



PARSHWANATH CHARITABLE TRUST'S

## A.P. SHAH INSTITUTE OF TECHNOLOGY

Department of Computer Science and Engineering  
Data Science



# Traffic Congestion Prediction

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**Project Guide  
Ms. Aavani N.**

# Outline

- Introduction
- Literature Survey of the existing systems
- Limitations of the existing systems
- Problem statement
- System Design
- Technologies and methodologies
- Implementation
- Conclusion
- References

# Sustainable Development Goals (SDG) mapped

- SDG 3: Good Health and Well-Being ❤️
  - Less congestion reduces commuter stress and travel fatigue
  - Improved air quality lowers pollution-related health risks
- SDG 9: Industry, Innovation and Infrastructure 🚧
  - Uses machine learning and predictive analytics for smart mobility
  - Strengthens urban transport infrastructure with data-driven insights
- SDG 11: Sustainable Cities and Communities 🏙
  - Reduces traffic congestion and supports efficient transport systems
  - Helps city authorities with long-term infrastructure planning
- SDG 13: Climate Action 🌎
  - Minimizes fuel wastage and vehicular emissions
  - Contributes to cleaner air and lower carbon footprint

# Introduction

- Traffic congestion is a growing urban challenge, leading to long commute times, fuel wastage, stress, and environmental damage.
- Existing systems (Google Maps, Waze) focus only on real-time display, not predictive insights, limiting their usefulness for planning.
- Our system leverages machine learning and time-series forecasting to predict congestion before it occurs and suggest alternate routes.
- By providing predictive analytics, alerts, and visualizations, the system supports both commuters in daily travel and authorities in long-term infrastructure planning.

# Introduction

## ► Objectives

- **To provide a web-based platform** that integrates real-time traffic congestion data with interactive visualizations including graphs, charts, and predictive indicators.
- **To develop a data-driven congestion forecasting model** using rule-based logic and machine learning techniques applied to historical traffic datasets.
- **To enhance spatial awareness** by integrating geospatial mapping tools for dynamic visualization of traffic patterns and zone-based congestion metrics.
- **To implement an automated alert system** that delivers real- time notifications of predicted traffic incidents and congestion levels to end-users.

# Literature Survey of the existing system (Most Relevant to Least)

Sr. No.	Title	Author(s)	Year	Outcomes	Methodology	Our Evaluations
1.	Traffic Flow Prediction with Big Data: A Deep Learning Approach [1]	Y. Duan, W. Kang, Z. Li, F. Wang	2019	The primary goal is to leverage big data techniques to enhance traffic flow prediction accuracy in complex urban environments.	This approach utilizes Deep Learning models, specifically employing Stacked Autoencoders and Recurrent Neural Networks (RNN).	Achieves high accuracy, but the implementation is often constrained by being computationally expensive and data-hungry.
2.	Short-Term Traffic Volume Prediction: A KNN Approach Enhanced by Constrained PCA [2]	H. Zheng, W. Wu, W. Chen	2018	The objective is to establish an improved model for short-term traffic volume prediction.	The methodology combines the K-Nearest Neighbor (KNN) algorithm with Constrained Principal Component Analysis (PCA).	Demonstrates good performance in short-term prediction, but exhibits weak adaptability in the face of sudden, non-recurring events like accidents or weather.

# Literature Survey of the existing system (Most Relevant to Least)

Sr. No.	Title	Author(s)	Year	Outcomes	Methodology	Our Evaluations
3.	Traffic Signal Timing via Deep Reinforcement Learning	L. Li, Y. Lv, F.-Y. Wang	2016	The study focuses on optimizing traffic signal timing in real-time.	The approach uses Deep Reinforcement Learning (DRL).	The DRL model is highly adaptive, but its deployment requires large-scale infrastructure and substantial training data.
4.	Google Maps Traffic API [3]	Google Developers	2024	To provide developers and end-users with real-time traffic data.	It relies on crowdsourced GPS Data.	Provides high accuracy, but is computationally expensive and data-hungry

