



Rail Madad with AI-Powered Complaint Management System

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Abstract

Rail Madad is an essential platform for passenger grievance redressal in Indian Railways, but its current manual categorization and routing system often causes delays, inefficiencies, and inaccurate resolutions. These challenges are more critical when passengers submit complaints in the form of photos, videos, or audio, which require significant manual effort to interpret. To address this, the proposed project introduces an AI-powered Complaint Management System that integrates automation, intelligence, and predictive analytics into Rail Madad. Using computer vision, the system analyzes images and videos to automatically categorize complaints such as cleanliness, staff behavior, or infrastructure damage, while urgency detection models prioritize critical issues like safety hazards. Optical Character Recognition (OCR) extracts relevant text from visual data, and metadata analysis enhances context with time and location details. AI chatbots provide instant acknowledgments, gather additional inputs, and reduce response time. Smart routing algorithms ensure accurate forwarding of complaints to the right departments for quick action. Predictive maintenance models further analyze complaint trends to identify recurring issues and suggest proactive interventions. Sentiment analysis of passenger feedback and AI-driven performance monitoring ensure continuous improvement. By automating classification, prioritization, and routing, the system enhances resolution speed, accuracy, scalability, and passenger satisfaction, ultimately transforming Rail Madad into a faster, smarter, and more reliable grievance redressal system.

Keywords: Rail Madad, Artificial Intelligence, Complaint Management, YOLOv3, Chatbot, NLP, Indian Railways, Deep Learning, Grievance Redressal, Passenger Satisfaction

1. Introduction

Indian Railways is one of the largest and most extensively used transportation networks in the world, carrying millions of passengers daily across diverse regions. With such a vast operational scale, ensuring timely redressal of passenger complaints is essential for maintaining service quality, safety, and customer satisfaction. To address these issues, the Indian Railways introduced Rail Madad, a unified passenger grievance redressal platform that enables travelers to report issues related to cleanliness, staff behavior, amenities, security concerns, and other operational challenges. While Rail Madad has significantly streamlined the process of complaint registration, its current workflow still relies heavily on manual interpretation and categorization of complaints. This dependency results in several

limitations such as delays in routing, inaccuracies in complaint classification, and inconsistencies in resolution time. A major challenge arises when passengers upload complaints in unstructured formats such as images, audio recordings, and videos. These multimedia inputs require substantial human effort to analyze, interpret, and forward to the appropriate department. As complaint volume continues to rise, manual classification becomes increasingly inefficient, often leading to response delays and reduced passenger satisfaction. Moreover, the lack of automated urgency detection means that critical issues such as safety hazards, malfunctioning equipment, or medical emergencies may not receive timely attention. These limitations highlight the need for intelligent automation within the complaint-



handling pipeline. With the advancement of Artificial Intelligence and Machine Learning, particularly in fields such as computer vision, natural language processing, and predictive analytics, there is a growing opportunity to enhance existing railway complaint systems. AI technologies offer automated interpretation of visual and audio data, enabling faster categorization and more accurate mapping of complaints to specific departments. They can also analyze behavioral patterns, detect sentiment, and predict recurring issues, all of which support a more proactive maintenance culture within the system. Integrating such capabilities within Rail Madad can transform it from a reactive support platform into a fully automated, intelligent, and scalable grievance redressal solution. The proposed project, AI-Powered Complaint Management for Rail Madad, focuses on developing an intelligent system capable of automating the end-to-end complaint processing cycle. The system employs computer vision models to analyze images and videos uploaded by passengers and classify them into predefined categories such as cleanliness issues, coach damage, water leakage, track defects, or passenger safety concerns. Additionally, OCR (Optical Character Recognition) is used to extract textual information from signboards, receipts, or handwritten notes present within the uploaded images. Audio and speech inputs are processed using speech-to-text models, enabling seamless integration of voice complaints into the system.

