# Automated Railway Safety Management System

# Project Report

Prepared by: Anvin A Varghese

Institution: Edure

Department: Railway Automation and Safety Systems

Date: 05 November 2025

# Business Requirements Document (BRD)

**Project Title**: Automated Railway Track and Road Safety Management System with Emergency Override Feature

**Institution**: Edure

**Mentor:** Jash

**Prepared by**: Anvin A Varghese (Project Contributor – System Design & Feature Enhancement)

**Department**: Railway Automation and Safety Systems

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# 1. Document Control

## 1.1 Version History

| Version | Date | Description | Author |
|---|---|---|---|
| 1.0 | 05-Nov-2025 | Initial draft of BRD | Anvin A Varghese |
| 1.1 | 06-Nov-2025 | Review and formatting update | Jash (Mentor) |

## 1.2 Stakeholders List

| **Stakeholder Name** | **Role** | **Responsibilities** |
|---|---|---|
| Anvin A Varghese | Project Contributor | System design, documentation, and feature enhancement |
| Jash | Project Mentor | Guidance, technical validation, and review |
| Edure Project Team | Technical Support | Review, testing, and integration assistance |
| End Users | Public, Railway Operators, Emergency Services | System usage and feedback |

## 1.3 Additional Distribution List

| Department/Individual | Purpose of Distribution |
|---|---|
| Project Evaluation Committee | Review and assessment |
| Technical Development Team | Implementation and testing reference |
| Documentation Department | Archival and official record |

# 2. Purpose of this Document

The purpose of this Business Requirements Document (BRD) is to outline the functional and non-functional requirements for the Automated Railway Track and Road Safety Management System. This document serves as a blueprint for developers, testers, and stakeholders to understand system functionality, design expectations, and operational workflow. It ensures alignment among all parties by defining system objectives, boundaries, and features to deliver a safe, efficient, and automated railway-road intersection system.

# 3. Introduction

## 3.1 Background

Railway crossings are major points of intersection between road and rail traffic. Manual operation of gates often leads to delays, congestion, and potential accidents. This project aims to create a fully automated control system that uses intelligent sensors and emergency override features to ensure both safety and efficiency.

## 3.2 Objectives of this Project

- Automate railway-road crossing gates using smart sensors.
- Eliminate human error and ensure consistent safety standards.
- Provide emergency override access for ambulances and emergency vehicles.
- Improve traffic regulation through real-time detection and signaling.
- Integrate with existing railway timing systems for synchronization.

## 3.3 Known Business Rules

- Gate closure must begin a fixed interval before train arrival.
- Emergency vehicles are always prioritized during active crossing phases.
- System must automatically reopen gates after full train clearance.
- Manual override will be available in case of technical malfunction.

## 3.4 Scope of this Project

The scope covers the design, implementation, and testing of an automated railway-road safety system that detects approaching trains, closes and opens gates automatically, identifies emergency vehicles through RFID or GPS signals, and communicates real-time status via LED lights and alarms.

## 3.5 Exclusions from Scope

- Manual gate operations beyond initial testing phase.
- Integration with third-party emergency dispatch networks.
- Urban traffic control coordination beyond railway intersections.

## 4. Process Flow Diagram

(Figure 1: Process Flow Diagram Placeholder)

Workflow Description:

1. Train detection sensors activate when a train enters the monitoring zone.
2. Warning signals and alarms engage for vehicles and pedestrians.
3. Gates close automatically under control of the switch mechanism.
4. After the train passes, sensors confirm clearance.
5. Gates reopen, and normal traffic resumes.
6. In case of ambulance detection, the system overrides gate closure safely.

## 5. Business Requirements

### 5.1 Business Process Overview

The automated system integrates sensors, control units, and safety indicators to create a seamless coordination between road and rail. The process is fully autonomous and designed to operate with minimal human supervision.

### 5.2 Detailed Business Requirements

| Requirement ID | Description | Priority | Status |
|---|---|---|---|
| BR-01 | Train detection sensors shall identify train movement in real time | High | Planned |
| BR-02 | Automatic gate control to initiate closure before train arrival | High | Planned |
| BR-03 | Audible and visual warnings must precede gate closure | High | Planned |
| BR-04 | Emergency vehicle override through RFID/GPS | Critical | Planned |
| BR-05 | Real-time monitoring via control dashboard | Medium | Planned |
| BR-06 | Self-diagnostic alerts to detect malfunction | Medium | Planned |

## 6. Non-Functional Requirements

| Category | Description |
|---|---|
| Performance | System must respond to sensor input within 2 seconds. |
| Reliability | Must operate 24/7 with 99% uptime. |
| Scalability | Capable of integrating multiple crossings across a city. |
| Security | Emergency override restricted to authorized vehicles only. |
| Maintainability | Easy replacement of sensors and control modules. |
| Power Backup | Solar or battery-powered to function during outages. |

## 7. Glossary of Terms

| Term | Definition |
|---|---|
| RFID | Radio Frequency Identification – used for detecting emergency vehicles. |
| Sensor Module | Device used to detect train presence or movement. |
| Control Unit | The main processing module managing signals and gate mechanisms. |
| Override Mode | System state allowing authorized vehicles to bypass restrictions. |
| IoT Dashboard | Real-time monitoring platform for remote control and analytics. |

## 8. Project Cost Estimation

| Component | Description | Estimated Cost (INR) |
|---|---|---|
| Sensors and Detection Modules | Infrared & Ultrasonic sensors for train and vehicle detection | ₹80,000 |
| Microcontroller & Control Unit | Processing, relay control, and integration hardware | ₹65,000 |
| Software & IoT Dashboard | Real-time monitoring platform and backend systems | ₹90,000 |
| Communication & Signaling | LED signals, alarms, and wireless transmitters | ₹70,000 |
| Installation & Setup | Hardware installation and configuration | ₹60,000 |
| Testing & Quality Assurance | Functional testing and safety validation | ₹45,000 |
| Maintenance & Power Backup | Solar, battery, and system maintenance costs | ₹40,000 |
| Total Estimated Cost | | ₹5,00,000 |

*Note: This mid-level budget estimate is subject to revision based on final component costs and implementation scope.*

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