized system to uniquely identify each vehicle which electronically collect the toll and provide traffic monitoring and data collection.

Functioning of electronic toll collection allow more efficient electronic monetary transaction to take place between a vehicle and toll agency.

*Manuscript received*

*Amol A. Chapate, PG Student, Electronics and Tele Communication Engineering, SGBAU University/ Shri Sant Gajanan Maharaj College of Engg. Shegaon, MH, India. (e-mail: amolchapte@gmail.com).*

*D.D.Nawgaje, Assisant Prof., Electronics and Tele Communication Engineering, SGBAU University/ Shri Sant Gajanan Maharaj College of Engg. Shegaon, MH, India. (e-mail: dnawgaje@gmail.com).*

The fact that drivers need not to carry any cash is one of the main reasons why electronic tolling system is becoming

popular. There are many benefits of using Electronic Toll Collection namely; reduce time, reduction in vehicle emissions, increase in lane capacity and convenience to the users. ETC also helps in controlling the level of congestion with more accuracy, by allowing the road users to use dynamic pricing instead of fixed-step toll schedule. Most importantly, the system allows non-stop service to the road users without bothering about toll rates or money change, same tag is read at toll plaza on all the Highways across the country and we save paper as well as fuel.

Electronic toll collection utilizes radio frequency identification (RFID) technology. It contains RFID tag and transceiver, tag can be either active or passive and each tag has a unique identity number. Active tag has their own internal power supply allow a large range, while passive tag use incoming signal from reader thus have a shorter range. Reader contain antenna to transmit and receive signal from each tag. The tag which is sticked at the front glass of the vehicle is detected by the RFID reader and data is matched with the database provided at every toll booth, toll amount is deducted from his account, immediate gate is opened and message will be send to registered mobile number. User can recharge his account at any time. There is another facility of detection of stolen vehicle, database contain stolen directory in which stolen vehicle tag number is stored by the authority, when incoming vehicle data is matched then transaction will proceed and immediately message will send to registered police station, it is another advantage of this system.

## II. BACKGROUND OVERVIEW

### A. Existing system

There are two toll collection system are exist: All vehicle has to stop at toll plaza along the highway to pay the toll, one person collect the money and issue a receipt, after which gate is opened either mechanically or electronically for the driver to get through the toll plaza. Another is smart card system in which driver show a smart card to access the data to the system installed on toll plaza to pass.

### B. Drawback of existing system

The above system for collecting toll tax is time consuming method; there is long queue of vehicle at toll plaza chances of escaping the payment of toll tax.

## III. PROPOSED SYSTEM

The system is simple in construction; provide automatic toll collection and vehicle theft detection. A RFID tag is

mounted on each vehicle with unique ID. This ID is invisible on tag, it contain all the information about the vehicle and owner. When vehicle reach at toll plaza tag will emit the radio wave signal. RFID reader receives the signal from tag, decode that signal and send to ARM controller. The controller will display the vehicle number and amount on LCD. Microcontroller is interface with computer host to collect the vehicle data through serial port for future use. When access form database it shows all the vehicle details on computer screen such as ID, vehicle number, date, time. Microcontroller check the balance if sufficient balance deduct predetermined balance from prepaid account and update the balance in that account, message will send to vehicle owner by using GSM modem.

If the vehicle is stolen the vehicle owner register his complaint to police station, only authorized person update it on website with registration ID and RFID tag number. When vehicle passed by toll plaza every vehicle tag number is compare with stolen vehicle tag number in database at toll plaza if it is matched buzzer will be alarm and message will send to registered police station.

IV. HARDWARE DESIGN

Block diagram of electronic toll collection using RFID technology is as shown in Fig 1. A GSM module is interfaced with ARM controller which will send message to car owner regarding less balance or deduction balance. RFID reader decodes the data and sends to controller, PC is act as a database and LCD display the status of transaction.

