iJRASET
International Journal For Research in Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 13 **Issue:** VIII **Month of publication:** August 2025

**DOI:** https://doi.org/10.22214/ijraset.2025.73834

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com*

# The Need to Reform the Emergency Chain Pulling System in Indian Railways : Railway Advanced Alarm System

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***Abstract:*** ***The Emergency Chain Pulling (ECP) system in Indian Railways, originally designed as a safety measure, is now being frequently misused, leading to unnecessary train stoppages, delays, and operational inefficiencies. This research examines the limitations of the existing ECP mechanism, including its vulnerability to misuse, lack of accountability, and its impact on train schedules. Through an in-depth analysis of railway reports, case studies, and passenger behaviour patterns, this study explores the need for a more effective and controlled alternative to the current system. The research evaluates global best practices and technological advancements to propose a RAAS (Railway Advanced Alarm System) as a viable alternative. The proposed system uses Aadhaar-based authentication and verification for passengers as well as for train authorities, QR Code scanning for triggering the alarm and real time data transfer of the passenger to the train authorities to take an appropriate action if it is a false alarm. Through this research, we assess the feasibility, benefits, and challenges of implementing RAAS in Indian Railways. The findings aim to provide actionable insights for policymakers and railway authorities to modernize emergency stop system in trains while ensuring passenger safety and train punctuality.***

***Keywords: Emergency Chain Pulling, Railway Advanced Alarm System, Train Delays, Indian Railways, Passenger Safety.***

## I. INTRODUCTION

The Emergency Chain Pulling (ECP) system in Indian Railways was introduced as a critical safety feature to allow passengers to stop a train in emergencies. However, over the years, this system has been extensively misused for non-emergency reasons, such as passengers missing their stops, boarding delays, or personal convenience. This misuse results in significant train delays, operational inefficiencies, and security risks, impacting millions of passengers and disrupting railway schedules.

Despite existing penalties for false ECP usage, enforcement remains weak, and the lack of passenger accountability allows frequent misuse. The current system relies solely on manual intervention, with no verification process before stopping a train. This raises the need for a modernized approach that balances passenger safety with railway efficiency.

This research aims to analyze the shortcomings of the current ECP system, assess its impact on train operations, and propose the Railway Advanced Alarm System (RAAS) as an alternative. RAAS is a digital solution that integrates Aadhaar-based authentication, QR code scanning, and real-time request approval by railway authorities. By replacing unverified manual chain pulling with a controlled and accountable system, RAAS ensures that emergency stops occur only when genuinely needed.

The study follows a structured research approach:

*1)* Understanding the extent of ECP misuse through data analysis and surveys.
*2)* Comparing Indian Railways with global best practices for emergency stop mechanisms.
*3)* Evaluating the feasibility, benefits, and challenges of implementing RAAS.
*4)* Providing policy recommendations for a more secure and efficient emergency stop system.

Through this research, we aim to demonstrate that RAAS is a scalable and practical solution to modernize railway safety, reduce train delays, enhance passenger security, and improve operational efficiency.

## II. LITERATURE REVIEW

### *A. Current System Overview*

The Emergency Chain Pulling (ECP) system is a safety feature implemented across all trains in Indian Railways, designed to allow travellers to stop a train during emergencies such as medical crises, fire, or criminal incidents.

 

The mechanism is simple: a passenger pulls the red emergency chain located in each coach, which activates a mechanical and pneumatic process that reduces the train's brake pressure, forcing it to stop.

While this system was introduced with the intention of enhancing passenger safety, it suffers from several critical limitations in practice:

1) Frequent Misuse: A significant number of chain-pulling incidents are not due to real emergencies. Passengers often misuse the system for personal convenience, such as boarding/alighting late, avoiding missed stops, or delaying trains intentionally.
2) Lack of Accountability: The current system lacks any form of identification or verification of the individual who pulled the chain. This anonymity encourages irresponsible behaviour and makes it difficult for authorities to penalize misuse effectively.
3) Train Delays and Operational Inefficiency: Unwarranted stops caused by ECP misuse led to major delays in train schedules, especially for long-distance express trains. This not only disrupts passenger plans but also affects the entire railway network, causing cascading delays.
4) Safety Risks: Sudden halts caused by ECP activation can pose safety hazards, especially on high-speed routes. Abrupt braking may injure standing passengers or those not expecting the motion, and it can also lead to accidents in extreme cases.
5) No Real-Time Communication: There is no way for train staff or authorities to immediately know the reason for the emergency stop. This delays response time and creates confusion during genuine emergencies.

In summary, while the ECP system plays a vital role in ensuring safety, its outdated and easily exploitable design significantly hampers train punctuality and operational efficiency. These limitations underscore the urgent need for a more accountable, controlled, and technologically advanced alternative.

