Proposal On
TrafficRhythm: Smart Traffic Signal Optimization Using AI for Bangladesh 2.0

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Identified Problem

One of the most pressing challenges facing Bangladesh today is the **inefficiency of its traffic management system,** particularly highlighted after August 5, 2024, when the temporary absence of traffic police made the citizens take on the responsibility of directing traffic. This situation showed the heavy reliance on manual intervention in managing traffic congestion, revealing systemic vulnerabilities. The existing traffic control mechanisms are often inconsistent, and not well suited to handle the growing volume of vehicles in major cities. This not only affects daily commuters but also decreases economic productivity and causes problems for emergency services. To address this critical issue, we propose using Artificial Intelligence to develop an intelligent traffic system that can automate, optimize, and adapt traffic control in real time, thereby increasing efficiency, reducing congestion, and improving road safety across the country.

Proposed Solution

The aim of this project is to develop an AI-based traffic signal control system that dynamically adjusts signal timings based on real-time traffic patterns. The proposed solution is a simulation-based model that optimizes traffic light duration using machine learning.

This system will:

- Analyze historical and simulated traffic data to understand traffic flow patterns.
- Predict future traffic conditions at intersections.
- Automatically adjust green/red light durations to reduce congestion.
- Prioritize smoother flow during peak hours and improve waiting times.

The project will be implemented in Python using publicly available or simulated datasets, without requiring real-time video feeds. The output will be a prototype model showing how signal timings can be optimized to ease traffic conditions.

Justification for Using AI

AI is well-suited for solving traffic congestion problems because:

- **Pattern Recognition**: Machine learning models can recognize traffic flow patterns across time and intersections.
- **Predictive Analysis**: AI can forecast peak traffic hours and preemptively adjust signal timings.
- **Automation**: Reduces the need for manual signal control by traffic police.
- **Scalability**: The model can be trained for multiple intersections and scaled to other cities.
- **Adaptability**: The AI model can learn and improve over time as traffic patterns evolve.

In traditional systems, fixed-time signals fail to respond to changing traffic volumes, especially during events, strikes, or festivals. AI can adapt in real-time based on data.

AI Methodology

We will use **Supervised Machine Learning** and **Reinforcement Learning** in the following way:

A. Supervised Learning

Train a model (e.g., Decision Tree or Random Forest) on traffic data to predict congestion levels based on:

- Time of day
- Day of the week
- Vehicle count (simulated)
- Previous signal cycles

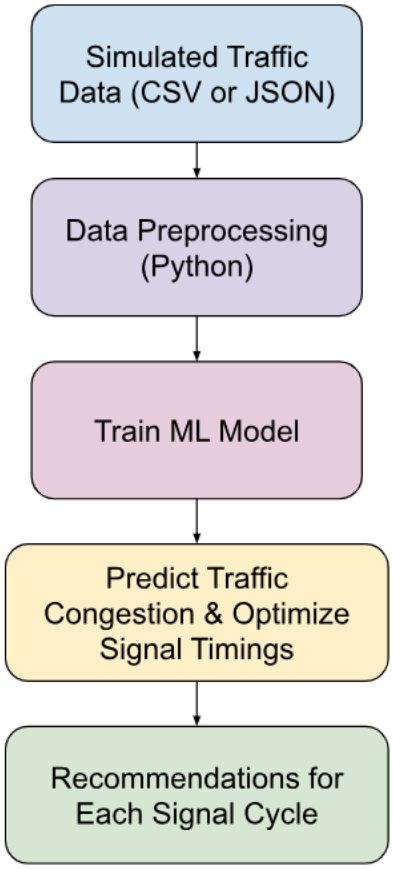
B. Reinforcement Learning

Implement a simple simulation where the AI agent (traffic light controller) learns the optimal duration for each signal by receiving feedback (e.g., lower average waiting time = higher reward).

Tools and Libraries to be used:

- Python
- Scikit-learn (ML models)
- NumPy, Pandas (Data processing)
- Matplotlib (Visualization)

High-Level System Architecture / Workflow



Data Collection and Processing Plan

Since this is a prototype, we will-

Either use publicly available traffic datasets from platforms like Kaggle, or simulate realistic traffic data using random data generators.

Data Features:

- Intersection ID
- Time of day
- Day of week
- Number of vehicles per direction
- Signal cycle duration
- Waiting time per lane

Steps:

- Generate or download dataset
- Clean and preprocess using Pandas (handle missing values, normalize)
- Split into training and testing sets
- Train supervised ML model
- Evaluate using metrics like Mean Absolute Error (MAE), accuracy
- Simulate output: how signal timings change and how congestion is reduced

Conclusion

This project presents a simple, cost-effective, and scalable AI solution to a major challenge in Bangladesh. It promotes automation, fairness, and overall an improved traffic system, all key values of Bangladesh 2.0. With further expansion, this system can be integrated into real-world traffic systems to greatly benefit the people.