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- **Problem Statement ID : 1711**
- **Problem Statement Title : Enhancing Rail Madad with AI-powered Complaint Management**
- **Theme - Smart Automation**
- **PS Category- Software**
- **Team ID : 48148 Team**
- **Name : Neuratech**

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Transforming Rail Madad: AI-Powered Smart Complaint Management

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- **Proposed Solution (Describe your Idea/Solution/Prototype)**

Solution

Automated Categorization, Prioritization & Smart Routing

A **CNN model** processes complaint text and images, extracting features to classify, prioritize, and route complaints.

Predicting Recurring Issue

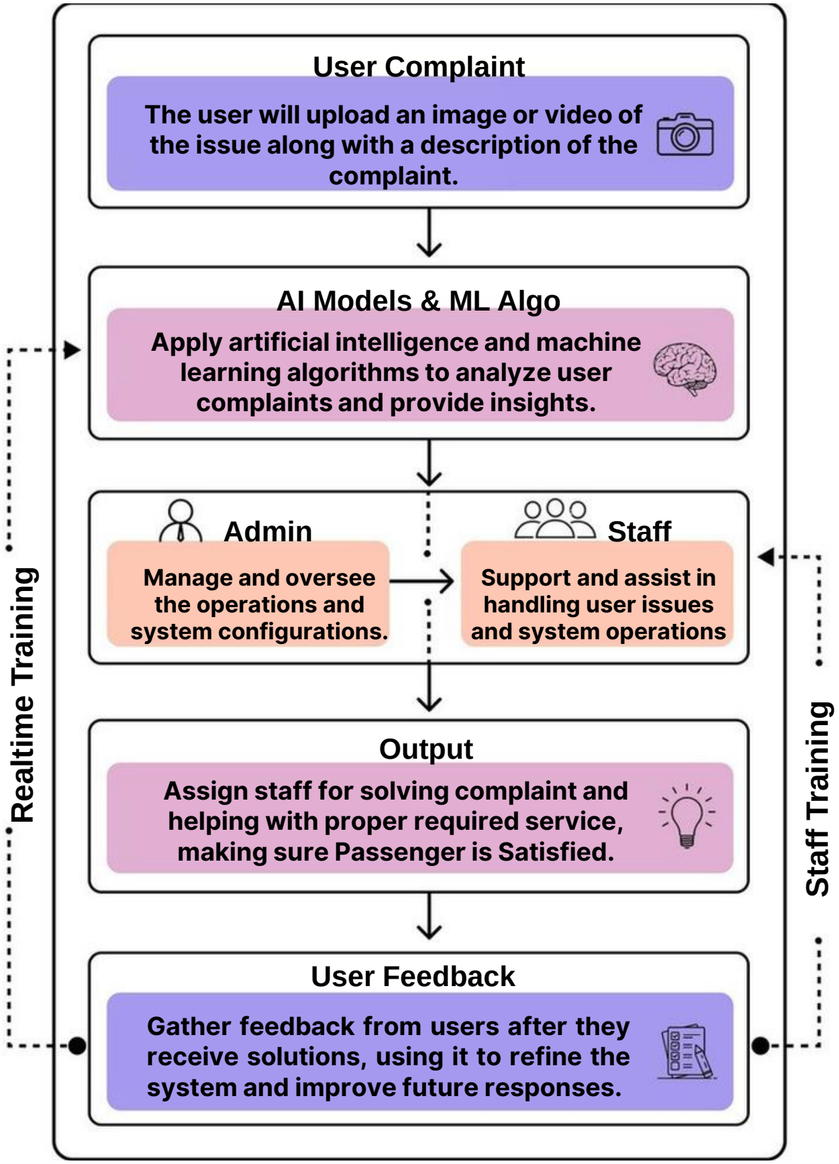
An **LSTM model** analyzes historical complaint data to detect patterns, predicting recurring issues and allowing proactive maintenance. Helps in preventing problems before they become widespread

API - Integration with Rail Madad

Creating **APIs** to connect the **AI system** with **Rail Madad**, enabling seamless data exchange. This ensures real-time updates and automated workflows across the complaint management system.

Sentiment Analysis - Feedback Management

Sentiment analysis uses **NLP models** to assess emotional tone of complaints, urgent responses to **negative feedback**. Improves customer satisfaction by addressing critical issues faster.



Uniqueness

Complaint Source Integration

Aggregates complaints from diverse sources like **social media** and **news** into one system, automatically categorizing and routing them for efficient handling.

