Project Report

1. INTRODUCTION

1.1. Project Overview

TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning is an innovative project designed to enhance urban traffic management through intelligent data-driven insights. Traditional traffic monitoring methods, such as manual counting or fixed sensor systems, are often limited in accuracy, scalability, and cost-efficiency. TrafficTelligence addresses these limitations by leveraging machine learning models to predict traffic volume based on various contextual features, including time, weather conditions, holiday indicators, and more.

The project uses supervised regression models like Random Forest, XGBoost, Decision Trees, and Support Vector Regression to analyze patterns in historical data and provide accurate, real-time predictions. A Flask-based web interface allows users to input data and receive immediate traffic volume estimates, making the system accessible and practical for traffic authorities and city planners.

By incorporating standard preprocessing techniques like scaling and saving trained models using pickle, the system ensures consistent performance and easy deployment. This solution not only improves traffic monitoring efficiency but also supports informed decision-making for infrastructure planning, congestion management, and emergency response.

TrafficTelligence plays a vital role in the evolution of smart cities by enabling scalable, adaptive, and intelligent traffic solutions, ultimately aiming to reduce congestion, enhance commuter experience, and contribute to sustainable urban mobility.

1.2. Purpose

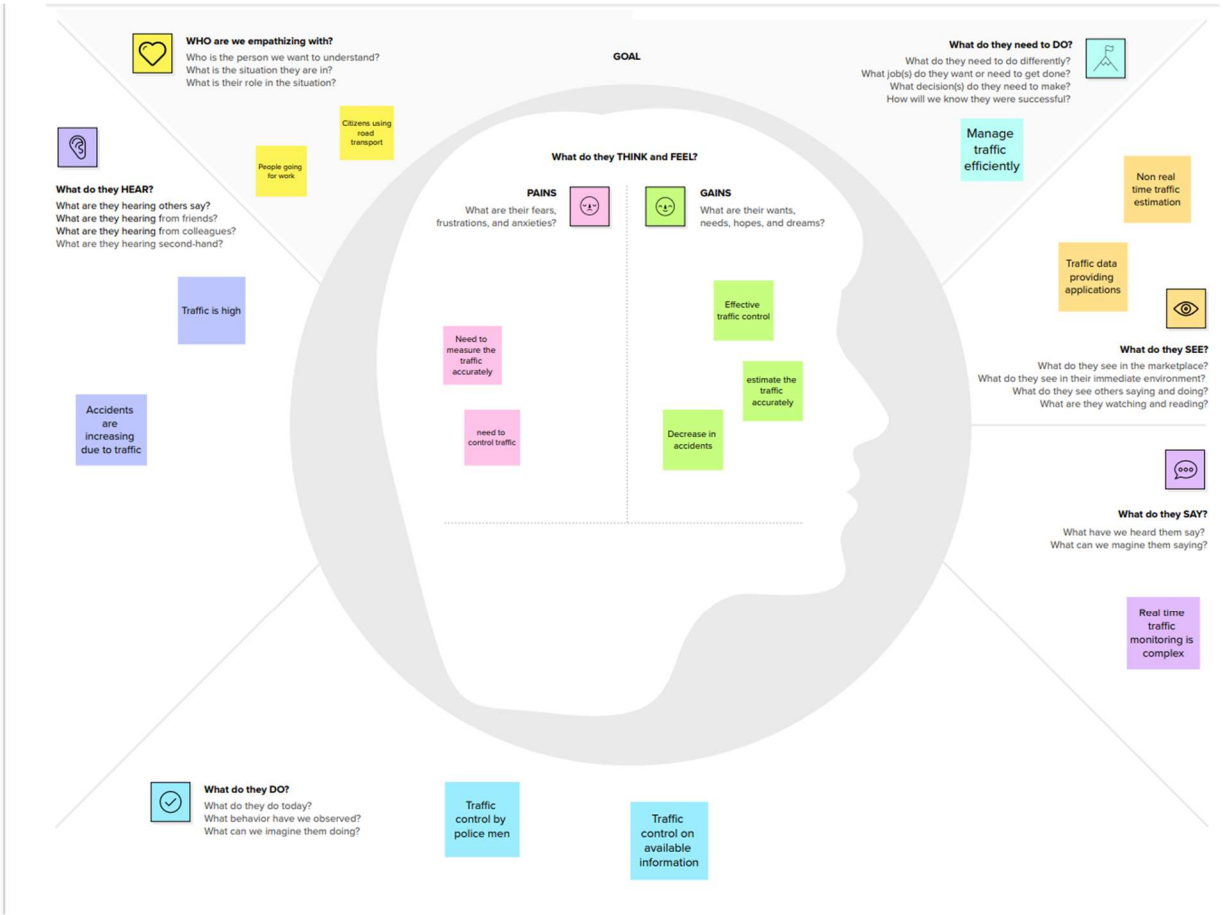
The purpose of *TrafficTelligence* is to develop an intelligent, machine learning-driven system for accurate and real-time traffic volume estimation. By integrating data from multiple sources—such as surveillance cameras, GPS, and environmental sensors—the system aims to overcome the limitations of traditional traffic monitoring methods. This innovation will support urban planners, traffic engineers, and policymakers in making informed decisions to reduce congestion, improve road safety, and enhance commuter experience. The project also seeks to promote efficient resource allocation, optimize traffic signal timing, and contribute to the development of smarter, more sustainable cities through advanced data analytics and predictive modelling.

