BASIC DETAIL OF THE TEAM AND THE PROBLEM STATEMENT

SMART INDIA HACKATHON 2025

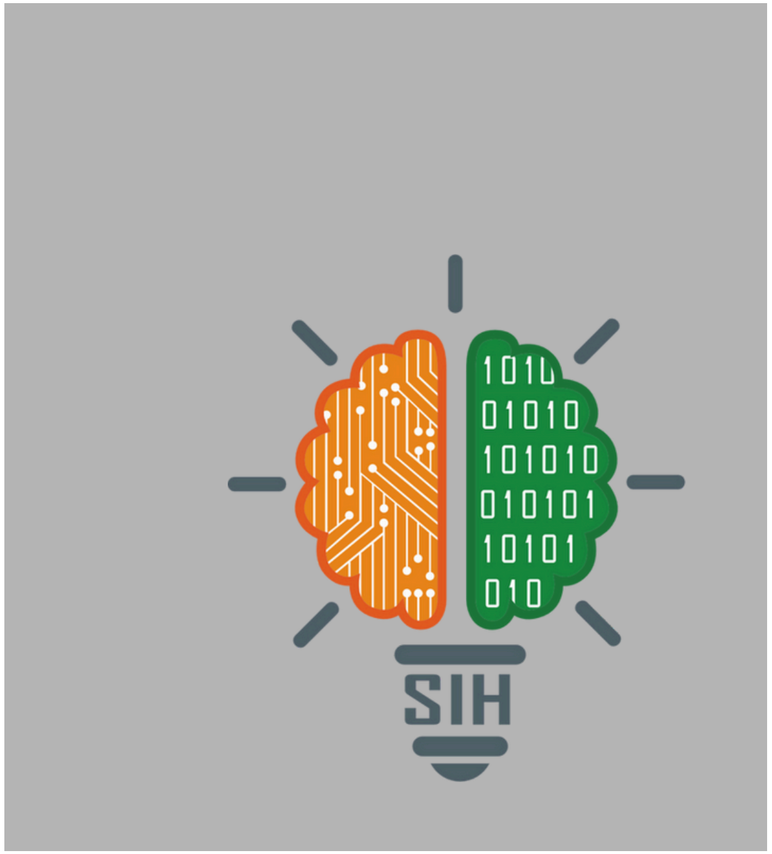
Problem Statement ID - SIH25022

Problem Statement Title - Maximizing Section Throughput Using Al-Powered Precise Train Traffic Control

Theme -Transportation & Logistics

PS Category - Software

Team Name - NeuroRail



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IDEA/APPROACH DETAILS

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Proposed Solution:

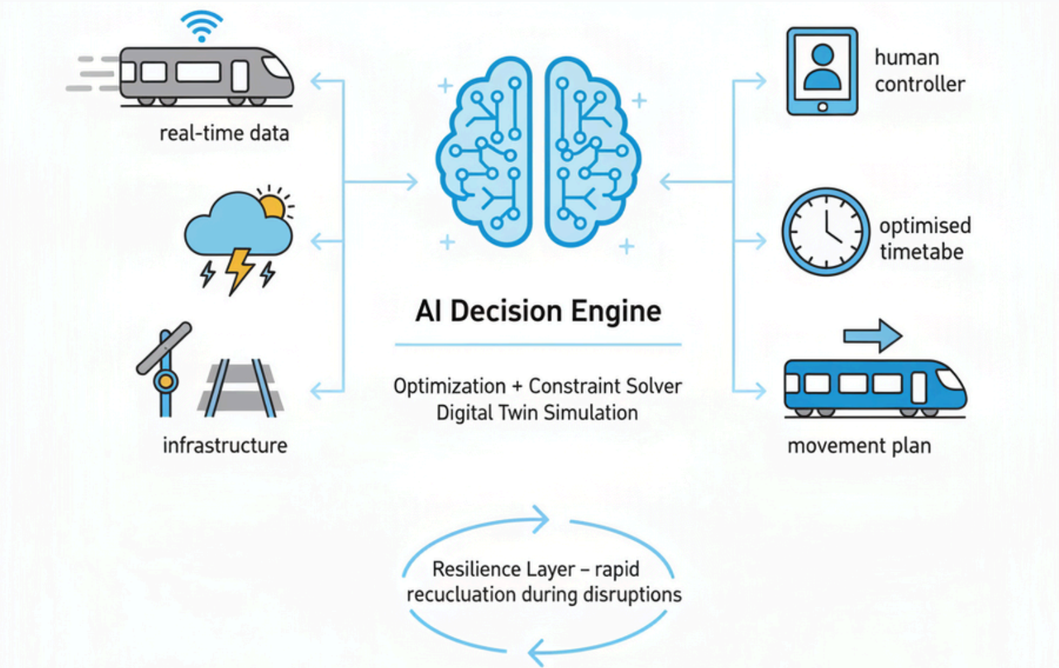
AI-powered decision-support system for real-time train scheduling, precedence, and crossings — with **optimization, digital twin simulation**, and **controller-friendly dashboard.**

