© August 2022| IJIRT | Volume 9 Issue 3 | ISSN: 2349-6002

Anti Collision Avoidance System Using RFID Tags

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***Abstract* - In practically all of the world's major cities are using railways and railways are a popular means of transportation. Railways are the most secure and dependable means of transit. Indian railways have installed a collision avoidance system that includes GPS, RFID tags, and readers. Accidents are caused by a variety of circumstances, including miscommunication, bad weather, erroneous signals, and a hurried route change. Because unsafe conditions can emerge if the loco pilot does not receive appropriate information on time and ahead of time, railways have implemented the following equipment to address this issue.**

***Index Terms* - RFID Tags, RFID Readers, LDR Sensor, Android device.**

1.INTRODUCTION

The Anti-Collision Device system has been installed by Indian Railways. An automatic surveillance system is installed on each locomotive. Trains are one of the most extensively used and comfortable modes of transportation, yet collisions do occur rarely. Due to the fast speed of the trains, which necessitates a significant stopping space, it is extremely difficult to prevent such tragedies. Around the world, there are numerous train accidents. This technology is cutting-edge to help to resolve challenges by applying an automated surveillance system based on RFID, ARM Controller, and GSM. The anti- collision system takes into account train speed, position, distance to the signal ahead, signal characteristics, and other parameters.

The train tracks are separated into several frames, each of which is 10 kilometers long and labelled with a unique track number that is read by the locomotive's surveillance system. As a result, the track id must be provided at a distance of 10 kilometers on the train track. Radio Frequency Communication technology will be used to send this track number to the base station.

2.MICRO-CONTROLLER BASED SURVEILLANCE SYSTEM

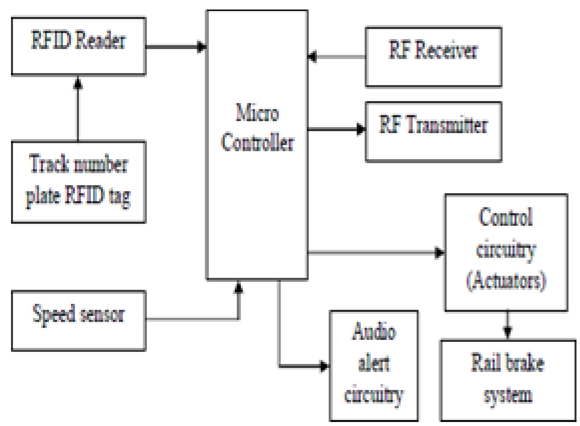

Fig.1: Block diagram of the proposed system

Train tracks are separated down into parts, each parts has its own number. The track number is read by the Radio Frequency Identification (RFID) tags at the start of each section when a train arrives at a starting of the track. The track number is saved by the RFID reader and then communicated to Radio Frequency (RF) Transceivers. A radio frequency contact is established by an algorithm between close trains in the range the allows the track numbers to be communicated. The track number of the RFID reader is now compared with the track numbers of other trains using the RF Receiver. If the system discovers the similar track number, the loco will be notified. If the loco pilot does not take any additional action which is detected with the help of a speed sensor during an interval of human response time, the system will override the loco pilot by applying the breaking of train with the help of actuators.

3.RFID SYSTEM

The following are the RFID installation guidelines:

- To convey Trackside information to the Loco ACAS unit, RFID tags will be installed on track in the station segment, point zones, nearby Signals, and track in the block section.

- RFID tags will be copied at all sites, with the irregularity of the Unique ID, which carries similar information about operations.

4. RFID TAG SPECIFICATIONS

1. It has a top speed of 200 kilometers per hour.
2. The operational frequency is 865-867 MHz
3. It can be programmed with at least 128 bits of user data (with CRC).
4. It might even be submerged in water up to the rail level.
5. It should have an IP rating of at least 68. It will work after being dipped in water for 24 hours at a depth of 1 meter.
6. The RFID reader antenna must be able to read the RFID tags from a vertical distance of 700mm and from the bottom of the RFID reader antenna to the top of the rail level in field operation of settings.

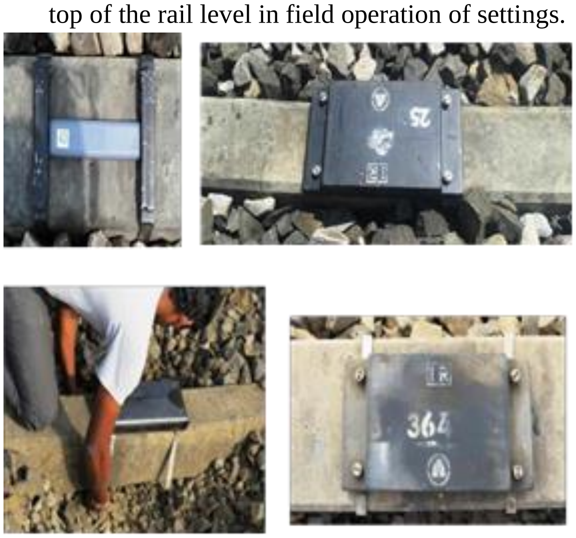

Fig 2: RFID Tags

5. RFID TAG INSTALLATION PROCESS

- The RFID reader antenna should be positioned in a horizontal plane, with a vertical distance of 400mm to 450mm between the bottom of the RFID reader antenna and the top of the rail level, and a horizontal gap of 100mm between the RFID reader antenna and the rail level's center.
- The RFID tags will be spaced around 1 kilometer apart, however this may be reduced near stations; no holes should be drilled in the sleeper columns, and the tags should be kept in place using the clamps.
- At the bottom of all RFID tags, the tag number and kind should be written.

