



Comparative Study of Active RFID and Passive RFID Technologies in Context of Electronic Toll Collection (ETC) System

KEYWORDS

Radio Frequency Identification, Electronic toll collection, Active RFID, Passive RFID

Mr. Kapil K. Shukla

Assistant Professor, Department of MCA,
B. H. Gardi College of Engineering & Technology,
Opp. Hotel Shiv-Shakti, Kalawad Road, Anandpar –
361 162

Dr. Bankim Radadiya

Director of Information Technology,
Near Eru Char rasta, Navsari Agricultural University,
Navsari (Gujarat) – 396 450

ABSTRACT Radio Frequency Identification (RFID) is a data collection technology. It uses radio frequency communication to collect data from RFID tags. The RFID system uses two main components namely the RFID card and the RFID reader. Nowadays, Electronic Toll Collection (ETC) Systems are built using two types of RFID Technologies. Active RFID and Passive RFID both are having different functionalities and resource requirements. In this paper we focus on pros and cons of active and passive RFID in context of ETC System.

I. INTRODUCTION

Electronic toll collection (ETC) system is nowadays not new for anyone. It has been invented for to collected highway or private road toll without human interaction. ETC System is capable to identify vehicle through the RFID which is fixed inside the vehicle. By reading RFID system get information about owner and its account registered with ETC. [1]. An ETC systems are built using RFID technologies. In which to identify any object radio frequency is used. [2]. RFID technology was first introduced by Harry Stockman. He described it in his research paper "Communication by Means of Reflected Power" [3].

A radio frequency identification system composed of four sub parts. 1) Computer 2) RFID tags (transponder), 3) writer/reader, and 4) antenna. In these RFID tag having an antenna system in a compact package which is actually a microchip. This microchip sending and receiving data to reader for that it uses logic circuit and memory which is contained with it [4].

Computer is used as an interface for RFID system and the user to transfer information. Computer convert data received from RFID system into useful information for users. [5]

Two different types of tags can be used to build an ETC system. 1) Active tag which is require power source to generate radio signal and 2) Passive tag which is just react when it gets radio signal from its reader. [6].

Tags (transponders) are classified by Electronic Product Code (EPC) Global Standard. They classified it in classes where range is started from 0 up to 5. RFID tags in different classes are having difference in their characteristics and functionalities. These tags can be divided into two categories 1) One time programmable and 2) reprogrammable. One time programmable tags can be programmed by factory or users. The class structure for the tags is shown in the table below.

TABLE I
Class Structure for Tags

EPC	Class	Definition Programming
Class-0 Gen-1	Read only, Passive tags	Programmed by the factory
Class-1 Gen-1	Write once, read-many, passive tags	Programmed by the user and then locked
Class-1 Gen-2	Write-many, read-many, passive tags	Programmed by the user and then locked
Class-2	Rewritable passive tags with extra functionality, including encryption and emulation	Can be reprogrammed

Class-3	Semi-passive tags that support broadband communication	Can be reprogrammed
Class-4	Active tags that can communicate with other peers	Can be reprogrammed
Class-5	Readers, they can power other tags of Class 1, 2 and 3, can communicate with Class 4 wirelessly	Not applicable

Using an antenna reader can receive and transmit data from tag. Radio frequency (RF) module and decoder are subpart of reader. [5]



FIGURE 1: Complete RFID System

II. RELATED WORK

The ETC system is currently being used throughout the world either using active RFID or passive RFID. Here we have try to analyses different ETC systems categorized by the type of RFID they used.

III. ETC System using Passive RFID:

For studying ETC system built using passive RFID we selected ETC System proposed by KHADIJAH KAMARULAZIZI and DR. WIDAD ISMAIL. They proposed system for both Prepaid and postpaid mode of payment. The overall system cost is low because of cost of Passive RFID tags and its durability. Its efficiency is higher than other ETC system they compared. The tags which they used in their proposed system are very small so it's very easy to affixed it on any size of vehicle from two wheelers to heavy and huge size truck or buses. [5]

B. ETC System using Active RFID:

To study ETC system built using Active RFID we have selected work done by A.Ashok, V.Thangavelu, and N.Harikrishnan. They discuss the issues arises when they proposed ETC systems using active RFID.[7] Those issues are as per follow: 1) the compatibility with heterogeneous systems. [8] 2) The lifetime of active RFID tags.. 3) The ability to identify multiple tags. 4) The security mechanism to prevent accessing by malicious users. [7]

IV. Conclusion

In this paper we have reviewed ETC system built using active

RFID and passive RFID. From the comparison of them (Table II), we conclude that selection of technology between active RFID and passive RFID is based on some factors like cost, tags life, power consumption, range of tag etc.

TABLE II
COMPARISON OF ETC SYSTEM BUILT USING ACTIVE RFID AND PASSIVE RFID UNDER DIFFERENT FACTORS

Factor	ETC Built using Passive RFID	ETC Built using Active RFID
Cost	Passive tags are relatively cheap than active tag so it reduces the overall ETC system cost.	It is more costly than passive tag so it increases the overall ETC system.
Power	Passive doesn't require any power consumption so it can be easily plot on vehicle.	It require power source to operate which can be provide from vehicle battery.

Range	Up to 40 feet (fixed readers) Up to 20 feet (handheld readers) Tag reader get small amount of time to detect and identify tag, so tag reader is placed far from toll gate and vehicle speed is also controlled.	Up to 300 feet or more Because of longer range tag readers get more time to identify vehicle at toll gates.
Tag Life	Up to 10 years depending upon the environment the tag is in	3-8 years depending upon the tag broadcast rate
Tag Reader	Typically higher cost. They are placed only at entry and exit of toll collection gate.	Typically lower cost, so it can be placed at different place over toll road to track vehicles.
Use	It only used to identify vehicle at entry and exit gate.	Using active RFID, we can easily track the movement of vehicle and traffic detail on road.

REFERENCE

- [1] S. Lauren, B. Mariko (2007, June 20). Electronic Toll Collection [Online]. Available: <http://www.atm.com> | [2] C.M. Roberts, "Radio Frequency Identification (RFID)," Computers & Security, Elsevier, 2006. | [3] L. Jerry, C. Barbara "Shrouds of Time: The History of RFID", AIM Publication, ver. 1.0, 2001. | [4] M. Ayoub Khan, S. Manoj and R. B. Prahu "A Survey of RFID Tags", International Journal of Recent Trends in Engineering, vol 1, no 4, May 2009. | [5] Khadijah Kamarulazizi, Dr.Widad Ismail(2011), "Electronic Toll Collection System Using Passive RFID Technology".Journal Of Theoretical And Applied Information Technology. | [6] The Basics of RFID, Veri-Logic, LLC, 2003 | [7] A.Ashok, V.Thangavelu, N.Harikrishnan, "Electronic Toll Collection using Active RFID System", Georgian Electronic Scientific Journal: Computer Science and Telecommunications 2010, No.1(24).