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Dynamic Approach towards Toll Tax Collection and Vehicle Tracking With the Help of RFID

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Abstract*—This paper focuses on use of radio frequency identification (RFID) technology for electronic toll collection system. This system has been around since 1992, during which RFID tags began to be widely used in vehicles to perform toll collection process automatically. The primary requirement is to eliminate the need for motorists and toll authorities to manually perform ticket payments and toll fee collections, respectively. The proposed RFID system uses tags that are mounted on the front glass of vehicles, with the help of which information on the tags are read by RFID readers. Data information exchanged between the owner of vehicle and toll authorities is done efficiently. Due to which the problem of traffic congestion and human errors in the system is effectively rectified and provides efficient toll collection facility for the consumers.

***Index Terms* — Antenna, Middleware, RFID Tag.**

I. INTRODUCTION

Million of drivers/consumer passes through toll booths paying toll tax. The past toll payment system was manual and drivers are using manual system using coin or cash by hand to cross the toll plaza gate. Manual process is too much time consuming and drivers have to wait in row for long time for crossing the toll plaza. In waiting time fuel of vehicle is also consuming fuel. Now days this manual toll deduction system is changed to automated system. Where driver no wait for pay cash or get token to cross the toll plaza. This automatic system used the technology of RFID. This new automated system works very fast with the help of RFID. RFID based automated Toll Collection system (RATS) is a fairly mature technology that allows for electronic payment for motorways and expressways. An Electronic Toll Collection system is able to determine if a car is registered in a toll payment program, alerts enforcers of toll payment violations, and debits the participating account [2]. Electronic toll collection is fast becoming a globally accepted method of toll collection, a trend greatly aided by the advancement in the field of interoperable Electronic Toll Collection technologies.

II. MOTIVATION

Radio Frequency Identification (RFID) is an auto identification technology which uses Radio Frequencies (between 30 kHz and 2.5GHz) to identify objects remotely. The system does the job of detecting and accounting for vehicles as they pass through a tollgate using RFID as the identification technology [3]. The system is a great asset in the transport industry. It reduces the common problems in accounting for the transportation of goods from point to point. This can be further developed to support the satellite surveillance systems once all toll gates are networked. An RFID tag is loaded with information in the form of an Electronic Product Code, which can be read over a considerable distance, with the help of which we can identify the vehicle and enhance a transaction to be undertaken with respect to the specific tag data, taking advantage of radio frequencies and ability to travel longer ranges with better data capacities and high speed attained with maximum accuracy.

III. OBJECTIVE & SCOPE

A. Radio Frequency Identification is one of the systems designed for tracing and tracking objects both globally and locally using tags. It is an auto-identification procedure for identifying objects automatically within range. It allows information about an object to be collected automatically without having a human being to handle the object or enter its data manually.

B. RFID uses tags which transfer information by radio wave through antennae on tiny computer chips attached to item so that such objects may be identified, traced, and tracked. This technology has found large area of application in business supply chains, in medical line applications, in security, and in fact many areas of human effort.

C. Automatic Radio Frequency Identification technologies are developing at an enormous rate with novel information appearing daily, particularly on the Internet, the areas of applications of this technology could be industries, health care management and security.

IV. LITERATURE SURVEY

A. RFID Applications: An Introductory and Exploratory Study

Radio Frequency Identification is not a new technology and has passed through many decades of use in military and various sectors of industry and other areas. Industries use RFID for number of applications such as personal/vehicle access control, security of departmental store, tracking of equipment, baggage, establishments of fast food franchisee, logistics, etc. The improvement in RFID technology has brought returns that are related to resource optimization, enhanced efficiency within business paths, and enhanced customer support, improvements in business operations and healthcare operations. This is a big project approach; aiming to produce a model for mobile technology implementation for hospital patient's movement process.