# Literature Survey of the existing system (Most Relevant to Least)

Sr. No.	Title	Author(s)	Year	Outcomes	Methodology	Our Evaluations
5.	<b>Waze Live Map &amp; Traffic API [4]</b>	Waze Mobility Team	2023	The system's outcome is to offer fast, user-generated traffic and incident updates.	The core methodology involves combining crowdsourced GPS with Incident Reports from users.	It delivers fast updates, but its fundamental accuracy depends on its active user base and coverage.
6.	<b>Expressway Monitoring and Advisory System (EMAS)</b>	Singapore Land Transport Authority (LTA)	2015	Designed for incident management on expressways, focusing on detection and advisory to quickly restore traffic flow.	EMAS utilizes a blend of technologies including Sensor Fusion, CCTV monitoring, and dedicated systems for Incident Detection	The technology is highly effective, but the required dedicated infrastructure makes it costly and not scalable to all city roads.

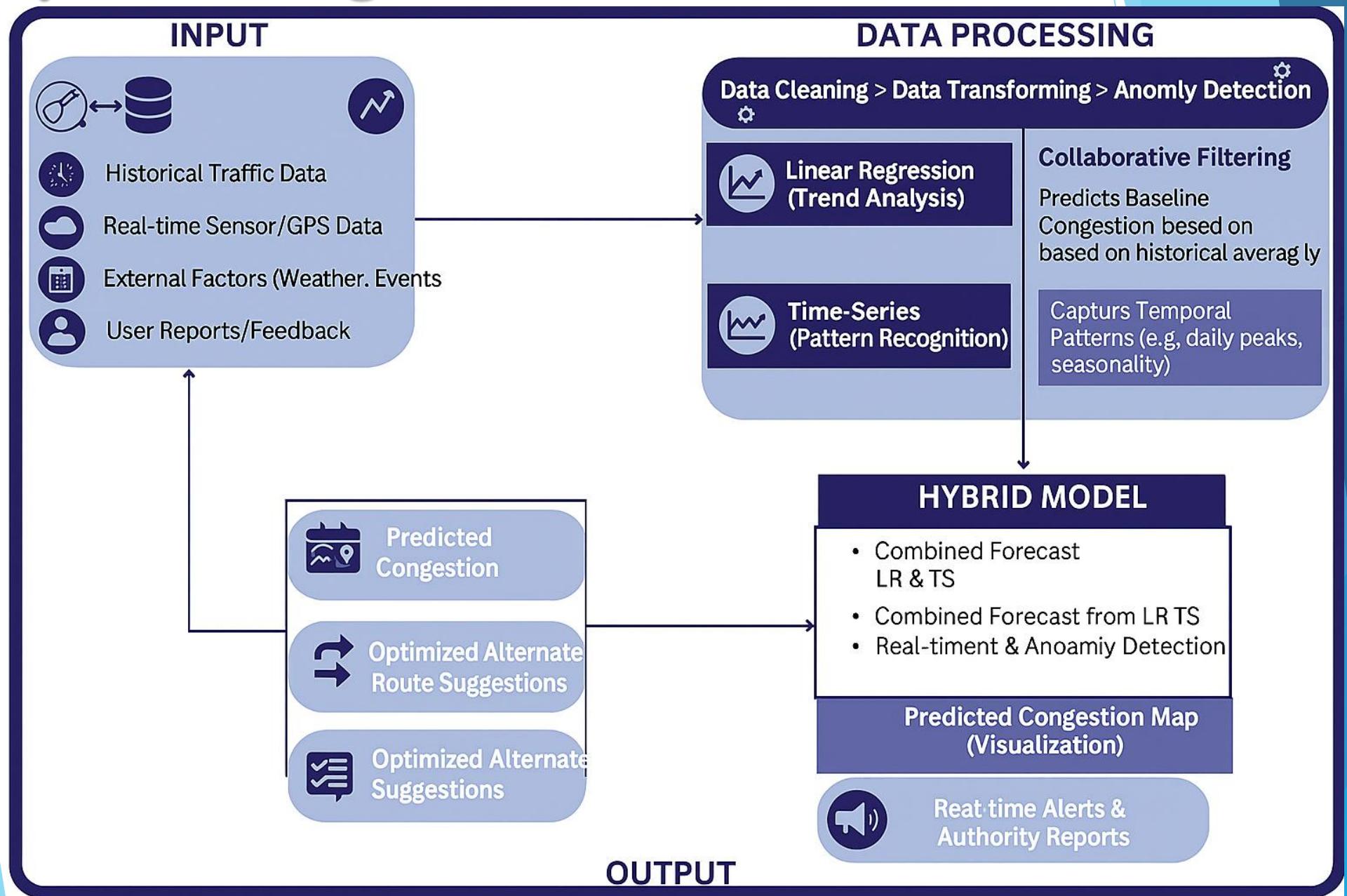
# Limitations of existing systems

- **Domain Restrictions:** Current systems rely heavily on historical datasets and fail to adapt to sudden disruptions such as accidents or weather changes.
- **Computational Complexity:** Deep learning and graph-based models achieve high accuracy but are resource-heavy and unsuitable for lightweight real-time deployment.
- **Limited Predictive Power:** Most existing solutions provide only real-time updates, not proactive forecasts.
- **Scalability Issues:** Integration with multiple live data sources and city-wide traffic planning is still underdeveloped.

# Problem statement

- **The Challenge:** Urban traffic congestion prediction is challenging because existing systems fail during sudden disruptions (accidents, bad weather) and often rely too heavily on weak historical patterns.
- Our Goal is to Design a Lightweight Solution that:
  - Uses Linear Regression and Time-Series forecasting for traffic prediction.
  - Provides simple visualization of congestion trends via a web-based interface.
  - Offers alerts/reports to commuters and authorities

