Automated Toll Collection: A review

Ms Tarannum Sheikh , Dr Naveen Hemrajani , Ms Nilam Choudhary, Mr Gaurav Bagaria

Abstract— This paper discusses the Electronic Toll Collection (ETC) and Radio Frequency Identification Technology (RFIT). The proposed system eliminates the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. Data information are also easily exchanged between the motorists and toll authorities, its various components and working is briefly discussed in this research paper. Benefits to different users are also elaborated in this article.

Index Terms — ETC, Motorists, RFIT

1 INTRODUCTION

Electronic collection of toll payments is made through a technology known as Electronic Toll Collection (ETC). Various researchers have been working on it applied it in various highways, tunnels and bridges which requires sophisticated technology like ETC. With the help of this system one can easily determine the authentication of registration of car and if there exists any violation in debits then authorities are being informed. It provides opportunity to eliminate congestions in tollbooths. Generally tollbooths get congested during festive season when traffic gets heavier than normal. It also gives marvelous benefits to toll.

2 RELATED WORK

The ETC system is currently being used throughout the world. In the United States alone, various states have implemented an ETC system called E-Z Pass. Other countries that have applied the ETC system are Canada, Poland, the Philippines, Japan and Singapore, among many others. Some of the applied ETC systems are discussed in the proceeding section.

A. Canada

The ETC system used in Canada is known as the Canada 407 Express toll route (ETR). It is one of the most sophisticated toll roads in the world .The Canada 407 ETR is a closed-access toll road, which means that there are gantries placed at the entrance and exit points of each toll. In this system, cameras are equipped with Optical Character Recognition (OCR).
The OCR cameras are used to photograph license plate numbers of vehicles that do not have transponders. The toll bill will then be sent directly to the registered address of the vehicle owners. Other than that, two laser beam scanners are placed above the roadway to detect the types of vehicles passing through the gantries. Nevertheless, this toll road bears a very high infrastructure cost, and the users are the ones who help recover the cost through increments in their toll bills: Canada's 407 ETR for ETC.

B. Poland

The ETC system used in Poland has been proposed by the Motor Transport Institute along with the University of Technology in Warsaw and Dublin. This system is called the National Automatic Toll Collection System (NATCS), and consists of the National Automatic Toll Collection Center (NATCC), control gates, and on-board units (OBU). The NATCS uses a combination of mobile telecommunication technology (GSM) with satellite-based Global Positioning System (GPS). Using GPS technology, the OBUs determine the kilometers that have been driven, calculate the toll fees and rates, and then transmit the information to the NATCS computer center. Each vehicle will be charged from the highway entrance up until the end of the highway. In order to identify the plate numbers of trucks, the system has control gates equipped with digital short range communication (DSRC) Detection equipment and high resolution cameras. Due to the technical specifications, this system incurs a high cost for motorists.

C. Philippines

The ETC system used in the Philippines has been implemented at the South Luzon Expressway (SLEX) since August 2000. The ETC is referred to as the E-PASS system, which uses Transcore technology. Here, electronic transponders are placed in front of a vehicle's rearview mirror. Each time a vehicle enters the toll booth, the tag is read by the receiver, automatically identifying the account and debiting the toll fee amount from the corresponding account. Once the amount has been debited, the control gate will lift and the vehicle is allowed to pass through.

D. US Patent

In 2007, Tang et al. filed a US patent on their proposed ETC system[1]. Their proposed system provides two lanes: one on

- *Ms Tarannum Sheikh is currently pursuing PhD degree program in Information technology in Suresh Gyan Vihar University,Jaipur,India PH-7737037255. E-mail:tanusheikh@gmail.com*
- *Professor Dr Naveen Hemrajani is currently working as HOD in Computer Science Department in JECRC university, Jaipur India.PH-9829032657 E-mail: naveen.hemrajani@jecrcu.edu.in*
- *Ms Nilam Choudhary is currently working as Assistant professor in Computer Science Department in Vivekananda Institute of Technology, Jaipur, India PH-9829803880. E-mail:nilamvit@mail.com*
- *Ms Gaurav Bagaria is currently working as Assistant professor in Computer Science Department in Vivekananda Institute of Technology, Jaipur, India PH-9929708312.E-mail: bagaria_gaurav@yahoo.co.in*

the side and the other where overhead-based antennas are installed per lane. Both antennas are used for conducting toll transactions. Of the two, the side antenna will act as a backup in case the overhead antenna fails to capture the signal emitted from the vehicles. In the case of a failure, the overhead antenna will be deactivated, and the side antenna will be activated. If the side antenna also fails, then an error signal will be issued.

3 PROPOSED SYSTEM

In this paper after reviewing previous work and system the proposed system will work in more efficient way as compared to existing manual toll collection system in Rajasthan. It will monitor the vehicles automatically and as per the type of vehicle the necessary amount will be deducted from the account of the vehicle owner.

