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RFID Applications in Railway Industry

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Abstract:

The increased growth in the railway sector has resulted in an increase in the train traffic density across the world. This has resulted in the increase in the number of accidents involving trains. In this project, the proposed system aims on current applications of Radio Frequency Identification (RFID) in railway industry. Application of RFID is one of the promising wireless communication technologies in the railway industry. A wide range of applications of RFID in railways is in the incipient stage in different parts of our globe. These are position and location of trains, operation and maintenance, train axle temperature measurement, track inspection system etc. All these applications are presented in this project along with their advantages over the existing system. A new application, i.e. train over speed protection system is proposed here. Application of RFID results in automation of huge and complex railway system. Thus, application of RFID technology can improve the operating efficiency greatly, ensure the safety of men and machines, andreduces the economic losses.

Keywords:

RFID Tags and Reader, RFID Application, Railway Transportation System, Intelligent Transportation System.

1 .INTRODUCTION:

In this project, we provide a survey of current RFID applications in the railway industry. With an increase in demand of railway transportation system (RTS), overall infrastructure of RTS has been growing in a very rapid manner. This is to control the heavy traffic density and also to provide safety in its operations. Although the railway system made use of automation in some areas at present but, there are still many areas that are controlled/ managed manually. RFID is a contactless wireless technology that allows the remote identification of objects automatically by using radio waves instead of light viz. Bar-Code System.

The major components of an RFID system are shown in Fig.1. These components are reader/interrogators with an antenna, a tag or transponder, and a database stored in a Personal Computer (PC) with connection to a larger network. RFID was invented in the year 1948 while developing and improving the RADAR system. As the technology was on developing stage so lots of experiments were performed and tested between the years of 1950-1980. In the year 1990, there is a rapid growth in the use of RFID technology and also it is being used in some of the different applications.

In the 20th century, there is standardization in RFID technology which caught the main attraction of many industries and also become a part of human's daily life. With the reduction in its cost and growing maturity many industries are now adopting this technology for a better and safer operation including railways. From the market overview, CNN included RFID as one of the "Ten Technologies to Watch in 2004" . AICPA announced RFID as one of the "Top Ten Major Technologies Impacting the Accounting Industry in 2004".

ZDNet called RFID one of the "Ten Strategic Technologies for 2005". Wal-Mart handled about 4 billion cartons in 2004 and 5 billion cartons in 2005. The ABI_s report predicts the total revenue earned by RFID products and services will amount to more than $5.6 billion in 2009. The market for RFID transponders, readers, software, and services will generate $70.5 billion from 2012 to the end of 2017 [7].

The market was boosted by a growth of $900 million in 2011 and the market is expected to grow 20% year over year (YOY) per annum as per the report of Cellular-news. RFID was third on the list of technologies that can dramatically decrease transit times and increase operational efficiencies as per the 24-7 newsletter in July 2013. All these information show a rapid development in RFID with an increase demand of the applications.

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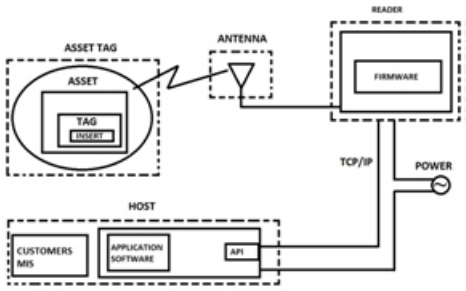

Fig.1. Components of RFID

2. RFID COMPONENTS AND ITS FUNCTIONS:

In this Section the key components of an RFID system with their functions are briefly discussed. The modern RFID system consists of basically three componentstag/ transponder, reader and back-end database and are discussed below:

A. Transponder/Tags:

It is divided into two parts: chip and antenna. A chip contains memory which is used to store some unique information and the memory inside a chip can be designed in four ways according to the specific requirements, which are read-only, read-many, write only and read-write. The antenna helps the transponder that sends data to the reader. Types of Transponder/Tags:

a) Active:

A regular two way radio communication is achieved as the active tags consists of the battery and a conventional transmitter. It has longer read range as compared to passive tags and also due to the lower power consumption the power source of active tags can live for upto ten years.

b) Passive

A passive tag does not have a battery; they use the energy that the electromagnetic wave from the reader inducesin the antenna to power up the chip and to transmit the data back to the reader. Passive tags reflect energy from the reader or receive and temporarily store the energy in order to generate the tag response to the reader. Use the Backscattered signal for the tag-to-reader communications, they have a battery designed to help them power the tag circuit and support the data storage.

c) Semi-passive :

Its working is similar to passive tags, they also use serial number that cannot be modified but have a memory space where one can put his own information. Data can be altered dynamically.