# System Design



# Technologies

- **Frontend Development:**
  - HTML, CSS, JavaScript → Interactive web dashboard
- **Backend Development:**
  - Python (Machine Learning Models), APIs
- **Database:**
  - Processed traffic datasets (historical + real-time[GOOGLE])
  - DATASETS (1month [57,601 X 7], 3month [1,72,801 X 7],  
6month [3,45,601 X 7], 1 year [7,00,801 X 7])
- **Machine Learning Models:**
  - >> Linear Regression (baseline)
  - >> LSTM(Simulation)
  - >> ARIMA (time-series forecasting)
  - >> Prophet(Simulation)
- **Data Sources:**
  - Traffic logs, live traffic feeds, weather reports

# Methodologies

1. **Data Collection:** Gather Traffic logs (historical), live traffic feeds, and Weather reports (via APIs) and store them in the Database.
2. **Data Preprocessing:** Use Python (Backend Development) to clean, normalize, and handle outliers in the data.
3. **Feature Engineering:** Use Python scripts to extract key features (time, day, weather) and transform data for model input.
4. **Model Training (Python ML Models):**
  - a) Apply Linear Regression for the traffic baseline prediction.
  - b) Apply ARIMA for time-series forecasting (sequential patterns).
  - c) (Optionally, explore LSTM and Prophet for simulation).
5. **Output & Visualization:** Use HTML, CSS, JavaScript (Frontend Development) to build the Interactive web dashboard displaying the Python-generated forecasts.

# Implementation – Home Page

Login    Signup

EVERY JOURNEY MATTERS – LET'S MAKE IT FASTER & SAFER

## TRAFFIC CONGESTION PREDICTION

⚠ Get Notified

Start    Destination    Date    Time    Mode of transit    Weather

Your start location    My location    Where to?    05-10-2025    18:11    Driving    Normal    GO

START NOW    BEST TIME (OVERALL DAY)    BEST TIME OF DAY

Range from database    30 days    Showing: 30 days

Waiting for a route...

Minutes    Hours

Speed: 18.78 Mbps | Ping: 54 ms | Latency: 54 ms

Hour of day

Map

Top 5 Most Searched Routes

962 A. P. Shah Institute of Technology (D)

Searches: 3

Quick FAQs

Q: How is the traffic prediction calculated?

Q: What do the different colors on the chart mean?

