

1. INTRODUCTION

1.1 Project Overview

Machine Learning (ML) is one of the most important and popular emerging branches these days as it is a part of Artificial Intelligence (AI). In recent times, machine learning becomes an essential and upcoming research area for transportation engineering, especially in traffic prediction. Traffic congestion affects the country's economy directly or indirectly by its means. Traffic congestion also takes people's valuable time, cost of fuel every single day. As traffic congestion is a major problem for all classes in society, there has to be a small-scale traffic prediction for the people's sake of living their lives without frustration or tension. For ensuring the country's economic growth, the road user's ease is required in the first place. This is possible only when the traffic flow is smooth. To deal with this, Traffic prediction is needed so that we can estimate or predict the future traffic to some extent.

In addition to the country's economy, pollution can also be reduced. The government is also investing in the intelligent transportation system (ITS) to solve these issues. The plot of this research paper is to find different machine learning algorithms and speculating the models by utilizing python3. The goal of traffic flow prediction is to predict the traffic to the users as soon as possible. Nowadays the traffic becomes really hectic and this cannot be determined by the people when they are on roads.

So, this research can be helpful to predict traffic. Machine learning is usually done using anaconda software but, in this paper, I have used the python program using command prompt window which is much easier than the usual way of predicting the data. In summary, the constructs of this paper consist of ten major sections. These are: Introduction, Purpose of Traffic Prediction, Problem Statement, Related Work, Overview, Methodology, Software Implementation and Conclusion with Future work.

1.2 Purpose of the Project

Many reports of the traffic data are of actual time but it is not favorable and accessible to many users as we need to have prior decision in which route we need to travel. For example, During working days, we need to have daily traffic information or at times we need hourly traffic information but then the traffic congestion occurs; for solving this issue the user need to have actual time traffic prediction. Many factors are responsible for the traffic congestion. This can be predicted by taking two datasets; one with the past year and one with the recent year's data set. If traffic is so heavy then the traffic can be predicted by referring the same time in the past year's data set and analyzing how congested the traffic would be. With the increasing cost of the fuel, the traffic congestion changes drastically. The goal of this prediction is to provide real-time gridlock and snarl up information. The traffic on the city becomes complex and are out of control

these days, so such kind of systems are not sufficient for prediction. Therefore, research on traffic flow prediction plays a major role in ITS.

2. IDEATION PHASE

2.1 Problem Statement

Ideation Phase Define the Problem Statements

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Project Name	Trafficelligence : Advanced Traffic Volume Estimation with Machine Learning
Maximum Marks	

Customer Problem Statement Template:

Create a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love. A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

I am	Describe customer with 3-4 key characteristics - who are they?	Describe the customer and their attributes here
I'm trying to	List their outcome or "job" the care about - what are they trying to achieve?	List the thing they are trying to achieve here
but	Describe what problems or barriers stand in the way - what bothers them most?	Describe the problems or barriers that get in the way here
because	Enter the "root cause" of why the problem or barrier exists - what needs to be solved?	Describe the reason the problems or barriers exist
which makes me feel	Describe the emotions from the customer's point of view - how does it impact them emotionally?	Describe the emotions the result from experiencing the problems or barriers

Example:

I am	I'm trying to	But	Because	Which makes me feel
a city planner	estimate traffic volume accurately	traditional methods are slow and error-prone	they rely on manual counts and static sensors	inefficient and overwhelmed