Cross-Department Collaboration

Facilitates collaboration by allowing shared access to complaints, creating a dedicated space for departments to work together on **multi-category issues**.

Complaint Recommendation

When users submit a complaint, the system shows similar **past complaints** and their **resolutions**. This helps users see how **similar issues** were handled and potentially resolve their concerns faster

Emergency Live Video Complaint/SOS

Introduces **real-time** video-based complaint reporting for emergencies, enabling **instant verification and prioritization**. Adds a new level of immediacy to critical situations.

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TECHNICAL APPROACH

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Frontend

React for admin website and Flutter for user and staff applications

Backend

Flask for building APIs and handling logic and Python for the server side solutions

Preprocessing

NLTK for text preprocessing & OpenCV for image & video preprocessing

Machine Learning

scikit-learn for machine learning tasks and TensorFlow for convolutional neural networks

Text Extraction

Optical Character Recognition for Text Extraction

Visualization

Matplotlib for Model Visualization & Chartjs for Analytics

Database

Realtime updates, Auth & Storage

Presentation Layer

- Registration and Login
- User
  - Complaint Submission
  - Real-Time Updates
  - Feedback Collection
- Staff
  - Complaint Management
  - Training Portal
- Admin
  - Admin Dashboard

Integration Layer

- API Integration
  - Flask APIS's accessing ML models
  - Integration With Rail Madad
- Middleware Component
  - Data Transformation Preprocessing
  - Complaint Queues

Application Layer

- ML Algorithms & Models
  - Automated Categorization & Prioritization
  - Enhanced Data Extraction(OCR)
  - Automated Response and Routing
  - LLM Based Chatbot
  - Sentiment Analysis
- Complaint Management
  - Complaint Registration and Tracking
  - Departmental Management
- Real Time Training Module
  - Performance Monitoring
  - User Feedback
- Media Handling
  - NLP Based Feature Extraction
  - Multilingual Support
- Emergency
  - SOS Live with help of Sockets

Persistence Layer

- Complaint Database
  - Structured Storage
  - Data Accessibility
- AI Model Storage
  - Model Repository
  - Version Control
- Additional Data Stores
  - Caching Systems
  - Logging and Auditing

Security Layer

- User Authentication
  - Secure Login Protocols
  - Multi-Factor Authentication (MFA)
- Data Encryption
  - Encryption at Rest
  - Encryption in Transit
- Access Control
  - Role-Based Access Control (RBAC)