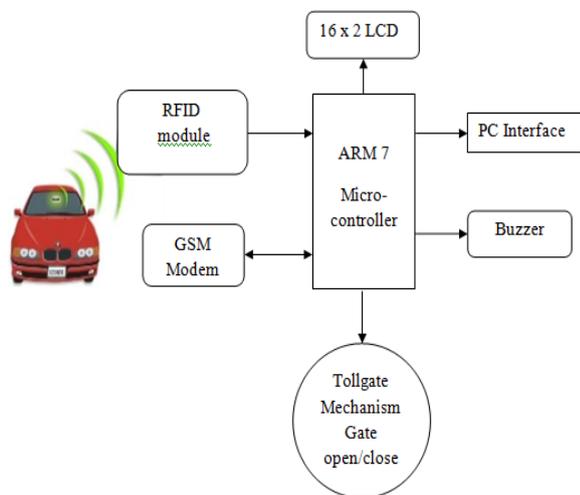


Fig 1: Block Diagram of ETC

V. RFID TECHNOLOGY

RFID (Radio frequency identification technology) used for automatic identification and tracking of the people or object, it contain tag and reader. Data contained on a tag is scan by reader and send to controller.

A. RFID Tag

RFID tag has two types: passive and active tag. Passive tags require no internal power source; they are active only when a reader gives power to them, the small electrical

current induced in the antenna by incoming radio frequency signal provides enough power for the tag to send the signal. Whereas active tags use a power source in terms of small battery, which is used to power the integrated circuits and broadcast the signal to the reader. Active tags are typically much more reliable because it is used for longer distance than passive tag. The RFID tag is as shown in Fig 2.

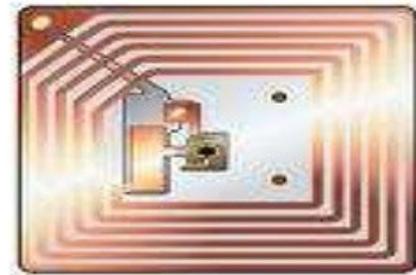


Fig 2: RFID Tag

The tag is attached or embedded in an object to be identified, RFID tag or transponder consist chip and antenna. A unique serial number that identifies a person or object store on a microchip that is attached to an antenna. The combined antenna and microchip are called as "RFID transponder" or "RFID tag" and work in combination with an "RFID reader". Antenna attached to chip transmits the information from chip to the reader using radio frequency. Tag classified based on memory, it can be read-only, read-write, or write once read-many. The passive tags do not transit its data until it will active by the reader, the reading distance is much shorter than with active tags. However, active tags are typically larger, more expensive, and require occasional service.

B. RFID Reader

The RFID Reader Module is designed specifically for low-frequency (125 kHz) passive tags. RFID reader as shown in Fig 3.

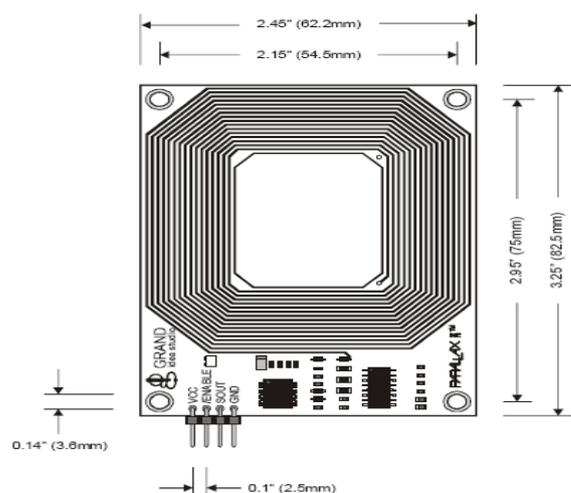


Fig 3: RFID Reader

Reader is the device that scans the tag and decodes the received data, which is used to convert the received radio signals of a particular frequency into the digital form usage by the controller and data passed to host computer. This reader has on-chip power supply. It incorporates energy

transfer circuit to supply the transponder. Readers can process multiple items at once, allowing for increased read processing times. The RFID tag can be affixed to an object and used to track and manage inventory, assets, people, etc. The tag can be read inside a case, carton, box or other container.

The module used has following salient features.

- 1) Fully-integrated, low-cost method of reading passive RFID transponder tags.
- 2) Single-wire, 9600 baud Serial TTL interface to PC and other processors.
- 3) Requires single +5V DC supply.
- 4) Bi-color LED for visual indication of activity.

### VI. GSM MODEM

GSM is the global system mobile communication which is very simple to serial interface. The GSM modem is shown in Fig 4. The standard RS232 interface used to interface the modem to microcontroller and computer, which control the modem to send SMS, make call and receive calls, and other GSM operation. SIM300 GSM modem with power regulation, external antenna, SIM holder, etc.