Q: Can I get real-time traffic updates?

Q: Why is a login required for notifications?

Q: How accurate is the prediction?

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Map data ©2025 Google

Contact: 1234567890 | Email: apsit.teds.grp2@gmail.com

Speed: 16.24 Mbps | Ping: 68 ms | Latency: 68 ms

# Implementation – Login / Signup / Verification

**Login**

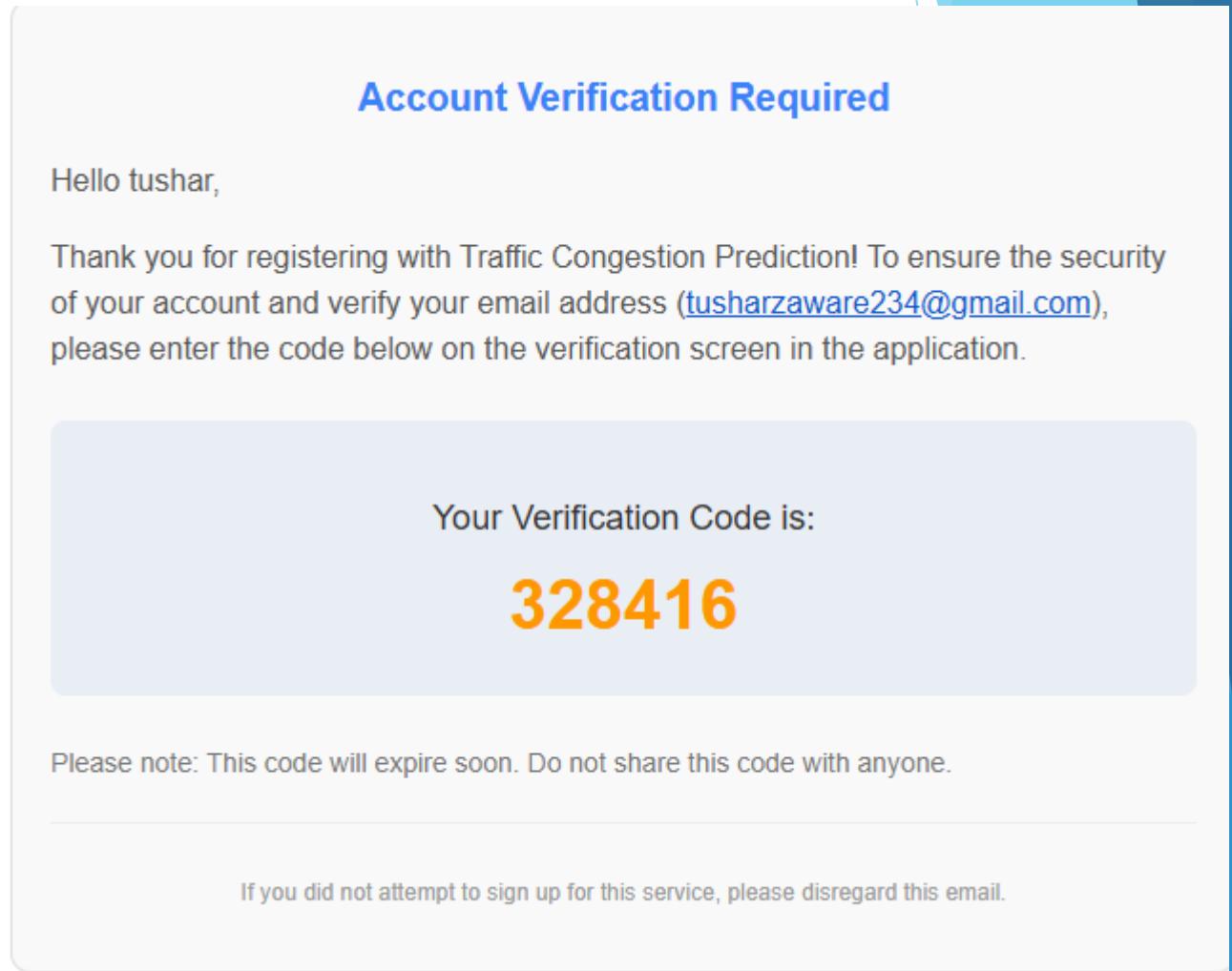
**Login**   **Cancel**

Not signed up yet? [Sign up](#)

