

A Survey on Applications of RFID Technology

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Abstract

Background/Objectives: Recent trends use Radio Frequency Identification (RFID) technology in day to day life. At the beginning RFID was developed to replace barcodes in supply chain. They are the ubiquitous tool available for monitoring any item in various fields. The main objective of this paper is to survey RFID technology based on its security and safety applications. **Methods/Statistical Analysis:** RFID technique is mainly used for the security, tracking and monitoring purposes. **Findings:** This paper presents a survey on the applications of RFID in the tollgate transactions, bank locker security system, automatic vehicle speed control and library books security system. Many applications visualized have a genuine use. The communication is in the wireless manner and does not require line of sight. **Applications/Improvement:** This paper presents a survey on the applications of RFID in the tollgate transactions, bank locker security system, automatic vehicle speed control and library books security system.

Keywords: Automated Data Capture, Features, RFID Applications, Survey, Supply Chain Management

1. Introduction

The RFID is basically a method for automatic identification and data transfer. It is similar to barcode, smart cards. In the process of scanning products with bar codes, human intervention is required. But an RFID is capable of being read in an automatic manner¹. RFID arose in the 1940s is a wireless technology that use electromagnetic fields to transfer data. It relies on storing and retrieving data by using devices called RFID tags or transponders. The motivation behind the ubiquitous use of RFID systems is to automate remote tracking and identification of objects². An RFID tag is a miniature electronic circuit capable of storing information, processing and radio communication³.

RFID authentication on location based authentication is a new method with various parameters for secure authentication. Encrypting and decrypting the information in the reader is costly and hence difficult to implement. To overcome these problems, GPS (Global Positioning System) is implemented in both the RFID tag and reader. Data can also be stored and retrieved⁴.

An RFID reader that is designed to communicate with the tag can extract information from the tag. The range of communication for this varies from centimeters to hundreds of meters based on the design⁵. In the area of Supply Chain Management (SCM), RFID is an emerging technology. They are referred to as Automated Data Capture(ADC) due to the usage of low-power radio waves to transfer data between the reader and tag. By tagging the RFID in the product, the company can monitor the product as it passes through the supply chain. A small mishandling of a product can be detected using this technology and the fraudulent activity can be prevented. RFID is also used as Business Intelligence (BI). They believe it to be more accurate and work in timely manner⁶.

Generally RFID tags are two categories: active and passive based on their source of electrical power. Active RFID tags have their own power source whereas passive tags obtain power from the signal of external reader⁷. Many patients are concerned about the security and privacy. Hence RFID technology is implemented to identify patients, medical equipment and medicines⁸. RFID based

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toll collection system is fast and efficient method at the toll plazas. It does not require any human interference as the communication is through RF modules⁹. RFID uses electromagnetic fields to identify and track the tags attached to the object to transfer the data¹⁰.

2. Features of RFID

The main features of RFID are

- RFID has unique ID and hence no duplication.
- It does not require line of sight.
- It can capture data at high speed.
- It has the ability to read 10 to 50 tags per second.
- It has the ability to store data into tag memory with read/write password protection mode.
- The lifespan of the tag is based on the packaging quality.

3. Benefits of RFID Over Barcode

The benefits of RFID over Barcode are

- The major advantage of RFID is that it does not need line of sight. The barcode to be read must be placed directly in front of scanner whereas the RFID use radio wave communication only the RFID tag must be in read range based on the equipment.
- In the barcodes the data can never be changed once printed and hence it can only be read. The RFID tags can be read and rewritten based on the user's requirement.
- The barcodes can get damaged when placed on the paper labels or unprotected surface. But the RFID tags are durable and reusable since they are designed to support harsh conditions like humidity, heat, change in weather etc.
- The standard barcodes are designed with limited information. The RFID tag store data in non-volatile memory and can hold 8 kilobytes of data.
- The RFID tags have unique code meaning that each RFID are labeled individual and can be identified as individual.
- The RFID can be implanted on human and animals whereas barcodes and other optical technologies do not work.
- The RFID can store information which is dynamic but the barcodes can store only static information.