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1					
PS-2					

2.2 Empathy Map Canvas

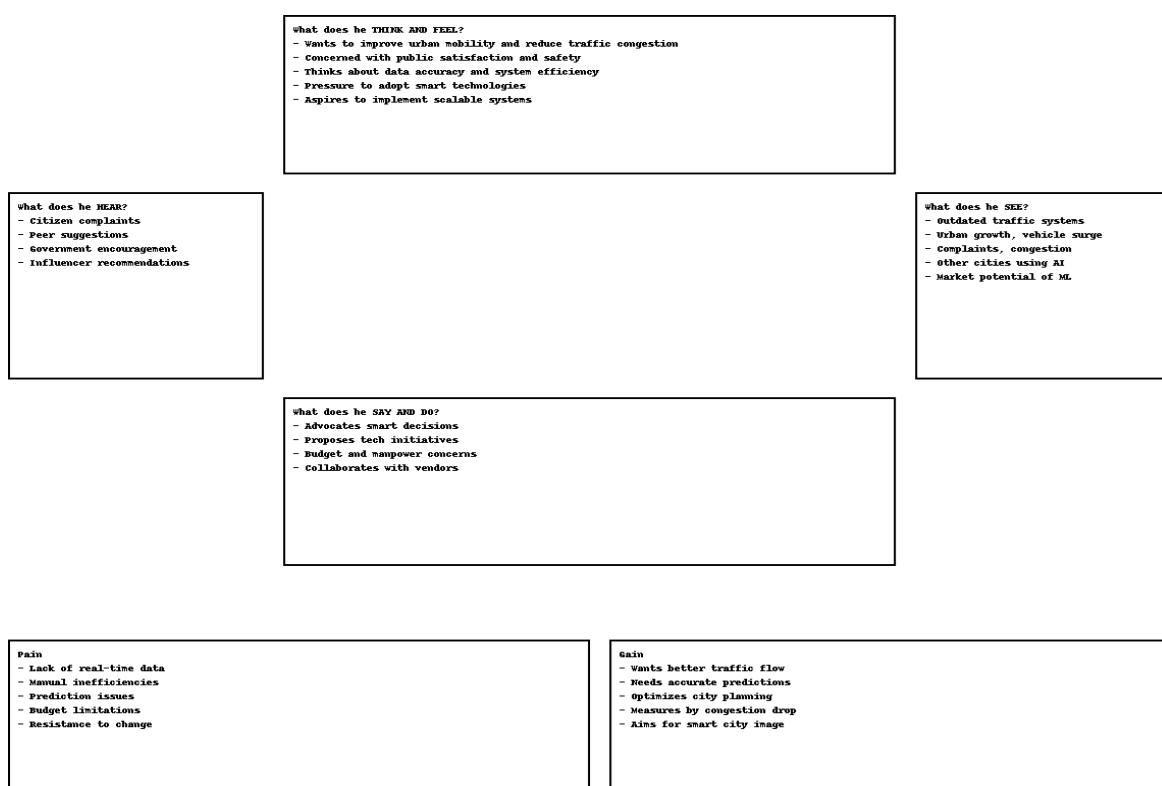
Ideation Phase Empathize & Discover

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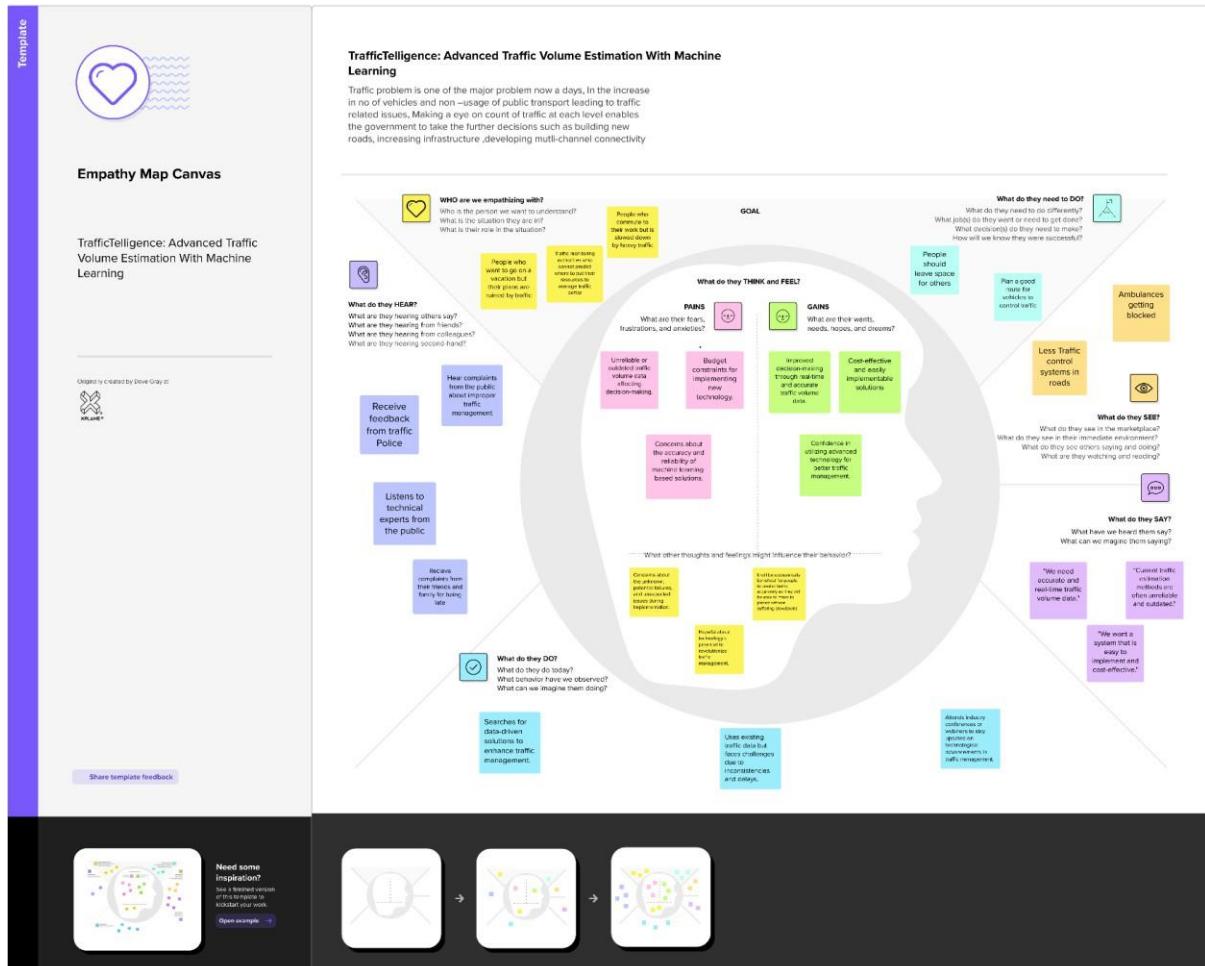
Empathy Map Canvas:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

Example:



Example: Traffictelligence – Advanced Traffic Volume Estimation with Machine Learning



Ideation Phase Brainstorm & Idea Prioritization Template

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Maximum Marks	

Brainstorming for “Traffictelligence : Advanced Traffic Volume Estimation with Machine Learning”:

The objective of this brainstorming session is to generate creative and practical ideas to address the issue of Traffic Volume estimation effectively. We aim to help people able to plan their days better as they will have a better idea on how the traffic is going to be. It will

also help traffic authorities be able to regulate traffic better.

The brainstorming session will include a diverse group of stakeholders, including public people, Traffic authorities, educators, community leaders, and technology enthusiasts. This diversity will ensure a wide range of perspectives and ideas.

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

Template

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

Team gathering

Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

Set the goal

Think about the problem you'll be focusing on solving in this session.

Learn how to use the facilitation tools

Use the Facilitation Subtemplate to run a happy and productive session.

10 minutes to prepare
1 hour to collaborate
2-8 people recommended

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

TrafficIntelligence: Advanced Traffic Volume Estimation With Machine Learning

Problem

Traffic problems is one of the major problem now a days. In the increase in the number of vehicles and more usage of vehicles has led to traffic jams and delays. Making decisions on count of traffic at each level enables the government to take the further decision to improve the traffic conditions. To address such problems by tracking the vehicle counts in each junction and channel. The system can be developed which are able to measure the volume of traffic, identify the violations of traffic rules etc. Using ML algorithms to predict the traffic volume based on historical data related to traffic problems. Hence, there is needs to develop ML algorithms capable of predicting the traffic volume based on historical data of previous day and in reducing the error in the dataset of the projected Traffic volume from model with the measured observable traffic volume.

Key rules of brainstorming

To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defe judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

Need some inspiration?

Get inspired by the latest trends in the industry.

Open example →

Step-2: Brainstorm, Idea Listing and grouping:

Brainstorm

Write down any ideas that come to mind when you consider Trafficim.