2. IDEATION PHASE

2.1. Problem Statement

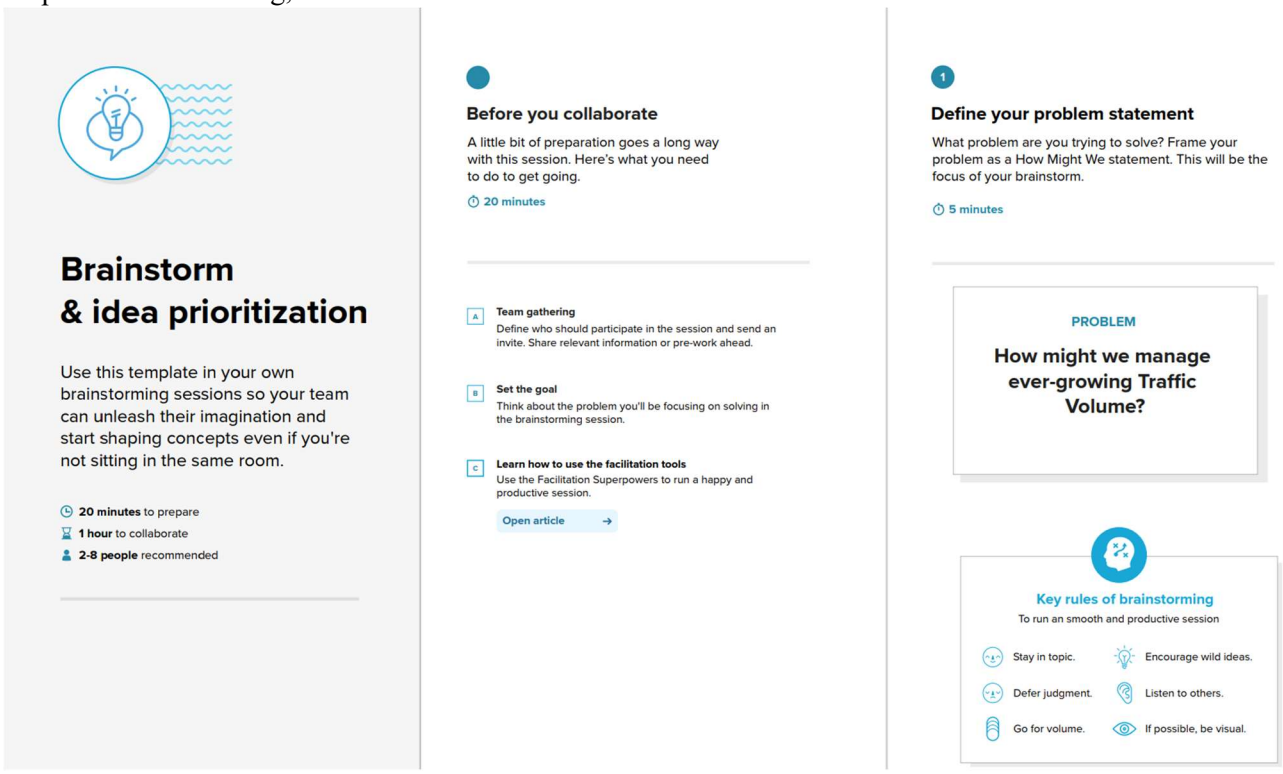
Accurate traffic volume estimation is vital for efficient urban planning, congestion management, and environmental monitoring. Traditional methods like manual counting or inductive loop detectors are costly, labor-intensive, and often lack scalability. *TrafficTelligence* proposes an advanced machine learning-based solution to estimate traffic volume using data from cameras, sensors, and contextual features (e.g., time, weather, location). The challenge lies in integrating heterogeneous data sources, handling noisy inputs, and achieving real-time predictions with high accuracy. This project aims to build a robust, scalable model that adapts to dynamic traffic conditions and offers actionable insights for smart city traffic management systems.

