

Smart Junction AI: A Predictive and Adaptive Traffic Control System

Team Name: Spartanz

Problem Statement

Most urban traffic signals operate on fixed-time intervals without considering real-time vehicle density or traffic patterns. This results in unnecessary waiting time, congestion, fuel wastage, increased pollution, and delayed emergency response. There is a need for an intelligent system that can dynamically adapt signal timing based on live traffic conditions and predicted congestion.

Proposed Solution

We propose **Smart Junction AI**, a multi-stage AI-powered traffic management system that combines computer vision, time-series forecasting, and reinforcement learning to optimize signal control in real time.

The system uses CCTV feeds to detect and classify vehicles, calculate lane-wise congestion levels, and predict near-future traffic buildup. Based on these insights, an intelligent decision engine dynamically adjusts green signal duration to minimize overall waiting time. A web/mobile dashboard enables authorities to monitor traffic conditions and receive automated summaries.

Objectives

1. Perform real-time vehicle detection and counting using YOLOv11.
 2. Compute lane-wise congestion and traffic performance index.
 3. Forecast short-term congestion (15–30 minutes ahead) using LSTM.
 4. Dynamically optimize signal timing using Deep Reinforcement Learning.
 5. Implement emergency vehicle priority with automatic green corridor activation.
 6. Provide live monitoring dashboard with traffic analytics and summaries.
-

Methodology

- CCTV video feeds are processed using YOLOv11 to detect cars, buses, bikes, and emergency vehicles.
- Vehicle counts are converted into congestion scores for each lane.
- An LSTM model analyzes historical traffic data to predict future congestion.
- A Reinforcement Learning agent (DQN/PPO) selects optimal signal phases and adjusts green time dynamically.
- Emergency vehicle detection triggers immediate signal override.
- A web/mobile dashboard displays real-time traffic data, congestion levels, and human-readable reports for authorities.