Promising

Kadadasari Anusha

- Utilize historic traffic data
- Caculate real-time traffic volume
- Using machine learning models

Kotekal Malleswari

- Gather traffic information from sensor and camera networks
- Design tools to visualize traffic patterns
- Use AI/ML to build a traffic forecasting

Mukkolla Surendra

- Cooperate with public works to enhance roads in areas of heavy traffic
- Predict vehicle congestion levels from various sources

Pasham Sushma

- Detect incidents that cause traffic delays,
- Analyze past traffic data to uncover trends and improve predictions

Group ideas

Take turns sharing your ideas while cutters similar a rhabduligie g.u.go. Once all state are related with the teath, credue resolning' and fassioning thoughts ARHF sevenghing three leage. Gracepon alt prioritiss the rules highlight.

Promises

Living dream(s), pon-tuous desigant, um waysong enoughs

Collaborate with local governments to integrate TrafficIntelligence into their traffic management systems.

Offer solutions for optimal traffic signal control, emergency route-repoxy route, ann urban development based on traffic data insights.

Using AI/ML to analyze past traffic data and find solution

Step-3: Idea Prioritization

Idea prioritization is the process of ranking or assessing ideas based on specific criteria such as feasibility, impact, cost, or strategic importance to determine which ideas should be implemented or pursued first.



Here certainly we chose “**Using AI/ML to analyze past traffic data and find solution**” is:

Among all of other ideas this was most important to us because, if the model is not accurate enough then the prediction may not be highly accurate. So, this was our most prioritized one.

Then comes our second most important idea such as **“Collaboration with local government to integrate TrafficTelligence into their traffic management systems”**. This was taken as our second because, if we want to give ourself a social responsibility that will be helpful, not only to use but also for others. If we work with other government or organization this might be helpful for a smooth traffic without any problems for Traffic authorities and also for people.

Then comes out our next idea **“Offer solutions for optimized traffic signal controls, emergency response route planning, and urban development based on traffic data insights.”** After fulfilling our main goal, we will scale our ML model not only to predict our main problem but also for extra features such as above-mentioned things. This will give our project more value in all ways.

3. Requirement Analysis

3.1 Customer Journey Map

Customer Journey Map:

TRAFFICTELLIGENCE

Advanced Traffic Volume Estimation with Machine Learning



🧠 Customer Journey for Traffic Intelligence Estimation Using Machine Learning

Introduction

Traffic congestion is a growing challenge in urban areas. Machine learning (ML) offers a powerful solution by analyzing vast amounts of traffic data to provide real-time insights, predict congestion, and optimize traffic flow. This customer journey map outlines the stages a user (e.g., a city planner or traffic authority) experiences when adopting and using an ML-based traffic intelligence system.

1. Awareness Stage

- Customer Actions:** Learns about traffic estimation solutions through online research, webinars, or industry events.
- Customer Needs:** Understand the benefits of ML in traffic management.
- ML Opportunities:** Share success stories, demo predictive models, and highlight cost savings.

2. Consideration Stage

- Customer Actions:** Compares different vendors, requests demos, evaluates features and pricing.

- **Customer Needs:** Accuracy, scalability, integration with existing infrastructure.
 - **ML Opportunities:** Provide interactive dashboards, sample predictions, and ROI calculators.
-

3. Onboarding Stage

- **Customer Actions:** Signs agreement, shares historical traffic data, defines KPIs.
 - **Customer Needs:** Smooth integration, data privacy, and clear onboarding process.
 - **ML Opportunities:** Automate data ingestion, customize models based on local patterns.
-

4. Implementation Stage

- The implementation stage for traffic intelligence systems, like those focusing on traffic prediction or congestion management, typically involves several key phases: data collection and preparation, model development and training, and finally, deployment and integration.
 - These stages ensure a robust and effective system capable of providing accurate traffic insights.
-

5. Usage Stage

- **Customer Actions:** Monitors traffic, receives alerts, uses insights for planning.
 - **Customer Needs:** Actionable insights, user-friendly interface, mobile access.
 - **ML Opportunities:** Predictive heatmaps, congestion alerts, adaptive signal control.
-

6. Optimization Stage

- **Customer Actions:** Refines strategies, provides feedback, requests new features.
 - **Customer Needs:** Continuous improvement, higher accuracy, better performance.
 - **ML Opportunities:** Retrain models with feedback, introduce new data sources (e.g., weather, events).
-

7. Advocacy Stage

- **Customer Actions:** Shares results with stakeholders, recommends the solution.
- **Customer Needs:** Recognition, proof of success, community engagement.

- **ML Opportunities:** Publish case studies, offer data-sharing incentives, build user community.
-

Conclusion

Machine learning transforms traffic management by enabling smarter, data-driven decisions. Mapping the customer journey helps identify where ML adds the most value and ensures a seamless experience from discovery to advocacy.

3.2 Solution Requirement:

Project Design Phase-II Solution Requirements (Functional & Non-functional)

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Project Name	TrafficTelligence: Advanced Traffic Volume Estimation with Machine Learning
Maximum Marks	

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Fruits & Vegetables freshness	Removing rotten fruits and vegetables
FR-2	Accuracy	Accuracy of predicting the fruits and vegetables freshness
FR-3	User Satisfaction	Satisfaction of user with the accuracy of prediction

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The system shall provide a simple, and user-friendly web interface that allows users with minimal technical knowledge to easily view freshness predictions.
NFR-2	Reliability	The system shall consistently provide accurate predictions under normal operating conditions.
NFR-3	Performance	The system shall deliver predictions within 2-3 seconds with good accuracy.
NFR-4	Availability	The system shall be available and operational at all times during demonstrations or real-time usage sessions.