2.2. Empathy Map Canvas

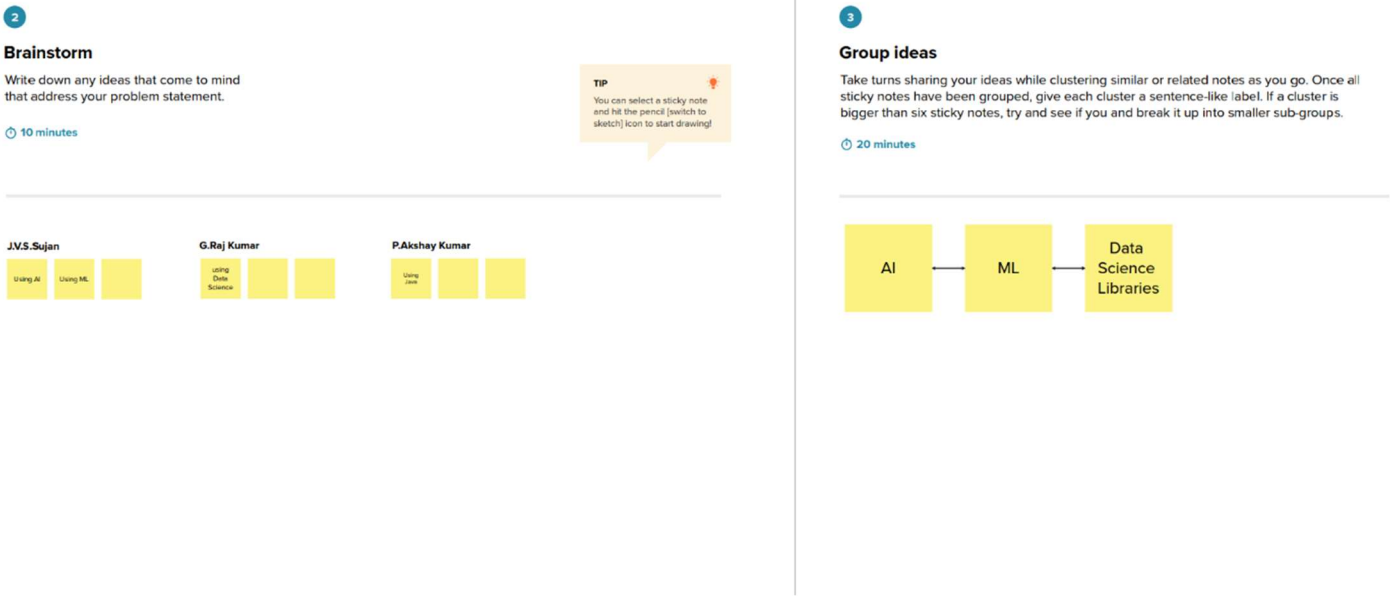


2.3. Brainstorming

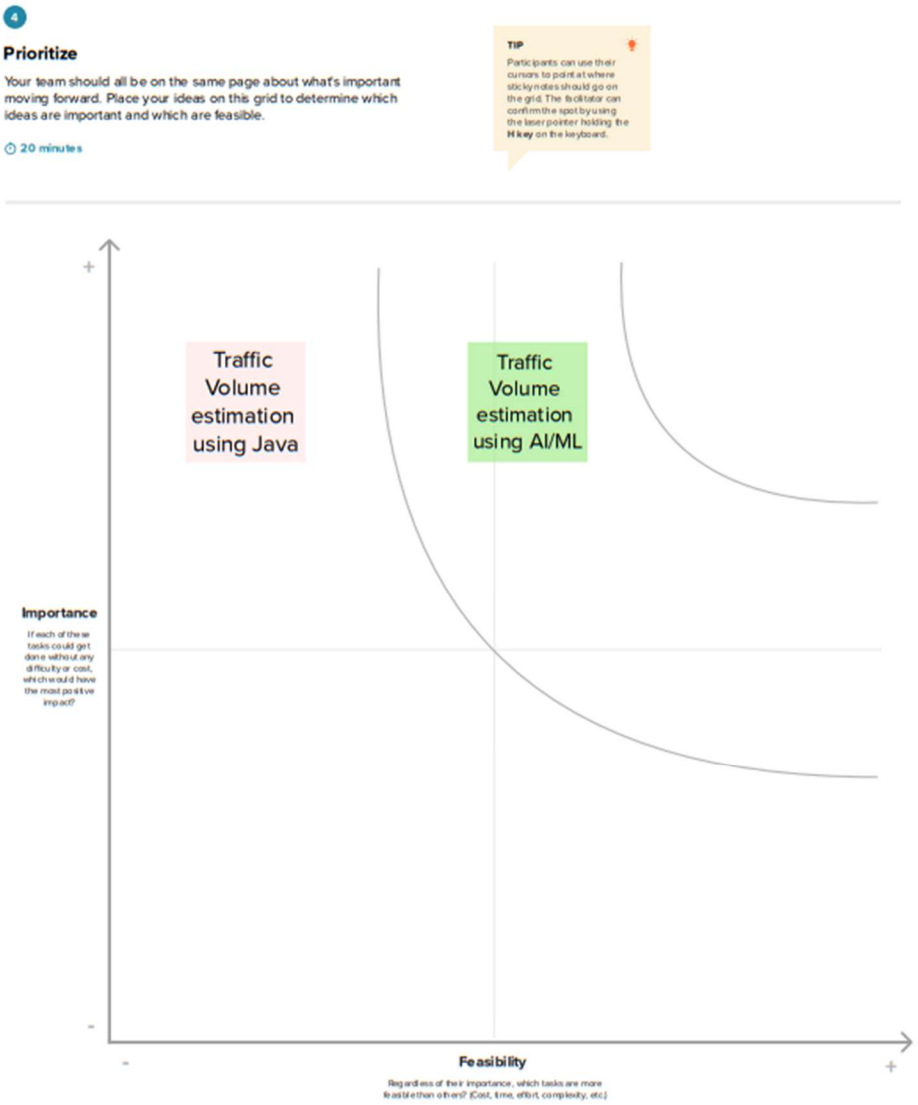
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping

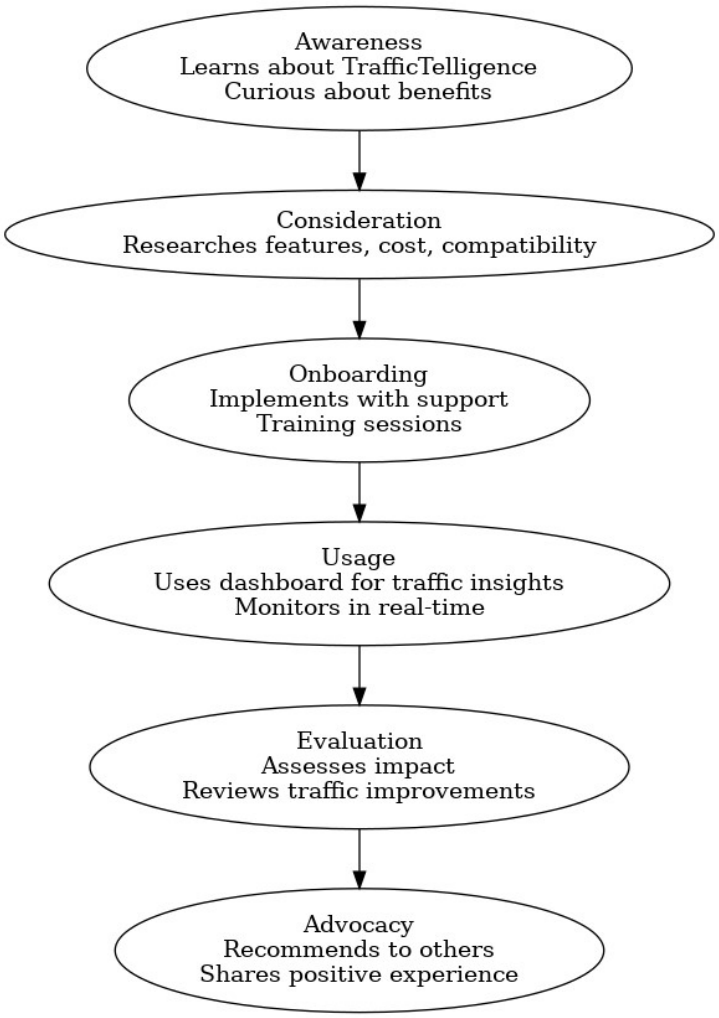


Step-3: Idea Prioritization



3. REQUIREMENT ANALYSIS

3.1. Customer Journey map



3.2. Solution Requirement

Functional Requirements:

Following are the functional requirements of the proposed solution.