Types of Transponder Tag memory:

a) Read Only (RO):

The memory contains a pre-programmed serial number during the chip manufacturing process and cannot be modified. The data communication is unidirectional; data transmission from the reader to the tag is not possible. While using it one have to connect the serial number of the tag with particular software. It can be easily integrated with data collection systems and also cheaper as compared to read-write tags.

b) Read Write (RW):

It can be used to write new information as well as to read information from the tag. It also has a pre-programmed serial number that cannot be modified but have a memory space where one can put his own information. Data can be altered dynamically.

c) Write Once Read Many (WORM):

It is in between RO and RW tags. It is written to thetag one time, and read it as much. Once the data on the tag are written, it becomes locked and only data can be read.

B. RFID readers:

The RFID reader is another important component of RFID systems and it is a device that is used to interrogate an RFID. It is based on backscatter modulation and the reader has an antenna that emits radio waves and the tag responds by sending the information back from it. It serves the following functions:

- Communicating bi-directionally with the tags.
- Initial processing of information that is received.
- Connection with the server which mainly links the information into the enterprise.
- It provides the connectivity between individual tags and the tracking/management system.

There are two types of readers exist i.e. read and read/ write.

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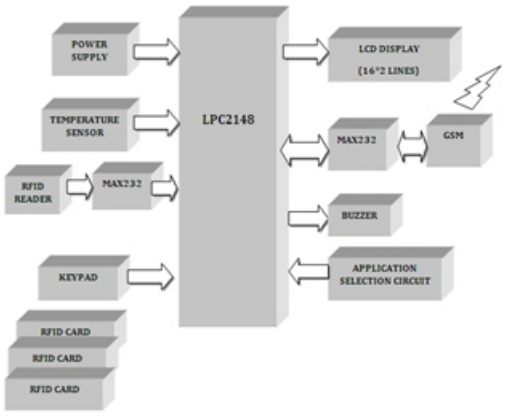
C. Back-end Database:

A networking element is present in most of the RFID readers viz. wired Ethernet or wireless Ethernet which mainly connects a single RFID- read event to a central server. Also the data are stored in the database and the central server runs a database application that functions for the object matching, tracking and storing. All these components play an important role in the proper operation of an RFID system. There is also a continuous research which is in progress with the development in RFID standards and is described in the next section.

BLOCK DIAGRAM:
UNDER GROUND MINER SECTION:



1 .RFID TICKETING SYSTEM:

The ticketing system at present can be automated with the implementation of RFID technology. As Compared with ordinary ticket, this automated ticket is more resistant to fake tickets and facilitates contactless automatic identification RFID system offers some advantages over the conventional paper based ticketing system. The system works in this way, firstly the requirement of RFID cards will be mandatory for all the travelers choosing railway as a mode of transport and with the initiative of the government it will become easier. A wireless hand-held device will be provided to the ticket checker consisting of a card reader during the journey. The checker will swipe each and every card of the passenger. During swiping, the device is capable of displaying the details of the passenger viz. card id number, name, The destination code could be entered by the checker so that exact amount can be deduced. With the RFID technology the problem of passenger identification can be done easily as the card holder would carry a photograph, a unique id number and also for more security the card holder may have a key which is known to him only. The process of automated ticketing can be done through the phone or the internet and it will make the job of ticket checker easier. The proposed system consists the RFID Reader to identify the passenger and keypad to authentication and select from/to stations. The system provides the GSM to send the SMS alerts.

2. Identification and Positioning system:

The RFID system can be used for the purpose of Railway Vehicle Identification (RVI) system. This system can work effectively where the continuous signaling system is not present. This system provides the positive reports for the identity of the vehicle for several applications viz. Traffic and Passenger Information Display System, Vehicle Maintenance System, Vehicle Location/Positioning System. The working of this system includes RFID Tag which is mounted oj the track that transmits the identity of each of the corresponding location and received by the RFID Readers mounted under the bogie, normally on the sleepers at a regular interval of time and connected to a computer control system installed in the stop through a serial link. The arrival or departure information to the control system is obtained when the reader once receives the vehicle identity from the tag and at the same time this information can be displayed in a platform if at each stop, a Reader is installed. The first reader is installed at the arrival end of a platform which will report the arrival and the second reader installed at the departure end of the platform, for reporting the departure of a vehicle from the platform.

3. Track Inspection System :

At present, in railways the track inspection is done by the permanent way maintenance. It mainly consists of gangs consisting of gangmen under the supervision of a gangmate. This is one type of patrol system and it checks a particular assigned section of track normally 6km-10km. This system also consists of some visual inspection to inspect the track and perform normal routine maintenance. Therefore, the present system may have some inaccuracy due to the human intervention and if any irregularity which occurs in the track if not reported on a specific time then cases of derailment may occur. So, to improve the standardization, control level of operation and to monitor the patrol team scientifically and accurately RFID system

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can serve the application. In the proposed application the rfid tag is placed at the tracks and the reader section with the inspection person. When the person goes to inspection the details will be automatically forwarded to the railway department..

