ENHANCING RAIL MADAD WITH AI POWERED COMPLAINT MANAGEMENT

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Keywords:
Artificial Intelligence, Vision Transformer (ViT-B16), Image Classification, Smart Routing System, Complaint Management System.

Introduction:

Indian Railways is one of the largest transportation networks in the world, serving millions of passengers every day, making efficient complaint management a critical requirement for ensuring safety, comfort, and service quality. Passengers frequently report issues such as cleanliness problems, infrastructure damage, electrical faults, and overcrowding, which require timely attention. However, the existing Rail Madad system largely depends on manual verification and categorization of complaints, leading to delays, inaccurate classification, and improper prioritization of critical issues. Text-based complaints often lack clarity and sufficient evidence, making it difficult for authorities to assess the severity and urgency of problems. With the widespread use of smartphones, passengers can now capture and upload images as proof, but current systems do not effectively utilize this visual data. Recent advancements in Artificial Intelligence and Deep Learning enable automated image analysis, offering an opportunity to improve complaint management systems. This project proposes an AI-powered enhancement to Rail Madad by integrating image classification using a Vision Transformer (ViT-B16) model. The system automatically classifies complaint images into predefined categories and captures metadata such as GPS location and timestamp for accurate validation. Based on classification results, complaints are prioritized and routed to the appropriate railway authorities through a smart routing mechanism. This approach reduces manual effort, improves response time, enhances transparency, and supports efficient resource allocation. Overall, the proposed system contributes to modernizing railway grievance redressal and improving passenger satisfaction.

Objectives:

1. To develop an AI-powered system for automatic classification of railway complaint images.
2. To design and implement a Vision Transformer (ViT-B16) model for accurate complaint categorization.

3. To enable priority-based complaint handling for faster response to critical and safety-related issues.
4. To implement a smart routing mechanism for directing complaints to appropriate railway authorities.
5. To reduce manual effort and improve efficiency in complaint verification and processing.
6. To enhance transparency and real-time monitoring in the grievance redressal system.

Methodology:

1. The proposed system follows a modular and systematic approach to automate railway complaint management using Artificial Intelligence. Initially, passengers submit complaints through a web-based interface by uploading images along with optional textual descriptions. At the time of submission, the system captures essential metadata such as GPS location and timestamp to provide accurate contextual information. The uploaded images are then preprocessed through resizing, normalization, and format standardization to ensure compatibility with the AI model.
2. A fine-tuned Vision Transformer (ViT-B16) model is used for image classification, which analyzes the input images and categorizes them into predefined classes such as cleanliness issues, infrastructure damage, electrical faults, and overcrowding. Each prediction is associated with a confidence score to indicate classification reliability. Based on the predicted category and severity level, the system assigns priority to each complaint, ensuring that critical issues receive immediate attention.
3. A smart routing mechanism is implemented to automatically forward complaints to the appropriate railway authority, such as maintenance staff, Railway Protection Force (RPF), or station administrators, based on complaint type and geographic location. The backend system, developed using Flask, handles all processing logic, API communication, and interaction with other components.
4. All complaint data, including images, metadata, classification results, and status updates, are stored in a centralized MongoDB database to enable efficient tracking and retrieval. The frontend, developed using Next.js, provides role-based dashboards for passengers and railway staff, allowing real-time monitoring, status updates, and complaint management.
5. The system architecture ensures seamless integration between frontend, backend, AI model, and database through REST APIs. Additionally, analytical features such as complaint tracking and visualization can be used to identify patterns and improve resource allocation. Overall, the methodology ensures scalability, automation, and efficient handling of railway complaints while reducing manual intervention and improving response time.