### *B. Case Studies*

#### *1) Case Study 1: Surge in ECP Misuse in Vijayawada Division*

The Vijayawada Division of Indian Railways has witnessed a significant increase in the misuse of Alarm Chain Pulling devices. In the current financial year, a total of 2,159 incidents were recorded, with the highest occurrences during October 2023 and the festive season. Such misuse has led to prolonged detentions of express and passenger trains, causing disruptions in train operations and inconveniences to passengers. The transition from conventional ICF coaches to LHB coaches, where passengers inadvertently dislocate the alarm chain by hanging personal items, has also been identified as a contributing factor. To address this issue, the division issued a travel advisory urging passengers to refrain from misusing these devices (Deccan Chronicle, 2023 [1]).

#### *2) Case Study 2: Jalgaon Train Accident Triggered by ECP Misuse*

On January 22, 2025, a tragic incident occurred near Maheji railway station in Jalgaon district, Maharashtra. Passengers aboard the Pushpak Express, fearing a fire due to observed sparks, pulled the emergency chain, bringing the train to an unscheduled halt. In the ensuing panic, several passengers disembarked onto adjacent tracks and were struck by the oncoming Karnataka Express, resulting in 13 fatalities and multiple injuries. Investigations revealed that the panic was caused by unfounded rumours, and there was no actual fire onboard (Associated Press, 2025[2], The Times of India, 2025[3]).

#### *3) Case Study 3: The Godan Express Incident Involving ECP Misuse*

In May 2022, the Godan Express was brought to an unscheduled stop on a bridge due to the pulling of the emergency chain. The loco pilot had to risk his life by stepping onto the bridge to reset the alarm chain knob, highlighting the dangers railway personnel face due to improper use of the ECP system. Such incidents not only endanger staff but also cause significant delays and operational challenges (The Times of India, 2022[4]; NDTV News, 2022[5]).

These case studies highlight the urgent need for a more controlled, accountable, and technologically advanced approach to handling train emergencies.

### *C. Global Comparisons*

Rail networks around the world have adopted sophisticated alternatives to traditional emergency braking to reduce misuse and enhance operational control.

In the United Kingdom, trains utilize a Passenger Alert System, where travellers can notify the driver or crew using a button or intercom. This doesn't cause an instant stop; instead, the situation is assessed remotely, and the train is halted only when it's safe and necessary. (Wikipedia [6])

In Germany, modern trains feature an Emergency Brake Override (Notbremsüberbrückung or NBÜ) setup. This mechanism allows the train operator to temporarily delay the brake effect if an emergency stop is triggered in a risky area—like a bridge or tunnel—providing time to evaluate the situation before acting. (Wikipedia [6])

What's common in these systems is the layer of human or automated verification before stopping the train. This reduces false alarms and ensures that the train halts only when absolutely required—an area where India's current Emergency Chain Pulling (ECP) mechanism falls short.

These examples offer valuable insight for Indian Railways, reinforcing the need for a system like the Railway Advanced Alarm System (RAAS) that blends technology, authentication, and operational flexibility.

### *D. Gap Analysis*

Despite being an essential safety feature, the Emergency Chain Pulling(ECP) mechanism in Indian Railways suffers from several operational drawbacks that have not been adequately addressed in existing research or policy frameworks. A review of current literature and practices reveals the following critical gaps:

*1)* Lack of Control and Verification Mechanisms: Most existing studies acknowledge the misuse of ECP but do not propose or implement effective technological safeguards to differentiate between genuine and false alarms. There's minimal research on integrating passenger identity verification, real-time location tracking, or backend monitoring—features that are essential in modern transport systems.

*2)* Outdated Infrastructure and Lack of Technological Upgrades: While several global railway systems have adopted smart alert mechanisms, India's ECP system remains largely mechanical, lacking digitalization and connectivity with centralized control rooms. Existing literature lacks sufficient exploration of how emerging technologies-such as Aadhaar-based authentication, QR code system and real-time data analytics-can be effectively integrated to modernize the ECP mechanism.

*3)* Limited Empirical Data and Case-Based Insights: Most previous work relies on general commentary or policy notes. There is a lack of empirical studies, case investigations, or statistical data analysis that highlight the real-world consequences of ECP misuse—such as delays, accidents, and staff risk. This research bridges this gap by incorporating actual case studies like the Jalgaon Train Accident and Godan Express incident, supported by real-world data and official reports.

*4)* Policy and Implementation Gaps: There is a noticeable disconnect between existing safety policies and ground-level implementation. Despite travel advisories or public announcements, there is no systemic shift in the way ECP misuse is managed. This research proposes Railway Advanced Alarm System (RAAS) as a structured, enforceable system, closing the gap between intention and execution.