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Rail Madad VS Rail Sahayta

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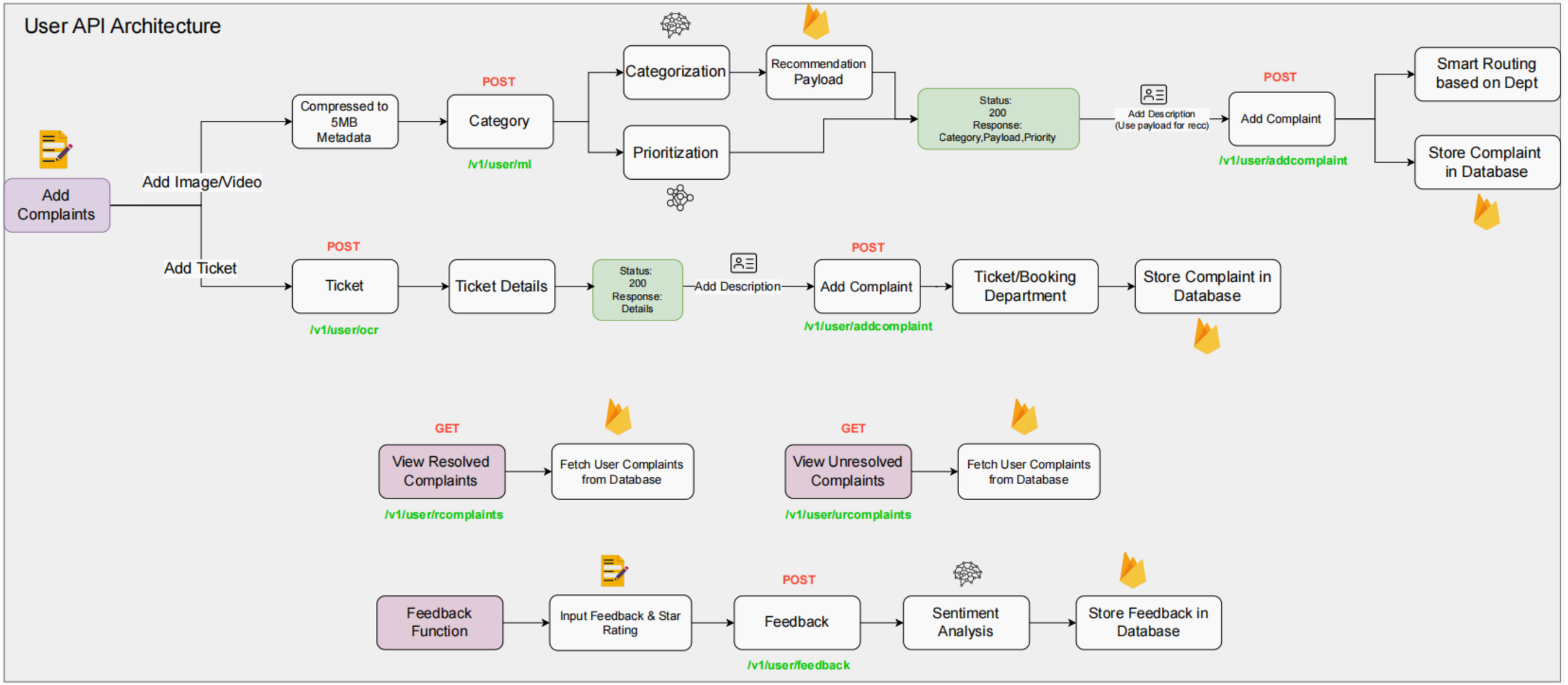
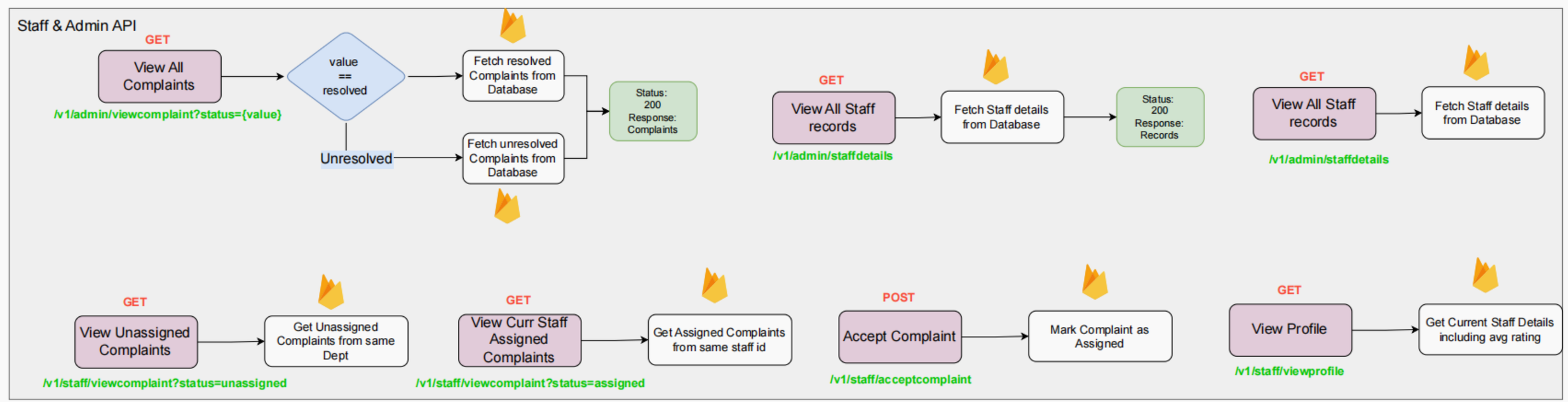
Rail Madad	Rail Sahayata
1. Manual Categorization	1. Auto Categorization
2. Upload file limit 5 MB	2. Auto compression file limit 5 MB
3. No suggestion	3. Complaint suggestion
4. Manual feedback rating	4. Auto (Smart) feedback rating [Time of completion, sentiment analysis]
5. Poor complaint tracking (ref. no. required)	5. Organised complaint section for tracking
6. Time consuming for registering complaint (select category, time & date, sub-category, etc…)	6. Not time consuming for registering complaint (Auto category, time & date, sub-category, etc…)
7. There is no provision to reopen the complaint if the complainant is not satisfied by the resolution provided by Railways	7. There is provision to reopen the complaint if the complainant is not satisfied by the resolution provided by Railways (by accessing complain history)
8. One cannot see their history of the lodged complaints	8. One can see their history of the lodged complaints
9. No prediction mechanism	9. AI model to predict recurring issues
10. Limited analytics	10. Auto performance monitoring and analytics
11. No staff training	11. Personalized staff training
12. No prioritization of complain	12. Prioritization on basis of severity