2. Literature Review

Modern public service systems, especially in large-scale transportation networks such as Indian Railways, face significant challenges in handling multimodal complaints efficiently. Traditional manual systems struggle with high complaint volumes, inconsistent categorization, and delayed routing. To address similar limitations in other sectors, Kumar and Verma proposed an AI-based complaint management framework that leverages supervised machine learning to automate classification and routing of textual grievances, achieving higher precision and reduced turnaround times compared to manual or rule-based systems. Their study demonstrates how complaint-processing

workflows can be transformed through automation, providing a strong methodological foundation for integrating intelligent categorization into Rail Madad's grievance pipeline [1]. He and colleagues introduced Deep Residual Networks (ResNet), a major advancement in deep learning that solved the performance degradation problem in extremely deep neural networks. Traditional CNNs struggled to train beyond certain depths due to vanishing gradients, but ResNet overcame this using skip connections that allowed gradients to flow more effectively. The architecture enabled networks with over 150 layers to be trained successfully, achieving state-of-the-art accuracy on image classification benchmarks like ImageNet. ResNet became a backbone for several computer vision applications, including object detection, segmentation, and anomaly identification. For automated complaint systems, the ability of ResNet to recognize complex patterns makes it ideal for analyzing passenger-uploaded images in Rail Madad. Issues such as dirty coaches, damaged infrastructure, water leakage, overcrowding, or security vulnerabilities can be detected with high precision using ResNet-based classifiers. Transfer learning capabilities further enhance usability by enabling model training with limited railway-specific data. The architecture's robustness, noise tolerance, and ability to generalize across large datasets make it suitable for real-time visual complaint analysis. Overall, ResNet provides a powerful foundation for automating image-based grievance processing [2]. Vaswani and colleagues revolutionized natural language processing by introducing the Transformer architecture, eliminating the need for recurrence and allowing full attention-based modeling. The Transformer uses self-attention mechanisms to capture relationships between words regardless of their distance in the sequence, enabling more accurate language understanding. Its parallel processing capability significantly reduced training time compared to RNNs and LSTMs. Transformers quickly became the backbone of NLP systems, powering models such as BERT, GPT, and T5. In complaint management systems, the ability to understand context, sentiment, urgency, and user intent is crucial. Transformers excel in extracting



semantic meaning from complaint descriptions, enabling accurate classification and prioritization. They can also analyze emotional tone and detect high-severity cases like safety threats or emergencies. When integrated into chatbots, Transformers enable natural and human-like interactions, allowing seamless user engagement. Their multilingual support is beneficial for transportation systems where complaints may be submitted in various Indian languages. Overall, the Transformer architecture provides the accuracy, scalability, and interpretability needed for an advanced complaint-handling system [3]. Smith's work on the Tesseract OCR engine provided a robust open-source solution capable of extracting text from printed and handwritten images. Tesseract uses adaptive thresholding, connected component analysis, and character shape modeling to accurately recognize textual content even under noisy conditions. Its ability to handle skewed, low-resolution, or distorted images makes it a valuable tool in real-world applications. For systems like Rail Madad, passengers often upload images containing textual information such as coach numbers, berth details, ticket numbers, station signs, regulatory notices, and handwritten complaints. Manually reading such images is time-consuming and prone to error. Tesseract automates this process by converting visual text into machine-readable form, enabling faster analysis and routing. Its multilingual support, including Indian languages, further enhances applicability. Tesseract's integration with NLP pipelines supports extraction of key entities, allowing more informed decision-making. The OCR engine plays a vital role in bridging visual and textual data, ensuring multimedia complaints are processed effectively [4]. Ghosh and Singh extensively surveyed computer vision applications in intelligent transportation systems, demonstrating the growing importance of automated visual monitoring. Their work explored various techniques such as object detection, crowd monitoring, infrastructure damage identification, and traffic anomaly detection. They highlighted how AI-driven visual analysis enhances safety, reduces manual inspection requirements, and provides real-time decision support. For railway environments, these applications translate into