### *E. Conclusion*

The review of existing literature demonstrates the crucial role, emergency braking systems play in ensuring passenger safety. However, it also highlights significant shortcomings, particularly in the areas of technological modernization, accountability, and effective misuse prevention. While several international railway systems have transitioned towards controlled and digitally monitored emergency response mechanisms, Indian Railways continues to rely on a largely manual and easily exploitable Emergency Chain Pulling (ECP) system. These insights point to a clear need for adopting a more secure, technology-driven solution. In response to these identified gaps, **this research proposes the Railway Advanced Alarm System (RAAS)** — a comprehensive model aimed at modernizing emergency management processes, minimizing misuse, and enhancing operational efficiency within the Indian railway network.

## III. RESEARCH METHODOLOGY

This research adopts an exploratory and descriptive design to study the misuse of the Emergency Chain Pulling (ECP) system in Indian Railways and propose a technological alternative in the form of the Railway Advanced Alarm System (RAAS). The methodology is structured to understand the existing challenges, analyze real-world incidents, gather stakeholder opinions, and conceptualize a modern solution based on technological integration.

### *A. Research Design*

An exploratory research design was chosen to investigate the gaps in the current ECP mechanism and to formulate a feasible and structured solution. The research focuses on qualitative analysis through case studies and quantitative insights from surveys conducted among people(including passengers, railway employee, policymaker and student).

 

*B. Data Collection Methods*

*1) Primary Data*

- Surveys: Structured questionnaires were designed and distributed via Google Forms targeting passengers, railway employees (station masters, train guards, TTEs), policymakers and students.
- The survey focused on awareness of ECP, experiences with misuse, perceptions of the current system, and openness to adopting a technology-driven alternative.
- Interviews: Informal discussions and interviews were conducted with railway staff to gather qualitative insights on operational challenges due to ECP misuse.

*2) Secondary Data*

- Case Study Analysis: Documented incidents such as the Jalgaon Train Accident (2025), Godan Express Emergency Stop (2022), and misuse statistics from the Vijayawada Division were analysed.
- Document and Report Review: Railway safety report, new articles, and official advisories were reviewed to support the identification of patterns and impacts related to **ECP** misuse.

*C. Sampling Technique*

A simple random sampling method was employed to select survey respondents. Participants included:

- Daily and occasional train passengers
- Railway operational staff (ticket collectors, station managers, guards)
- Policymakers and railway safety officers

The goal was to collect unbiased, diverse perspectives to enhance the validity of the findings.

*D. Data Analysis Techniques*

- Quantitative Data Analysis: Survey results were tabulated, and basic statistical measures (percentages, frequency distributions) were applied to interpret respondent views on ECP misuse and technology acceptance.
- Qualitative Analysis: Themes from interviews and case studies were analysed to identify common operational challenges and stakeholder expectations from a new system like RAAS.

*E. Limitations of the Study*

- Data Limitations: Limited access to internal railway records and incident databases restricted the scope of case study analyses.
- Sample Size Constraints: Survey responses were limited due to time constraints and participant availability, which may affect generalizability.
- Technology Validation: The RAAS system remains at the conceptual stage; full-scale prototyping and field testing would be required for practical validation.

## IV. PROPOSED SOLUTION

*A. Overview of the Proposed Solution*

The Railway Advanced Alarm System (RAAS) is a technology-driven solution designed to replace the traditional Emergency Chain Pulling (ECP) mechanism currently used in Indian Railways. RAAS aims to address the longstanding issues of misuse, lack of accountability, and operational delays caused by the existing manual system. By integrating modern technologies such as Aadhaar-based passenger authentication, QR code scanning, and real-time digital communication between passengers and railway authorities, RAAS ensures that emergency stop requests are genuine and verifiable. The system not only enhances passenger safety by allowing legitimate emergencies to be reported efficiently, but also minimizes unwarranted train stoppages, thereby improving operational punctuality across the railway network. In contrast to the immediate and often unjustified halts triggered by physical chain pulling, RAAS introduces a controlled and accountable emergency response mechanism, aligning Indian Railways with global best practices in railway safety management.

*B. Key Features of RAAS*

- Aadhaar-based passenger authentication
- QR code scanning inside compartments

- Real-time digital emergency alarm
- Real-time data transfer of accountable to railway authorities

### *C. System Architecture*

The Railway Advanced Alarm System (RAAS) is designed as an integrated, multi- component framework that ensures secure, accountable, and efficient management of emergency stop requests within Indian Railways. The system architecture consists of three primary layers: Passenger Interface, Security Layer and Backend Processing Server.