The following are the markings:

- RFID number
- Type
- Absolute Positioning
- The topmost component of the Fixing Arrangement must not be higher than 75mm above the top surface of the PSC Sleeper in the middle when installed.
- The RFID Fixing Arrangement would be installed so that the width of the RFID Fixing Arrangement does not exceed 380mm along the length of the PSC Sleeper.
- All RFID tags must be labelled at the bottom with the tag number and kind. The marking technique is as follows: Absolute Location-Number-Type-RFID Keep the following considerations in mind when selecting a location for RFID installation.
- RFID tags and fasteners should be avoided in the turnout area in general. These are not to be installed in the switch area of the turnout, from the Actual Toe of Switch (ATS) to the heel of the switch.

Fig 3: RFID Tags installation on tracks

6. JUSTIFICATION OF THE PROPOSED SYSTEM

The grounds for the proposed surveillance system are as follows:

- This system is completely automated.
- RFID tags are more dependable than other methods of transmitting data to the system as a result of this, it will prevail over human neglect (such as track numbers). Natural interference or inconvenience have no effect on this process.

- Track numbers can be duplicated outside the RF zone of older track sections using a well-defined track numbering technique. By storing track numbers in fewer bits, the microcontroller's calculation load is reduced, which is especially essential in big railway networks (16 bits).
- Rather than using external components, a microcontroller with built-in peripherals produces a less complex system that is easier to programmed and modify.
- The odds of data collision are minimized because RF trans receivers are configured to communicate three times, at randomly determined time periods within a second.

7.STATIONARY TCAS

Stationary TCAS Units must be generally suitable for all types of signaling used by Indian Railways, including color light signaling. By default, it should work with Panel Interlocking and Electronic / Solid State Interlocking. Stationary TCAS Units are often used to cover all trackside signals at stations.
Where the station TCAS tower's radio signal coverage is insufficient, it will also be provided at Intermediate Block Locations (IBS) and middle interlocking Level Crossing Gates. This will be connected to interlocking equipment so that real-time dynamic information may be obtained about signaling, such as different signal aspects.
It has a database of static signaling- related data, such as RFID tag location and details, as well as Speed Restrictions. Through UHF Radio Communication, it receives real-time information about the locations, speeds, and other characteristics of various trains in its jurisdiction. It recognizes any critical condition based on this data and can direct the command to Loco to take action to stop it.

The components of a stationary TCAS unit are as follows:

a. TCAS Vital Computer (Station/LC/IB)
b. TCAS Radio Unit (Stationary)
c. Remote Interface Unit
d. Indicator Panel for Station Master Operation (SMOCIP)

Fig 4: Station TCAS unit

8.TOWER AND ANTENNA

A combination of vertically polarized omni and/or directional antennae must be used for the station's fixed communication system, IBS, and middle interlocked Gate unit. The antenna cable is activated when the first signal from the Stationary TCAS unit approaches.
A minimum communication range of 1.5 kilometers must be provided by the antenna (typically 4.5 kms in case of Double-Distant territory of Indian Railways).The activities involved in tower construction are listed below:

- Selecting a foundation design based on soil test results: Bearing Capacity of the Soil
- Sand, cement, cube, metal, bolt, steel, and TMT bar tests done during (a) foundation construction. (b) Erection - verify for verticality and galvanization
- In partnership with the Civil Engineering department, the base and tower will be constructed.
- After building the activities including tower painting, fencing, earthing (ring earth), lightning arrestor, and aviation lamp fitting
- Install a radio modem and protocol converter at the base of the tower.

9.INSTALLATION OF COMMUNICATION EQUIPMENT'S

ACAS is installed on the following frequencies: 441.8 MHz, 456.8 MHz, 416.8 MHz, 466.8 MHz, and 426.8 MHz. FDMA- TDMA is used for communication. The following items must be installed:

- 406-470MHz, 25KHz BW radio modem installation.
- Stacked Dipole Omni-Directional Gain 9dBi Station Radio Antenna Installation.
- Radom, Omni Direction, Gain 3 dBi

Loco Radio Antenna. Installing a GPS antenna is necessary for time synchronization.

Fig: GPS Antenna & Loco Radio Antenna

Fig: Station Radio Antenna

Fig: Radio Modem

10.GSM & GPRS COMMUNICATION

GSM/GPRS connectivity is used by TCAS for the following purposes: (A) Using the NMS to Send Fault Messages The Stationary TCAS and Loco TCAS units log unusual fault/critical notifications, which are delivered to the NMS in hot standby mode via respective GSM interfaces. Failure of radio communication for a duration longer than the applicable time-out (30 seconds).

11.GPS/GNSS COMMUNICATION

For effective data transfer among various TCAS units, time synchronization is critical. Errors and defects are frequently caused by a lack of temporal synchronization. TCAS employs the Time Division Multiple Access (TDMA) protocol, which necessitates unified time synchronization. Because India lacks a Universal Time clock, we rely on GPS/GNSS clocks to fix any system's Real Time Clock (RTC).

12.CONCLUSION

Anti-Collision avoidance systems are extremely important since they automatically inform level crossing gate operators to train concerns and accidents. We can save the lives of plebeians by execute this technology into railways. With the help of this technology the sequence of the railway accident caused by a collision will be controlled. Train accidents could be avoided, according to estimates, if the technology is adopted in railway networks.

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