detecting platform congestion, identifying hazardous conditions like broken equipment, and monitoring passenger behavior. Their findings show how computer vision reduces operator workload and improves system responsiveness. They also emphasized challenges such as lighting variations, occlusions, and environmental noise, proposing deep learning as the most effective solution. The relevance of their work to Rail Madad is clear: vision-based automation can significantly enhance the platform's ability to process multimedia complaints. Their research validates the importance of integrating CV models for real-time safety complaint detection and railway infrastructure surveillance[5]. Zhang and Wang investigated machine learning techniques for automated complaint categorization in customer service systems. They evaluated multiple algorithms, including Support Vector Machines, Gradient Boosting, and Random Forests, demonstrating that ML-based models outperform manual sorting in speed and reliability. Their study emphasized the importance of carefully engineered features such as TF-IDF vectors, word embeddings, and sentiment indicators. The authors showed that machine learning significantly reduces the cognitive burden on human operators, especially in large organizations receiving thousands of grievances. They also demonstrated how classification accuracy improves service quality and response consistency. Their model achieved high F1-scores across categories, proving its robustness. The study provides strong justification for implementing automated categorization in Rail Madad, where complaints must be mapped to departments like security, sanitation, maintenance, and operations. Their methodology also highlights how ML-based classification eliminates human bias and improves decision uniformity [6]. Sharma and Gupta explored the integration of NLP-driven chatbots into customer support systems, focusing on automating interactions and improving response reliability. Their chatbot architecture incorporated intent classification, entity extraction, and dialogue management modules. They demonstrated how automation reduces dependence on human agents and ensures 24/7 availability. The chatbot successfully handled repetitive queries, gathered missing



information, and guided users through complex procedures. Their research highlighted significant improvements in customer satisfaction and service accessibility. In the context of Rail Madad, a chatbot can provide instant acknowledgment, guide passengers through complaint submission, and collect supporting details. The authors also emphasized the importance of conversational AI for multilingual support, which is essential for a diverse user base like Indian Railways. Their work proves that chatbots can serve as an efficient front-end for AI-driven grievance platforms [7]. Prasad and Radhakrishnan analyzed the use of AI and IoT technologies in predictive maintenance for railway systems. Their work focused on sensor-based monitoring and machine learning models to identify anomalies before they lead to major failures. They demonstrated how real-time data streams from railway assets can be analyzed to detect patterns indicative of wear and tear, malfunctioning equipment, or structural issues. Implementing predictive maintenance reduced downtime, improved safety, and extended asset life. Their methodology included anomaly detection algorithms, statistical forecasting, and decision-support systems. For Rail Madad, predictive analytics can use historical complaint patterns to identify recurring issues and recommend preventive actions. This reduces repetitive grievances and improves service reliability. Their study demonstrates the effectiveness of AI in optimizing operational efficiency within large transportation networks [8]. The World Bank's report on artificial intelligence in transportation provides global insights into the opportunities, risks, and design principles associated with integrating AI in large public systems. The report emphasizes how AI-driven automation improves service efficiency, transparency, and user experience across transport sectors. It discusses applications such as predictive maintenance, real-time monitoring, intelligent routing, and automated customer support. The report also stresses the need for robust data governance, ethical AI frameworks, and interoperability between systems. These guidelines are highly relevant for Rail Madad, which handles sensitive passenger data and requires scalable, secure AI-driven workflows. The

report's case studies from various countries demonstrate successful deployment of AI in public transport systems, validating the feasibility of implementing similar solutions in Indian Railways. Overall, the report offers a macro-level perspective that strengthens the strategic justification for AI-powered grievance redressal systems [9]. The official Rail Madad documentation outlines the operational structure, workflows, and limitations of the existing grievance redressal system in Indian Railways. It highlights key challenges such as manual complaint categorization, dependency on human staff, inconsistent routing decisions, delayed resolution times, and the inability to efficiently process multimedia complaints like images and videos. The documentation also provides details about the volume of complaints, the types of issues reported, and the current methods used for verification and forwarding. These insights reveal significant gaps that can be addressed through AI integration. The need for automation in categorization, prioritization, and routing becomes evident from the data provided. The documentation establishes a strong baseline for understanding how AI components such as machine learning, OCR, computer vision, and chatbots can modernize the Rail Madad system. It also reinforces the importance of scalability, speed, and accuracy in handling millions of passenger grievances annually [10].