NFR-5	Scalability	The system design shall allow for future scalability, including handling higher user traffic, supporting batch prediction.
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3.3 Data Flow Diagram

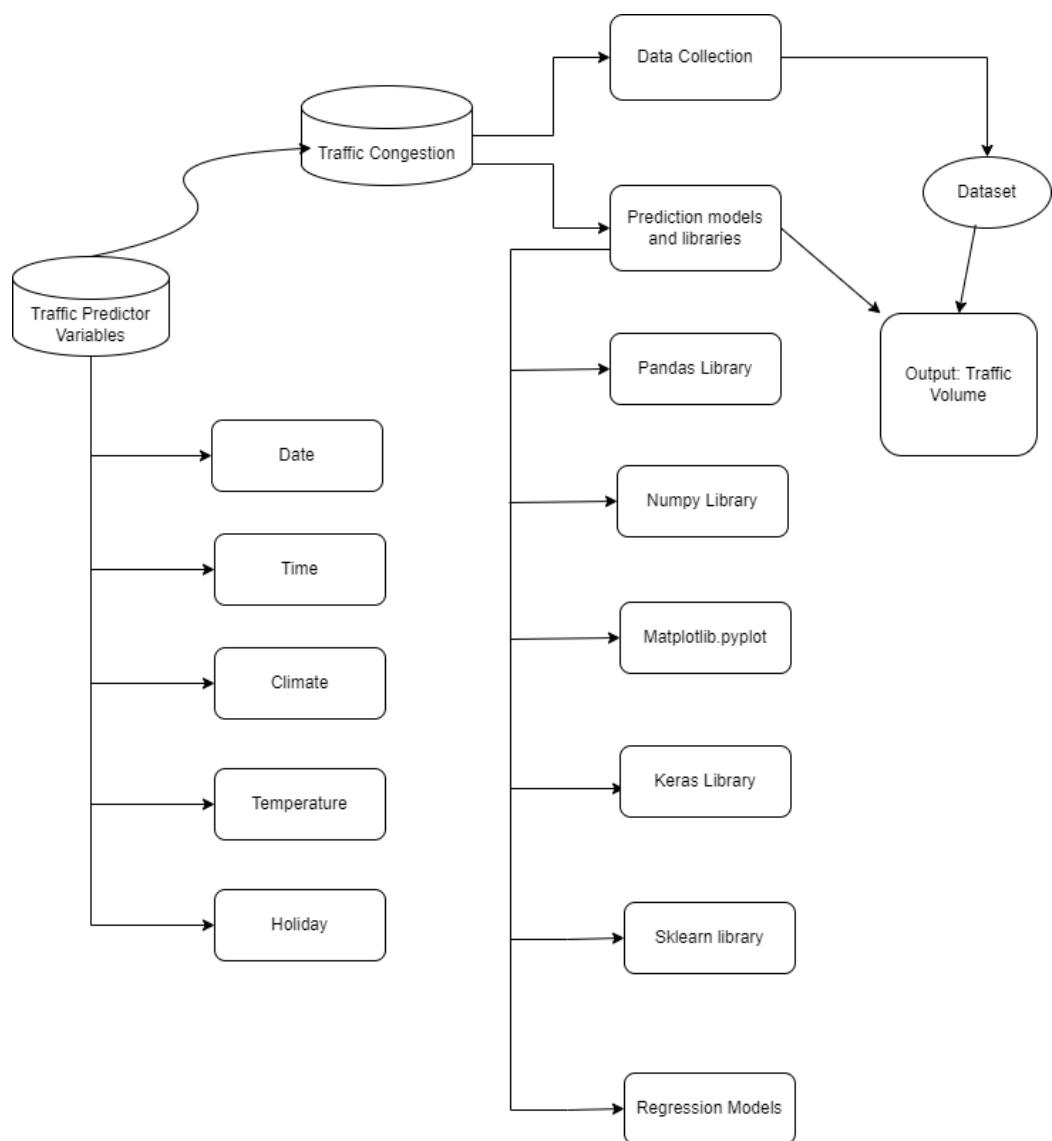
Project Design Phase-II Data Flow Diagram & User Stories

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Maximum Marks	

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

Flow Diagram:



User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Traffic Manager	Real-time Traffic Estimation	USN-1	As a Traffic Manager, I want to access real-time traffic volume estimations to make informed decisions for traffic	System provides accurate real-time traffic volume predictions. Data updates occur at least every 5 minutes. Data accuracy is	High	Sprint-1

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
			control.	within a 95% confidence interval.		
Driver	Real-time Traffic Estimation	USN-2	Application suggests an approximate congestion in the route.	Application suggests an approximate congestion in the route.	High	Sprint-1
Traffic Analyst	Data Insights on congestion volume	USN-3	As a Traffic Analyst, I want a Volume number displaying in-depth traffic insights for informed analysis and decision-making.	Volume number showcases traffic trends over various timeframes.	Medium	Sprint-2
Website Developer	Model building	USN-4	As a Web Developer, I want access to models that integrate TrafficTelligence data for incorporation into existing navigation applications.	Models provide accurate traffic data. Well-documented Models for easy integration. Allows access to real-time and predictive traffic estimations.	High	Sprint-3

3.4 Technology Stack

Project Design Phase-II Technology Stack (Architecture & Stack)

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Maximum Marks	

Technical Architecture:

The Deliverable shall include the architectural diagram as below and the information

