

Automated Toll Plaza System Using Radio Frequency Identification Device (RFID) on Highways

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Abstract: It Is Based On Automatic Toll Collection Sysyem Wherein User Doesnot Have To Pay Toll By Cash, User Has To Purchase Etc Tag From Designated Counters And Get It Fixed On Vehicle, Tag Will Act Like A Prepaid Card Wherein User Has To Recharge The Same To Ensure Sufficient Balance, As And When Vehicle Passes Through The Etc Lane On Toll Plazas, The Balance Will Be Automatically Deducted From Card And User Need Not To Stop His Vehicle Since After Deduction Of Money From Certain Length, The Traffic Barrier Will Automatically Open Thus Allowing User To Avoid Waiting In Long Queus Which In Turn Saves The Fuel As Well As Time Of User

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I. Introduction

Electronic toll collection (ETC) is a technology enabling the electronic collection of Toll Payments, it has been applied to Few Highways and Expressways for faster toll collection and reduced traffic congestion, The current system of collection of Toll is on basis of manual transaction, Each vehicle has to stop at Toll Plaza for payment thus causing Traffic Jams, Increase in pollution and wasting of precious time of Motorist but the advantage of ETC technology is that it eliminates congestions near Toll Booth, An Radio Frequency Identification (RFD TAG) is installed on each vehicle with Read/Write Memory, As The vehicle approaches near the Toll system, the computerized units placed near toll plaza in dedicated ETC lane receives the identifier signal and calculates the toll to be debited and electronically debits the toll on the account of the particular vehicle enrolled in the program.

Main Advantages of RFID Technology

- Reduce time for collection of Toll at Toll Plaza
- Smooth traffic flow at toll gates
- Reduction of Management costs
- The well timed notification to Users Via the Push notification that informs them about their current account status
- Minimizes Air Pollution

Charles Walton is known as the first patent holder for the RFID Device. Many individuals contributed to the invention of the RFID, but Walton was awarded ten patents in all for various RFID-Related devices, including his key 1973 design for a 'Portable radio frequency emitting identifier' this patent was awarded in 1983 and was the first to bear the acronym 'RFID'. This technology is used for tracing, tracking and identifying objects, RFID System consists of a transponder (tag), reader, antenna and host computer. The Tags are a microchip combined with an antenna in a toolkit. The system contains a microchip which contains memory and logic circuits to receive and send data to the reader. These tags are classified as either active or passive tags. The batteries in the active tags provide a longer range and larger memories and on other hand the passive tags are powered by the signals of the reader and hence have to read short Range. The technical differences between Tag types do not affect their ability to collect travel time data, the necessary UID data are transmitted from the transponders to the road side units regardless of transponder type

The reader contains two components a decoder along with the RF module and an antenna to send and receive data from the tag, the desktop host acts as the interface for IT Platform for transferring information from RFID system to end user. This host then transforms the information received from the RFID tag into usable resource for the end user



RFID TAG

A basic RFID system consists of three components:

- I. An antenna
- II. A transceiver with decoder
- III. A transponder electronically programmed with unique information

Automatic vehicle identification tags can be further broken down into distinct tag types based on the degree to which they can be programmed and the type of power source

TYPE-1: The information stored in these tags is fixed (read-only) and the tags do not have processing capabilities

TYPE-11: These tags contain an updateable (Read/Write) area on which the antenna/reader may encode information such as point of Entry, Date/time of passage

TYPE-111: Smart tags are used in conjunction with an in lane RF antenna/reader to communicate identifying information about vehicle, customer and account balance information to the toll system. Some portions of the tag information are fixed such as vehicle and customer while others are updateable such as balance information, the smart Tags contain a Microprocessor, which maintains account Balance information that is updated each time the smart card is used