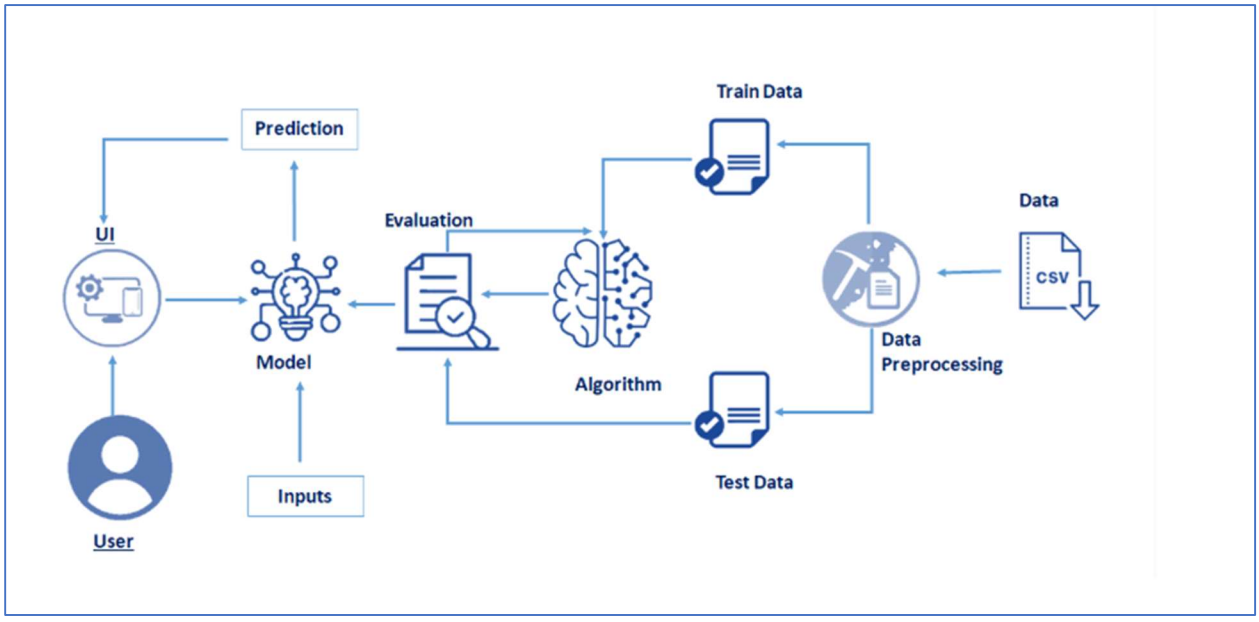
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Input entry	User should be able to enter all the required values
FR-2	Input options	User should get what is allowed in a particular field
FR-3	Traffic estimation	User should Traffic estimation value

Non-functional Requirements:

Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**User friendly interface**	Interface should be user friendly
NFR-2	**Reliability**	Estimated value should be given with accuracy
NFR-3	**Performance**	User should take less time to get the output
NFR-4	**Scalability**	User should be able to get values for a variety of input combinations

3.3. Data Flow Diagram



3.4. Technology Stack

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application	HTML, web application using flask framework
2.	Application Logic	Logic for the process in the application	Python
3.	Machine Learning Model	To process, train the data and build the model to estimate traffic	Linear Regression
4.	Infrastructure (Server / Cloud)	Application Deployment on Local System	Local.

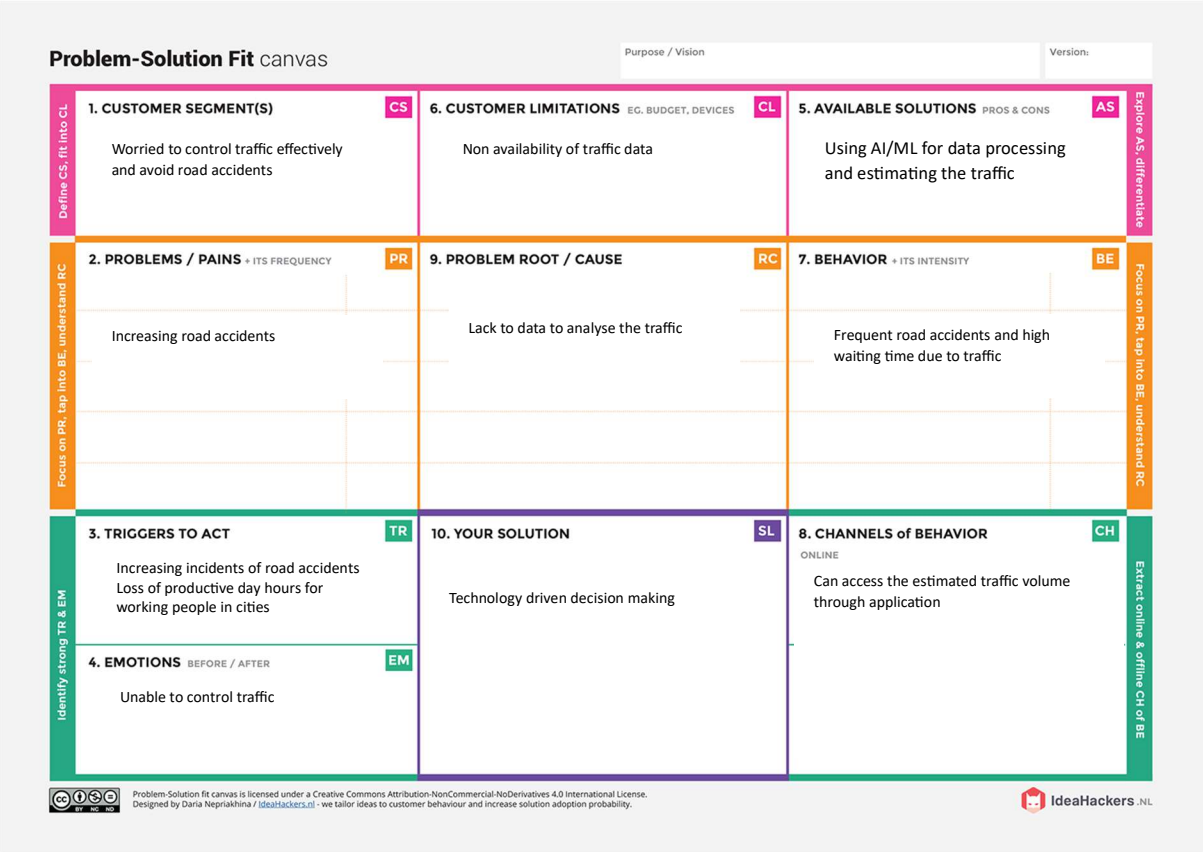
Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
	Can handle complex data	Regression algorithm is used for classification	Linear regression
	User friendly interface	User can easily enter with the instructions provided while entering data	HTML
	Accuracy	Model can give data accurately	Python

