

# Rolling Stock Monitoring With RFID Technology

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**Abstract**—For automate the maintenance record of rolling stock (Wagon, Coach, Engines) nowadays RFID technology has been successfully adopted by Indian Railways. This review paper explains some of salient features of RFID (Radio Frequency Identification) including RFID reader, RFID passive tags, Antenna and power backup. The key requirements are that the reader should work with LLRP protocol and communicate through TCP/IP interface and that the reader should be GS1 compliant. The reader should be capable of reading (from a distance of approx. 1 meter) compatible tags fitted to trains moving up to a speed of 200 KMPH. Some common applications of RFID including animal identification, automatic car parking, automatic banking system, attendance system, railway system, road toll tax, ATM machine and lots more. Indian Railways need to adopt RFID Technology successfully to automate and maintain records of rolling stock (Wagon, Coaches and Engines) and to track Wagons Fitted with RFID Tag using Fixed RFID Readers with LLRP Protocol. LLRP protocol is mounted near the Railway Tracks in Specified Routes using Customized Reader Software as per GS1 Standard. This review paper explains some of salient features of RFID (Radio Frequency Identification) including RFID reader, RFID passive tags, Antenna and power backup.

**Keywords:** Passive TAGS, TPDs, Microcontroller, GS1, RFID, LLRP, TCP/IP

## Introduction

RFID – Radio frequency identification, is a modern technology for the recognition as well as tracking of living or non-living objects. RFID uses radio waves for the exchange of data between RFID card and tag. While exchanging data (digital information) between RFID card and tag, we did not bother about the LOS (Line-of-Sight) which is the common problem with barcodes. RFID could be considered as the better substituent of barcodes.

Advantages of RFID over barcodes

(A) “Line-of-sight” is the common problem when we deal with barcodes but RFID needn’t any LOS for any communication.

(B) RFID tags could be easily “Rewritten” as compared to the barcodes.

(C) RFID has improved read rates as compared to barcodes.

This technical paper explains how RFID technology helps in maintenance record of rolling stock (Wagon, Coach, Engines) in Indian Railways. Alignment of RFID fixed reader as well as RFID passive tag plays a vital role in this project. Additionally, the orientation must be at 90° to the track. Also, the orientation of the antenna does not change due to passage of train. In addition to this Multiple antenna may be used for data recording. For meeting the global standards GS1 provides optimum solutions. GS1 increases the longevity of the system as components that are standards-based can be sourced from different suppliers. Automatic identification and visibility systems based on global standards helps users focus on the business requirements instead of developing their own standards for identification and data communication. A basic RFID system consists of mainly two devices RFID card (reader) and passive RFID tag. The technology requires some extent of cooperation of RFID card and passive tag. Now we can also see another aspect of RFID in another domain. In this paper, we have given Introduction of RFID in Section I. Section II briefly explains Literature Review and highlights on some more information with respect to RFID Technology. Section II includes parts of RFID. Section II describes the proposed model of RFID in Railway System. Section IV explains the Technical proposal for the proposed network model. Section V explains the working of proposed model and its benefit. Finally we acknowledge and concludes the paper.

## More Information

**Literature Survey:** RFID is not a new technology implemented in Railways. It is already in use in various areas to make the work easier. It has observed during study that, the railways system still there are many areas that are controlled and managed manually. Implementation of RFID automate the Railway Transport System (RTS), which made easy to control the heavy traffic density and to provide safety operations. The application of RFID technology in railways is one of the tools that can improve the quality of transport services and the ability to apply to the transport market. Integration of RFID can provide benefits to carriers and consumers both. Jaroslav Masek, Peter Kolarovszki, Juraj Camaj introduced the

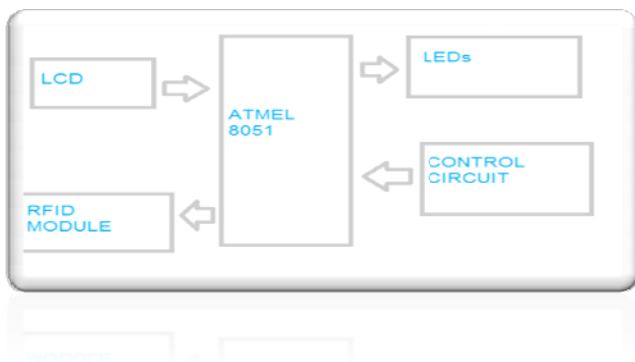
possibility of using technology for automated data collection and processing, development and testing new RFID technology for railways.