How it Works

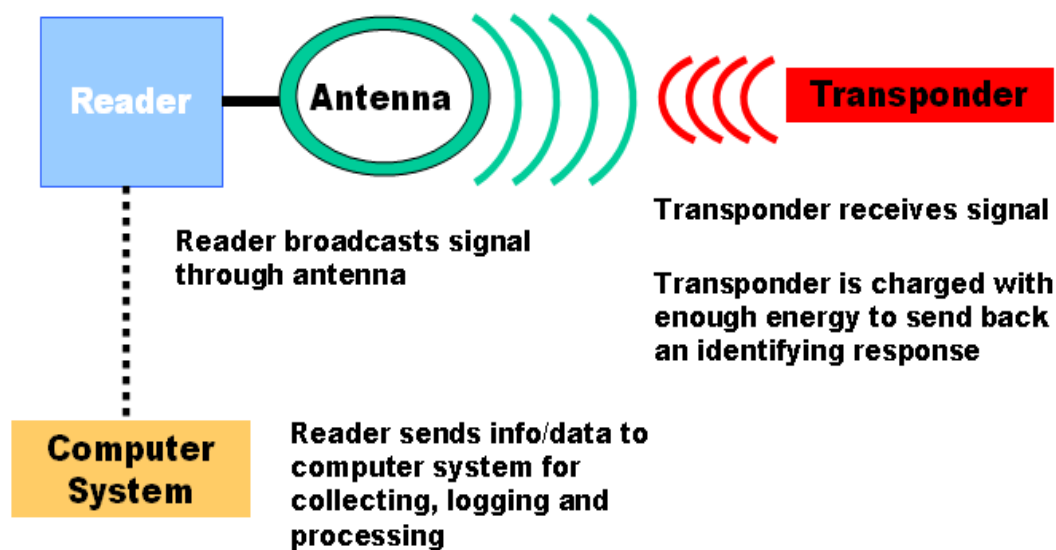
The vehicle fitted with ETC Tag contains a unique ID, the tag gives out RF signals. When vehicle reaches the entrance of the toll booth the RFID receiver Detects these signals with the help of sensors, the signals are then passed to controlling device. The reader receives the signal then the data is sent over to COM port of the connected device via the USB cable. With the help of COM port the data is transferred to the mobile

device or laptop. The front-end software developed will display the details of the vehicle owner's account on the screen. Information such as Name, Date, time, total balance will be stored in data base. A detailed screen will be prepared from the information retrieved from data base that gives a complete description of owners account. By the end of the month the system will give the bill and the total amount pending of the user for the current month will also be printed. This regular bill will be sent to the user via an android application through the notification service.

The vehicle owners running short of balance at the toll booth will be sent through a separate where they can recharge their balance to pay their undue amount. Another option given to the users is that they can recharge their account by using mobile phones and visiting website of Banks offering Fastag

Currently FastTag are available at ICICI Bank and soon FastTag will be available from Axis Bank.

How does RFID work?

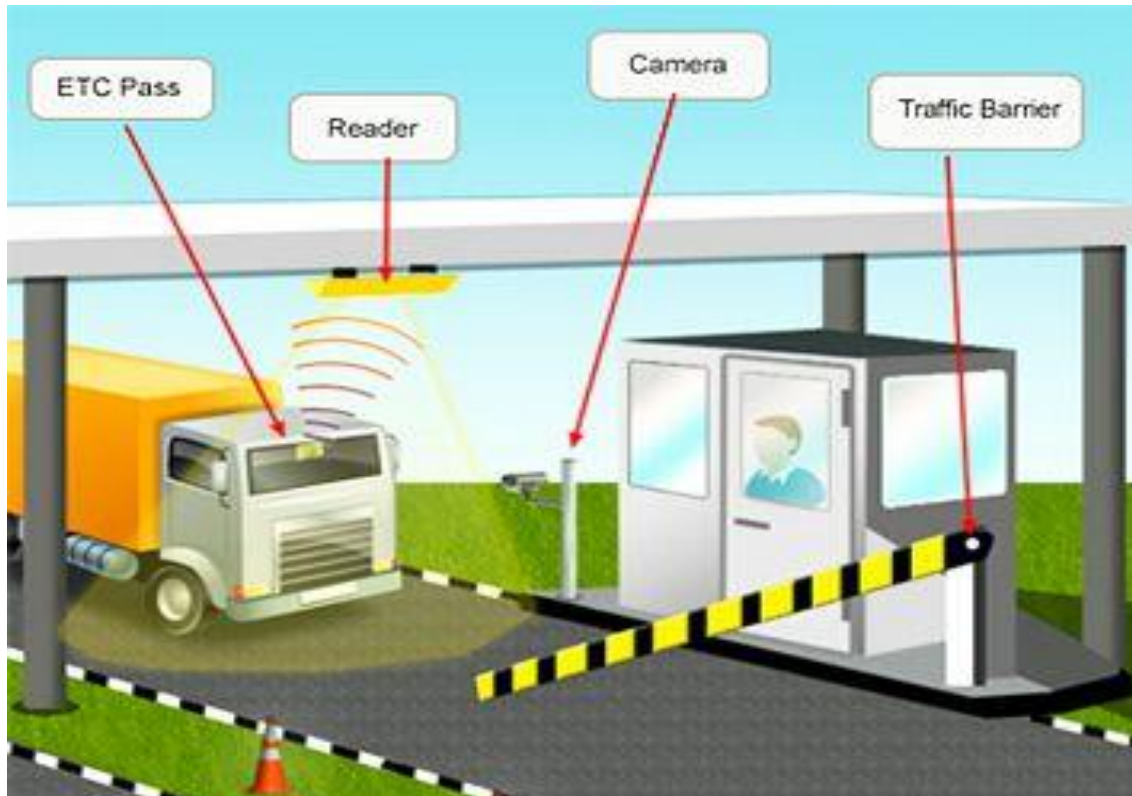


Components in the RFID Tool kit

The following components are included in the RFID Tool kit which is necessary for proper functioning of the system