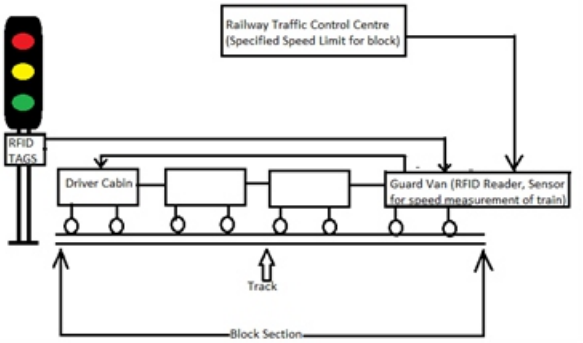
4. Axle monitoring System :

The temperature of train axles increases with an increase in train speed. Due to overheating of the train axles there are chances of sudden accidents if not properly monitored. Nowadays the temperature of the train axles is monitored by the wayside monitoring system and also some sensors are used to monitor the same. The present system works only for a nominal speed but with higher speed the system is unable to record the temperature of train axles. RFID system is designed which makes the use of a passive tag for the train axle temperature measurement system This prototype introduces an RFID-based system to be used for train axle temperature measurement system. In this system the tag is fixed beside the track, and a reader is attached to each train axle. Assume an effective range radius of a reader, when a train passes by the tag, the time during which the tagged axle passes through places is the communication time for the reader and tag. The time is an important factor in this system as the tag should have measured the temperature, and sent it to monitor within a short time. For successful measurement of the temperature of a running train axle, the train velocity requires a lowest reader-tag link rate for Read-tag communication and a longest conversion time for the temperature sensor. The effective communication range of tag is decided by the velocity of the train, the total time available to complete the measure/store/sequence and with the help of some other parameters.

5. Speed indication system:

Transportation on railways provide excellent safety despite sometimes there have been occasions when drivers have allowed their train to pass a point where they should have stopped. Many of these incidents have resulted in collisions, some involving loss of life and most involving damage to equipment or property. Most incidents are the result of a driver failing to ensure that his train stops at a stop signal and this situation is known as SPAD or Signal Passed at Danger. There are various systems that have been introduced to prevent this kind of situations.

The protection systems used by the Railways are TPWS (Train Protection and Warning System), TCAS (Train Collision Avoidance System) and ACD (Anti- Collision Device). The proposed system for over speed control basically comprises of two parts: placement of RFID sensors (tags) in the railway traffic signals and the on-board systems in the guard's van of the train. A train must run at a speed as specified for a particular block section and determined by the railway traffic control centre. A block diagram of the proposed system is shown in fig. 3. From the different sensor readings the Railway Guard can compare the running speed and actual speed for a particular block section. The railway traffic control centre sends the information about the specified speed for a particular block only to the railway guard so if a train is running beyond the nominal speed the guard can pass the information to the train driver so that the train must run at nominal speed in a particular block section.



APPLICAIONS:

New applications and various report formats can be rapidly prototyped and deployed. In addition to the standard configuration, we design a systems to meet specific application requirements. Some of the customized applications developed to integrate with the system include:

RFID Ticketing System:

Identification and Positioning system
Track Inspection System
Axle monitoring System
Speed indication system

6. RESULT AND CONCLUTION:
RESULT:

The proposed system was fully developed and tested to demonstrate its feasibility and effectiveness.

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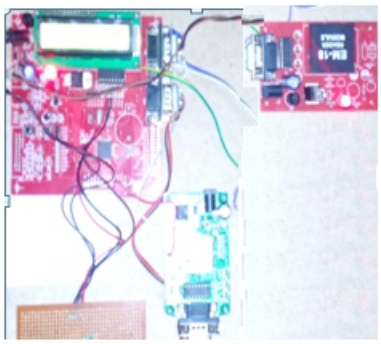
The screenshots of the smart home app developed has been presented in Figure bellow.



7.CONCLUSION :

In this project, a survey on applications of RFID technology in railway industry is presented. Five different current applications of RFID in railway industry are designed and discussed. Some of these applications are implemented in some part of the globe. The scope of an intelligent RFID railway transportation system is proposed and this could bring new research opportunities for the researchers. It is expected that with advancement in next generation RFID technology (standard-2), the performance of various current applications will improve and also it may be made applicable in other areas of the railway system. Finally, a wide scale commercial implementation of RFID applications in railway system will enhance its overall performance.

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