In addition to this, RFID not only changes but also improves the business environment of today’s market entire the globe. The objective of this Program is to develop a suitable RFID reader with customized software as per requirements and to demonstrate the capability of reading compatible tags fitted to fast moving trains at a specified site to be assigned by Indian Railways. Today’s RFID technology is widely used for tracking as well as identifying of different goods throughout the globe. When it comes the most trustworthy technology for identification as well as tracking the goods throughout the globe then RFID technology is at top-notch position. Nowadays RFID modules are easily available across the globe with pocket-friendly prices.

As we already discussed that a basic RFID system consists of mainly two devices RFID card (reader) and tag.

**Parts of rfid**

RFID card (reader) is a kind of transceiver which communicates with the tag. Additionally reader is responsible for the generation of RF fields. When the passive tag comes in contact with these RF fields then it transmit its stored information. The information could be a single binary bit or a large array of bits.



**Fig. 1. A typical RFID based system**

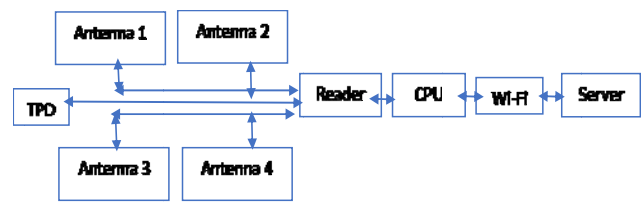
The above diagram (typical basic RFID system) shows a typical RFID based system consisting of RFID module, microcontroller, LEDs, control circuit and LCD. Some common applications including shopping cart, voting machine, telemedicine system, challan system, animal identification, automatic car parking, automatic banking system, attendance system, railway system, road toll tax, ATM machine and lots more.

Some of the key points of this model including GS1 compliant UHF RFID reader with LLRP & TCP/IP support. LLRP protocol used in this software communicates with the reader and performs read/write operation of tags, configuration of

reader and other required commands. Additionally, up to 4 antennas as required to be placed near the railway tracks with battery back-up for supporting up to 72 hours of operations. In addition to this 5Wagon Wheel (Train) Presence Detection (TPD) sensor to be suitably placed in the track rails. The reader will normally be in SLEEP mode and will wake up when triggered by a signal from the TPD sensor placed on the tracks when a train moves over it. After the train passes and no activity for a few seconds, the reader will go back to sleep mode.

**Technical Proposal and proposed model**

This is proposed technical system having 04 antennas, RFID fixed reader, TPD, CPU, Wi-Fi module and server. All the 04 antennas connected directly to the RFID fixed reader using GPIO ports. TPD always wakeup the RFID antenna when train approaches and send back to sleep mode when train moves away. For making smart decisions, RFID reader attached with CPU. After fetching information from RFID passive tags, critical information further passed to Wi-Fi and then move to nearest sever.



**Fig. 2: Technical Proposal of System**

**Proposed Networking Model**

This is simple networking diagram of module having four components RFID passive tag, RFID reader, Antenna, Integration computer and WAN. As per the proposed system, in Railways the main requirement is to track Wagons Fitted with RFID Tag using Fixed RFID Readers with LLRP (Low Level reader Protocol) Protocol. As per GSI Standard, the LLRP protocol is mounted near the Railway Tracks in Specified Routes using Customized Reader Software. All the passive RFID tags are designed are to fetch data at the speed of 200Km/h. All the antennas are twisted at 110-degree azimuthal angle for making proper communication between passive tag and RFID reader. In addition to this, 04 additional GPIO’s (General-purpose input output) are also available for interfacing further modules for making optimum system. After fetching data from antenna, RFID fixed reader passes away the information to integration computer, which is further forwarded to WAN. For security purpose, the whole information is GIAI-202 encoded. In addition to this, the role of TPD (train presence detector) is also critical which wakeup the reader whenever train comes.

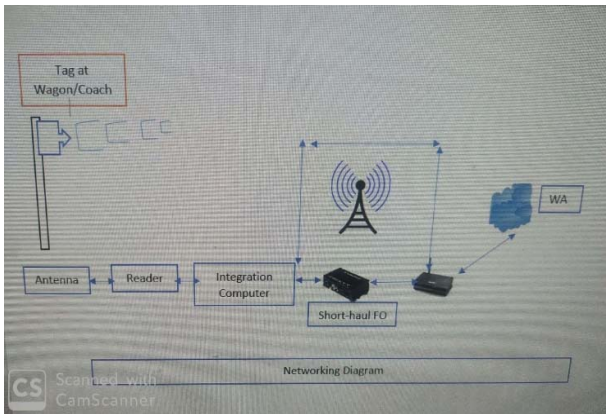


Fig. 3. Networking Diagram of Proposed Model

**Working of proposed model**

The working of proposed model mentioned below in three different steps. These are:

**Step1: Write your code in the above-mentioned environment.**

Write your program (as per application) either in C or assembly language in the KEIL software environment. The KEIL software environment includes mainly three main tools including assembler, compiler and linker. It converts the high-level language into machine level language. Better we can say that KEIL is responsible for the conversion of C/Assembly language into hex language. For better understanding, please refer the given screen shot in Figure