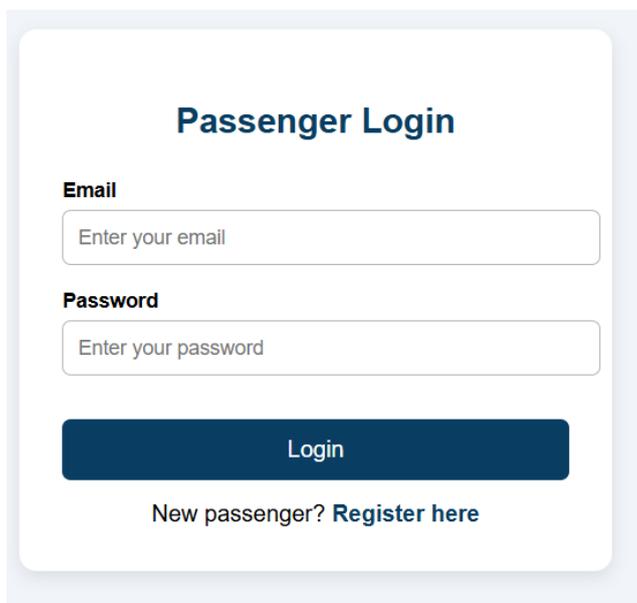
3. Proposed System

3.1. System Architecture

The system architecture of the AI-Powered Rail Madad Complaint Management System is designed as a multi-layered, modular, and scalable model that enables automatic complaint intake, AI-based classification, multimedia analysis, urgency detection, and department-wise routing. The architecture consists of five major layers: User Interface Layer, Data Acquisition Layer, AI Processing Layer, Prioritization Layer, and Service Routing Layer. Each layer communicates through secure REST APIs and ensures seamless processing from complaint submission to resolution. Figure System Architecture Diagram (you can insert the generated image here) provides an overview of the workflow.

3.2. Passenger Login Page

The Passenger Login Page is the first interface that passengers interact with when accessing the AI-powered Rail Madad Complaint Management System. This module enables secure authentication by requiring users to provide their email or username along with a valid password. The page is designed with a simple, clean, and user-friendly layout to ensure easy access for all passengers. The interface contains three main input fields: the Email/Username field, which identifies the passenger's registered account; the Password field, which protects the user's credentials through encrypted storage; and the Login button, which initiates the verification process.



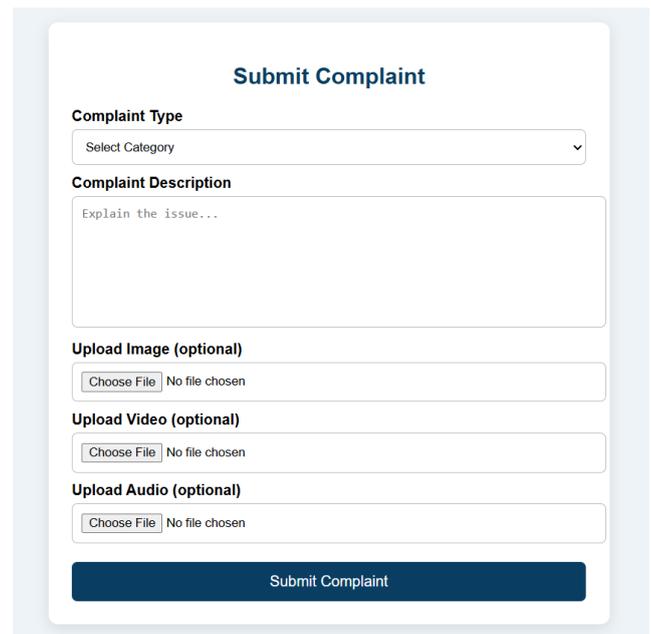
The screenshot shows a 'Passenger Login' form. It has a title 'Passenger Login' at the top. Below it are two input fields: 'Email' with the placeholder 'Enter your email' and 'Password' with the placeholder 'Enter your password'. A dark blue 'Login' button is positioned below the password field. At the bottom, there is a link that says 'New passenger? Register here'.

