Trafficelligence: Advanced Traffic Volume Estimation With Machine Learning

1. INTRODUCTION

Overview:

This project aims to help traffic authorities, urban planners, and transport researchers estimate road traffic volumes using Artificial Intelligence (AI). Many cities, especially in developing regions, struggle with real-time traffic monitoring due to limited infrastructure and high costs. This results in poor traffic management, congestion, and increased emissions.

To address this, our team built a simple AI-powered web application. Authorities or users can upload a road image, and the app analyzes it using a pre-trained deep learning model (VGG16) to estimate traffic density. It then displays the traffic level (e.g., low, medium, high) along with basic suggestions for action.

Key Features:

- • Image-based traffic estimation using Transfer Learning (VGG16)
- • Simple and user-friendly web interface
- • Traffic condition displayed after prediction
- • Future support for multilingual interfaces (e.g., Telugu, Hindi)
- • Usable in both urban and semi-urban areas with limited tech infrastructure

1.1 Ideation Phase

Date	16th June 2025
Team ID	LTVIP2025TMID34422
Project Name	Trafficelligence: Advanced Traffic Volume Estimation With Machine Learning
Maximum Marks	4 Marks

Problem Statement:
Urban and semi-urban areas often lack automated, cost-effective systems for estimating traffic volume. Manual observation and traditional sensor-based systems are expensive and limited in coverage, resulting in poor data and inefficient traffic planning.

Problem Statement Table:

Problem Statement Table

PS No	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	A traffic planner	Manage traffic effectively	I can't get real-time data	I don't have live monitoring tools	Helpless and reactive
PS-2	A local authority	Allocate patrol units dynamically	I don't know peak congestion times	Manual data is outdated	Frustrated and delayed

1.2 Empathize & Discover

Empathy Map:

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Empathy Map Canvas: Trafficelligence Project

User: Urban Traffic Control Officer / Smart City Analyst

Says:

I need accurate data to manage congestion effectively.

Manual traffic counting is time-consuming and outdated.

I want an easier way to estimate traffic volumes without deploying teams on-site.

Thinks:

If I can monitor traffic automatically, I can improve city planning and reduce jams.

A reliable prediction model can help with peak-hour adjustments and reduce accidents.

I hope the system works with existing surveillance cameras.

Does:

Reviews traffic camera feeds manually.

Relies on periodic traffic surveys or manual counts.

Responds to congestion reports from the public or field agents.

Coordinates with municipal teams to adjust traffic signals.

Feels:

Frustrated by inconsistent traffic data and delays in receiving accurate insights.

Hopeful about AI-based automation reducing workload and improving response times.

Overwhelmed during peak traffic hours with limited resources.

Relieved when systems help visualize patterns and predict volume accurately.

Empathy Map

Says	Thinks	Does	Feels
I need better traffic data to make decisions	AI could help automate data collection	Reviews CCTV footage or traffic reports	Frustrated due to incomplete data sources

1.3 Brainstorm & Idea Prioritization

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Team Members:
- Team Leader: D Anusha
- Team Member: A. Nithya phani sri
- Team Member: A. Archana
- Team Member: A.Naga renu gopal

Generated Ideas:

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• Build a web/mobile app to estimate traffic volume using uploaded images
• Use pre-trained AI model (Transfer Learning – VGG16)
• Simple interface for traffic authorities
• Multilingual voice/text support
• Tips for congestion mitigation
• Integrate with traffic cameras
• Offline usage support
• Display prediction confidence level
• QR-based instant access
• Educate officials about AI tool benefits

2. REQUIREMENT ANALYSIS

Customer Journey Map:

Customer Journey Map

Stage	User Action	Touchpoints	Pain Points	User Emotion
Awareness	Hears about traffic AI tool	Posters, Social Media	Unsure if it works	Curious

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Consideration	Decides to test tool	Website, Browser	New to AI tools	Hopeful
Interaction	Uploads traffic image	Web interface	Poor internet	Nervous
Diagnosis	Gets traffic volume result	AI Model Output	Unsure about accuracy	Relieved
Action	Uses data for planning	PDF/Report	Limited follow-up	Satisfied
Feedback	Shares result with peers	Peer Networks	No verification	Neutral

3.DATA FLOW DIAGRAMS (DFD):

Data Flow Diagram (DFD)

DFD Level 0 (Context Diagram):

User → uploads traffic image → System → returns predicted traffic volume

DFD Level 1 (Detailed Flow):

User uploads traffic surveillance image

Web Application validates image and sends it to the AI (VGG16-based) Model

AI Model processes the image and estimates traffic volume

Predicted result is shown on the Web Interface

(Optional) Result is stored in database for user's history/logs.