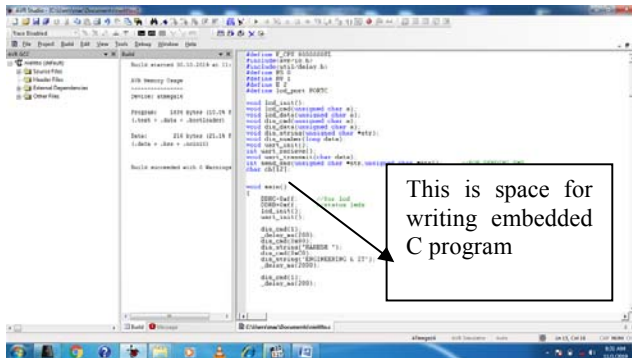
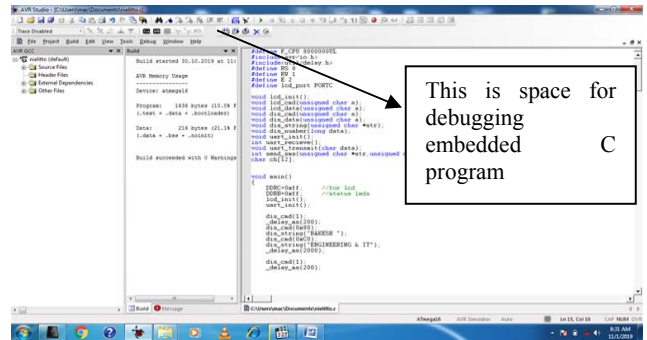


Fig. 4. Sample Program Written in C in KEIL Software

**Step2: Debug your embedded c program by pressing the mentioned button**

A HEX file is a hexadecimal source file typically used by programmable logic devices, such as microcontrollers in remote controls, office machines, and automobile engine control systems. It contains settings, configuration information, or other data saved in a hexadecimal format. When Arduino compiles your sketches, it produces an output

file called Hex file. This file is usually stored in some remote location usually under user/appdata. The hex file of the application program looks like this. Now the hex file of the application program is ready to move into target IC (integrated circuit).



**b) Making HEX file by again pressing the mentioned button.**

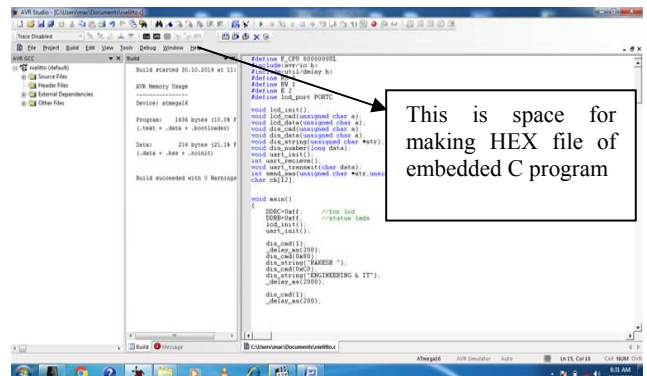
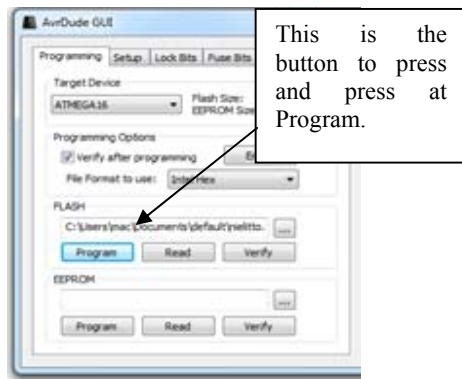


Fig. 5: The Output in Hex File Format

**Step3: Dump your HEX file into target IC using AVR DUDE burner by pressing at the mentioned button**

Once the hex file is ready to move into the target IC, we need a programmer or better we can say a burner. Programmer/burner is actually responsible for transferring the hex file of the application program into target IC. Here we are

using FLASH burner, which is responsible for the 8051 family.



**Fig. 6. Sending Hex File into IC Using DUDE Burner**

It is necessary to always make a new hex file and again need to burn it into target IC for implementing the every time new application. It is very easy to develop huge number of applications by changing only software but without further modifying the hardware.

#### **Acknowledgment**

We are thankful to all the reviewers for their relevant comments and guidance to improve the paper. The various published research papers and the research work done by all of them have supported a lot to complete this paper.

#### **Conclusion:**

Automatic identification of rolling stock (coach, wagon, locomotives) is the main aim behind launch of this project. Additionally reducing human intervention resulting less error is also the main concept behind this project.

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