*1)* Passenger Interface(Mobile Application): Passengers will access the RAAS through a mobile application that will ensure that the passenger registration is successful after verifying with their Aadhaar ID. For developing this application, Flutter can be a good choice as it can develop applications that supports cross platform availability. Passengers will need to update the train number whenever they are travelling, in case of any emergency a passenger needs to scan the QR code that will fetch the passenger's details like name, address, phone number and will send this information to the railway authorities who are present in that train as well as this information will also get stored in a database to keep a record. Once the QR code of any compartment is scanned there will be an alarm triggered to the loco pilot's device which will be a signal for him to stop the train immediately.

*2)* Security Layer(Aadhaar-based passenger authentication): While registering to the mobile application every person needs to verify himself/herself using their Aadhaar ID, this is applicable for the normal passengers as well as for the railway authorities. The application will be designed in such a way that it would store only the required information of any person. For additional security while using the application JWT authentication and authorization can be used for securing the APIs(Application Programming Interfaces).

*3)* Backend Processing Server: For the backend processing server, Spring Boot(Java) can be used as it has many features such as microservices, cloud-native readiness, robust ecosystems and many more.
Some of the key functions of backend include:

*a)* JWT authentication and authorization.
*b)* Loggin emergency requests with a timestamp and **GPS** location.
*c)* Triggering the alarm on the loco pilot's device.
*d)* Storing the passenger's information who has scanned the QR code.
*e)* Transferring the fetched information to the railway authorities available on that train.

### *D. Workflow / Working Process*

The Railway Advanced Alarm System (RAAS) operates through the following sequential process to ensure controlled, accountable emergency response within trains:

- All public users must register themselves on the RAAS application.
- Aadhaar ID verification is mandatory during registration to authenticate the identity of each user.
- Upon successful registration, passengers are required to set up their profiles within the application.
- Railway employees such as Loco Pilots, Railway Protection Force (RPF) personnel, and Ticket Collectors (TC) must additionally verify their employment credentials during profile setup.
- Before traveling, passengers must enter the train number into the application to link their journey with the correct train service.
- Each Loco Pilot is provided with a device pre-installed with the RAAS application, which they must log into at the start of their duty.
- QR codes containing the train number and compartment number are installed inside every coach.
- In case of an emergency, passengers are required to scan the QR code, which immediately triggers an alarm notification on the Loco Pilot's device.
- Upon receiving the alert, the Loco Pilot assesses the situation and takes appropriate action, including stopping the train if necessary.
- Passenger details such as name, address, and phone number are automatically fetched upon scanning the QR code, enhancing traceability.
- This information promotes accountability, ensuring that in cases of false alarms, appropriate disciplinary or legal actions can be taken against the responsible individual.

- Simultaneously, notifications are also sent to RPF and TC staff, indicating the specific compartment where the emergency was reported.
- In cases where a passenger attempts to flee, the pre-recorded personal information ensures that authorities can trace and penalize the offender effectively.
- All incident data, including passenger details and alarm logs, are securely stored in the backend database, enabling railway authorities to monitor the usage patterns of RAAS and generate detailed analytical reports.

## V. FEASIBILITY ANALYSIS AND CHALLENGES

The proposed Railway Advanced Alarm System (RAAS) was evaluated for technical, operational, economic, and legal feasibility to assess its practicality for implementation across the Indian Railways network.

### *A. Technical Feasibility*

RAAS leverages widely available and mature technologies such as mobile application development (Flutter), backend servers (Spring Boot), cloud databases (MySQL/Firebase), and Aadhaar-based authentication APIs.

QR code scanning and real-time notification systems are standard features in modern mobile applications and can be seamlessly integrated into the system architecture.

Therefore, the technological components required for RAAS are readily available, and development can be achieved without significant innovation barriers.

### *B. Operational Feasibility*

The RAAS interface is designed to be user-friendly and accessible to both passengers and railway staff.

Passengers will use simple actions such as scanning a QR code and authenticating via Aadhaar, while railway staff (loco pilots, TTEs, and RPF personnel) will receive clear and actionable alerts through dedicated devices.

Minimal training would be required for effective usage, and integration into the daily railway workflow can be accomplished through basic orientation programs.

### *C. Economic Feasibility*

The financial investment required for RAAS includes mobile application development, backend server hosting, and initial deployment of QR codes in coaches.

Compared to the recurring operational and delay costs caused by frequent misuse of the Emergency Chain Pulling (ECP) system, the cost of implementing RAAS is relatively low.

Moreover, reducing unnecessary delays would translate into significant savings in fuel costs, time, and manpower, making RAAS a cost-effective solution over the long term.