How the Solution Address the Problem

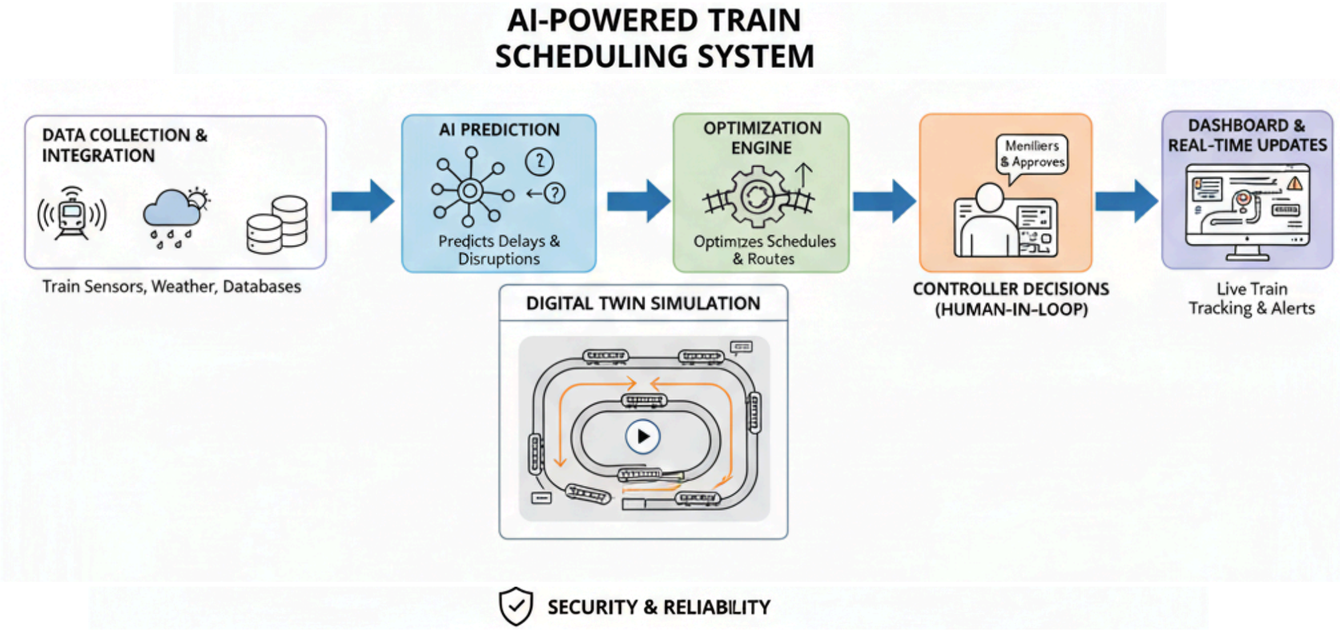
- **Real-time Optimization** → AI + constraint solvers decide precedence & crossings to minimize delays.
- **Decision-Support for Controllers** → Clear recommendations with manual override for safety.
- **Efficient Resource Use** → Optimizes tracks, signals, and platforms for both passenger & freight trains.
- **Resilient Under Disruptions** → Recalculates schedules quickly during delays, breakdowns, or weather.

Innovation of Solution

- **Real-time AI Optimization** – Dynamic decisions for throughput.
- **Resource Maximization** – Smarter use of signals & platforms.
- **Adaptive System** – Stays robust during disruptions.



