

Development and Implementation of UHF -RFID Based Electronic Toll Management System(ETMS)

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Abstract : The Radio Frequency Identification System (RFID) has become a far and wide context and its applications have reached out in the majority of the fields like Toll Collect, inventory Management, etc. The RFID Plays a vital role in the fields of Transport. At present transportation is one of the major debates in our country. RFID labels started to be widely utilized in vehicles to automate the toll process. The unconstrained Electronic Toll Management System relies upon RFID. RFID technology uses tags that are fixed on the windshield of the vehicle, read by a fixed reader which is placed 10meters away from the vehicle. This paper presents the work in the development of a system where the Tag(FASTag) with the details of the User or vehicle owner is read by a fixed UHF RFID long-range reader when the vehicle is in motion. This avoids the vehicle to stay at the toll plaza for cash payment further reducing time and fuel.

Keywords:- Electronic Toll Management System; RFID, FASTag, Traffic Management Automation.

I. INTRODUCTION

India is the second-largest country in the world road network. Among 5.4 million km of the road network, almost 97,991 km is covered by national highways. The National Highways Authority of India (NHAI), a nodal agency of the Ministry of Road Transport and Highways is responsible for the maintenance and the expansion of the highways [1].

The traffic is increasing day to day in recent years due to the increasing number of vehicles. Every day, millions of people use their personal vehicles instead of public transport systems and due to this, there is an increase in traffic in developing countries. The increasing number of vehicles on the roads, resulting in many problems such as congestion, air pollution, and fuel wastage, etc. There are certain types of roads where you have to pay money to travel on the road which is called Toll Roads. To travel on that road, you need to pay a tax called a toll tax. Toll tax is applied only to the users of the toll road. Sometimes there may also be more than one Toll Plaza on one particular toll road [2].

Nowadays, increasing traffic volume causes congestions commonly around the toll gate of the highway. Therefore, the new technique is urgently required to reform the problem of congestions. An automated toll management system is one of the methods to solve the above conditions. The automated system is composed of several subsystems. The RFID technology, computer database, power supply, and inferred device are included. The automated system can bring the several sectors for toll gates as saving time and reducing the human workers. Develop the prototype model, which reproduces the operation states of various tollgate systems: passing time and waiting time [3]. The RFID tag and RFID reader are contained in RFID technology.

II. RFID TECHNOLOGY

RFID means Radio Frequency Identification that consists of the tags which can be either active or passive tag. A passive tag does not have its own power supply, much cheaper to manufacture and a small coil antenna is used. On the other hand, the active tag must have its own power supply. It has a longer range and larger memories. It can store additional information sent to the RFID reader. The RFID reader is an interrogator. It is placed at the toll gate on every single row where vehicles are passed. The reader contains an RF module, which acts as both transmitter and receiver of radio frequency signals. The reader generates the signal to receive the data from the tag. The received signals send to the computer system which contains Graphical User Interface (GUI) and the database of all users[4]. The ID number from the tag checks with the recorded database and deduces the toll tax. The computer and RFID reader are connected with USB cable. A general RFID based Toll management System is shown in figure 1.

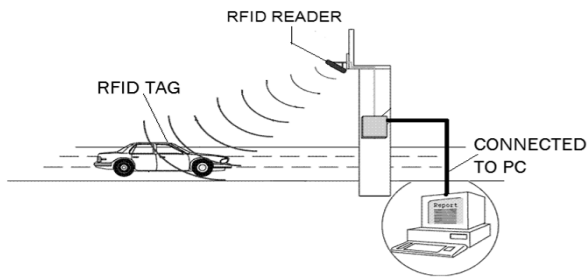


Figure 1: RFID based System for Toll management

III. HARDWARE TOOLS USED

The paper emphasis on work development of UHF RFID based Electronic Toll Management System, It comprises the following hardware components

1. UHF long-range integrated reader
2. UHF desktop USB reader writer
3. UHF RFID transparent anti-tamper windshield tag

3.1 UHF long-range integrated reader (CF-RU5112)

CF-RU5112 is a high-performance UHF RFID integrated reader. Figure 2 shows a UHF long Range integrated reader. It is designed upon the fully self-intellectual property. Based on a proprietary efficient digital signal processing algorithm, it supports fast tag read/write operation with a high identification rate. It can be widely applied in many RFID application systems such as logistics, access control, anti-counterfeit, and industrial production process control systems.



Figure 2: UHF long-range integrated reader

Features:

1. Self-intellectual property
2. Size:445mmx445mmx55mm
3. Support ISO18000-6B, ISO18000-6C(EPC C1G2) protocol tag

4. 865~868MHz, 902~928MHz frequency band(frequency customization optional)
5. FHSS or Fix Frequency transmission
6. RF output power up to 30dbm
7. 12dbi antenna optional with effect distance up to 10m~20m*
8. Support auto-running, interactive, and trigger-activating work mode
9. Low power dissipation with single +9 DC power supply
10. Support RS232, RS485, Wiegand TCP/IP interface.

