Human Rail Accident Prevention System

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ABSTRACT

Transportation systems include air, water, and land modes, with the latter comprising roadways, railways, and off-road transport. Among these, roadways, railways, and airways are the most commonly used. Railways are often preferred due to their affordability and convenience. The Indian railway network, the third-largest in the world, plays a significant role in transportation. However, railway accidents remain a concern, particularly those occurring at stations due to the gap between the train and the platform. This "platform gap" poses a serious risk to passenger safety. To address this issue, the Indian government has proposed raising platform heights to reduce the gap. However, this solution is both challenging and costly, as it disrupts platform accessibility during construction. My project introduces a more practical and cost-effective alternative: mechanical platform gap fillers.

Keyword : *Railway Safety, Platform Gap Prevention, Passenger Safety Technology, Automated Gap Fillers, Servo Motor Control, Arduino-Based System.*

1. INTRODUCTION

Railway transportation plays a vital role in connecting communities, offering a cost-effective and efficient means of travel. With the Indian railway network ranking as the third largest globally, it is an indispensable mode of transport for millions. However, safety concerns persist, particularly accidents caused by the gap between railway platforms and trains. These "platform gap" accidents pose a significant risk to passengers, often resulting in injuries or fatalities.

Efforts to address this issue have included raising platform heights, but such measures are costly, disruptive, and time-consuming. In response, this research proposes an innovative and cost-effective solution: an automated platform gap filler system. By integrating ultrasonic sensors, Arduino microcontrollers, and servo motors, this system ensures passenger safety by dynamically bridging the gap between the platform and train during boarding and alighting.

This paper explores the design, implementation, and advantages of the proposed system, which aims to prevent accidents, enhance railway safety, and provide an uninterrupted passenger experience. The findings contribute to ongoing efforts to improve safety standards in railway infrastructure.

2. PROBLEM STATEMENT

The safety of railway passengers is a critical concern, especially in densely populated countries like India, where railways serve as a primary mode of transportation. One of the significant hazards at railway stations is the platform gap — the space between the train and the platform. This gap poses a severe risk to passengers during boarding and alighting, leading to accidents, injuries, and fatalities. Existing methods, such as raising platform heights, are resource-intensive, time-consuming, and disrupt station accessibility during implementation.

Despite ongoing efforts, the lack of a cost-effective and efficient solution to bridge this gap continues to jeopardize passenger safety. A robust system is required to prevent accidents without affecting the operational efficiency of railway platforms. This research focuses on addressing this gap by proposing an automated, real-time platform safety mechanism that ensures the safety of passengers while maintaining the functionality of railway infrastructure.

Current measures to address railway platform safety, such as raising the height of platforms or installing fixed barriers, face significant limitations. Raising platform heights is a resource-intensive and time-consuming process that often disrupts regular train operations and passenger accessibility. Fixed barriers, while providing some level of safety, lack adaptability for different train sizes and designs, making them less effective in diverse railway networks. Additionally, overcrowding during peak hours increases the likelihood of accidents, as passengers may unintentionally step into the platform gap.

Furthermore, the absence of dynamic safety mechanisms leaves railway stations vulnerable to human errors, such as slips, trips, or missteps, especially for children, elderly individuals, and people with disabilities. Despite advancements in railway infrastructure, a scalable, cost-effective, and real-time solution to bridge the gap between the platform and train remains largely unimplemented, emphasizing the need for an innovative approach to passenger safety.

3. METHODOLOGY

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4. SCHEMATIC CIRCUIT DIAGRAM

The ultrasonic sensor is mounted at a strategic location on the platform, facing towards the area where the safety grill needs to be monitored. To measure the distance of an object from the sensor, and the Arduino triggers the sensor by sending a short pulse. Arduino continuously reads the distance from the ultrasonic sensor. The Arduino sends a signal to the servo motor to move the safety grill to an open position, allowing passengers to move freely on the platform.