4. PROJECT DESIGN

4.1. Problem Solution Fit

The problem of traffic management has been increasing day by day which needs continuous monitoring and data-driven decision making to address it properly. The current application using AI/ML is a viable solution to the problem. This could assess the traffic on a variety of parameters and can given estimated traffic volume promptly. This could help traffic managing authorities to address the problem effectively and accurately.



4.2. Proposed Solution

Project team shall fill the following information in the proposed solution template.

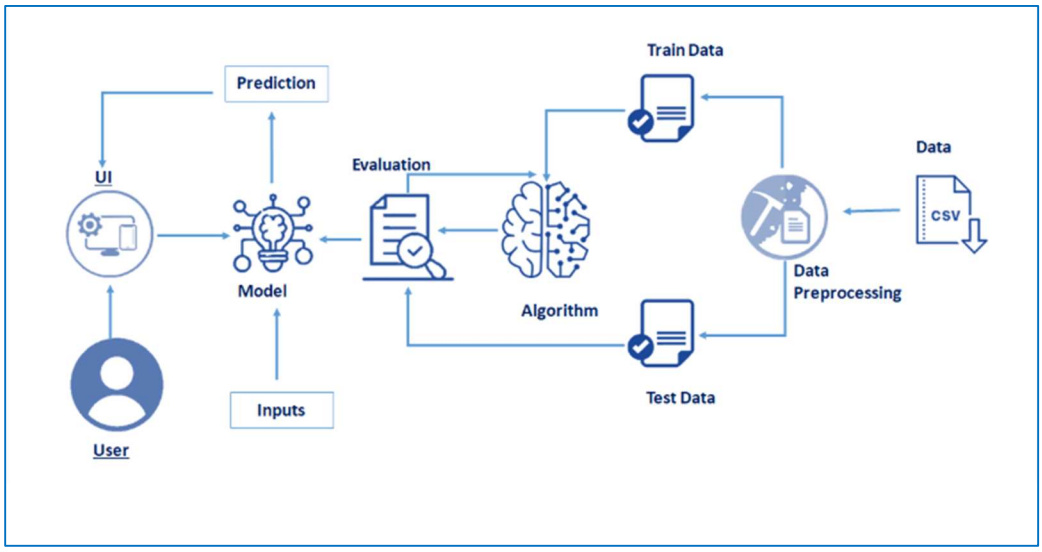
S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To estimate the traffic under given parameters

2.	Idea / Solution description	Traffic can be estimated by entering the required fields
3.	Novelty / Uniqueness	The output will be given fastly and accurately
4.	Social Impact / Customer Satisfaction	This could enable the traffic management authorities take reliable data driven decisions and plan accordingly. This could reduce accidents due to huge traffic, save time and improve public work productivity.
5.	Business Model (Revenue Model)	This would in turn save time for citizens and make them contribute more towards their livelihoods.
6.	Scalability of the Solution	This model can be used for complex data

4.3. Solution Architecture

- Best solution to estimate traffic is to use AI/ML
- For this we use python programming, HTML and flask framework.
- This application will enable us to enter the parameters and get the estimated traffic.

Solution Architecture Diagram



5. PROJECT PLANNING & SCHEDULING

5.1. Project Planning

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

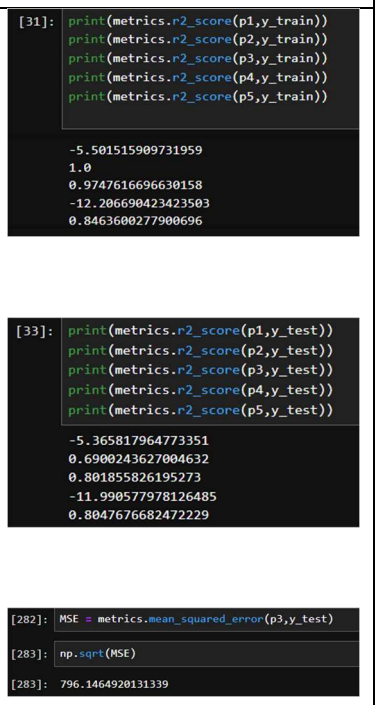
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Input entry	USN-1	As a user, I can enter all the required values in the required fields.	20	High	3
Sprint-2	Input options	USN-2	As a user, I will get the options allowed for fields	20	Low	3
Sprint-3	Traffic estimation	USN-3	As a user, I can know the estimated traffic value.	20	High	3