- **Power Supply**- The power supply is required to fulfill the components attached in the tool kit; it contains a transformer, filter and rectifier. The system uses 9-10 v of power supply
- **MAX 232**- This component is required to convert TTL logic into RS232 logic and vice-versa. In TTL: Logic 1 is + 5v and logic 0 is 0 V. in RS232: Logic 1 is -10V and logic 0 is +10V. This unit provides an interface required for communication required between micro controller and RS232 based devices using serial communication port. The MAX 232 IC is dedicated for logic conversation. The unit requires +5vdc for normal operations
- **RF ENCODER HT 12E**- This unit is used for the encoding of 4 bit data before passing it in the communication channel. Essentially it creates a serial bit stream out of the parallel bits of input data. After that it transmits data stream to RF transmitter component, The unit requires +5 v -12 V DC for its normal functioning
- **RF TRANSMITTER**- This unit plays an extremely crucial role. it Handles Modulation of the data or packet to be transmitted. After the data is modulated then it is transferred over Air with the help of Antennas. The baud rate is normally 1100 bps and the range would be around 90 ft. the unit requires +5 – 12 V DC for its normal Functioning
- **RF RECIEVER**- This unit forms the core part of the system; it demodulates the signal after reception from air as the medium. This component is created with amplifying unit, Filtering unit, peak detection, and sampler. This unit requires +5V DC FOR FUNCTIONING
- **PC SERIAL PORT CONTROLLING**- Serial communication port of PC Is also called as RS232 Port. The connector type is 9 and the pin used is 3D-Type male connector

- **DATA BASE MANAGER-** A data base management system consists of software that operates databases, access and security, providing storage, backup and other facilities. Databases are designed to offer an organizes mechanism for managing, storing or receiving information. They do so with the help of Tabs. Any of the software technology can be used for database management. MS Access 2007 manages data base in one database file ,it is portable and can be copied and pasted to any other system and can run without installing the software. MS SQL Server 2000-it is complex at installation part and easy to use. The data base developed on it cannot be easily copied and paste on another system, in addition to this, it requires the software to be installed to use the database files.



The country's first interoperable RFID based electronic toll collection was rolled out on the Ahmadabad-Mumbai National Highway which is also connected to National Express Way 1 (NE-1) and the system allows vehicle fitted with electronic tags to sail through six toll plazas operated by three road developers- Larson and Turbo (L&T), IRB infrastructure and NHAI, It works as a pre paid toll account and toll is deducted automatically when vehicle crosses toll plaza, the initial cost of the tag has been kept at Rs 150 and the minimum amount to be deposited for a car is Rs 200. The toll collection project is equipped with RF Scanner that detects the passive tags operating at frequency of 850 MHz to 950 MHz at the distance of 90 feet with a response time of 10 milliseconds .The Road user can enroll and get TAG affixed on their vehicles at designated toll plazas or point of sale stations of authorized Bank

Ministry has rolled out ETC Programme in the country under the brand name **FASTag s**
ETC system is intended to save commuters time, fuel, money and reduce pollution and is installed at 55 Toll plazas and their integration with central cleaning house (CCH) operators is almost complete. A web based portal lets National Highway users to access

Information on toll fee and other details .Being GIS Based, toll plazas can be searched on a map. State-Wise list of toll plazas are listed with name, location, national highway and section/stretch numbers are easy to find. User can acquire information by entering toll plaza "name" for information. Toll plaza location and fee amount can be ascertained easily. Rates can also be accessed on mobile phones by sending SMS to 56070 with predefined text.



II. Conclusion

The FASTag is a passive RFID tag affixed at the centre of the windscreen. All user have to do is Recharge their Tag Account and drive through FASTag Lanes at the toll plazas, and appropriate toll would automatically be deducted from your balance. SMS alerts will be sent on the registered mobile number giving information on toll fee deducted and low balance. Automatic Toll Collection System Not Only Helps User To Save His Fuel And Time But It Reduces Pollution To Large Extent And Heavy Traffic Jams Near Toll Collection Centers

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