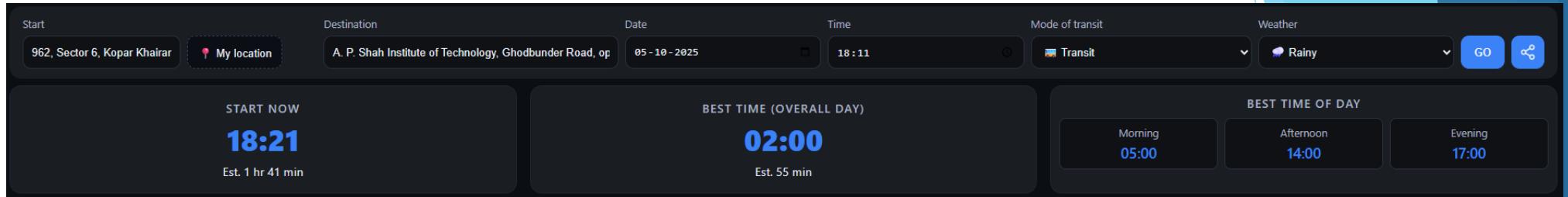
**Signup**

**Register & Send Verification Code**   **Cancel**

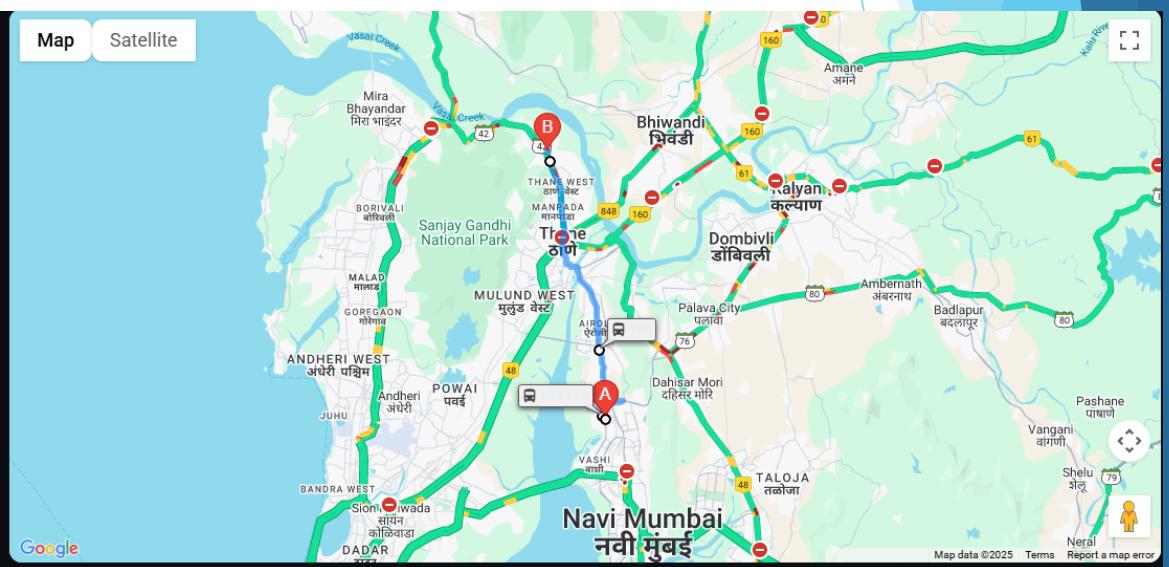
Already have an account? [Log in](#)



# Implementation



## 1. Major Input / Output



## 2. Prediction Visualization / Live Map Data

# Implementation

### Alternative Routes & Times

Fastest alternative routes from Google Maps, sorted by minimum time. Click a route to see it on the map.