3.1 Radio Frequency Identification Technology:

Electronic Toll Collection system generally uses Radio Frequency Identification Technology. It is a generic term used to identification of technologies which utilize radio waves for the identification of persons or objects. RFID technology was introduced in 1948 when Harry Stockman dispersed a paper discussing RFID technology "Communication by Means of Reflected power" (Jerry & Barbara, 2001).[2] RFID technology has gone through evolution and implemented in different applications. People used it in library management, warehouse management, prevention of theft etc. Commonly RIFD is used for tracing, identifying and tracking of persons and objects [3].

Components of RIFD:

RIFD consists of following components:

1) Transponder
2) Reader of writer
3) Antenna
4) Computer host

3.2 Benefits:

Benefits to motorists:

Following are the benefits of Electronic Toll Collection to motorists:

>Shorter queues at toll plazas because of increment of turnaround rate on toll booth service.

>Efficient and rapid service.

If the credit card is loaded then payments automatically credited from the accounts of card holder and balance remains on the card.[4]

> No need to make receipts.

>Fuel saving

Benefits to toll operators:

>Decrease in toll collection costs

>Centralized user accounts make better audit control.

>Expansion in capacity

4 SPECIFICATION, DESCRIPTION AND DESIGN OF HARDWARE

4.1 Transponder:

Transponder or tag is a microchip which is combined with an antenna system which is assembled in a compact package. The microchip consisted of logic circuits to receive and memory (Ayub khan, Manoj, & Prabhu, 2009) [5]. Transponders are of two types, passive and active tags. Active tags have internal battery while passive tags are empowered with signals from the signals from its readers.

4.2 Reader: A reader contains an antenna to transmit and reception of data from the transponder. Reader also consists of a decoder and a RF module.

4.3 Antenna:

Antenna capture signals from transponder.

4.4Computer Host:

Computer host plays role as interface to an IT platform and exchange information between the RFID system and the receiver or end-used. Host system then transform this information in a format that could be easily understandable by end-user.

4.5. GP20:

Product Name: GP20 Proximity Reader

PROXIMITY 125 KHz readers are high performance proximity readers featuring long range and small dimensions. The readers run from any voltage from 5 to 12.5 VDC and feature high read range at as low as 5 volts making it ideally suited to a wide variety of applications, particularly access control. The same basic unit can be configured to output most of the common interface formats, including Wiegand, Magstripe, Clock/ Data
and RS-232 serial ASCII output, making it easy to upgrade existing installations.

4.6 Standard clamshell card

CSC-125, 125 KHz RFID Clamshell cards are water proof and provide best reading range with 125 KHz RFID readers. Clamshell cards are very popular in Access control applications but can be used in wide range of RFID applications. They are lowest cost RFID cards available currently in the market. They have 26bit factory written ID that cannot be changed, though selected number sequences can be supplied for volume orders. These are Read only tags.

REQUIREMENT SPECIFICATION

Software requirement

Framework: NET 3.5
Software Package: VISUAL STUDIO .NET. 08
Language for Development: C# .NET
Database: SQL Server 2008

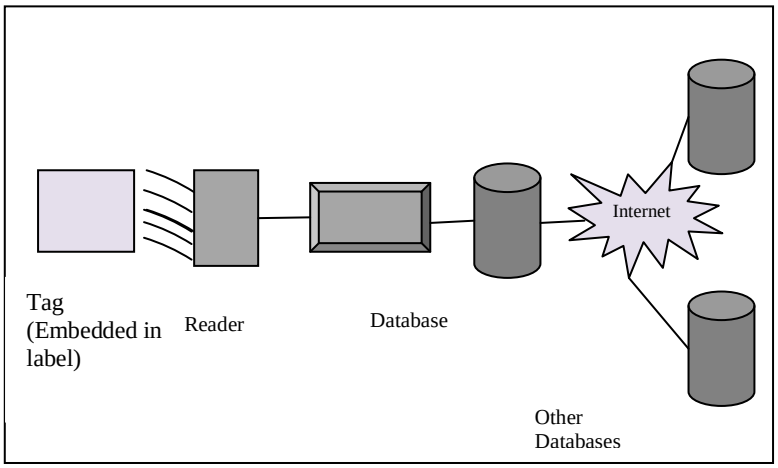

Figure.1 Component of RFID system

5. CONCLUSION:

In this article, the authors have discussed various types of ETC systems applied in some countries. The proposed ETC system discussed in this work It has been shown that Electronic Toll Collection is widely used technology throughout the world. ETC uses Radio Frequency Identification technology. RIFD consists of various components. ETC provides various benefits to its users

6 FUTURE SCOPE

Although in Rajasthan at Jaipur Ajmer highway Automatic toll collection is in working stage, but one of the drawback is that the camera mounted for monitoring of vehicles records every moment; whether a vehicle arrives or not. A big amount of data collection need to be managed. To overcome this we propose the use of a beam sensor, so that only necessary video recording can be captured. It will help us to manage bigdata captured from camera.

7. REFERENCES

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