### *D. Legal and Privacy Feasibility*

The use of Aadhaar information for passenger authentication aligns with digital governance practices in India, provided that appropriate data privacy and consent measures are enforced.

RAAS would need to comply with regulations such as the Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2011, and any applicable guidelines under the Aadhaar Act.

By ensuring encrypted data storage and user consent during registration, the system can operate within legal boundaries while maintaining passenger trust.

### *E. Challenges and Solutions*

#### *1) Challenge 1: Network Connectivity in Remote Areas*

- In some remote or rural railway sections, mobile network coverage may be weak, affecting real-time request submission and authority notifications.

Solution:

- Implement an offline fallback mechanism where QR scans are stored locally and transmitted as soon as connectivity is restored.

- Additionally, assign one trained railway worker per three coaches, responsible for manually verifying emergencies and communicating directly with the loco pilot in case of technical failures. This dual approach ensures uninterrupted emergency reporting even in network blackouts.

*2) Challenge 2: Passenger Adaptation and Digital Literacy*

- A segment of passengers, especially the elderly or digitally inexperienced, may find it challenging to use a mobile application during emergencies.

Solution:

- Conduct awareness campaigns at stations and onboard.
- Install assistance kiosks at major railway stations where staff can help passengers register and learn to use the RAAS system.

*3) Challenge 3: Data Privacy and Security Concerns*

- Use of Aadhaar and personal information can raise concerns among passengers regarding data misuse.

Solution:

- Ensure strict data encryption, anonymized storage, and transparent user consent processes as part of the app onboarding.
- Regularly audit the system for vulnerabilities and comply with national data protection standards.

4) *Challenge 4: Initial Implementation and Cost Barriers*

- Full-scale deployment across all trains and stations might require considerable initial investment and logistics management.

Solution:

- Implement RAAS in phases, starting with high-priority trains and gradually expanding across the network based on performance and feedback.
- Seek government grants or public-private partnerships to ease funding.

*F. Summary*

The feasibility analysis of the Railway Advanced Alarm System (RAAS) demonstrates that the proposed solution is both technically achievable and operationally practical with today's technological infrastructure. By utilizing common platforms such as Flutter for mobile applications, Spring Boot for backend development, and cloud databases for secure storage, RAAS can be efficiently developed and deployed across the Indian Railways network.

Operationally, the system's user-friendly design ensures that both passengers and railway staff can adapt to its usage with minimal training. Economically, the investment in RAAS is justified when compared to the recurring costs associated with train delays and operational inefficiencies resulting from ECP misuse. Legal and privacy considerations, primarily around Aadhaar integration, can be effectively managed through strict data protection measures and user consent protocols.

Potential challenges, such as limited network connectivity and passenger adaptability, have been anticipated, with viable solutions such as offline fallback mechanisms and human support roles proposed to maintain system reliability.

Overall, the Railway Advanced Alarm System (RAAS) is a feasible, scalable, and forward-thinking solution that promises to modernize emergency management practices in Indian Railways, ensuring greater passenger safety, accountability, and operational efficiency.

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## VI. DATA ANALYSIS AND SURVEY FINDINGS

*A. Survey Overview*

To assess public perception regarding the Emergency Chain Pulling(ECP) system and the potential adoption of a technology-based alternative like the Railway Advanced Alarm System(RAAS), a structured survey was conducted.

A total of 50 participants responded to the survey, representing a diverse demographic group in terms of age, occupation, and train travel frequency.

*1)* Age Distribution:

- Below 18 years: 2%
- 18–25 years: 72%

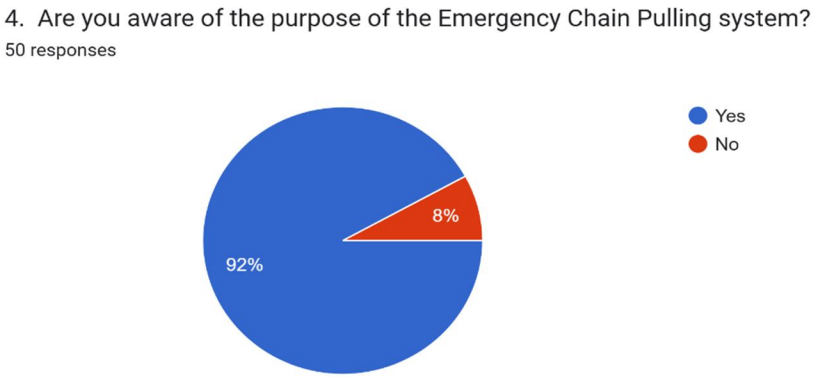
- 26–40 years: 22%
- 41–60 years: 4%

2) Occupational Role:
- Passengers: 92%
- Railway Employees: 2%
- Policymakers: 2%
- Students: 4%