3.2 UHF desktop USB reader writer(CF-RU5102)

CF-RU5102 is a high-performance Multiple Protocol UHF RFID Reader and Writer. Figure 3 shows the UHF desktop reader/writer is designed upon the fully self-intellectual property. Based on a proprietary efficient digital signal processing algorithm, it supports fast tag read/write operation with a high identification rate. It can be widely applied in many RFID application systems such as logistics, access control, attendance system, anti-counterfeit, and industrial production process control system.



Figure3: UHF desktop USB reader writer

Features

- Self-intellectual property
- Support ISO18000-6B, ISO18000-6C(EPC C1G2) protocol tag
- 902~928MHz、860~868Mhz frequency band(frequency customization optional)
- FHSS or Fix Frequency transmission
- RF output power up to 10dbm(adjustable)
- No external power source needed
- Built-in antenna with effect distance up to 200mm
- Support USB1.1 interface with VSP(Virtual Serial Port) or HID mode.

3.3 UHF RFID transparent anti-tamper windshield tag(G9307)

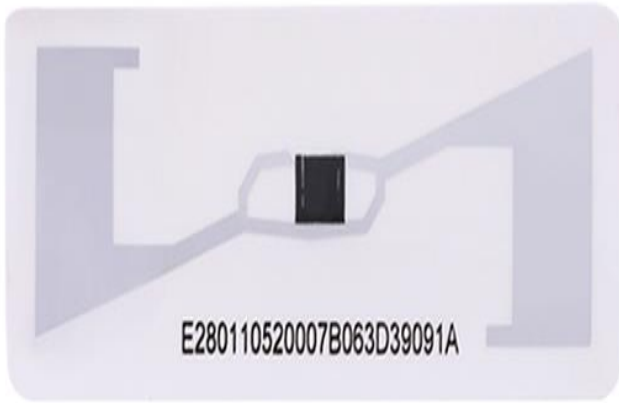


Figure 4:UHF RFID transparent anti-tamper windshield tag

Figure 4 shows a UHF RFID transparent anti-tamper Windshield tag with model number G9307 operating Frequency of 860-960MHz. It is a Standard IS018000-6C EPC GEN2 employs Chip type Impinj M4QT, has Memory of 48bits TID, 128bits EPC, 512bit user memory and works in both read or write mode and Read distance read(1-15m) (Reader dependent) Write distance write(0-1m) (Reader dependent) with Data retention 10(yrs).

IV. SOFTWARE TOOLS USED

To accomplish the system, choosing software is very important. The MySQL and Microsoft Visual Studio 2012 are used as Integrated Development Environment (IDE). The C# language is used to implement the system. The C# language is familiar to many users and suitable for GUI design. MySQL is a relational database management system. As a database, it is a software product whose primary function is to store and retrieve data as requested by other software applications, be it those on the same computer or those running on another computer across a network (including the Internet). Figure 5 shows the Flow chart of Electronic Toll Management System.

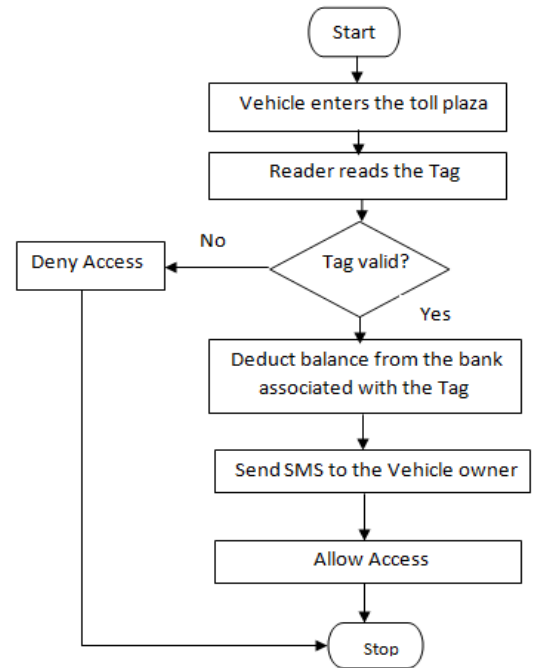


Figure 5: Flowchart of Electronic Toll Management Application

V. RESULTS AND CONCLUSION

Figure 6 represents the real-time implementation of the application. The application was tested and verified by applying Fastag to the vehicle windshield and the details of the vehicle were written to the Tag. The data is written with the help of an application developed built using visual studio and the details were saved in the Database. The Tag is Read by using a UHF RFID reader which was located at a distance of 10 meters away from the tag is compared with the database, if the details of the read tag matches with the database the verification will be successful and the toll fee amount will be deducted as per the toll. The user will receive a message(SMS) about the amount toll fee that has been deducted after passing through the Toll.