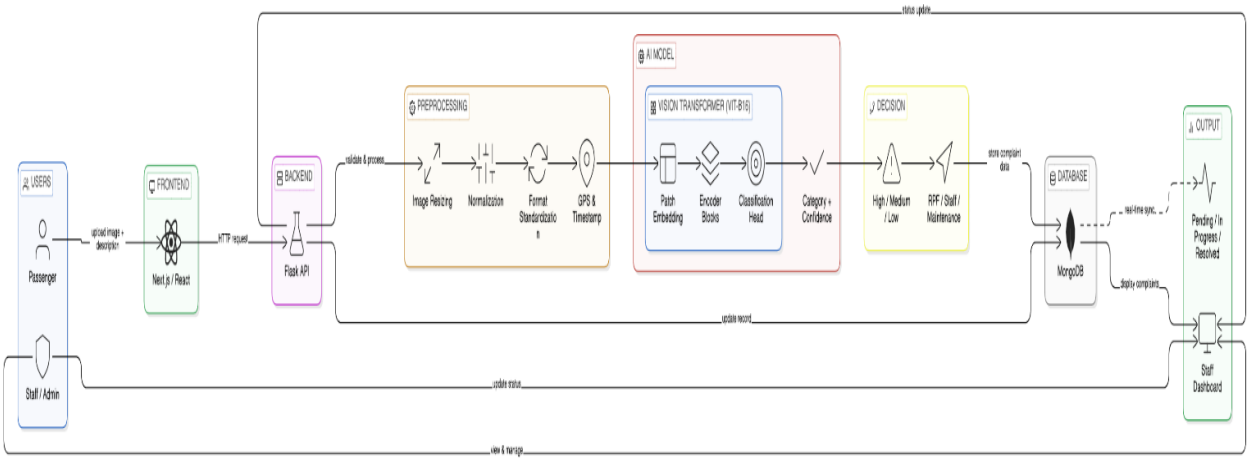

Fig.4.1 *Architecture diagram*

Result and Conclusion:

1. The proposed AI-powered Rail Madad complaint management system was successfully developed and tested, demonstrating effective automation in handling railway complaints. The Vision Transformer (ViT-B16) model achieved accurate classification of complaint images into predefined categories such as cleanliness issues, infrastructure damage, electrical faults, and overcrowding. The system significantly reduced dependency on manual complaint verification and improved classification consistency.
2. The integration of metadata, including GPS location and timestamp, enhanced the validation process and enabled location-aware prioritization of complaints. The smart routing mechanism effectively assigned complaints to the appropriate railway authorities, ensuring faster response and efficient handling of critical issues. Observations from system testing indicate a noticeable improvement in response time and reduction in processing delays.