Figure 1 Passenger Login

3.3. Complaint Submission Page

The Complaint Submission Page serves as the central interface through which passengers submit grievances to the Rail Madad platform. The module is designed to support multimodal complaint inputs, allowing passengers to upload text descriptions, images, videos, and audio recordings related to the issue they want to report. This ensures that complaints are captured with maximum clarity and evidence, reducing ambiguity and enabling more accurate AI processing. The page begins with a dropdown menu where users select the complaint category, such as cleanliness, infrastructure damage,

safety issues, staff behaviour, or other relevant options. This helps the system route the complaint more efficiently. A dedicated text description box allows passengers to describe the problem in detail, providing essential context for the AI-powered NLP classifier.



The screenshot shows a 'Submit Complaint' form. It has a title 'Submit Complaint' at the top. Below it are several sections: 'Complaint Type' with a dropdown menu labeled 'Select Category'; 'Complaint Description' with a text area labeled 'Explain the issue...'; 'Upload Image (optional)' with a 'Choose File' button and 'No file chosen' text; 'Upload Video (optional)' with a 'Choose File' button and 'No file chosen' text; and 'Upload Audio (optional)' with a 'Choose File' button and 'No file chosen' text. A dark blue 'Submit Complaint' button is at the bottom.

Figure 2 Complaint Submission Page

3.4. Data Display Flow Module

The Data Display Flow Module is responsible for retrieving, filtering, and presenting complaint-related information to both passengers and authorities in a structured and meaningful format. This module ensures that all processed data—whether submitted as text, images, videos, or audio—is displayed clearly, concisely, and contextually to support efficient decision-making within the Rail Madad platform. As illustrated in Figure Data Display Flow, this module acts as the bridge between AI-processed outputs and the user-facing dashboards. Once a complaint has passed through AI analysis stages such as NLP classification, computer vision detection, OCR extraction, and urgency scoring, the processed information is stored in the database with structured fields. When a user (passenger or authority) opens the dashboard, the Data Display Flow Module initiates a secure REST API request to fetch the relevant complaint data from MongoDB or SQL-based



storage. The system retrieves raw fields such as complaint ID, type, severity score, multimedia URLs, extracted text, timestamps, and routing history. To maintain clarity, the module performs internal filtering to remove redundant or noisy values. For instance, in multimedia complaints, only the detected objects, extracted text, and validated metadata are displayed, rather than the entire raw AI output. This highlights the most meaningful insights, such as identified problem category, severity indicators, detected safety hazards, and location cues. The module prioritizes the visibility of key features that help authorities make faster decisions, such as highlighting “HIGH PRIORITY” markers for urgent cases. For multimedia items, the module supports embedded previews. Images are displayed with bounding boxes or tagged labels showing detected issues, videos include AI-detected key frames, and audio complaints are shown with their converted text transcripts. This allows authorities to understand the complaint context instantly without needing to manually interpret raw media. On the passenger side, the module displays simplified complaint tracking information such as submission status, assigned department, progress updates, and expected resolution time. On the authority side, the module provides advanced details such as departmental logs, escalation notes, AI-generated recommendations, and verification status.

3.5. AI-Powered Complaint Redressal Platform

The AI-Powered Complaint Redressal Platform is an intelligent, automated grievance-handling system designed to modernize and enhance the efficiency of the Rail Madad service in Indian Railways. Traditional manual complaint management systems suffer from delays, inaccurate categorization, and an inability to effectively process multimedia complaints such as images, videos, and audio recordings submitted by passengers. The AI-powered platform addresses these issues by integrating advanced technologies including computer vision, natural language processing (NLP), optical character recognition (OCR), speech-to-text conversion, urgency detection, and automated routing algorithms. The platform begins by accepting complaints through

a user-friendly web or mobile interface, where passengers can submit text descriptions along with optional multimedia evidence. The system then preprocesses the complaint and uses NLP models—based on Transformer architectures—to understand the content, classify the complaint type, and identify relevant keywords. Simultaneously, images and videos are processed using deep learning-based computer vision models such as ResNet to detect visual cues related to cleanliness, infrastructure damage, overcrowding, vandalism, and safety hazards. OCR technology extracts textual information from signboards, coach plates, handwritten notes, and other visual inputs, while audio complaints are converted into text through speech recognition models.

