Weekly Progress Report

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Domain: Smart City Traffic Forecasting

Date of Submission: 10/08/2025

Week Ending: 03

I. Overview:

This week concentrated on refining model performance, testing hybrid approaches, and enhancing the dashboard with real-time data integration. Key attention was given to improving model generalization, scaling the system for multiple junctions, and incorporating feedback from stakeholders.

II. Achievements:

1.   1. Hybrid Model Development:

- Implemented a hybrid pipeline combining Prophet for seasonal trends and LSTM for short-term fluctuations.
- Achieved improved prediction accuracy (5–7% reduction in RMSE compared to standalone models).
- Conducted experiments with different weights for hybrid model outputs.

2.   2. Real-time Data Integration:

- Automated fetching of live data from transport APIs and integrated it into the preprocessing pipeline.
- Built a data caching mechanism to handle API latency and reduce downtime.
- Enabled automatic daily forecast updates for selected junctions.

3.   3. Dashboard Enhancements:

- Added map-based visualizations with color-coded congestion levels.
- Enabled side-by-side comparison of predicted vs. actual traffic flow.
- Integrated event overlays (holidays, concerts, sports matches) directly into the dashboard visuals.

III. Challenges:

4.   1. Scalability Issues:

- Hybrid models require high computational resources, leading to longer training times when scaling across multiple junctions.
- Considering distributed processing or cloud-based solutions for scalability.

5. 2. Event Impact Estimation:

- Difficulty in quantifying the exact impact of different event types (e.g., rallies vs. festivals).
- Currently using simple binary flags, but exploring weighted event features for better accuracy.

IV. Learning Resources:

6. 1. Advanced Forecasting Techniques:

- Explored literature on hybrid time-series models and ensemble learning approaches.
- Reviewed case studies on traffic forecasting in metropolitan smart city projects.

7. 2. Technical Tools:

- Experimented with Apache Kafka for real-time data streaming.
- Learned about containerization (Docker) for deploying forecasting models and dashboards.

V. Next Week's Goals:

1. Scalability and Deployment:
- Optimize hybrid models for faster training and prediction.
- Deploy the dashboard prototype in a cloud environment for remote stakeholder access.

2. Enhanced Event Modeling:
- Develop weighted event features (e.g., severity, duration, crowd size).
- Test their impact on forecast accuracy.

3. Collaboration:
- Share the updated dashboard with urban planning teams.
- Collect structured feedback to improve visualization and usability.

VI. Additional Comments:

- Hybrid models have shown clear performance benefits, but computational efficiency remains a challenge.
- The enhanced dashboard with real-time and event-aware insights is becoming a valuable tool for city traffic management.