4. Applications

4.1 Toll Collection System

The idea behind implementing toll collection system based on RFID is done to automate the toll collection process thus by reducing the long queues using RFID tags installed on the vehicles at toll booths. This technology provides fast and efficient collection of toll at the toll plazas. When a vehicle has been registered at the RTO office, the officials will assign a number plate to it and also provide a RFID enabled smart card or a tag. The card will have a unique ID that is feasible to use with that vehicle alone. An account for the particular smart card will be created and its transactions details are maintained in database. Whenever the vehicle approaches the toll booth, the infrared sensors will detect the presence of the vehicle and will activate the RFID circuit to read the RFID enabled smart card fixed on the vehicle. Transactions begin based on the balance available on the toll or the vehicle will be directed to another lane for manual tax payment. Further the software will update the detail in the centralized database server and also generate the bill as a text message to the user.

This has been made possible as the vehicle that is passing the toll plaza need not stop to pay toll since the payment is done automatically from the account of the driver. Moreover when a complaint is registered by the vehicle owner to the RTO office regarding the vehicle theft, the respective entries are done in the database. When any vehicle arrives at the toll booth with the same ID that has been stored in the stolen vehicle category is identified based on the unique ID. The vehicle identification has been done automatically by using the verification details of the ownership so that the corresponding customer will be charged at the toll. The vehicle that ignores the traffic signal is also detected using the RFID readers fixed at the signal crossing areas and also a notification has been sent to the police station. The Figure 1 shows the flow of working of the toll collection system. Once the RFID tag is detected, the vehicle number is read and analyzed from the database. Based on the details from the database, money transaction is done to pay the toll¹.

4.2 Library Books Security System

This system has been used to improve the library books security. The design is of two sections: transmitter (tag) and receiver (reader). These sections help the library in-charge to know when a book has been taken and when it

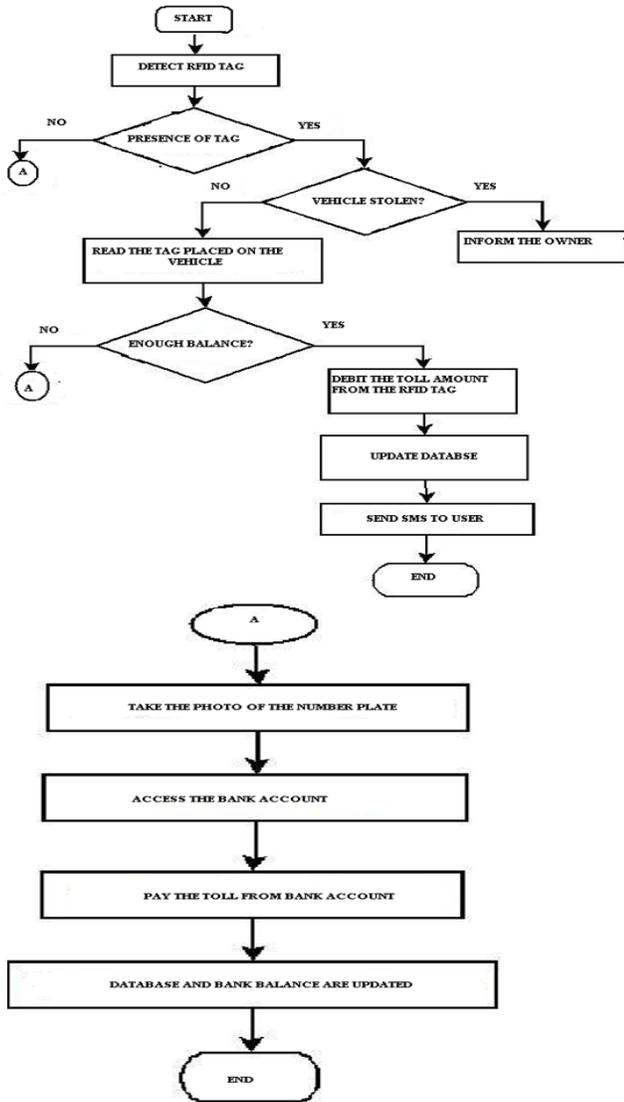


Figure 1. Working Of Toll Collection System¹.

is placed in its respective place. An alarm has been given when the book is taken. The LCD that has been used helps the in-charge about the status of the tagged books on the shelf. A Light Emitting Diode (LED) has been used as the sensory node on the receiver section to switch ON or OFF when a book is placed or taken from the shelf.