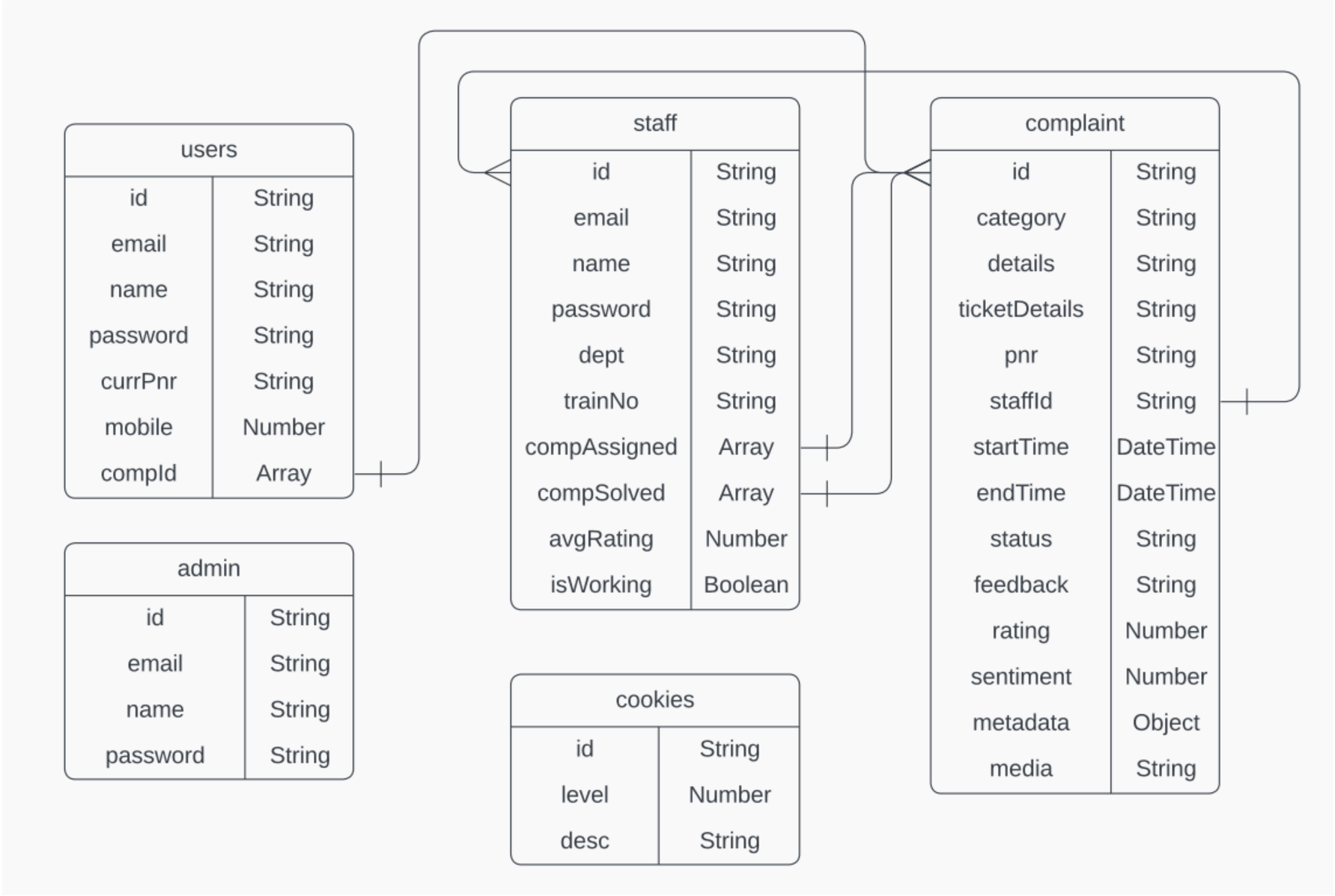
API Architecture



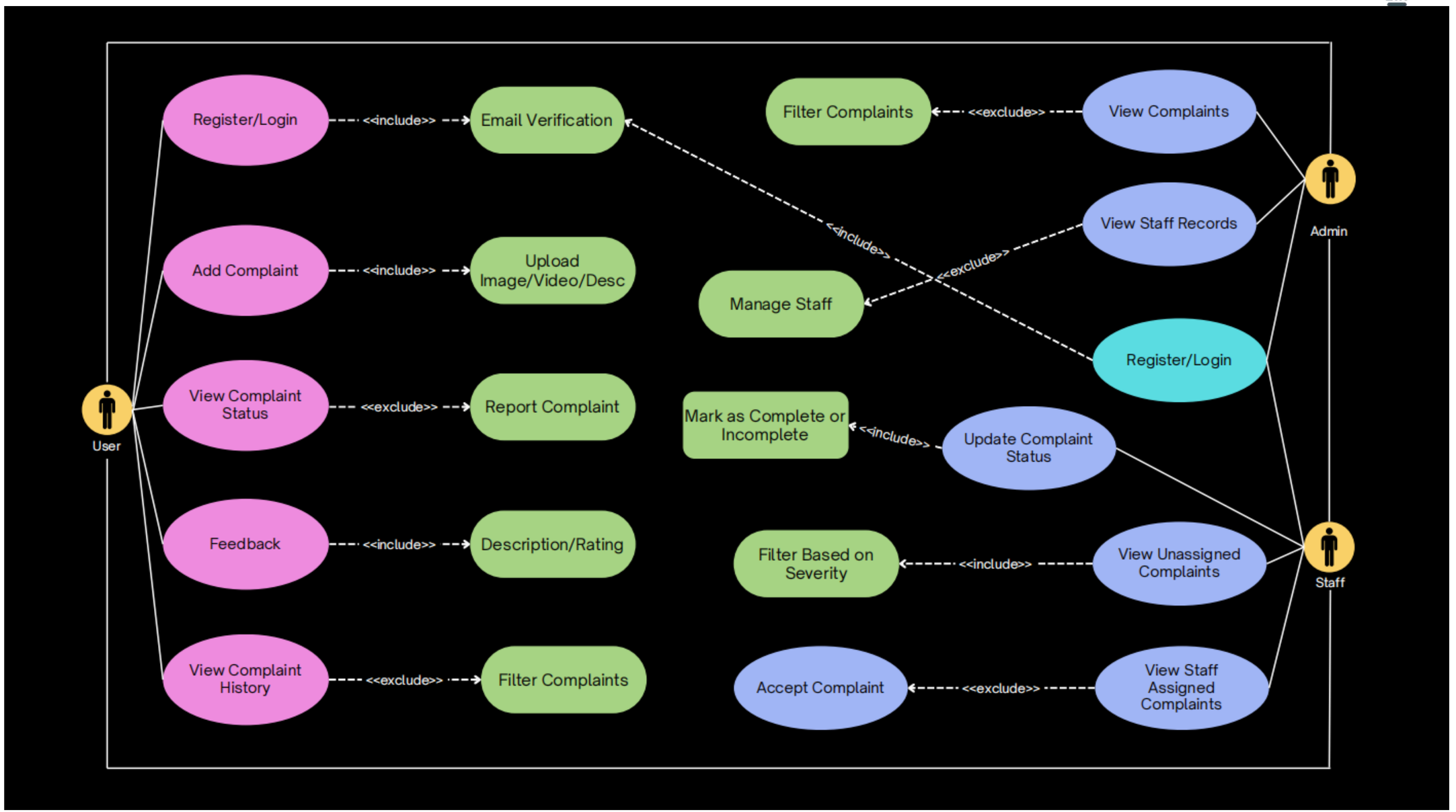
API Architecture



Database Model



Use Case Diagram



Business Model

RAILSAHAYTA BUSINESS MODEL

KEY ACTIVITIES

- AI-Based Complaint Categorization and Resolution:
- Integration with Rail Madad Platform:
- Real-Time Issue Tracking:
- Predictive Maintenance:
- Partnership Management:

CUSTOMER SEGMENTS

- Primary Users
- Railway Staff and Managemant
- Railway Authorities
- Indian Railway Partenrs

KEY PARTNERS

- Indian Railways
- Ai Technology Provider
- Maintanance and Service Vendors
- Goverment Digital Initiatives

VALUE PROPOSITIONS

- Faster and Efficient Complaint Resolution
- Predictive Maintenance
- Increased Operational Efficiency
- Real Time Emergency Handling
- Transperency and Accountability

KEY RESOURCES

- AI & ML Models
- Skilled Personnel
- Data Infrastructure
- Complaint And Feedback Database