962 → Survey No	<b>1 hr 27 min</b>	962 → Survey No	<b>1 hr 35 min</b>
962 → Survey No	<b>1 hr 37 min</b>	962 → Survey No	<b>1 hr 45 min</b>
962 → Survey No	<b>1 hr 46 min</b>	962 → Survey No	<b>1 hr 49 min</b>

### Latest Traffic Advisories

Relevant articles based on your route, date, and weather conditions.

**NO NEWS OUT THERE FOR YOUR ROUTE**

Everything seems clear! Enjoy the easy ride.

[Read More →](#)

[Refresh](#) [Hide](#)

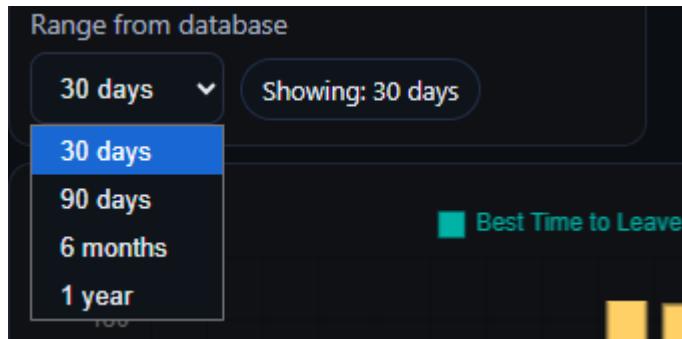
3. Alternate route suggestions - directly mapped as inputs once clicked
4. Latest news based on inputs of user

# Implementation

The screenshot shows a mobile application interface. On the left, under 'Top 5 Most Searched Routes', there are two items: '962 A. P. Shah Institute of Technology (D)' with 'Searches: 3' and '962 A. P. Shah Institute of Technology (T)' with 'Searches: 1'. On the right, under 'Quick FAQs', there are five questions: 'How is the traffic prediction calculated?', 'What do the different colors on the chart mean?', 'Can I get real-time traffic updates?', 'Why is a login required for notifications?', and 'How accurate is the prediction?'. Each question has a small yellow lightbulb icon next to it.

5. Most Searched Routes - get mapped directly as input when clicked too.

6. Static FAQs



Speed: 18.25 Mbps | Ping: 48 ms | Latency: 48 ms

7. User Selectable dataset options for visualization.

8. User device's network live status

# Implementation – MAIL REPORT / LIVE ANALYSIS

**Traffic Congestion Prediction Report**

Your journey from 962, Sector 6, Kopar Khairane, Navi Mumbai, Maharashtra 400709, India to A. P. Shah Institute of Technology, Ghodbunder Road, opp. Hypercity Mall, Bhawani Nagar, Kasarvadavali, Thane West, Thane, Maharashtra, India

**Route Summary**

Route: 962, Sector 6, Kopar Khairane, Navi Mumbai, Maharashtra 400709, India → A. P. Shah Institute of Technology, Ghodbunder Road, opp. Hypercity Mall, Bhawani Nagar, Kasarvadavali, Thane West, Thane, Maharashtra, India

Date & Time: 2025-10-05 at 18:51

Mode of Travel: DRIVING

Current Expected Duration: 18:52

Overall Best Time to Travel: 01:00

**Hourly Traffic Profile**

Below is the predicted congestion pattern for your route.

Legend: Best Time to Leave (Green), Moderate Traffic (Yellow), Most Traffic (Red)

Hour of Day	Best Time to Leave	Moderate Traffic	Most Traffic
00:00 - 01:00	High	Low	Low
01:00 - 02:00	High	Low	Low
02:00 - 03:00	High	Low	Low
03:00 - 04:00	High	Low	Low
04:00 - 05:00	High	Low	Low
05:00 - 06:00	High	Low	Low
06:00 - 07:00	High	Low	Low
07:00 - 08:00	High	Low	Low
08:00 - 09:00	High	Low	Low
09:00 - 10:00	High	Low	Low
10:00 - 11:00	High	Low	Low
11:00 - 12:00	High	Low	Low
12:00 - 13:00	High	Low	Low
13:00 - 14:00	High	Low	Low
14:00 - 15:00	High	Low	Low
15:00 - 16:00	High	Low	Low
16:00 - 17:00	High	Low	Low
17:00 - 18:00	High	Low	Low
18:00 - 19:00	Low	High	Very High
19:00 - 20:00	Low	High	Very High
20:00 - 21:00	Low	High	Very High
21:00 - 22:00	Low	High	Very High
22:00 - 23:00	Low	High	Very High
23:00 - 00:00	Low	High	Very High

**Route Map**

[View Full Report Online](#)

How would you rate your experience with our prediction service?

