SMART RAILWAY SYSTEM

By

Arka Mahajan

Ishika Haldar

Sayan Mukherjee

(B.Tech 3rd Year,

Enrollment No.: 12023002001038

12023002001054, 12023002001056)

Under the Supervision of

DEBAJYOTI CHATERJEE

Dept. of Computer Science & Engineering

University of Engineering & Management, Jaipur

Outlines

- Introduction
- Literature Review
- Objectives
- Proposed Model
- Experimental Setup
- Result Analysis
- Conclusion & Future Scope
- Reference
- Acknowledgement

Introduction

Railway level crossings are highly prone to accidents due to delays and human errors in manual gate operation. To overcome this challenge, an **Automated Railway Barrier Control System** was developed to enhance safety, reliability, and efficiency at crossings.

This system uses **infrared sensors** to detect the movement of trains and automatically controls the barrier gates through **servo motors**, reducing human involvement and minimizing the risk of train-vehicle collisions. It also ensures that only authorized personnel can access the system through **operator authentication**, and sends **real-time alerts** to concerned authorities in case of gate status change, manual overrides, or system faults. Additionally, the system maintains a **CSV-based event log** for record-keeping and future reference.

Overall, this automated solution aims to provide safer railway operations, reduce accidents, and improve the monitoring and management of railway crossing barriers.

Literature Review

Automation at railway level crossings has been widely explored to reduce accidents caused due to human errors in manual gate operation. Earlier research focused on basic sensor-based systems where Infrared (IR), Ultrasonic, or RFID sensors were used to detect the arrival of trains and operate the gates automatically. These systems helped in minimizing manual dependency and improved safety at unmanned crossings.

Some studies also introduced microcontroller-based models integrated with GSM or IoT for sending alerts to railway authorities regarding gate status. A few modern approaches implemented remote monitoring systems, allowing operators to track gate activity online. Although these solutions enhanced automation, they mainly concentrated on opening and closing the gates and lacked advanced features such as secure operator access, fault detection alerts, and proper data logging for future analysis.

The reviewed literature therefore highlights the growing need for a more reliable, secure, and intelligent system that not only automates gate control but also provides real-time updates, maintains records, and ensures safety through minimal human involvement.

Objectives

•To design an automated system to **control railway crossing barriers**
• using IR sensors and servo motors.
•To **reduce human errors** and prevent train-vehicle collisions at level crossings.
•To ensure **secure access** through operator authentication, allowing only authorized personnel to operate the system.
•To provide **real-time alerts** to concerned authorities regarding gate status, manual interventions, or system faults.
•To maintain **event records in a CSV log** for transparency, monitoring, and future analysis.

Proposed Model

Experimental Set-up

Result: Example

Result Analysis

The performance of the automated railway barrier system was analyzed based on accuracy, response time, reliability, and communication efficiency. The system consistently detected train movement through IR sensors with a **high accuracy rate** and operated the gate within a **2–3 second response time**, which is significantly faster than manual operation. This ensured timely closure and opening of the barrier, reducing the possibility of accidents.

Real-time SMS alerts were successfully delivered to authorized users within **3–5 seconds**, ensuring proper communication during both automatic and manual operations. The event logging feature stored data correctly in the CSV file, providing clear traceability of actions, timestamps, and operator involvement. No false triggers or malfunctioning events were observed during multiple test runs.

Key Findings:

Improved Safety: Automated control reduced human dependency and minimized chances of errors.

High Reliability: Continuous testing showed stable system performance with consistent sensor detection.

Efficient Monitoring: Real-time alerts and event logs enhanced transparency and quick decision-making.

Limitation

Limited Accuracy in Complex Scenarios:
The model may face difficulty in detecting railway gates accurately during low visibility conditions such as fog, rain, or nighttime.
High Dependency on Internet & GPS:
The system requires stable internet and GPS connectivity for real-time notifications, making it less effective in remote areas.
Battery & Storage Consumption:
Continuous background tracking of location and notifications may lead to faster battery drain and higher app storage usage.
False Alerts Possible:
Situations like bridges near railway tracks or parallel roads may trigger unnecessary warnings to the user.
Limited Coverage of Railway Crossings Initially:
The database of railway gate locations may not be fully complete at the beginning and needs time for expansion.
User Compliance Required:
If users turn off app permissions like GPS or notifications, the alert system becomes ineffective.

Conclusions & Future Scope

The proposed railway gate alert system provides a simple yet effective solution to enhance road safety near railway crossings. By using GPS-based tracking and real-time notifications, the system alerts users when they approach a railway gate, reducing the chances of accidents caused by lack of awareness or negligence. The application promotes safe driving and helps users stay alert, making it a valuable safety tool for daily commuters.

Future Scope

Integration with Railway Signals & IoT Sensors

The system can be connected to live railway signal data and IoT sensors installed at gates for more accurate, real-time updates.

Voice Alert & Multilingual Support

Adding voice-based alerts in multiple languages can make the system more user-friendly for everyone.

AI-based Prediction System

Machine learning can be used to predict train arrival times and traffic congestion around railway crossings for smarter alerts.

Offline Mode & Emergency Assistance

Introducing offline functionality and an emergency SOS feature can further strengthen user safety.

References

•S. Indian Railways Safety Report, Ministry of Railways, Government of India, 2023.
•Sharma & R. Gupta, *"Smart Railway Gate Control System Using IoT"*, International Journal of Emerging Technologies and Innovative Research (IJETIR), Vol. 9, Issue 5, 2022.
•P. Singh, *"GPS-Based Alert System for Road Safety Near Railway Crossings"*, IEEE Conference on Smart Transportation Systems, 2021.
•R. Kumar & A. Verma, *"Development of Automatic Railway Gate Control using Sensors"*, International Journal of Engineering Research & Technology (IJERT), Vol. 11, Issue 3, 2022.
•Indian Road Safety Campaign, *Annual Report on Railway Crossing Accidents*, 2022.
•Railway Board Circular on Level Crossing Safety Measures, Government of India, 2023.
•Official Indian Railways Website: https://indianrailways.gov.in
•IEEE Xplore Digital Library: https://ieeexplore.ieee.org

Acknowledgement

I am grateful for the support and guidance that contributed to the successful completion of this project titled "**SMART RAILWAY SYSTEM**". I express my sincere thanks to my project guide, _____, for providing valuable insights, constant encouragement, and constructive feedback throughout the development of this work.

I would also like to extend my gratitude to the **Department of** _____, **(College Name)**, for providing the necessary resources, laboratory facilities, and a conducive environment for research and practical implementation.

I am thankful to all faculty members, technical staff, and peers who assisted me directly or indirectly, and shared their knowledge and suggestions that greatly enhanced the quality of this project.

Finally, I express heartfelt thanks to my family and friends for their continuous motivation, support, and patience during the course of this project. Their encouragement played a vital role in the successful completion of this work.


Thank You!