B. Challenges in RFID Deployment –A Case Study in Public Transportation

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This approach focuses on how radio frequency identification technology can be used to solve problems faced by public transport in metro cities. Automated positioning of buses can be used to provide useful prediction of arrival times and enhance passenger convenience. There are, however, alarming obstacles in the way of widespread radio frequency identification network deployment. From a systems point of view, this highlight and explore the problem of data capturing, storage and retrieval and how event, condition and action rules developed for active databases can help us in managing the huge number of events generated each day[6]. It also highlights how the collected data can be used to predict bus movement timings in order to provide better customer service. The primary focus of this concept is the use of RFID technology to solve problems faced by passengers and bus operators in many metro cities. We will use Brihanmumbai Electric Supply and Transport undertaking (popularly known as BEST) which operates in Mumbai is used as a case study [6]. The Mumbai bus system is one of the largest in the country in terms of number of buses and its operation. Often the buses are overcrowded. As a result passengers usually spend long time at bus stops waiting. The bus arrivals at a particular stop are stochastic variables thanks to traffic congestion. This uncertainty can be partly alleviated by deploying a bus tracking and reporting system.

V. RFID TAGS

A. Active Tag

An RFID tag is an active tag when it is equipped with a battery that can be used as a partial or complete source of power for the tag's circuitry. Some active tags contain replaceable batteries. It is also feasible to connect the tag to an external power source. Active tags contain not only a battery, but also a transmitter on the tag. The disadvantage of having a battery is twofold. First, it adds cost, and second they run out of power eventually. The decision of which one to choose is solely depends on application. The tag is made of an IC and an antenna. The IC will contain memory and some processing capability. The memory may be of type read only or read/write.

❖ ***The advantages of an active RFID tag***

- It can be read at distances of one hundred feet or more, greatly improving the utility of the device
- It may have other sensors that can use electricity for power.

❖ ***The disadvantages of an active RFID tag***

- The tag cannot function without battery power, which limits the lifetime of the tag.
- The tag is typically more expensive.
- The tag is physically larger, which may limit applications.

B. Passive Tag

A passive tag is a tag that is without battery; the power for its operation is provided by the reader. When radio waves from the reader are detected by a passive tag, the coiled antenna on the tag forms a magnetic field. The tag gets power from it, energizing the tag circuitry. The tag then transmits the information encoded in the tag's memory back to the reader. So in case of passive tag the same radio wave is used for the carrying the data and powering the tag unit. This means that the tag is alive only when it is in the range of the reader.

❖ ***Advantages of a passive tag***

- The tag functions without a battery; these tags have a useful life of twenty years or more.
- The tag is typically much less expensive to manufacture.
- The tag is much smaller (some tags are the size of a grain of rice). These tags have almost unlimited applications in consumer goods and other areas.

❖ ***Disadvantages of a passive RFID tag***

- The tag can be read only at very short distances, typically a few feet at most. This greatly limits the device for certain applications.
- It may not be possible to include sensors that can use electricity for power.
- The tag remains readable for a very long time, even after the product to which the tag is attached has been sold and is no longer being tracked.

C. Parameterized Comparison between Active & Passive Tag

Sr. No.	Parameter	Passive Tag	Active Tag
1	Read Range	Up to 40 feet	Up to 300 feet or more
2	Power	No Power Source	Battery powered
3	Tag Life	Up to 10 years depending upon the environment the tag is in	3-8 years depending upon the tag broadcast rate
4	Tag Cost	Low	High
5	Ideal Use	For inventorying assets using handheld RFID readers. Can also be used with fixed RFID readers to track the movement of assets as long as security is not a requirement	For use with fixed RFID readers to perform real-time asset monitoring at choke-points or within zones. Can provide a better layer of security than passive RFID.
6	Readers Cost	Typically higher cost	Typically lower cost

VI. PROPOSED SYSTEM

In here, we put forward radio frequency identification toll system based on Radio Frequency Identification Technology. It can achieve the collection of charges without stopping the vehicle running in high speed. And tracking of vehicle can be done by browsing the data stored in the central database which can be requested with the help of SMS. The concrete operations are as follows: It is need to install hardware equipment required in each highway toll station, namely, reader, controller, data transmission unit, remote non-contact charging machines, bank payment gateway and other facilities in the control room of toll station, installing structure for mounting of reader mechanism and installing alarms and other devices in the side of road to realize automatically the release or