Following analysis, the platform performs urgency detection to determine the severity of the complaint. This includes evaluating sentiment, detecting critical keywords, identifying safety-related risk factors, and interpreting hazardous visual elements. Urgent complaints—such as medical emergencies, security threats, or infrastructure failures—are immediately escalated for priority handling.

The final stage involves intelligent routing, where the system automatically forwards the classified and prioritized complaint to the appropriate railway department such as Cleaning, Maintenance, Security, Electrical, or Station Administration. Role-based access control (RBAC) ensures that only authorized officials can view, update, and resolve complaints. The platform also maintains real-time status updates, enabling passengers to track their complaints easily. By integrating AI, the platform significantly reduces manual workload, eliminates delays, and increases the accuracy of classification and resolution. It provides a faster, more transparent, and more reliable grievance-handling system, ultimately improving passenger satisfaction and supporting the modernization of Indian Railways.

4. Results and Analysis

4.1. Improved Accuracy in Complaint Classification

The suggested system is expected to deliver highly accurate complaint classification using machine learning and deep learning techniques. By employing



advanced models such as ResNet for image-based issues and Transformer-based NLP models for text complaints, the system will ensure that grievances are automatically categorized with minimal human intervention. This improvement will reduce misclassification errors, enhance consistency, and enable faster identification of the complaint category. As a result, departments will receive more relevant and correctly sorted complaints, leading to quicker and more effective resolutions.

4.2.Faster Complaint Processing and Automated Routing

With automated routing mechanisms, the system is expected to significantly reduce the time required to process and forward complaints. Traditional methods involve manual review and departmental classification, which can introduce delays. The AI-driven routing model will analyze the complaint content and instantly assign it to the appropriate department, reducing processing time from minutes to seconds. This acceleration will improve operational efficiency, lessen system congestion during peak hours, and ensure that passengers receive timely updates and resolutions.

4.3.Enhanced User Interaction Through AI Chatbot

The AI-powered chatbot integrated into the system will offer a more interactive and user-friendly complaint submission experience. It is expected to guide passengers through the registration process, help them provide complete information, and answer common queries instantly. This intelligent support reduces dependency on human operators and ensures 24/7 assistance for all passengers. Additionally, the chatbot will minimize incomplete submissions and improve complaint accuracy, leading to fewer follow-up requests and smoother processing.

4.4. Accurate Urgency Detection and Prioritization

The system is expected to accurately identify high-priority complaints using sentiment analysis, keyword detection, and severity modeling. Critical issues such as safety violations, medical emergencies, criminal activity, or severe infrastructure damage will be automatically flagged as high urgency. This ensures they are escalated immediately to the

concerned authorities. Prioritization will prevent high-risk complaints from being delayed in the queue and improve passenger safety and service responsiveness.

4.5.Enhanced Handling of Multimedia Complaints

The system is expected to greatly enhance the ability to process multimedia complaints, including images, videos, and audio recordings. Using computer vision models, the system will accurately detect visible issues such as cleanliness problems, coach damage, overcrowding, or safety hazards from images and video frames. OCR will extract valuable text from signboards, coach plates, tickets, and handwritten notes, converting them into machine-readable content. Audio complaints will be converted into text using speech-to-text technology, enabling a unified processing workflow. This multimedia handling improvement reduces reliance on manual review, increases the precision of complaint analysis, and allows passengers to report issues more conveniently using any format.

Conclusion

The suggested SmartDrive Card offers a strong and creative answer to the changing needs of contemporary transport by combining IoT connectivity, NFC contactless access, and secure data management. Featuring automated driver verification, dynamic lent driver tracking with OCR image analysis, permit compliance management, and simplified RC renewal through integrated payments, the platform offers a full digital ecosystem designed for vehicle owners and authorities. The outlined future enhancements—such as Vahan database integration, edge-based digital twins for real-time monitoring, and blockchain for privacy-preserving updates—position the system as a transformative tool for lowering liability risks and improving compliance, even though its current limitations in full-scale deployment, multi-device interoperability, and advanced AI fraud detection are acknowledged. With the help of this research, next-generation transport systems that are user-centric, scalable, and secure will be able to move people more safely and effectively in connected car environments.



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