Project Tracker, Velocity & Burndown Chart: (4 Marks)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	7 Days	5 June 2025	11 June 2025	20	11 June 2025
Sprint-2	20	7 Days	12 June 2025	18 June 2025	20	28 June 2025
Sprint-3	20	10 Days	18 June 2025	27 June 2025	20	27 June 2025

6. FUNCTIONAL AND PERFORMANCE TESTING

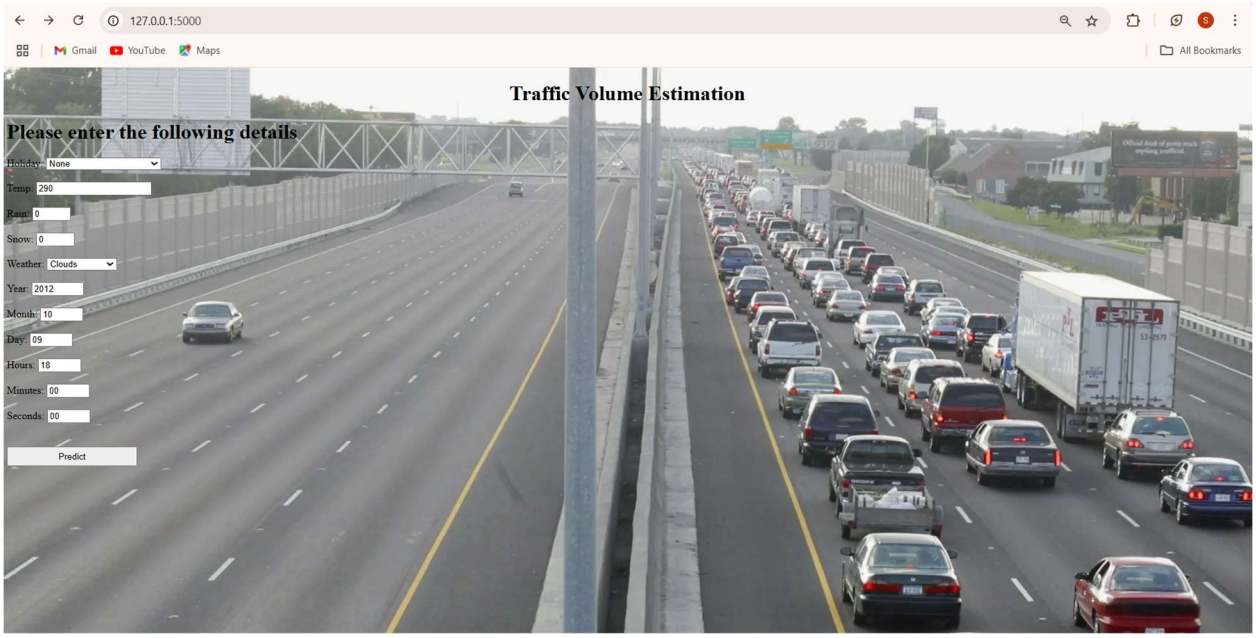
6.1. Performance Testing

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** RMSE - 796.1464920131339, R2 score - 0.801855826195273	