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block of vehicle after the payment [8]. When a high-speed vehicle drives into the toll booth area, the reader mounted on the pole automatically identifies information embedded in the tag, such as the code of electronic tag, the information of vehicle type, the information of ownership, the date and time of getting through toll station, and simultaneously carries on the confirmation of the vehicle identity, then the data information will be transmitted to toll collectors in the toll station using the data transmission unit after that confirmation is not wrong. By now, the toll collector in toll station will carry on automatic collection according to the amount of collection that is confirmed by the central toll collection system in the central server. After the successful collection, it gives green light to the vehicle and directs the vehicle to pass normally, with the acknowledgement of the payment confirmation to the owner of the vehicle Via SMS. The owner of the vehicle can also check the position of the vehicle by sending the request SMS to the central server. The information of which toll booth is passed by the particular vehicle is replied back to the user with the help of SMS. In other case if vehicle type is not legal, then the alarm will be given out and the toll station will execute the manual handling which includes the onsite charging of user account for example if the owner of the vehicle don't have enough cash in his account he can recharge his account on the toll booth. When all this proceeding is done the total information is automatically loaded into central server (i.e. Total management Centre) which can be use for further processing if required.

VII. . PROPOSED SYSTEM DESIGN

VIII. MODULES

A. The Identification module

The system was developed in a modular-based method. It contains an identification module, which has the RFID hardware to read tags as vehicles pass through the tollgate. This module sends information to the software module through RS232 serial connection. There are seven data lines from the RFID read/write module. The important ones for reading and writing are the lines for transmitting and receiving data in a two way communication between the RFID reader and the computer system. A RS232 connector is used to enable connect the RFID module to the Personal Computer. A tag is passed in the region of the magnetic field produced by the RFID module and a beep sound is produced signaling its detection [10]. The RFID module needs to be configured with certain communication parameters. This can be done using the given Specific instructions and can be achieved by using the Demo Application or an independent developed application. The RFID module is connected to the PC via the RS232 port.

❖ ***Components of an RFID Read/Writer system***

To have a complete RFID system, an interrogator, a transponder, an antenna and some tags were used [7]. These form the RFID hardware which is used in an information processing system (IPS) to acquire the total benefit of RFID. A reader system can detect many different RFID tags simultaneously as long as they are within the vicinity of the interrogator. The interrogator acts as the sensor as well as an interface between RFID transponders and the IPS. Antennae are attached to the interrogator and perform the actual Radio Frequency communication [11]. A computer hosting the IPS application pilots the interrogator and processes the data it sends. The IPS application monitors, configures and coordinates readers for data collection as well as the execution of business programs as dictated by programmed business rules and logic. The IPS normally is also referred to as the middleware [12] and can be addressed as the intelligent sensor network platform after configuration of parameters meaningful information has to be taken from the tag.

B. Software Module

The informatization and intelligence are the development course of highway management that are based on the collected information from vehicle, highway toll and traffic surveillance from the above mentioned sub-system as well as the real-time history data regarding road network using the networking communication and database technology to build a complete information management platform. With the application of this platform, it can achieve resources sharing and full use of information. For this system, we propose Windows XP as the operating system platform and adopt object-oriented programming platform for development. Its background database is Microsoft SQL Server2005 with Client/Server application mode. The system presents great stability, scalability and maintainability. The system has a security mechanism that refers to a security criteria to set up personal privileges. Thus, the system only allows access to authorized data and person.

Visual Basic Communication Application

The Visual Basic Communication application consists of different parts; the part which communicates with the RFID hardware, with the database, with the Programmable Interface Controller (PIC) and the part which enables addition of new users. The system will be developed with an aim towards enabling it to read the tag

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of a car as it passes, according to the tag details taken from the database. It also displays the current account balance from the database. There will be automatic deduction of balance which works according to an algorithm in the Visual Basic (VB) code. The deduction occurs with respect to the type of car which has passed.

IX. CONCLUSION

The RFID Automatic tollgate system designed could automatically detect the identities of the vehicles and performed the billing in accordance to the identity of each vehicle as prerecorded in the database. The system could automatically inform the owners of the vehicles. These were the major achievements met in the project, among other objectives also achieved which include tracking of the vehicles and remote database connection. Reading items and objects in motion can be done accurately using RFID. A system developed with a log in windows enables security and the overall cost of implementing the system may seem high but after a year of running the system, very high benefits will be realized.

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