★ ★ ★ ★ ★

This email was sent by the Traffic Congestion Prediction System.  
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Background image by Pixabay from Pexels

# Implementation – COMPARATIVE ANALYSIS

## Traffic Prediction — Comparative Visualizer

Run a 24-hour comparative analysis. LSTM/Prophet are proxies unless implemented.

Multiple algorithms · Comparative chart



## Which Algorithm is Best?

Usually, Prophet is the best balance of accuracy and interpretability.

Current dataset best: LSTM (sim) (Err 0.43%)

- Linear: simple, fast, but too limited.
- Time-Series Avg: smooths noise, poor long-term accuracy.
- LSTM: powerful with big data, but complex to train.
- Prophet: models trend+seasonality+holidays directly → ideal for traffic.

**Reason:** Traffic has strong daily/weekly seasonality (rush hours, weekends), which Prophet handles naturally. LSTM may outperform Prophet with huge datasets but needs more compute and tuning.

# Conclusion

- We have implemented **data collection, preprocessing, and traffic flow modeling** using advanced prediction algorithms. The system utilizes **real-time data** from sensors, GPS, and historical trends to forecast congestion accurately.
- **Traffic Congestion Prediction** represents an innovative and efficient approach to improving **urban mobility**, reducing **travel time**, and enhancing **road safety** through intelligent data-driven decision-making.
- Additionally, the system's **future scope** includes integration with **IoT-based smart city infrastructure, adaptive traffic signal control, crowd-sourced traffic data, and AI-driven route optimization** for sustainable and smarter transportation networks.

# References

[1] Y. Lv, Y. Duan, W. Kang, Z. Li, and F. Wang, “**Traffic Flow Prediction with Big Data: A Deep Learning Approach**”, IEEE Transactions on Intelligent Transportation Systems, Vol. 16, No. 2, pp. 865-873, 2019.

URL: <https://ieeexplore.ieee.org/document/6870035>

(Alt. PDF:

<https://bookdown.org/amanas/traficomadrid/docs/Traffic%20flow%20prediction%20with%20big%20data%20-%20A%20deep%20learning%20approach.pdf>)

[2] H. Zheng, W. Wu, and W. Chen, “**Short-Term Traffic Volume Prediction: A K-Nearest Neighbor Approach Enhanced by Constrained Linearly Sewing Principal Component Regression**”, Transportation Research Part C: Emerging Technologies, Vol. 43, pp. 143-157, 2018.

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(Alt. ResearchGate:

[https://www.researchgate.net/publication/260804708\\_Short-term\\_traffic\\_volume\\_forecasting\\_A\\_k-nearest\\_neighbor\\_approach\\_enhanced\\_by\\_constrained\\_linearly\\_sewing\\_principle\\_component\\_algorithm](https://www.researchgate.net/publication/260804708_Short-term_traffic_volume_forecasting_A_k-nearest_neighbor_approach_enhanced_by_constrained_linearly_sewing_principle_component_algorithm))

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[3] Google Maps Developers, “**Google Maps Traffic API Documentation**”, Google Developers Official Documentation, 2024.

URL: <https://developers.google.com/maps/documentation/javascript/examples/layer-traffic>

[4] Waze, “**Waze Live Map and Traffic API**”, Waze Mobility Documentation, 2023.

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[5] University of Mumbai, **Mini Project Presentation Format for CSE (Data Science)**, A.P. Shah Institute of Technology, 2025.

**Thank You...!!**