The system has been implemented in the libraries where the reserved books are to be secured. The communication to the display unit is done wireless using RFID technology. The Figure 2 shows the working of the library books security system. The transmitter transmits the status of the books and the receiver receives the status and displays it through the displaying unit. The RF transmitter and receiver modules used are small in dimension and operate

at the voltage range of 3V-12V. The system uses low cost RF transmitter and receiver to transmit and receive signals upto 100 meters. These RFIDs are good for short distance transmission. The transmitter and receiver are connected together on the board according to the circuit layout. The main advantage of this system is that the technical human errors are minimized and also the library books are secured. Due to the high cost of the RFID, this technique has been implemented only to the important reserved books⁵.

4.3 Automatic Speed Control

This system has been interfaced with the RFID reader and sensors to the microcontroller. The sensors monitor the various parameters of the vehicle and display the parameters values in the LCD (Liquid Crystal Display). The RFID reader fixed to the vehicle has been used to control the speed of the vehicle at the zones like schools, colleges and hospitals. When the vehicle crosses these zones, the RFID reader reads the RFID tag value placed in the zones and checks it with the value stored in the microcontroller. If the speed limit is crossed then the microcontroller

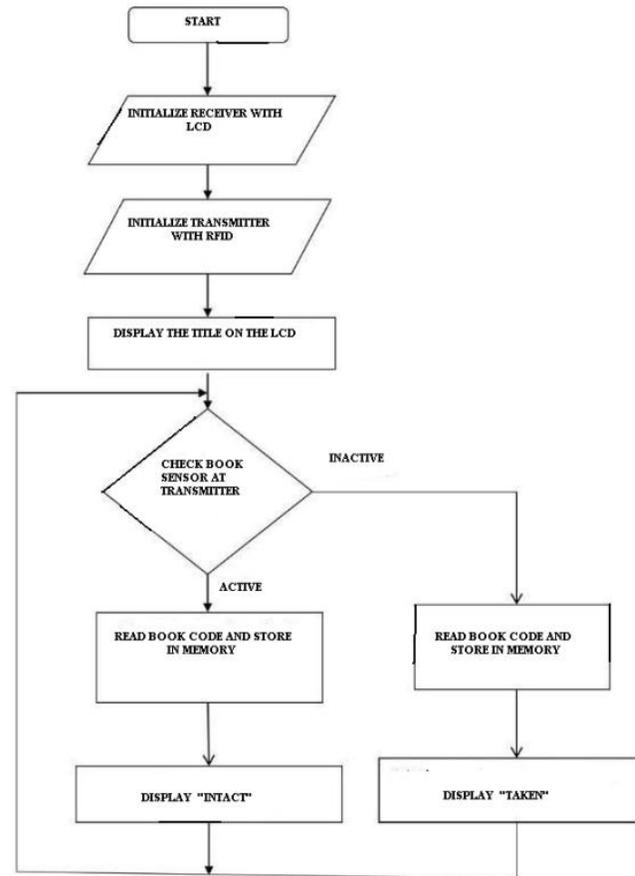


Figure 2. Working Of Library Book Security System⁵.

instructs the motor driver to reduce the speed of the vehicle automatically. A SMS alert has been sent to the owner regarding the vehicle's speed at the particular zone.

The Figure 3 explains the flow of the parameters monitoring and speed reduction system. The passive RFID tags have been used here since they do not need batteries