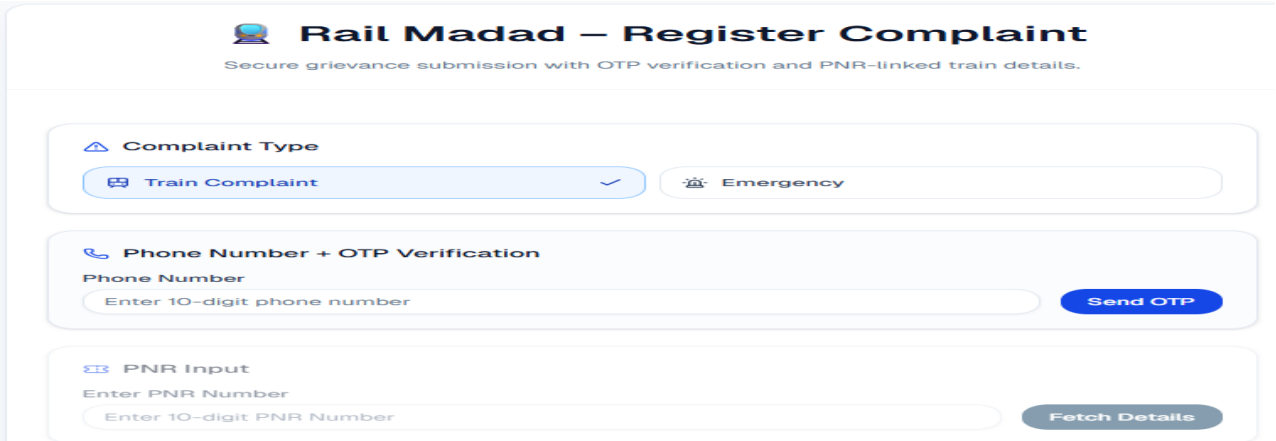

Fig.5.1 *Complaint form*

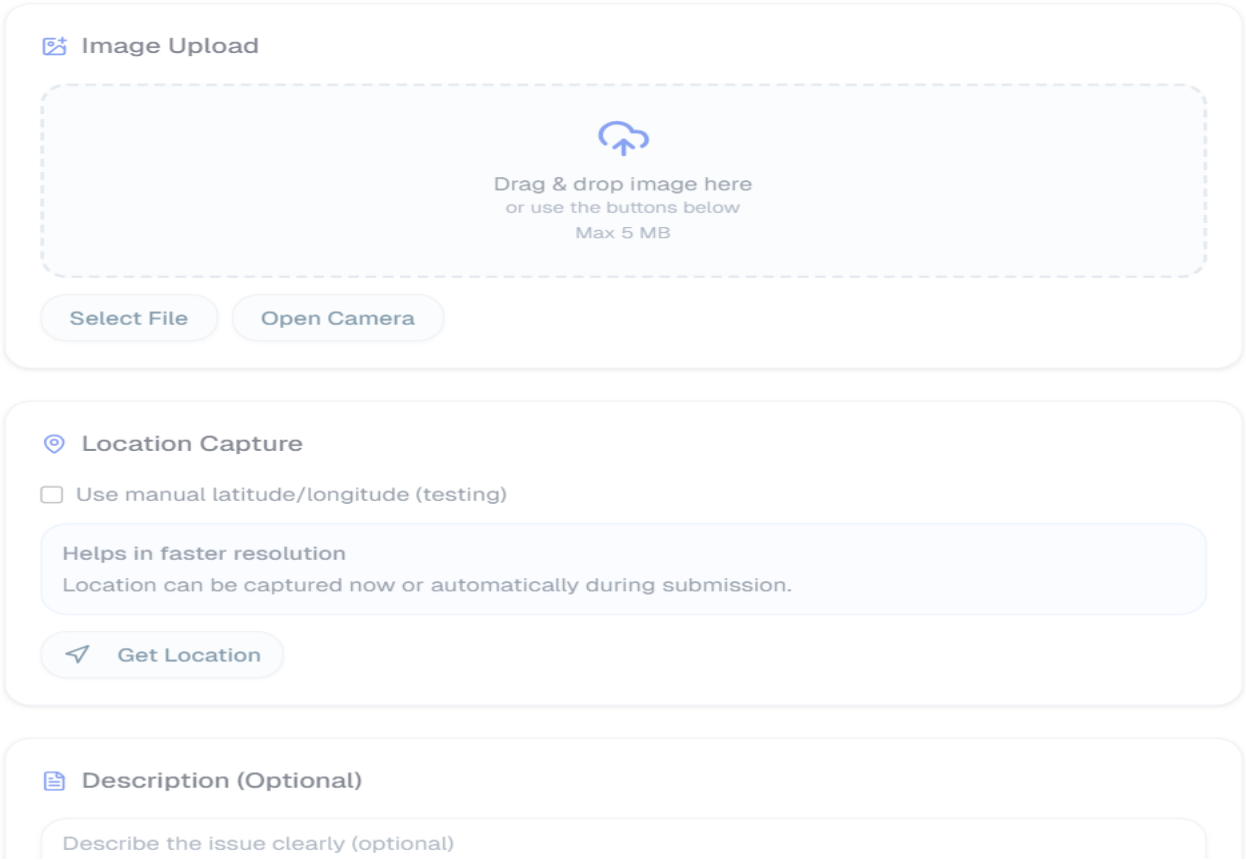

Fig.5.2 *Complaint form-continued*

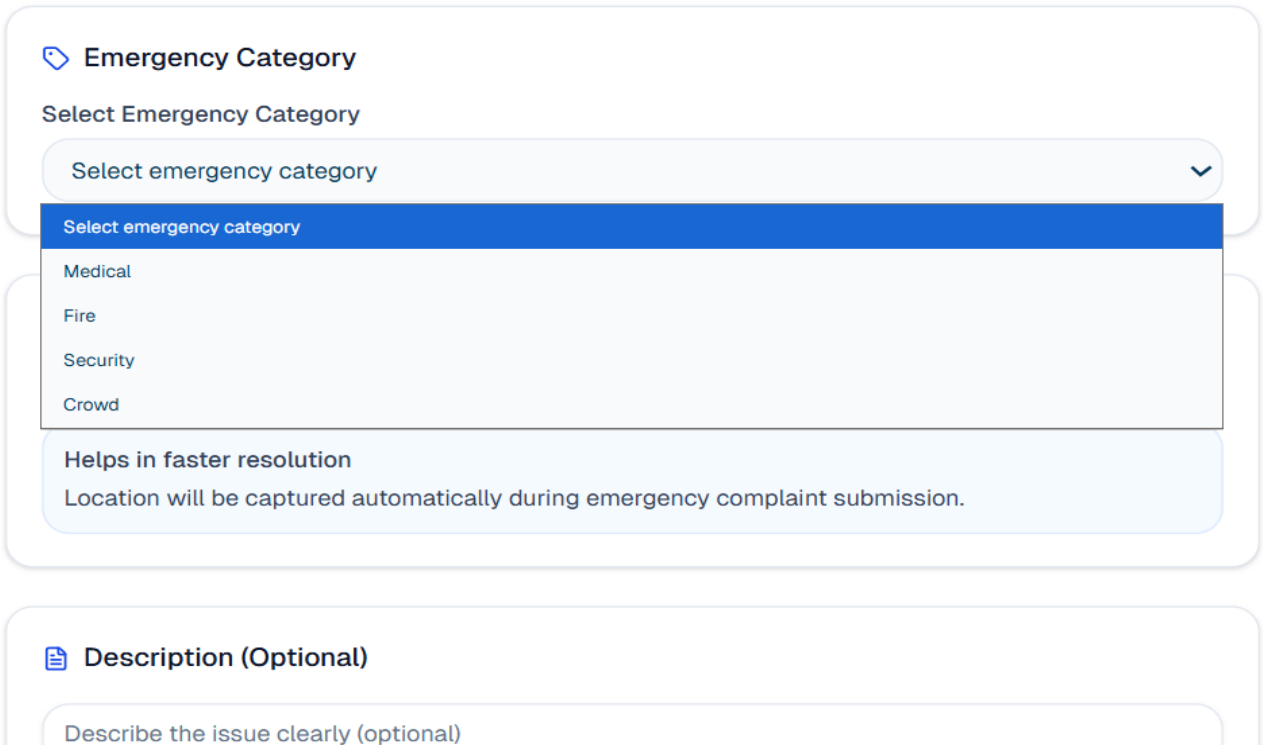

Fig.5.3 *Emergency complaint form*

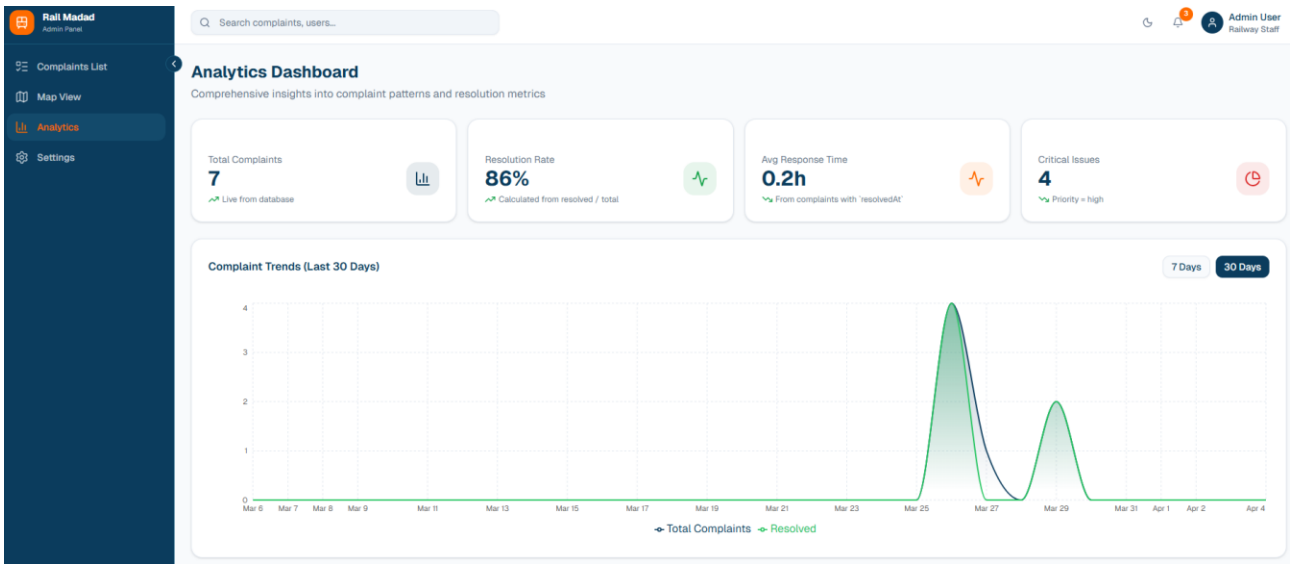

Fig.5.4 *Admin Analytics dashboard*

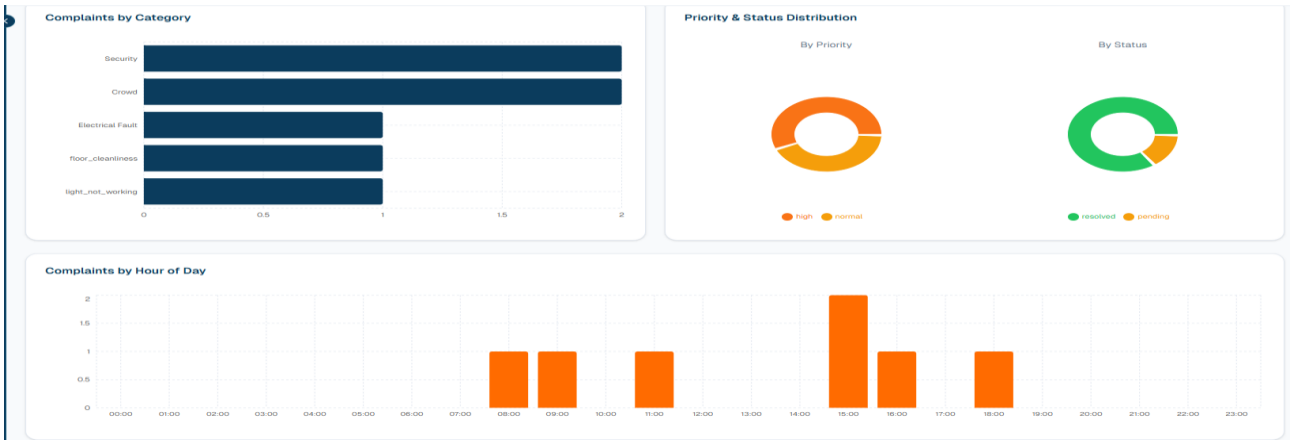

Fig 5.5 *Admin Analytics dashboard -continued*

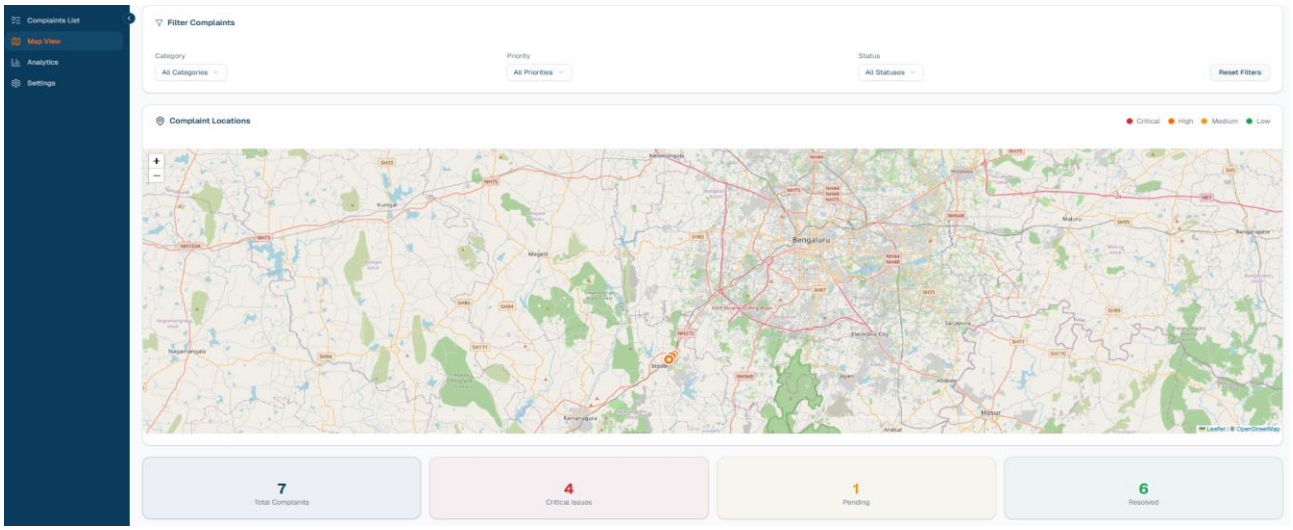

Fig 5.6 Admin *Map view (Complaint locations)*