Fig 4: GSM Modem

#### A. Features

- 1) High Quality Product
- 2) Quad-Band GSM/GPRS
- 3) Built in RS232 Level Converter (MAX232)
- 4) The SIM300 allows an adjustable serial baud rate from 1200 to 115200 bps (9600 default)
- 5) Built in SIM Card holder.
- 6) Most Status & Controlling Pins are available at Connector
- 7) Normal operation temperature: -20°C to +55°C
- 8) Input Voltage: 5V-12V DC.

### VII. OPERATIONAL FLOW CHART of SYSTEM

#### A. Flow chart of Electronic Toll Collection System using RFID.

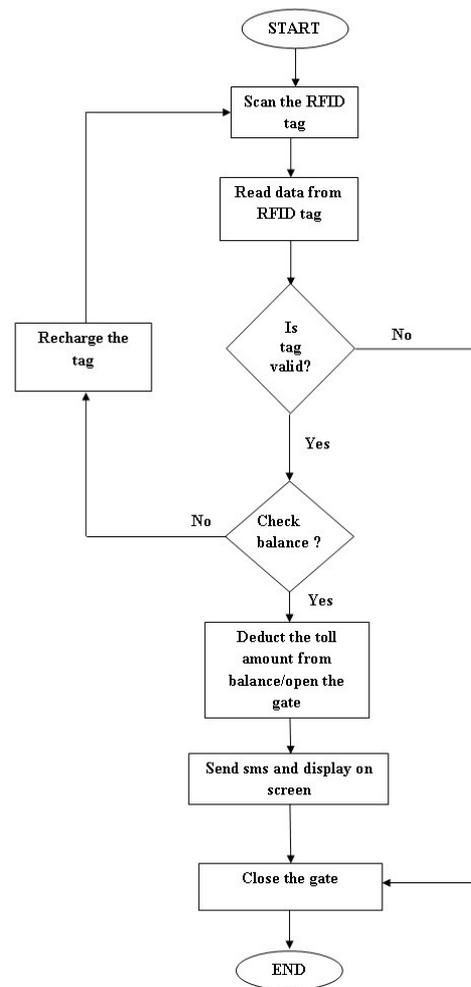


Fig 5: Flow chart of ETC System

#### B. Flow chart of ETC for detection of Stolen Vehicle.

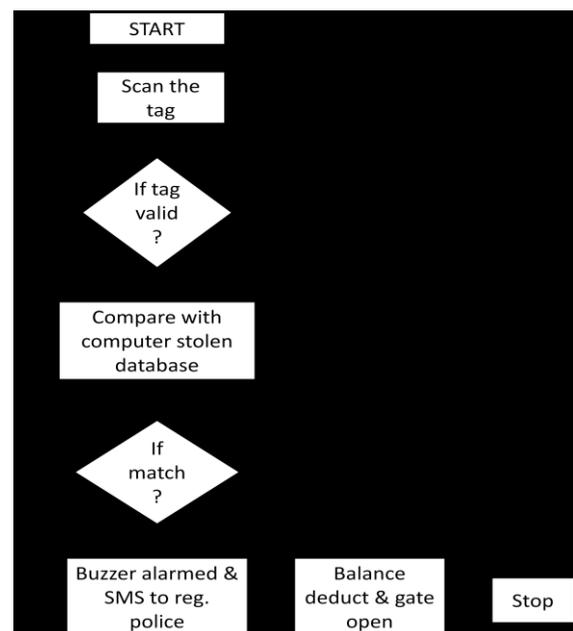


Fig 6: Detection of Stolen Vehicle at Toll Plaza

## VIII. SCOPE &amp; APPLICATIONS

The scope and application of system is as follows:

- 1) Automated Vehicle Identification.
- 2) Automated Vehicle Classification.
- 3) Transaction Processing (Toll Calculation).
- 4) Can be used to trace the vehicle if this system is centralized.
- 5) Parking system.

## IX. CONCLUSION

In this article, we have discussed about Electronic toll collection using RFID technology. RFID is a highly stable and reliable technology. The RFID automatically detect the identities of the vehicles, reading items in motion and tracking of the vehicles can be done accurate. With the elimination of human interaction in the entire toll collection process and also reduction of time at toll plaza, we can create a better ETC system to be implemented. It can also significantly improve the efficiency of toll stations and the traffic solution of the toll road. RFID technology can provide new capabilities as well as an efficient method to collect, manage, disseminate, store, and analyze information. It also eliminates manual data entry, system improves the better management, leading to lower operational costs and increased revenue generation.

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