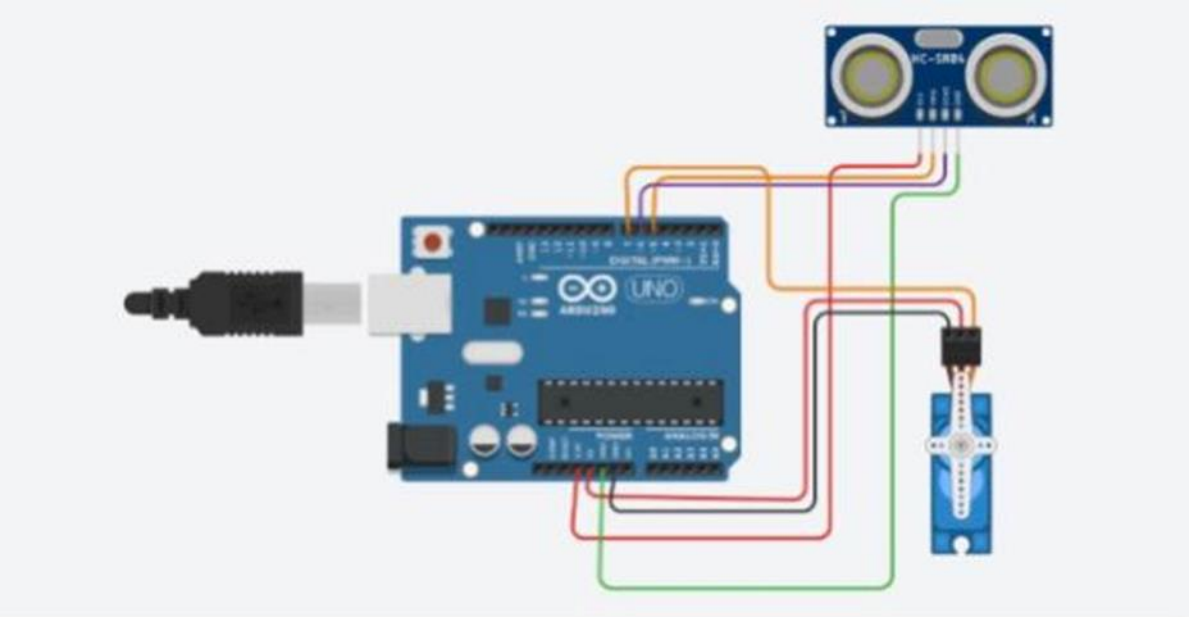

Fig -1: Circuit Diagram using Arduino, Ultrasonic Sensor and Servo Motor

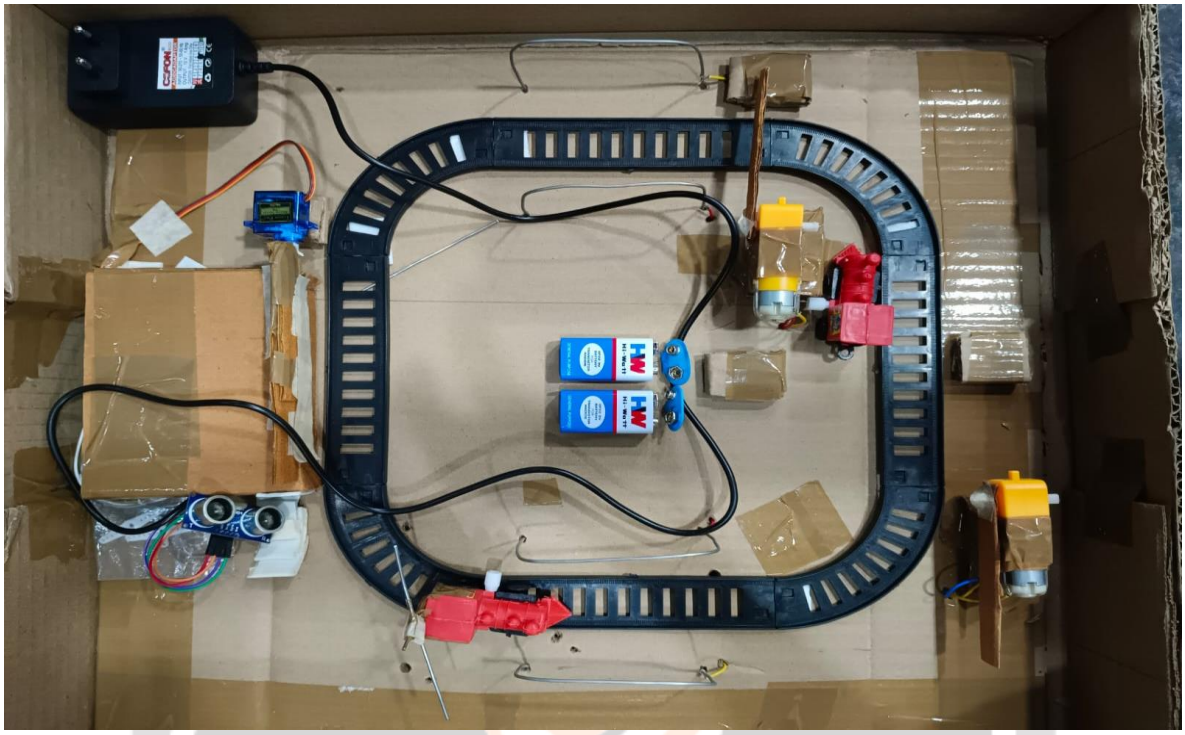

Fig-2: Prototype Model

5. OBJECTIVE

The primary objective of this project is to enhance passenger safety at railway platforms by preventing accidents caused by the platform gap. The proposed system aims to provide a cost-effective, automated solution using ultrasonic sensors, Arduino microcontrollers, and servo motors to dynamically bridge the gap between the train and the platform. This system ensures safe boarding and alighting for passengers while maintaining uninterrupted platform accessibility and improving overall railway safety standards.

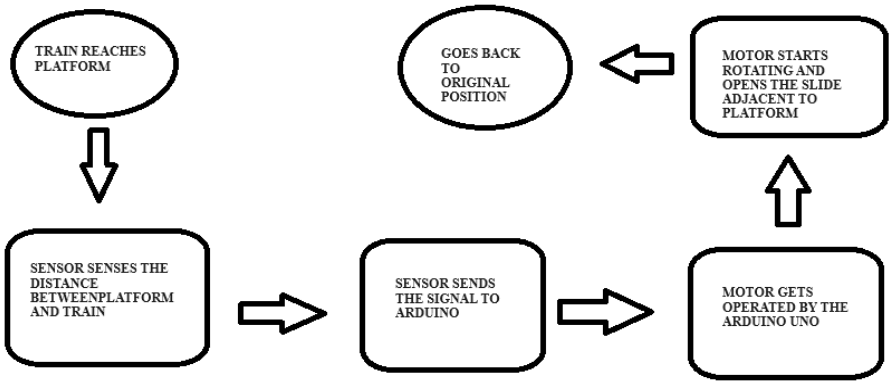

Fig -3: Block Diagram of the system

In the proposed system, we aim to enhance railway safety by integrating various sensors to provide real-time alerts to passengers waiting on the platform. A crucial component of this system is servo motor and ultrasonic sensor. Ultrasonic basically measures the distance between train and platform and sends this information to Arduino UNO. As the train approaches the platform, the ultrasonic sensor detects decreasing distance, triggering the activation of a Arduino to trigger its operation. Conversely, when the train departs and moves away from the platform, the ultrasonic sensor detects an increase in distance, triggering the servo operation that the train has departed, and it is safe to move away from the edge of the platform. This integrated system not only enhances safety for passengers but also ensures efficient boarding and departure processes.

6. ADVANTAGES