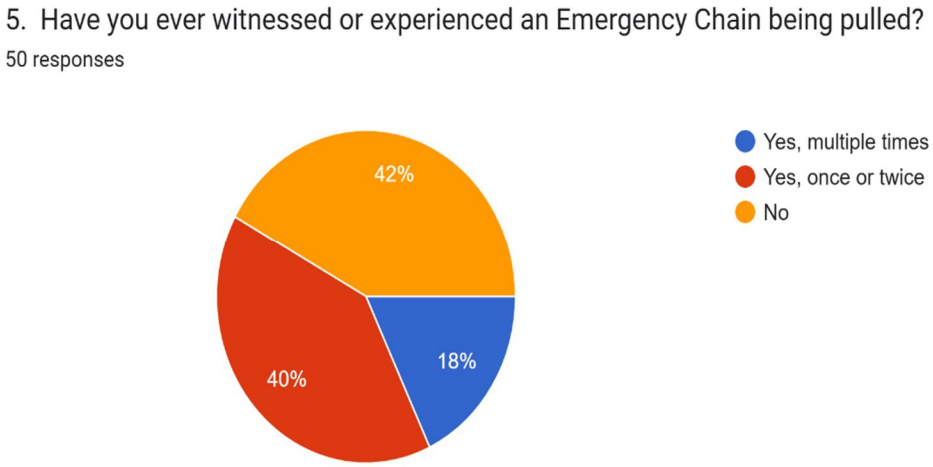
3) Frequency of Train Travel:
- Occasionally: 72%
- Monthly: 18%
- Daily: 6%
- Weekly: 4%

*B. Key Survey Results*

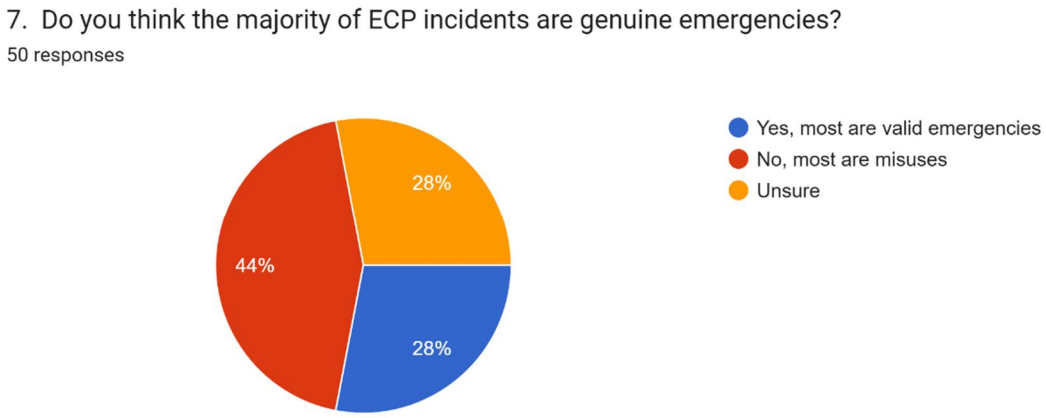
1) Awareness of ECP Purpose: 92% of respondents were aware of the purpose of Emergency Chain Pulling, indicating a strong understanding of its original safety intent.




2) Witnessing ECP Incidents: 18% had witnessed ECP being used multiple times, while 40% had seen it once or twice. 42% reported they had never witnessed it.

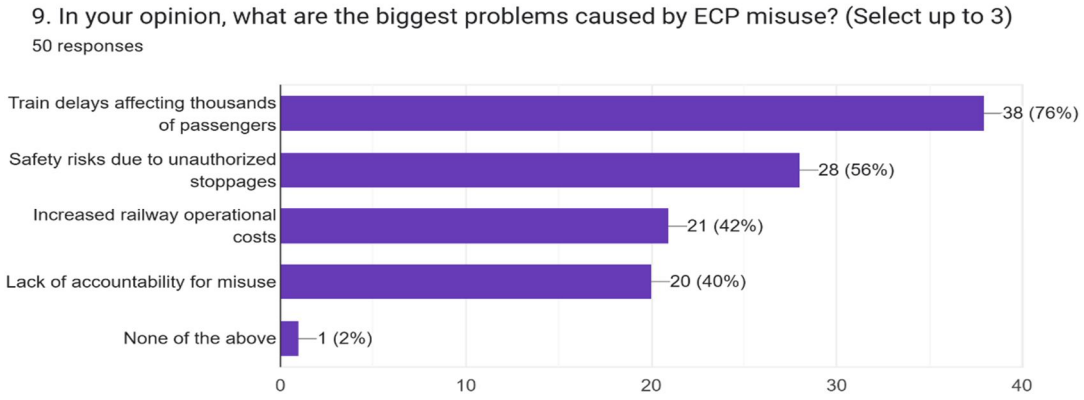


*3)* Perceptions of ECP Usage
- 44% believed that most ECP activations are cases of misuse.
- 28% believed that most cases were genuine emergencies.
- 28% remained unsure.