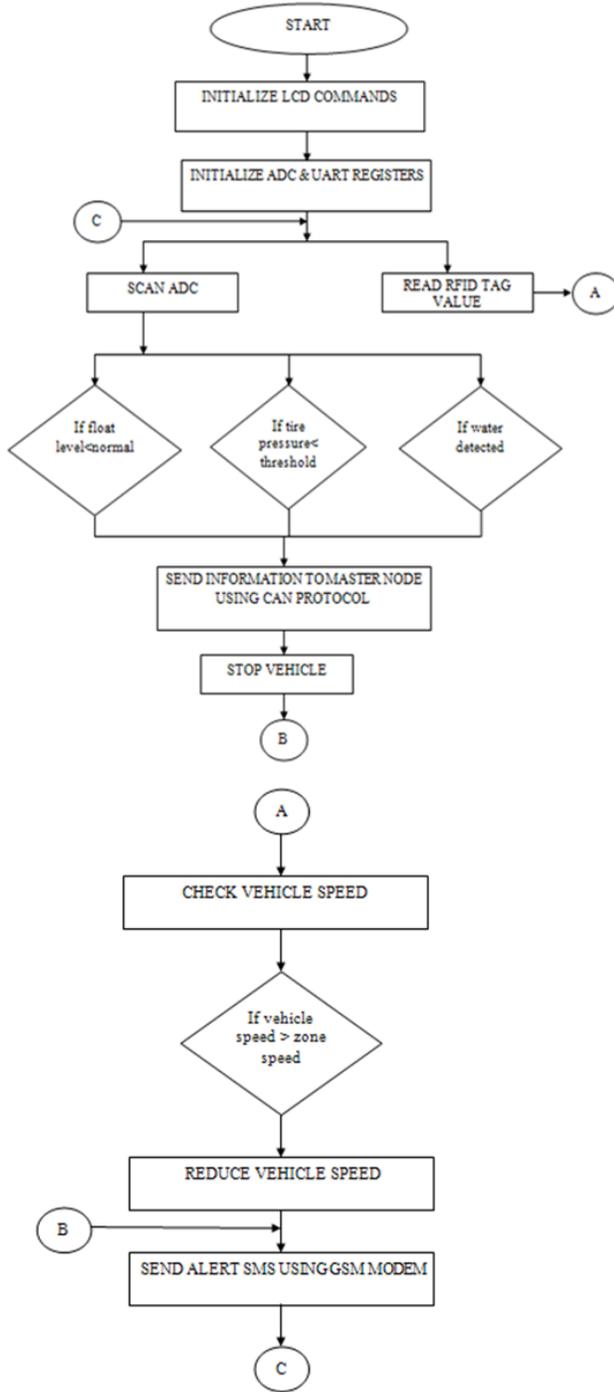


Figure 3. Working Of Automatic Speed Control⁹.

and also have unlimited life span. Moreover the accidents have also been reduced due to the RFID technology for automatic speed reduction⁹.

4.4 Bank Security System

The bank security system has microcontroller, RFID reader, security question software, electronic nose, GSM modem, keyboard and LCD. The passive RFID tag has been used in this system to read the ID number and sent it to the microcontroller to check whether it is the valid person or not. The unique ID numbers of different persons had been already stored in the memory of the microcontroller. If the valid ID number is identified, then the controller asks for the security question (different for different users) and checks whether the data given are correct or not. For the correct data, the microcontroller will send a SMS (Short Message Service) request through GSM (Global System for Mobile) to the authenticated person's mobile in order to get the original password to open the lock.

If the ID number is invalid, the locker will not be opened to the unauthenticated person. This system provides a good security system to the bank lockers at effective cost. An odor identification technique has also been used by introducing electronic nose system to identify the right person. The microcontroller compare the stored pattern with the input pattern and if matches the locker is opened. The Figure 4 explains the flow of

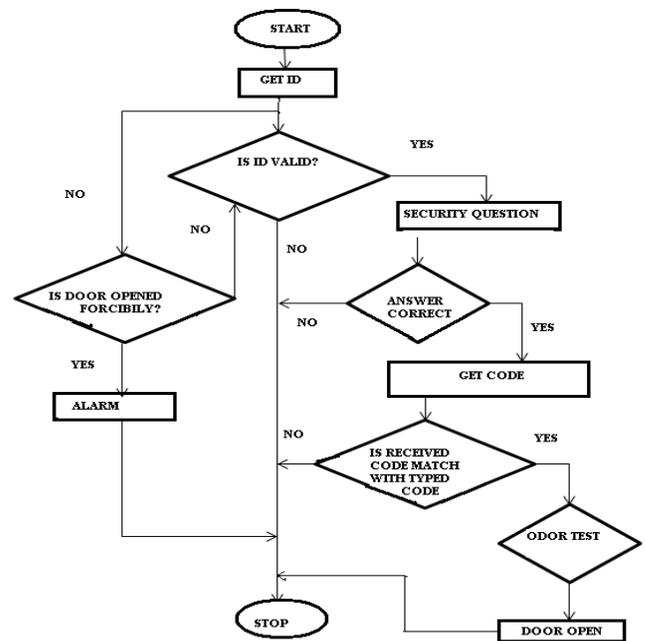


Figure 4. Working Of Bank Security System¹⁰.

the bank security system. The user is allowed to access the locker on the basis of the RFID value. This system is advantageous since the locker is secured and cannot be accessed by unauthorized person¹⁰.

5. Conclusion

RFID technology can be used in various areas like schools, colleges, industries, supermarkets, agriculture, hospitals, poultry, etc. based on the application. They are small in size and also do not consume more power. RFID tags are used mostly in areas of tracking and monitoring. They are low cost, high speed and high accuracy.

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