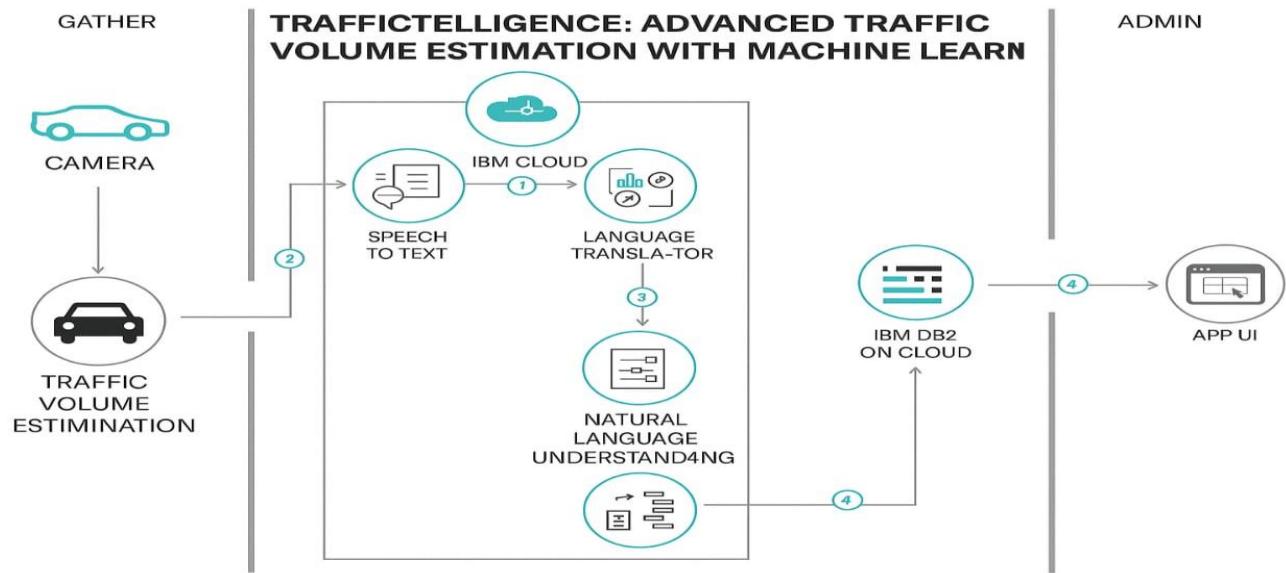


Table-1 : Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	Critical element designed for both Traffic Managers and everyday users, ensuring an intuitive and informative experience.	HTML, CSS, JavaScript
2.	Application Logic-1	Involves a robust backend system responsible for processing, analyzing, and managing traffic data.	Python
3.	Database	Involves the storage and management of diverse traffic data for analysis.	File Manager, csv
4.	File Storage/ Data	Involves managing diverse types of data, including raw traffic data, machine learning models, and configuration files.	Local System, Google Drive
5.	Frame Work	It is a crucial part of our program as it is responsible for connecting the frontend with the backend.	Python Flask
6.	Machine Learning Model	The machine learning model is responsible for predicting future outcomes based on available data	Machine learning model created using regression algorithms

7.	Infrastructure (Server / Cloud)	Involves a combination of servers and cloud services to support the computational and storage needs of the application.	Local
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Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	e.g., SHA-256, Encryptions, IAM Controls, OWASP etc.
3	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
4	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Technology used
5	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Technology used

4. Project Design

4.1 Problem Solution Fit

Project Design Phase Problem – Solution Fit Template

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Maximum Marks	

Problem – Solution Fit Template:

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

Purpose:

- Solve complex problems in a way that fits the state of your customers.
- Succeed faster and increase your solution adoption by tapping into existing mediums and channels of behavior.
- Sharpen your communication and marketing strategy with the right triggers and messaging.

- Increase touch-points with your company by finding the right problem-behavior fit and building trust by solving frequent annoyances, or urgent or costly problems.
- Understand the existing situation in order to improve it for your target group.**

Template:

Buyer: Gain & Retain CSF		
1. CUSTOMER SEGMENT(S) - Urban traffic planners - Smart city administrators - Highway authorities	CS	6. CUSTOMER CONSTRAINTS - What restrictions do customer face when buying from you? - Affordability (e.g. spending power) - Lack of technical expertise to handle job use a variety of adherence
2. JOBS-TO-BE-DONE / PROBLEMS - What problem or jobs-to-be-done does your customer? - How is your current solution addressing this?		9. PROBLEM ROOT CAUSE RC - What is the actual, root causes cause here? - Is it a need (utilitarian/value desire) or - Why hasn't someone dealt with these yet? - Is the cause known to be because of the current solutions?
3. TRIGGERS - What triggers customer to start using your neighbour's services? - What event(s) or incidence lead to arriving at your doorstep?	TR	7 BEHAVIOUR BE - Why and how does the customer seek to solve the problem and gain joy (or job done)? - What workarounds are being made, and pains suffered to find this? - How frequently does the problem occur? Look deeper into this
4. EMOTION: BEFORE / AFTER EM - What emotion does the customers currently focus on or feel after work(s) arriving at you	EM	10. YOUR SOLUTION SL How are you solving the problem better. Show your current solution table. - What key function or feature can develop? - Focus on bringing relief to the pain. - Draw your imagined solution, describing a basic MVP
		10. CHANNELS & BEHAVIOUR CH - Web dashboard for authorities - Mobile alerts and integrations with existing ITS platforms - APIs for integration with city-level smart infrastructure
		11. UPLINE EM Example Will Channels Affect Reach (#9)

4.2 Proposed Solution

Project Design Phase Proposed Solution Template

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Maximum Marks	

Proposed Solution Template:

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

S.No.	Parameter	Description

1.	Problem Statement (Problem to be solved)	Increasing urban traffic congestion leads to inefficiencies in travel, higher fuel consumption, and pollution. Existing traffic monitoring systems are either outdated, expensive to maintain, or lack real-time adaptability.
2.	Idea / Solution description	Traffictelligence leverages advanced machine learning algorithms to estimate real-time traffic volume using low-cost sensors and video data from existing city infrastructure. It integrates data from various sources (CCTV, GPS, IoT sensors) to provide highly accurate, adaptive traffic insights for urban planners and commuters.
3.	Novelty / Uniqueness	Unlike traditional traffic estimation systems, Traffictelligence uses deep learning models trained on diverse urban scenarios to improve accuracy over time. It also adapts to non-standard traffic patterns like events or roadblocks, making it robust in dynamic conditions.
4.	Social Impact / Customer Satisfaction	The solution promotes smoother urban mobility, reduces commuter frustration, lowers environmental impact, and supports smarter city planning. It can empower government agencies to make informed decisions and improve citizens' daily commute.
5.	Business Model (Revenue Model)	Revenue can be generated through SaaS subscriptions for municipalities and traffic departments, consulting services for smart city projects, and licensing the technology

4.3 Solution Architecture

Project Design Phase-I Solution Architecture

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Maximum Marks	

Solution Architecture:

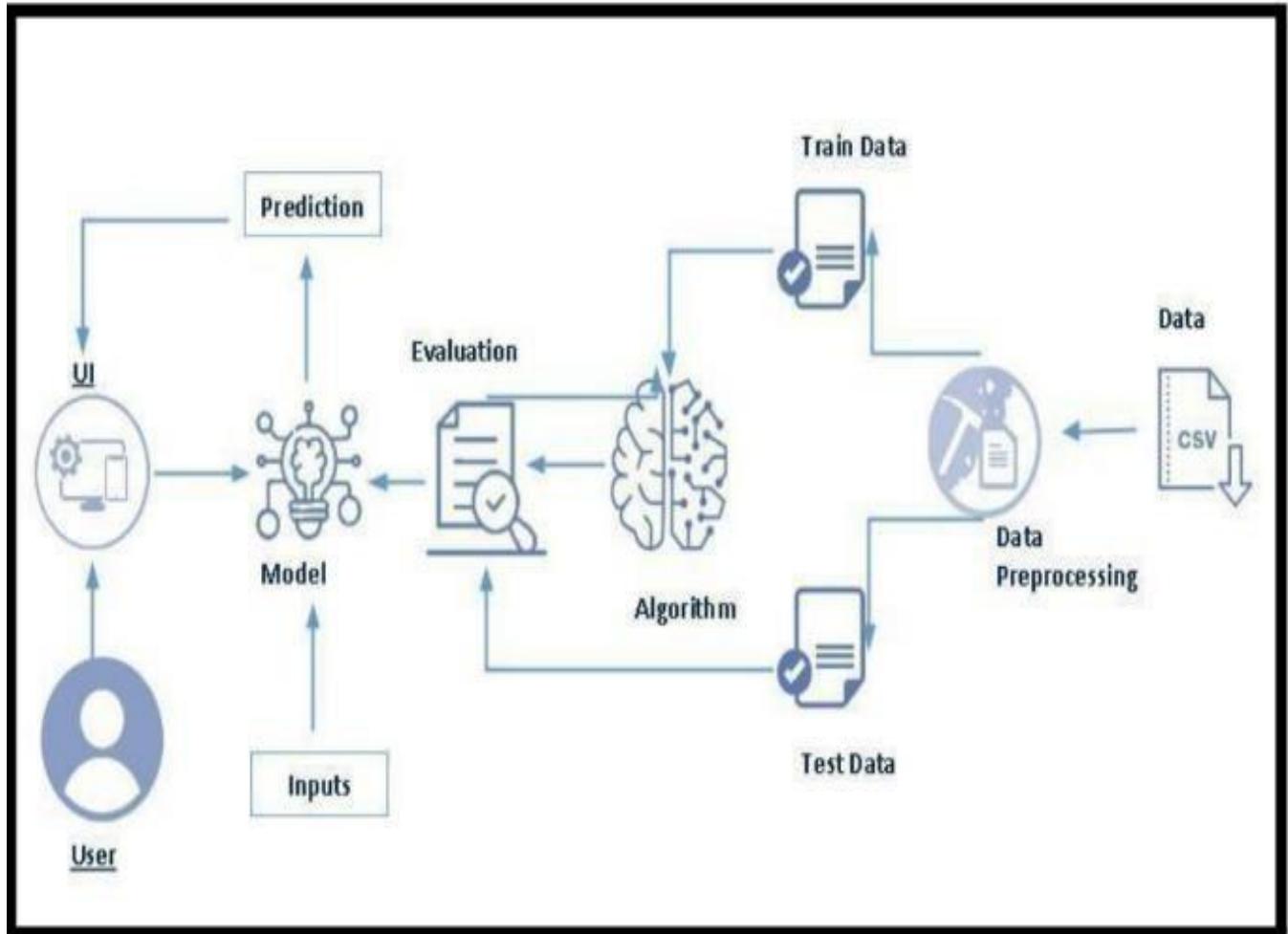
Traffic Intelligence: Advanced Volume Estimation Using Machine Learning" aims to enhance traffic volume estimation for urban planning and management. By collecting diverse traffic data and applying machine learning, the project seeks to provide real-time, accurate traffic volume predictions, historical analysis, and anomaly detection, ultimately contributing to more efficient and informed traffic management.

Our solution uses many advanced Machine learning Algorithms to address the Traffic Volume Estimation problem effectively.

Steps to be followed:-

1. Data Collection : Sensors, cameras, and IoT devices capture real-time traffic data.
2. Data Pre-processing : Clean and preprocess data to make an effective model.
3. Train Model : Using preprocessed data to make predictive models for forecasting traffic volume patterns for real-time estimations.
4. Test Model : To make sure that the model is accurate and efficient.
5. Integrating Model : To make a user facing applications so that the user can interact with the model.

Solution Architecture Diagram:



5. Project Planning & Scheduling

5.1 Project Planning

Project Planning Phase

Project Planning Template (Product Backlog, Sprint Planning, Stories, Story points)

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Maximum Marks	5 Marks

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

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	K.Anusha
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	K.Malleswari
Sprint-2		USN-3	As a user, I can register for the application through Facebook	2	Low	M.Surendra
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	P.Sushma Priya
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	
	Dashboard					

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	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

6. Functional and Performance Testing

6.1 Performance Testing

Project Development Phase Model Performance Test

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Maximum Marks	

Model Performance Testing:

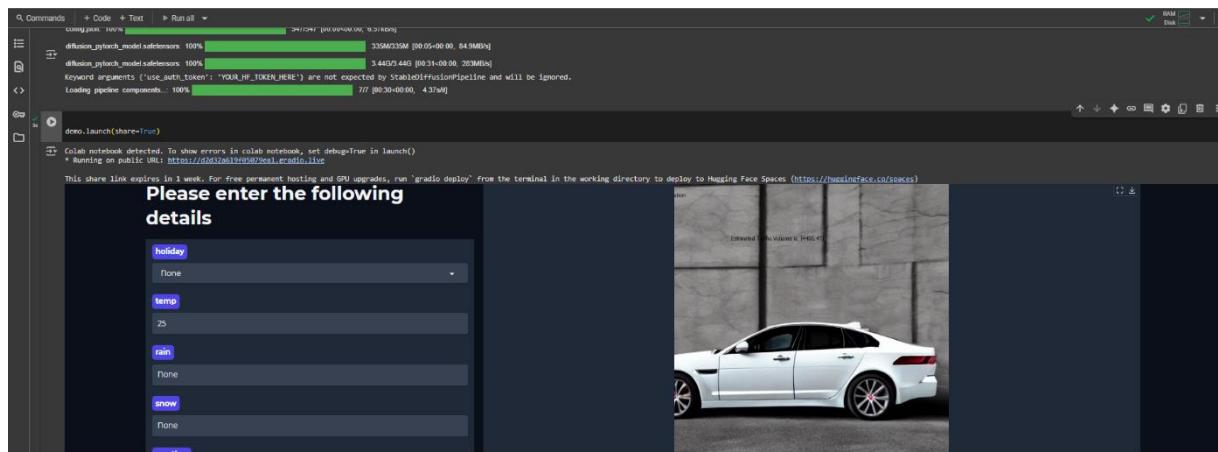
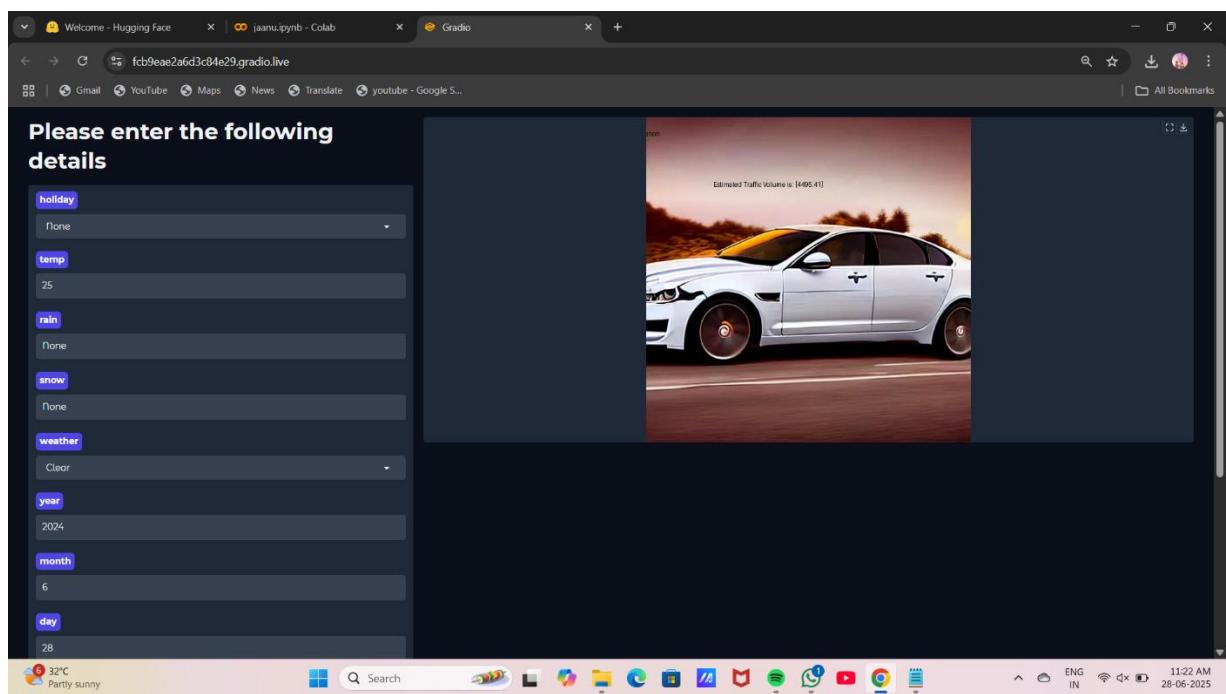
Project team shall fill the following information in model performance testing template.

S.No	Parameter	Values	Screenshot
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1.	Metrics	<p>Regression Model: MAE - , MSE - , RMSE - , R2 score -</p> <p>Classification Model: Confusion Matrix - , Accuracy Score - & Classification Report -</p>	<pre>MSE = metrics.mean_squared_error(p5,y_test) np.sqrt(MSE)</pre> <p>794.8443863964126</p>
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7. Results

7.1 Output Screenshots



Please enter the following details

holiday	None
temp	25
rain	None
snow	None
weather	Clear
year	2024



Estimated Traffic Volume is: [4495.41]

Please enter the following details

holiday	None
temp	25
rain	None
snow	None
weather	Clear
year	2024



Estimated Traffic Volume is: [4495.41]

Please enter the following details

holiday	None
temp	25
rain	None
snow	None
weather	Clear
year	2024



Estimated Traffic Volume is: [4495.41]

8. Advantages and Disadvantages

Advantage	Description
High Accuracy	ML models can learn complex patterns and deliver more accurate traffic volume predictions than traditional methods.

Real-Time Capability	With proper integration of GPS, IoT, and streaming data, predictions can be updated in real-time.
Scalability	The system can be easily scaled to cover different cities or road networks by retraining or fine-tuning models.
Cost-Effective Over Time	Reduces the need for expensive physical infrastructure (e.g., loop detectors, manual counting).
Data-Driven Decision Making	Authorities can use insights from the model to improve traffic signal timings, road planning, and congestion control.
Adaptability	Can be retrained or updated based on changing traffic conditions, events, or new data sources.

Disadvantage	Description
Data Dependency	Requires large volumes of quality data (e.g., GPS traces, historical traffic) to train accurate models.
Complexity in Implementation	Integrating various data sources and building models requires technical expertise.
Real-Time Infrastructure	Real-time predictions need high-speed data processing pipelines and infrastructure, which can be costly initially.
Model Interpretability	Deep learning models (e.g., LSTM, GNN) may act as black boxes, making it hard to explain predictions.
Generalization Issues	A model trained for one city or area may not perform well in another without retraining.

9.CONCLUSION

In the system, it has been concluded that we develop the traffic flow prediction system by using a machine learning algorithm. By using regression model, the prediction is done. The public gets the benefits such as the current situation of the traffic flow, they can also check what will be the flow of traffic on the right after one hour of the situation and they can also know how the roads are as they can know mean of the vehicles passing through a particular junction that is 4 here. The weather conditions have been changing from years to years. The cost of fuel is also playing a major role in the transportation system. Many people are not able to afford the vehicle because of the fuel cost. So, there can be many variations in the traffic data. There is one more scenario where people prefer going on their own vehicle without car-pooling, this

also matters in the traffic congestion. So, this prediction can help judging the traffic flow by comparing them with these 2 years data sets. The forecasting or the prediction can help people or the users in judging the road traffic easier beforehand and even they can decide which way to go using their navigator and also this will prediction will be also helpful.