This railway platform accident prevention system acts as a vigilant safeguard, providing multiple layers of defense against potential accidents. Central to its operation is the power supply circuit, which ensures continuous functionality even in challenging conditions. The ultrasonic sensor functions as the system's "eyes," constantly monitoring the platform's edge for any obstructions. Upon detection, the Arduino swiftly triggers a response to mitigate the risk. This system also facilitates easier monitoring by security personnel, helping manage crowd flow, particularly during peak hours, and fostering a sense of security that enhances the overall travel experience.

Beyond preventing accidents, safety slides at railway stations offer various benefits. They support surveillance by providing security personnel with a clearer view of activities, helping prevent damage and vandalism to railway property, thus reducing maintenance costs. Well-designed safety barriers can also enhance the station's aesthetic, creating a more pleasant environment for passengers. Additionally, these safety features can increase the value of surrounding properties, showcasing the broader economic advantages of investing in railway safety infrastructure.

Safety grills further assist in surveillance by offering unobstructed lines of sight for security cameras, helping deter criminal behaviour. Designed to align with the station's architectural style, these grills improve both security and the station's appearance. The installation of such safety measures signals to passengers that the railway authority prioritizes their well-being, boosting public confidence and trust in the system. Ultimately, these enhancements can lead to increased ridership, as passengers are more likely to choose stations that are perceived as safer.