TECHNICAL APPROACH



Techstacks used:

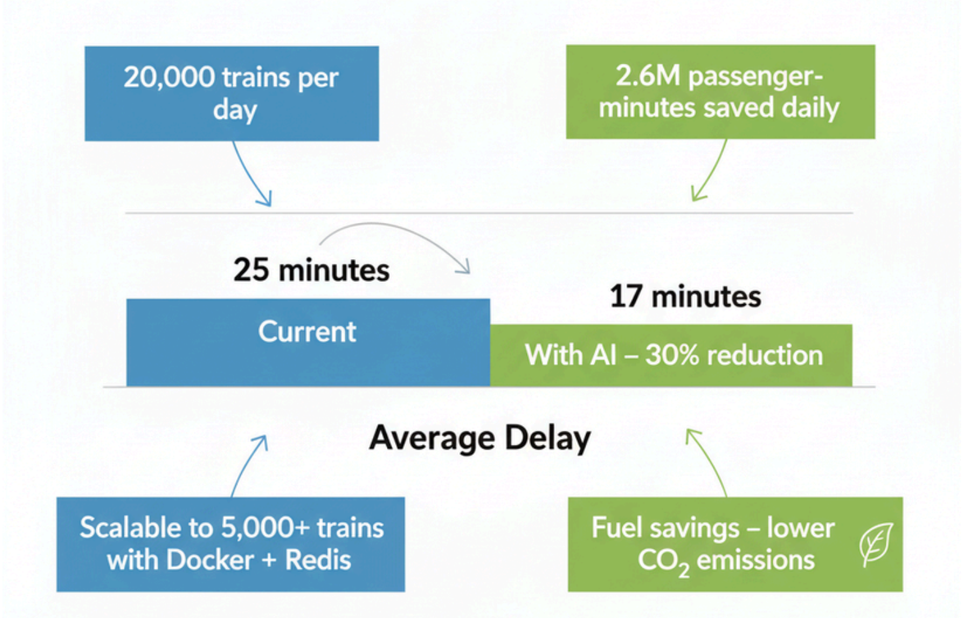
- **AI/Optimization:** Python, OR-Tools,Scikit-learn, TensorFlow/PyTorch
- **Backend:** FastAPI, PostgreSQL, Redis
- **Frontend:** React.js, TailwindCSS, Recharts/D3.js
- **DevOps:** Docker, GitHub Actions, Render/Heroku
- **Extras:** WebSockets (real-time), Figma (UI/UX)

FEASIBILITY AND VIABILITIES

Feasibility Analysis:

- **Technical →** Python, OR-Tools, React, FastAPI
- **Operational →** Simple dashboard, <1 day training
- **Economic →** Open-source + cloud saves ~40–60% cost
- **Integration →** APIs + PostgreSQL + Mapbox

Risk	Mitigations
Real-time data delay	Caching + predictive models
AI may fail in congestion	Fallback heuristics + priority scheduling
Integration issues	Use standard APIs + modular design
Dashboard lag with many trains	Optimized frontend + WebSockets



IMPACT AND BENEFITS

Impacts:

- **Reduced Delays →** Trains run on time, punctuality improves.
- **Passenger Experience →** Real-time updates reduce stress. Efficient Resource Use → Optimized track/platform usage.
- **Environmental Impact →** Fewer idle trains = lower fuel & emissions.
- **Data-Driven Planning →** Helps authorities anticipate & expand.

Benefits:

Social

- Passenger Satisfaction → Reliable schedules
- Better Travel Experience → Real-time updates
- Safety → Live tracking reduces risks

Economic

- Efficiency → Saves manpower & costs
- Better Decisions → Data-driven planning
- Scalable → Expand to more routes/networks

Environmental

- Lower Emissions → Less idle time, less fuel
- Resource Use → Optimized tracks & platforms

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RESEARCH AND REFERENCES

- **RTIS by Indian Railways + ISRO** – Real-time train tracking using satellites (NavIC). The Hindu
- **IIT Bombay + CRIS** – "Dailyzing" project to optimize non-daily train schedules, improving track use. India Today
- **Decision Support for Line Capacity** – Western Railway simulation model for better capacity planning. IIM Ahmedabad
- **Rake Optimization Study** – Indian Railways data shows fleet efficiency gains via scheduling models. arXiv
- **AI-Driven Scheduling in India** – Railways Minister reports >90% punctuality via AI + predictive maintenance. Jharkhand State News
- **Digital Twin Research (IIT Roorkee)** – Study on railway digital twins for Indian context. Taylor & Francis
- **Modelling Train Delays**: A Study of Indian Railways - Uses real delay data; helps in understanding delay patterns & planning mitigation. ScienceDirect