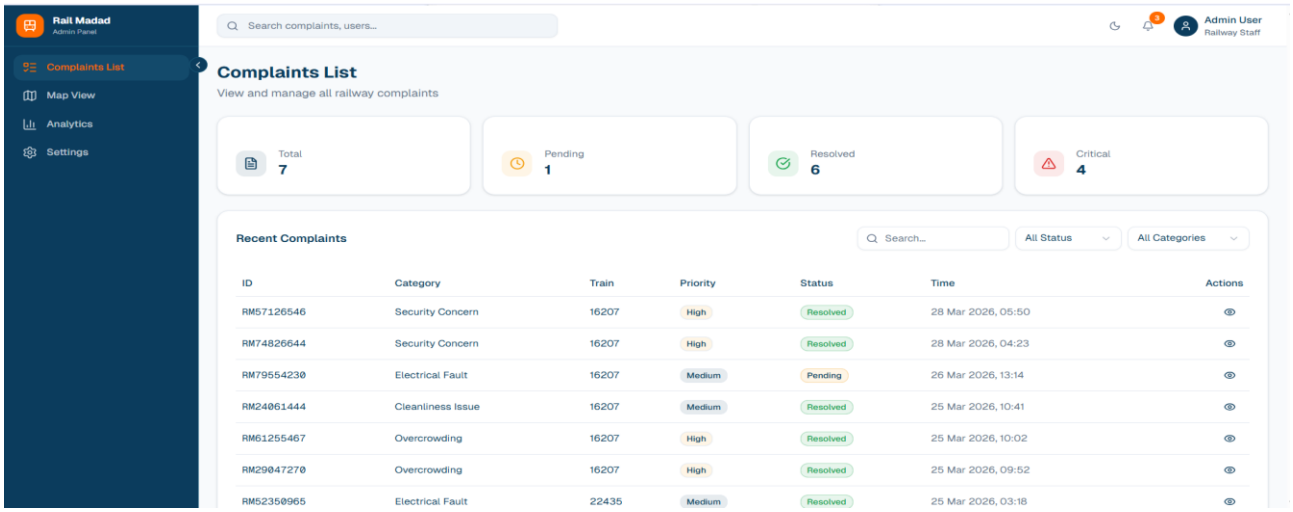

Fig .5.7 *Complaints List*

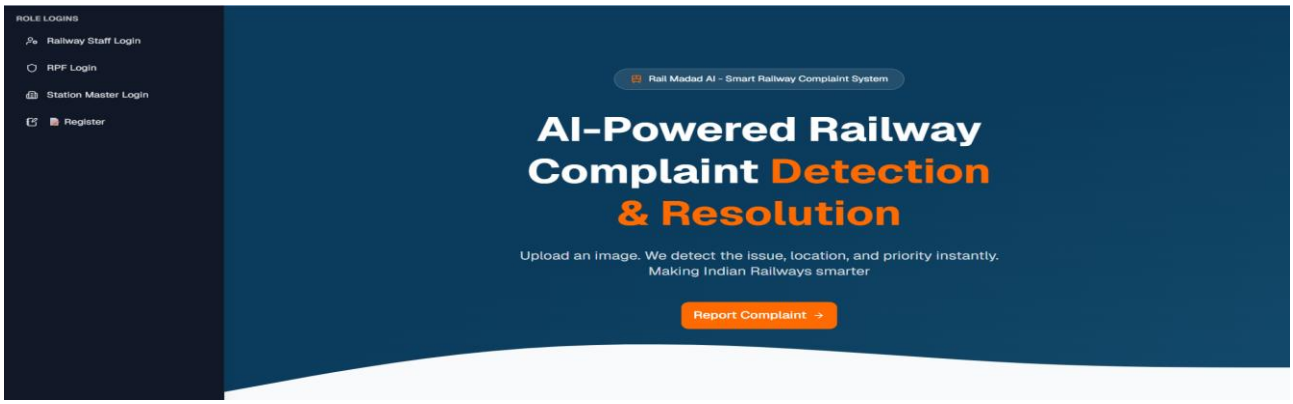

Fig 5.8 *Role Logins*

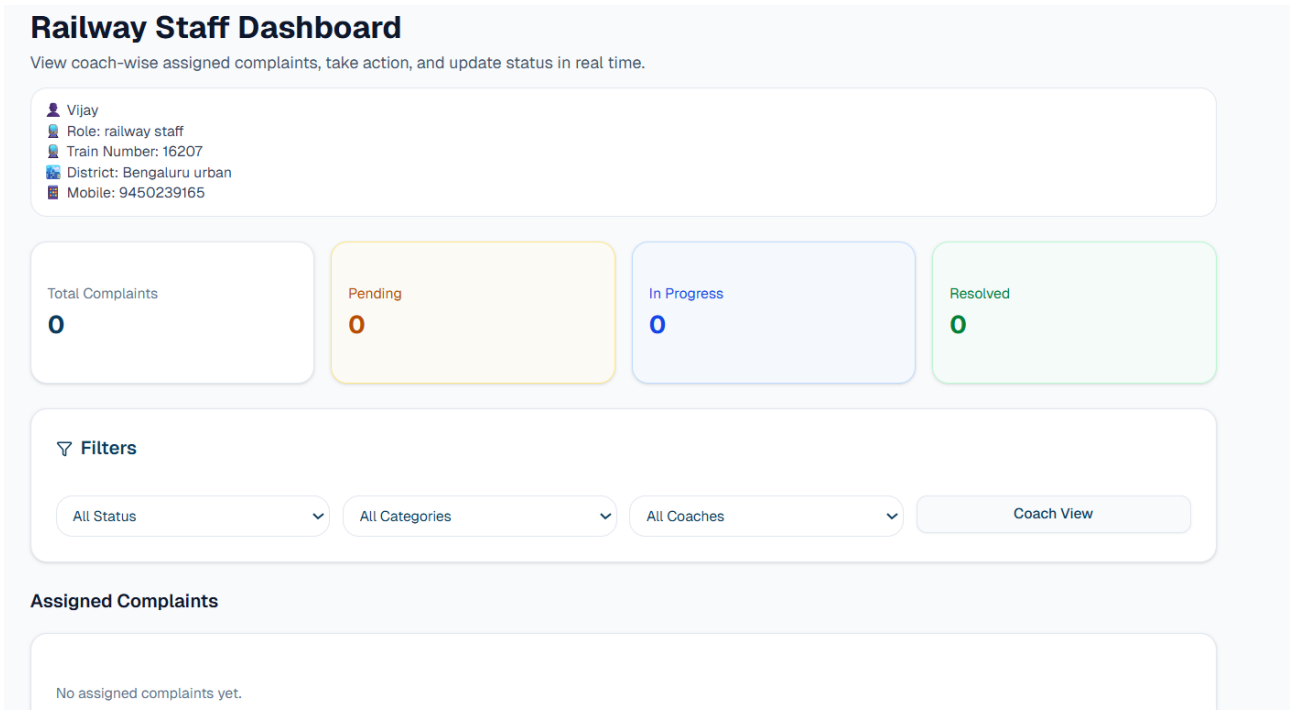

Fig 5.9 *Railway staff Dashboard*

1. The developed dashboards provided real-time tracking and monitoring capabilities for both passengers and railway staff, improving transparency and accountability. Graphs and charts generated from complaint data helped visualize trends, identify frequently reported issues, and support better decision-making. Sample test results and screenshots of the system interface demonstrate successful implementation of the complete workflow from complaint submission to resolution.
2. Overall, the system achieves its objective of enhancing efficiency, accuracy, and reliability in railway grievance redressal. The project concludes that integrating Artificial Intelligence, image-based classification, and smart routing mechanisms can significantly improve public service systems and passenger satisfaction.

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Future Scope:

The future scope of this project includes:

1. Integration of the system with official Indian Railways platforms for real-time deployment and large-scale usage.
2. Enhancement of the AI model using larger and more diverse datasets to improve classification accuracy and robustness.

3. Extension of the system to support video and audio-based complaint analysis for better evidence collection.
4. Implementation of multimodal AI models combining text, image, and voice inputs for more intelligent complaint understanding.
5. Incorporation of predictive analytics to identify problem-prone areas and prevent issues proactively.
6. Deployment of the system on cloud platforms to ensure scalability, reliability, and accessibility across multiple railway zones.