7. FUTURE SCOPE

The proposed system utilizing ultrasonic sensors, servo motors, and Arduino shows great potential for future advancements and integration with emerging technologies. Several developments could further enhance its capabilities:

- The integration of artificial intelligence (AI) and machine learning algorithms could improve the system's ability to detect and predict hazards more accurately.
- Advanced pattern recognition algorithms could analyse historical data to identify trends, enhancing the system's responsiveness and predictive abilities.
- By combining sensors with AI, the system could significantly reduce accidents caused by platform gaps, making the platform safer with dynamic safety mechanisms.

Additional future improvements include:

1. Increased Investment in Safety: Allocate more resources for track renewal, bridge repairs, signal upgrades, and coach refurbishments.
2. Employee Training: Offer comprehensive, ongoing training to railway staff to minimize human error and improve adherence to safety protocols.
3. Eliminate Level Crossings: Construct road overbridges (ROBs) or underbridges (RUBs) to replace both unmanned and manned level crossings, enhancing safety.
4. Adopt Advanced Technologies: Install anti-collision devices (ACDs) like Kavach, Train Collision Avoidance System (TCAS), Train Protection Warning System (TPWS), and Automatic Train Control (ATC). These technologies are currently being tested on some tracks but should be expanded across the entire network.

5. Performance-Linked Incentives: Introduce a system where railway staff are rewarded for their adherence to safety standards and overall performance.
6. Outsource Non-Essential Services: Outsource functions such as hospital and college maintenance to private or public entities to improve efficiency and reduce costs.
7. Create a Railway Safety Authority: Establish a statutory body responsible for setting safety standards, conducting audits, and ensuring accountability through penalties for lapses.
8. Conduct Regular Audits: Continuously monitor and evaluate the safety performance of railway staff and infrastructure to maintain high standards.
9. Enhance Coordination: Strengthen communication and collaboration between railway departments and associated organizations.
10. Confidential Incident Reporting: Implement a system that encourages staff to confidentially report safety concerns or irregularities, ensuring real-time data collection and analysis.
11. Cultural Shift in Management: Foster a culture that emphasizes collaboration, correction, and safety at all levels, moving away from a fault-finding approach towards a more supportive, safety-driven attitude.

5. CONCLUSION

In conclusion, the system designed to prevent railway platform gap accidents marks a significant step forward in railway safety technology. By integrating ultrasonic sensors, Arduino microcontrollers, and servo motors, this system establishes an active safety barrier between passengers and railway tracks. It effectively detects obstacles and deploys safety grills, significantly reducing the risk of accidents and improving passenger security at railway platforms. The system also incorporates audible and visual alerts, ensuring passengers are fully informed of potential risks and platform status. Overall, this safety system offers a comprehensive solution to minimize accidents, creating a secure and safe environment for both passengers and railway staff. As railway safety remains a top priority, innovations like this system play a vital role in enhancing the overall safety standards across railway networks.

6. REFERENCES

1. Pawar Ghanshyam Kailasrao, Mr. Dhatrak Rahul Sanjay , Mr. Pagar Somesh Shivaji , Prof. P C Patil RAILWAY ACCIDENT AVOIDING SYSTEM International Journal of Innovative Research in Electronics, Instrumentation and Control Engineering Impact Factor 7.047,Vol. 10, Issue 4, April 2022.
2. Prof. Sushant M. Gajbhiye Prof. Zen P. Raut Prof. Raju A. Bondre, A Review Paper on “Smart Railway Crossing using Microcontroller” issue 02-february 2020.
3. N. Pavithra, K. Tamil selvi, M. Kowsalya, UG Scholar, Railway Track Monitoring and Accident Avoiding System International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org ETEDM - 2019 Conference Proceedings Special Issue – 2019
4. Anil M.D et.Al. (2014), Advanced Railway Accident Prevention System Using Sensor Networks, International Journal of Advanced Research In Computers And Communication Engineering.
5. Sarath Chandran.P, Karthika.M “IOT Based Accident Prevention and Monitoring System In Railways International Journal of Advanced Research Trends in Engineering and Technology Special Issue 5, March 2018.
6. Ms.K.Divya & Ms.R.Anjugam “Railway Safety Monitoring System using Ultrasonic and IR Sensor” IJSRD- International Journal for Scientific Research & Development vol. 5, Issue 01, 2017.