*4)* Impact of ECP Misuse on Train Delays:
- 40% stated that ECP misuse causes train delays very frequently.
- 38% reported occasional delays.
- 14% believed it rarely causes delays.
- 8% felt it never causes delays.
-

*5)* Biggest Problems Caused by ECP Misuse:
- 76% cited train delays.
- 56% cited safety risks.
- 42% pointed to increased operational costs.
- 40% indicated a lack of accountability.
- 2% indicated that no big problems occur due to misuse of ECP.

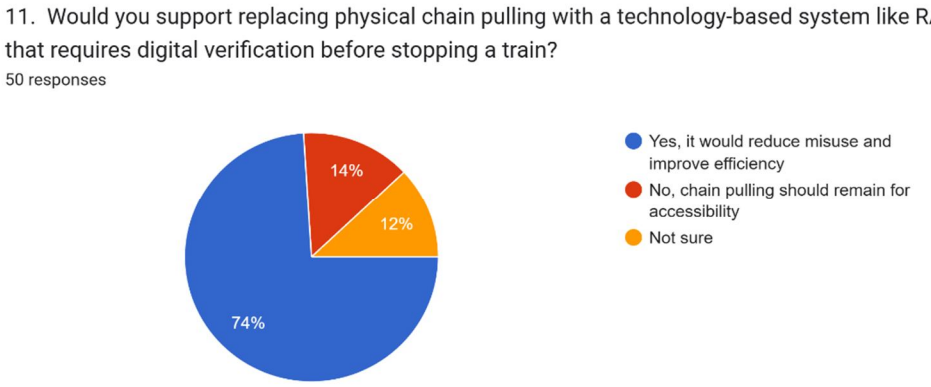


*6)* Stricter Penalties for Misuse

64% supported stricter penalties for the misuse of ECP, while 24% opposed stricter penalties, and 12% were unsure.

*7)* Support for Technology-Based Alternative (RAAS)

A significant 74% of respondents supported replacing the manual ECP system with a technology-driven solution like RAAS. 14% opposed it, and 12% were unsure.




*C. Interpretation of Findings*

The survey results clearly demonstrate a broad public recognition of the misuse of the existing Emergency Chain Pulling system.

A substantial majority believes that ECP misuse frequently causes train delays and creates additional safety and operational challenges.

Support for introducing a digital, accountable, and secure emergency system like RAAS is notably high, with nearly three-fourths of participants endorsing the replacement of the traditional chain-pulling mechanism.

These findings validate the necessity and timeliness of proposing the Railway Advanced Alarm System (RAAS) as a modern solution to address the inefficiencies of the current emergency stop system in Indian Railways.

## VII. CONCLUSION

The Emergency Chain Pulling (ECP) system in Indian Railways, though originally intended as a safety measure, has over time become a major source of operational inefficiencies, train delays, and safety concerns due to widespread misuse. The review of existing literature, real-world case studies, and survey findings clearly highlight the significant gaps in the current system — particularly the absence of accountability, technological integration, and misuse prevention mechanisms.

Through an in-depth analysis, this study proposes the Railway Advanced Alarm System (RAAS) as a practical and innovative alternative to the conventional ECP mechanism. RAAS introduces a controlled, Aadhaar-authenticated, QR-code-based alert system that enables passengers to report emergencies in a secure and verifiable manner. It ensures that emergency stops are executed only after proper validation, significantly reducing false alarms and enhancing overall operational efficiency.

The survey results further validate the urgent need for reform, with many participants acknowledging frequent misuse of the ECP system and strongly supporting the adoption of a technology-driven solution like RAAS.

In conclusion, the implementation of RAAS can not only modernize emergency management practices in Indian Railways but also contribute significantly to improving train punctuality, operational safety, and passenger accountability. With appropriate infrastructural support and awareness initiatives, RAAS has the potential to transform Indian Railways into a safer, smarter, and more efficient public transport system.

## VIII. FUTURE SCOPE

The Railway Advanced Alarm System (RAAS) presents a strong foundation for improving emergency management in Indian Railways, but several enhancements can be incorporated in future versions to further enrich the passenger experience and system reliability.