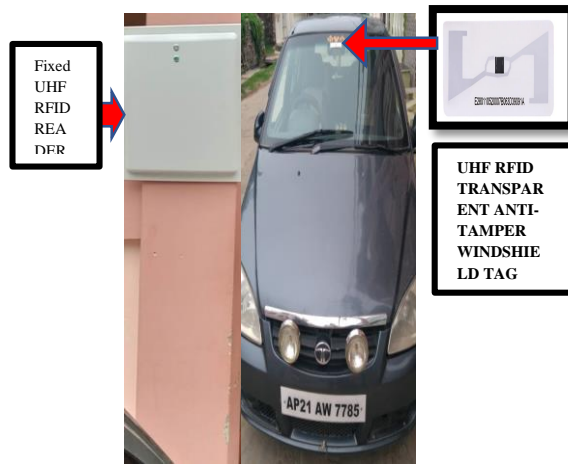


Figure 6: Implementation of ETMS Application

The following figure 7-11 are the various forms designed to develop this application the forms are used to provide access for user registration(vehicle) and verifying it automatically

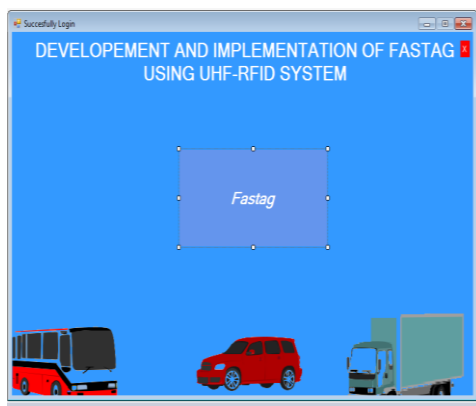


Fig 7: Open Application

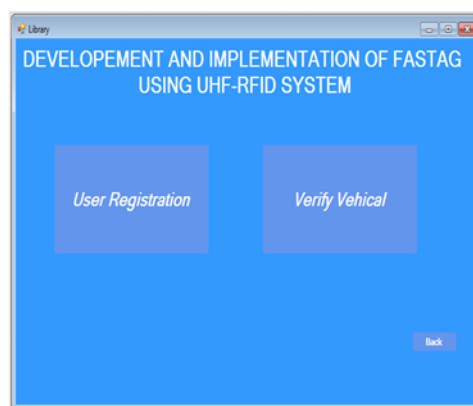


Fig 8: User Registration/Verify form

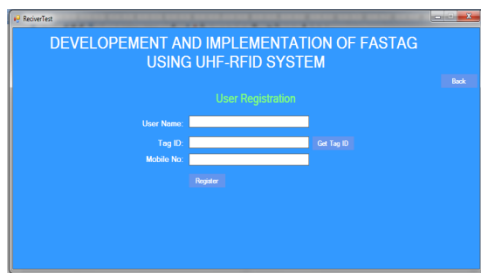


Fig9: User Registration



Fig 10: Writing Data to Tag

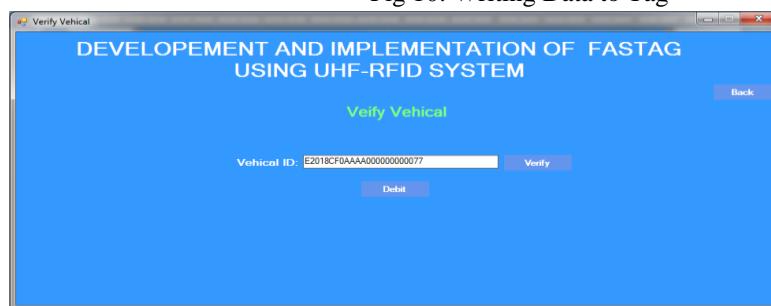


Fig 11: Verifying Vehicle

VI. REFERENCES

- [1]. Bharavi Joshi. "A Comparison study of toll collection systems in India." International Journal of Engineering Research and Development, Volume-13, no.11,2017.
- [2]. Preeti Giri, Priyanka Jain, Automated Toll Collection System Using RFID technology, International Journal Of Advance Research In Science And Engineering IJARSE, Vol. No.2, Issue No.9, September 2013.
- [3]. Navnath Dahifale, Sachin kadam, Swapnil Sabale, Chandan Chaubey4 – "RFID based Automatic Toll- Tax Gathering system" Volume3 Issue 2, May 2015.
- [4]. A.usha kiran – "Design of Electronic Toll Collection (Etc) System on Arm – 7 using RFID technology" Volume4 Issue 9 – Sep 2013.
- [5]. Adesh Mhatre, Shilpesh Agre, Anil Avhad, Dhruv Gandhi, Nilesh Patil – "Electronic Toll Collection System using Wi-Fi Tehnology" Volume:3 Issue:4 2015.
- [6]. Aditi Dambe, Upsana gandhe, Varsha Bendre – "Automatic Penalty Charging for Violation of Traffic laws" vol.2, Issue, Feb 2013.
- [7]. Wei-Hsun Le, Bor-Shenn Jeng, Shian-Shyong Tseng, Ching-Hung Wang. "Electronics Toll Collection Based on Vehicle-Positioning System Techniques" vol.11, pp.643-644, 2004.
- [8]. Sachin Bhosale, Dnyaneshwar Natha Wavhal. "Automated Toll Plaza System using RFID" IJSETR, Vol 2, Issue 1, 2013.
- [9]. Janani SP, Meena S, "Automatized Toll Gate System Using Passive RFID and GSM Technology", Vol. 5. Issue ECIA2012-3 Journal of Computer Applications, February 10, 2012.