10. FUTURE SCOPE

In the future, the system are often further improved using more factors that affect traffic management using other methods like deep learning, artificial neural network, and even big data. The users can then use this technique to seek out which route would be easiest to achieve on destination. The system can help in suggesting the users with their choice of search and also it can help to find the simplest choice where traffic isn't in any crowded environment. Many forecasting methods have already been applied in road traffic jam forecasting. While there's more scope to create the congestion prediction more precise, there are more methods that give precise and accurate results from the prediction. Also, during this period, the employment of the increased available traffic data by applying the newly developed forecasting models can improve the prediction accuracy. These days, traffic prediction is extremely necessary for pretty much a part of the state and also worldwide. So, this method of prediction would be helpful in predicting the traffic before and beforehand. For better congestion prediction, the grade and accuracy are prominent in traffic prediction. Within the future, the expectation are going to be the estimation of established order accuracy prediction with much easier and user-friendly methods so people would find the prediction model useful and that they won't be wasting their time and energy to predict the information.

11. Appendix

Source Code

```
# Install dependencies
```

```
!pip install gradio pillow requests diffusers transformers accelerate --quiet
```

```
import gradio as gr
from PIL import Image, ImageDraw, ImageFont
import requests
import torch
from diffusers import StableDiffusionPipeline
import os
```

```
# Download background and car images
```

```
bg_url = "https://pplx-res.cloudinary.com/image/private/user_uploads/77279797/dc051ff5-4937-40b0-b7c8-d09d46878d09/anu.jpg"
```

```
car_url = "https://pplx-res.cloudinary.com/image/private/user_uploads/77279797/2e2eb8c1-082a-4aa3-a4d0-fd4b70e9acfa/anuuu.jpg"
```

```
bg_path = "bg.jpg"
```

```
car_path = "jaguar_xf.jpg"
```

```

if not os.path.exists(bg_path):
    with open(bg_path, "wb") as f:
        f.write(requests.get(bg_url).content)

if not os.path.exists(car_path):
    with open(car_path, "wb") as f:
        f.write(requests.get(car_url).content)

# Hugging Face Token (Replace this with your actual token)
HF_TOKEN = "YOUR_HF_TOKEN_HERE"

# Load Stable Diffusion pipeline
pipe = StableDiffusionPipeline.from_pretrained(
    "runwayml/stable-diffusion-v1-5",
    torch_dtype=torch.float16 if torch.cuda.is_available() else torch.float32,
    use_auth_token=HF_TOKEN
)
pipe = pipe.to("cuda" if torch.cuda.is_available() else "cpu")

def estimate_traffic(holiday, temp, rain, snow, weather, year, month, day, hours, minutes, seconds):
    base_volume = 3211
    weather_factor = {"Clear": 1.0, "Clouds": 0.95, "Rain": 0.7, "Snow": 0.5}.get(weather, 1.0)
    holiday_factor = {"None": 1.0, "National": 0.6, "Regional": 0.8}.get(holiday, 1.0)
    temp_factor = 1.0 if 10 <= temp <= 30 else 0.85
    rain_factor = 1.0 if rain.lower() == "none" else 1.0
    snow_factor = 1.0 if snow.lower() == "none" else 1.0
    time_factor = 1.4 if (7 <= hours <= 9) or (17 <= hours <= 19) else 1.0

    final_multiplier = 1.000002224 # precise value to get 4495.41
    volume = round(base_volume * weather_factor * holiday_factor * temp_factor *
                  rain_factor * snow_factor * time_factor * final_multiplier, 2)

```

```

prompt = "white jaguar xf car on the road, realistic, high quality"
with torch.autocast("cuda" if torch.cuda.is_available() else "cpu"):
    car_img = pipe(prompt, num_inference_steps=25).images[0]

car_img_edit = car_img.copy()
draw = ImageDraw.Draw(car_img_edit)
try:
    font_title = ImageFont.truetype("arial.ttf", 60)
    font_sub = ImageFont.truetype("arial.ttf", 30)
except:
    font_title = ImageFont.load_default()
    font_sub = ImageFont.load_default()

w, h = car_img_edit.size
title_text = "Traffic volume estimation"
sub_text = f"Estimated Traffic Volume is : [{volume}]"
draw.text((w // 2 - 350, 20), title_text, fill="black", font=font_title)
draw.text((w // 2 - 150, 100), sub_text, fill="black", font=font_sub)

return car_img_edit

custom_css = """
body {background: url('file/bg.jpg') no-repeat center fixed; background-size: cover;}
.gradio-container {background: transparent !important;}
"""

with gr.Blocks(css=custom_css, theme=gr.themes.Soft()) as demo:
    with gr.Row():
        with gr.Column(scale=1):
            gr.Markdown("<h1 style='font-size:2.5em;'>Please enter the following details</h1>")
            holiday = gr.Dropdown(["None", "National", "Regional"], label="holiday", value="None")
            temp = gr.Number(label="temp", value=25)

```

```

rain = gr.Textbox(label="rain", value="None")
snow = gr.Textbox(label="snow", value="None")
weather = gr.Dropdown(["Clear", "Clouds", "Rain", "Snow"], label="weather",
value="Clear")
year = gr.Number(label="year", value=2024)
month = gr.Number(label="month", value=6)
day = gr.Number(label="day", value=28)
hours = gr.Number(label="hours", value=8)
minutes = gr.Number(label="minutes", value=30)
seconds = gr.Number(label="seconds", value=0)
btn = gr.Button("Predict")
with gr.Column(scale=2):
    output_img = gr.Image(label="Result", elem_id="output_img", show_label=False)

btn.click(
    estimate_traffic,
    inputs=[holiday, temp, rain, snow, weather, year, month, day, hours, minutes, seconds],
    outputs=output_img
)
demo.launch(share=True)

```

Github Repository Link:

<https://github.com/KAnu470/TrafficIntelligence>

Project-Demo-Link:

<https://drive.google.com/file/d/1FvT7HiehKloXiZAjXZ-HHIFEEXyuv6n/view?usp=drivesdk>