One important future upgrade is the integration of a Loco Pilot Communication Module within the RAAS application. In situations where trains experience unexpected stoppages or delays, the loco pilot could directly send real-time updates through the app, informing passengers about the cause of the stoppage and the estimated time to resume the journey. This feature would help in calming passengers by reducing uncertainty and frustration, thereby improving trust and satisfaction.

Additionally, RAAS can evolve by leveraging Artificial Intelligence (AI) for analysing emergency trends and predicting high-risk areas or times, allowing railway authorities to take preventive safety measures.

Blockchain technology could also be incorporated in future versions to ensure secure and tamper-proof logging of emergency events, enhancing system transparency and accountability.

By incorporating these future enhancements, RAAS has the potential to not only solve the current challenges related to ECP misuse but also to transform the overall passenger safety ecosystem within Indian Railways and beyond.

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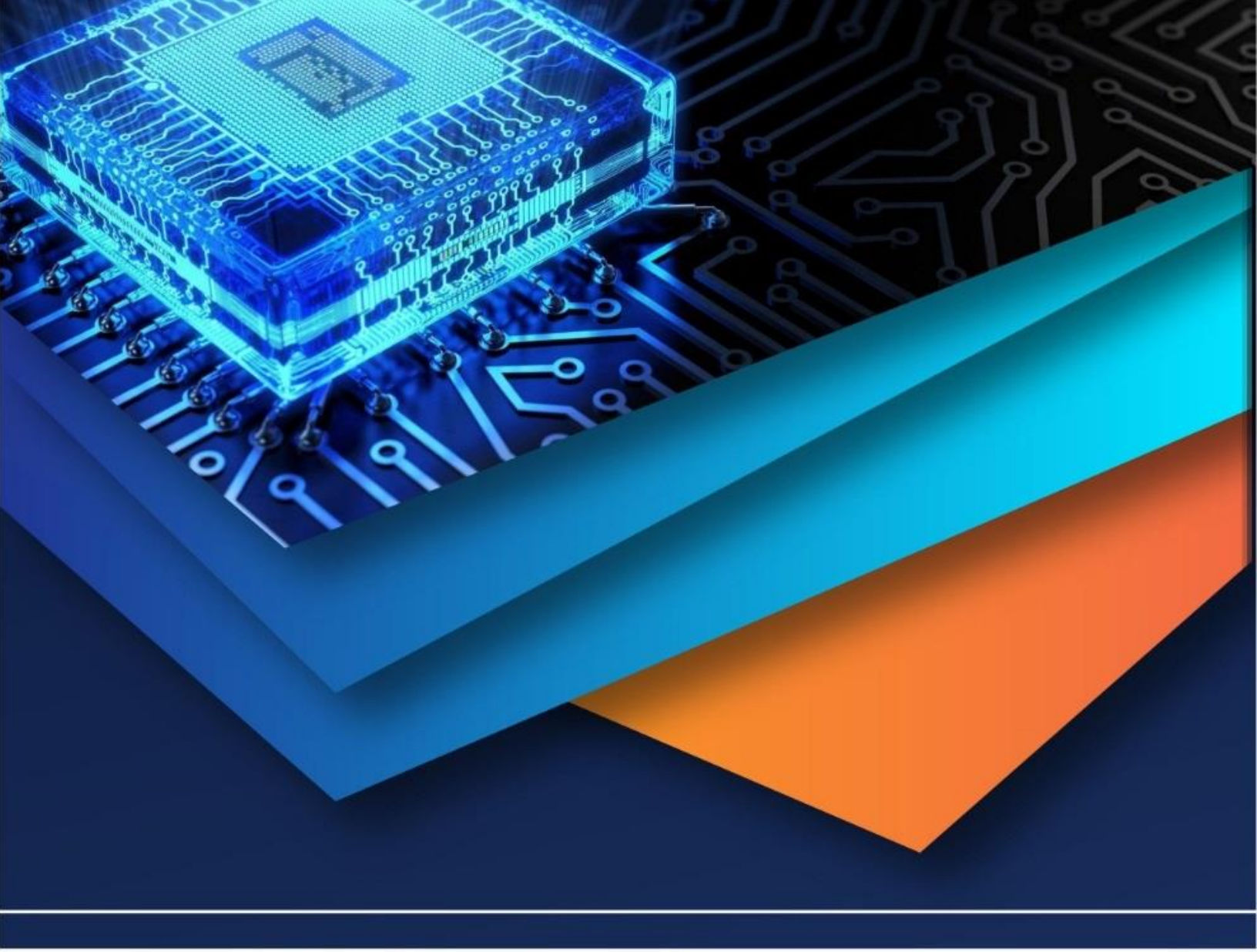

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