CHANNELS

- Mobile and Web Application
- SMS and Chatbot Integration
- Social Media Aggregation

CUSTOMER RELATIONSHIP

- Automated Acknowledgenmt and Followups
- Personalized Feedback Collection
- AI Driven Insights
- Helpdesk Support

COST STRUCTURE

- Development and Integration
- Data Storage and Processing
- Model Training and Updates
- Maintanance and Support
- Marketing and Awareness Campaigns

REVENUE STREAM

- Indian Railway Funding
- Service Contracts with Third Party Vendors
- Subscription Fees for Advanced Analytics
- Cost Saving through Automation

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FEASIBILITY AND VIABILITY

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Operational Feasibility

Automated Categorization and Prioritization: Implementing CNNs for image and video analysis enhances complaint classification, boosting processing efficiency.

Enhanced Data Extraction: Utilizing OCR and metadata extraction provides additional context, leading to more precise and informed resolutions.

Automated Response & Routing: AI chatbots and smart routing algorithms streamline complaint handling and ensure timely resolution by directing complaints to the correct departments.

Predictive Maintenance: Machine learning models for predictive analytics forecast recurring issues, enabling proactive maintenance and reducing future complaints.

Feedback and Continuous Improvement: Sentiment analysis and performance monitoring drive ongoing improvements in the complaint resolution process.

Technical Feasibility

Integration with Existing Systems: Requires complex API development and data synchronization for seamless functionality.

Real-Time Processing: Needs efficient processing pipelines and low-latency infrastructure for timely analysis.

Scalability and Performance: Must optimize algorithms and use cloud solutions to handle large data volumes and varying loads.

Economic Feasibility

Cost of AI Integration: High initial investment in AI technologies and system integration but offers long-term efficiency gains.

Resource Allocation: AI-driven optimization can lead to cost savings by dynamically adjusting staffing and resources.

Maintenance and Updates: Ongoing costs for system maintenance & updates are balanced by improved resolution speed and accuracy.

Problems	Solution
Data Quality & Availability	Data Preprocessing & Cleaning Manual Labelling & Annotation Data Augmentation
Model Accuracy	Continuous Model Training & Validation Human-In-Loop Approach
Scalibility Issues	Cloud Based Solutions Distributed Systems Data Prioritization
Handling Multimodal Data (Text, Image & Videos)	Hybrid AI Models Data Fusion Multimodal Frameworks
Cultural Resistance (staff)	Provide Training & Support Rewarding & Rankings

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RESEARCH AND REFERENCES

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CNN for image categorization & prioritization	CNNs excel at image categorization by learning hierarchical features from raw data, while the final softmax layer provides confidence scores that can prioritize complaints based on classification certainty.	https://www.tensorflow.org/tutorials/images/cnn
LSTM Model for Predicting Recurring Issue	LSTM models effectively capture temporal dependencies and long-term patterns in time-series data, making them ideal for predicting recurring issues by learning from historical trends and mitigating the vanishing gradient problem.	https://github.com/jaungiers/LSTM-Neural-Network-for-Time-Series-Prediction/tree/master
Sentiment Analysis using NLTK for User Feedback	NLTK (Natural Language Toolkit) effectively classifies sentiment in user feedback by analyzing text data and extracting sentiment scores, providing insights into user opinions and satisfaction levels.	https://www.kaggle.com/code/jonathanoheix/sentiment-analysis-with-hotel-reviews
OpenCV for Image Preprocessing	OpenCV provides robust tools for image preprocessing, including techniques like filtering, resizing, and normalization, which enhance and prepare images for further analysis.	https://docs.opencv.org/4.x/d2/d96/tutorial_py_table_of_contents_imgproc.html
Flask API for Integration	Flask enables the creation of RESTful APIs for integrating various components by providing tools for routing, request handling, and CRUD operations.	https://medium.com/@dennisivy/flask-restful-crud-api-c13c7d82c6e5text
Tesseract for OCR Text Extraction	Tesseract, accessed via the pytesseract library, provides powerful Optical Character Recognition (OCR) capabilities for extracting text from images.	https://pypi.org/project/pytesseract/
LLM Fine Tuning for Chatbot	Fine-tuning large language models (LLMs) allows for advanced chatbot development by adapting the model to specific conversational contexts and user interactions.	https://wandb.ai/mostafaibrahim17/ml-articles/reports/Fine-Tuning-Llama-2-for-Advanced-Chatbot-Development--Vmlldzo2NTY3ODUwparagraph text