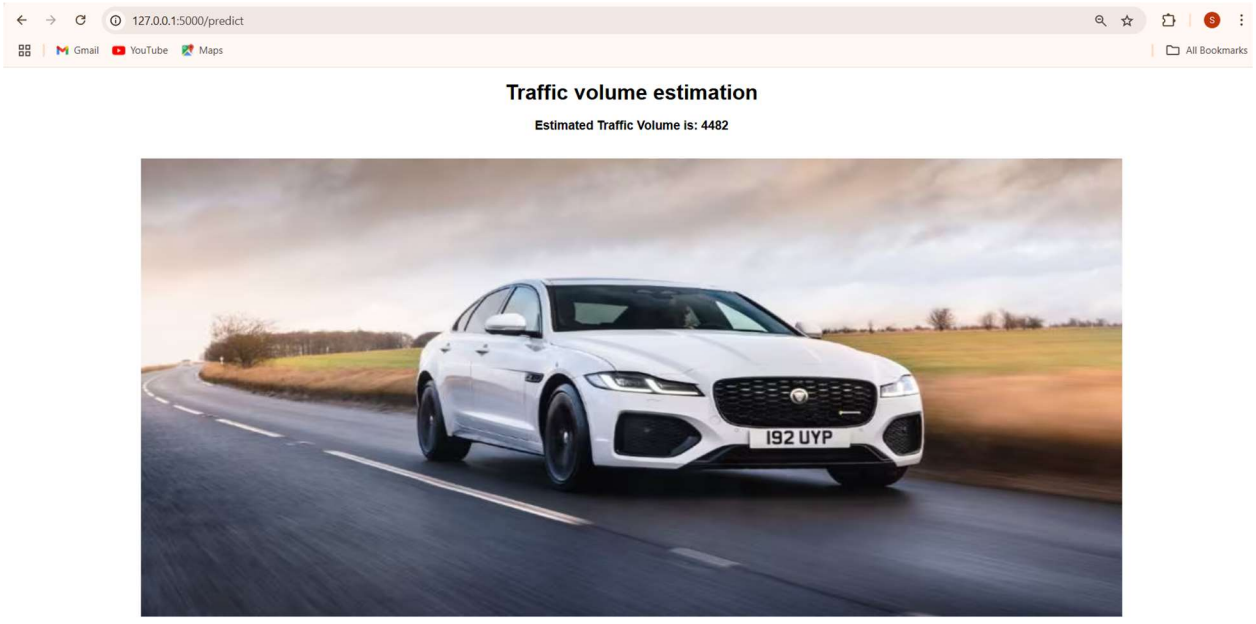
7. RESULTS

7.1. Output Screenshots

Entered all the required values



Got the Estimated traffic Volume



8. ADVANTAGES & DISADVANTAGES

Advantages:

1. Real-Time Predictions
   Predicts traffic volume instantly, helping city planners make quicker decisions.
2. High Accuracy
   Machine learning models can capture complex patterns, improving accuracy over traditional methods.
3. Scalability
   Works across multiple locations and can be expanded with additional data sources (e.g., cameras, weather, GPS).
4. Cost-Efficient Over Time
   Reduces long-term operational costs compared to manual traffic counting or sensor-heavy setups.
5. Smart City Integration
   Aligns with smart city initiatives by enabling automated, data-driven traffic management.
6. Customizable
   Can adapt to different regions, peak times, or special events by retraining the model with local data.

Disadvantages:

1. Data Dependency
   Needs quality, clean, and continuous data for accurate predictions — missing or noisy data can affect performance.
2. Initial Setup Complexity
   Requires model training, preprocessing, and infrastructure (e.g., APIs, sensors, or camera feeds).
3. Maintenance Required
   The model must be retrained periodically to stay relevant with changing traffic trends.
4. Privacy Concerns
   If using video or location data, strict data privacy and compliance measures are necessary.
5. Hardware/Software Costs
   High-quality data capture and real-time processing might require additional computing resources.

9. CONCLUSION

The *TrafficTelligence* project represents a forward-thinking approach to urban traffic management by leveraging the power of machine learning for real-time traffic volume estimation. Traditional methods of traffic monitoring, such as manual counting and static sensors, are often inefficient, inflexible, and expensive to scale. By integrating data from various sources—such as environmental conditions(like weather, rain, snow, temperature), time-based variables(date), situational variables like holidays and potentially sensor feeds—TrafficTelligence provides a smarter, data-driven solution that adapts to dynamic urban environments. The use of machine learning models like Random Forest, XGBoost, and SVR allows for accurate and reliable predictions, enabling city planners and traffic authorities to make informed decisions quickly. These insights can be used to optimize traffic signal timing, plan infrastructure improvements, and reduce congestion, leading to enhanced mobility and lower emissions in urban areas. While the system requires initial setup, quality data, and periodic updates, its long-term benefits in terms of scalability, accuracy, and efficiency far outweigh the limitations. Additionally, the project aligns with the goals of smart cities and sustainable urban development. TrafficTelligence is a promising and impactful tool that can transform how cities monitor and manage traffic, ultimately improving the quality of life for citizens and the efficiency of urban transportation systems.

10. FUTURE SCOPE

The future scope of *TrafficTelligence* includes integrating advanced data sources such as live video feeds, GPS data from vehicles, and IoT-based traffic sensors for more granular predictions. Incorporating deep learning models like CNNs and LSTMs could further enhance accuracy by capturing spatial and temporal patterns. The system can be expanded to support traffic incident detection, congestion forecasting, and adaptive signal control. Integration with smart city platforms and mobile applications could provide real-time traffic insights to commuters. Additionally, the model can be trained for region-specific behavior, making it applicable in diverse urban settings worldwide, contributing to smarter and greener cities.

11. APPENDIX

Source Code - https://github.com/Sujan-coder173/trafficTelligence/tree/main/Project%20Files

Dataset Link - https://drive.google.com/file/d/1iV5PfYAmI6YP0_0S4KYy1ZahHOqMgDbM/view

GitHub & Project Demo Link

GitHub Link – https://github.com/Sujan-coder173/trafficTelligence

Project Demo Link –
https://drive.google.com/file/d/1pgx06hJexst4lsiaaPZBF_HxrTWR20bF/view?usp=sharing