4. TECHNICAL ARCHITECTURE

The project uses a 3-tier architecture:

Frontend (User Interface) → Backend (Application Logic + AI Model) → Data Storage

Components and Technologies:

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Components and Technologies

Component	Description	Technology Used
User Interface	Interaction via browser	HTML, CSS, JavaScript, Flask
Backend Logic	Image handling & model prediction	Python, Flask
Image Preprocessing	Prepare image for model	OpenCV, Pillow
Model Prediction	Estimate traffic volume	VGG16, TensorFlow
Database	Optional – Store results	SQLite / MySQL
Deployment	Localhost or cloud	Google Cloud / AWS

Purpose:

Solution architecture helps bridge the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, behavior, and characteristics of the system to stakeholders.
- Define features, development phases, and solution requirements.

Provide specifications to ensure the solution is well-defined, managed, and delivered.

Architecture Overview:

Our poultry disease detection system uses a 3-tier architecture that includes the frontend, backend logic, and a trained machine learning model for disease prediction. The user uploads an image of a poultry bird, which is processed and predicted using a transfer learning model (VGG16). The result is returned on the interface, and optionally stored.

4. PROJECT DESIGN

Problem – Solution Fit:

1. CUSTOMER SEGMENT(S) (CS)

• Urban city planners, traffic management authorities

• Smart city project teams, municipal engineers

• Transport departments, data scientists in transport analytics

2. JOBS TO BE DONE / PROBLEMS (J&P)

• Unable to estimate traffic volume accurately in real-time

• Difficulty in planning infrastructure without reliable data

• Manual surveys are time-consuming and costly

3. TRIGGERS (TR)

• Rising traffic congestion

• Complaints from citizens about traffic delays

• Need for data in smart city planning initiatives

4. PROBLEM ROOT CAUSE (RC)

• Lack of real-time data collection tools

• Manual methods prone to error

• Inaccessibility of affordable AI-based tools for volume estimation

5. AVAILABLE SOLUTIONS (AS)

• Manual traffic counts (human observation)

• Expensive commercial AI solutions

• Static sensors and outdated traffic cameras

6. CUSTOMER CONSTRAINTS (CC)

• Budget limitations for smart tools

• Lack of trained manpower for high-end AI tools

• Inadequate integration with existing infrastructure

7. YOUR SOLUTION (SL)

• A web-based tool for traffic volume detection using video/images

• Employs VGG16 deep learning model to estimate vehicle count

• Easy-to-use, affordable, works on common computing platforms

8. BEHAVIOUR (BE)

• Using historical data for planning

• Relying on manual traffic police logs

• Avoiding technology due to cost or complexity

9. CHANNELS OF BEHAVIOUR (CH)

• Government portals or internal networks

• Communication with other departments or consultants

• Occasional tech searches or workshops/webinars

Problem – Solution Fit

Parameter	Description
Problem Statement	Lack of low-cost, automated traffic volume monitoring
Solution	AI-based tool using images for real-time traffic estimation
Uniqueness	Image-based, no special hardware needed, scalable
Social Impact	Improves traffic flow, supports smart city planning
Scalability	Can expand to video stream analysis and mobile deployment

5. PROJECT PLANNING & SCHEDULING

Sample Sprint Plan:

Sprint Plan

Sprint	Task	Story Points	Team Member	Priority
Sprint-1	Image upload feature	3	All	High
Sprint-2	VGG16 integration	5	Tech Team	High
Sprint-3	UI Design	2	Frontend Team	Medium
Sprint-4	Prediction output and result display	3	All	High

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Maximum Marks	5 Marks

Project Tracker, Velocity & Burndown Chart

Maximum Marks: 4 Marks

Sprint Tracking

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed
Sprint-1	20	3 Days	14 JUN 2025	16 JUN 2025	20
Sprint-2	20	3 Days	17 JUN 2025	19 JUN 2025	15
Sprint-3	20	3 Days	20 JUN 2025	23 JUN 2025	18
Sprint-4	20	4 Days	24 JUN 2025	27 JUN 2025	17

Velocity:

With a 10-day sprint duration and an average of 20 story points per sprint, the team's velocity is calculated as:

Velocity = Total Story Points / Duration = 20 / 10 = 2 story points per day.

Burndown Chart:

A burndown chart shows the remaining story points over time in a sprint. It helps track team progress. As tasks are completed, the chart drops downward toward zero. The ideal line shows steady progress; deviations help identify delays or blockers.

6. PERFORMANCE TESTING

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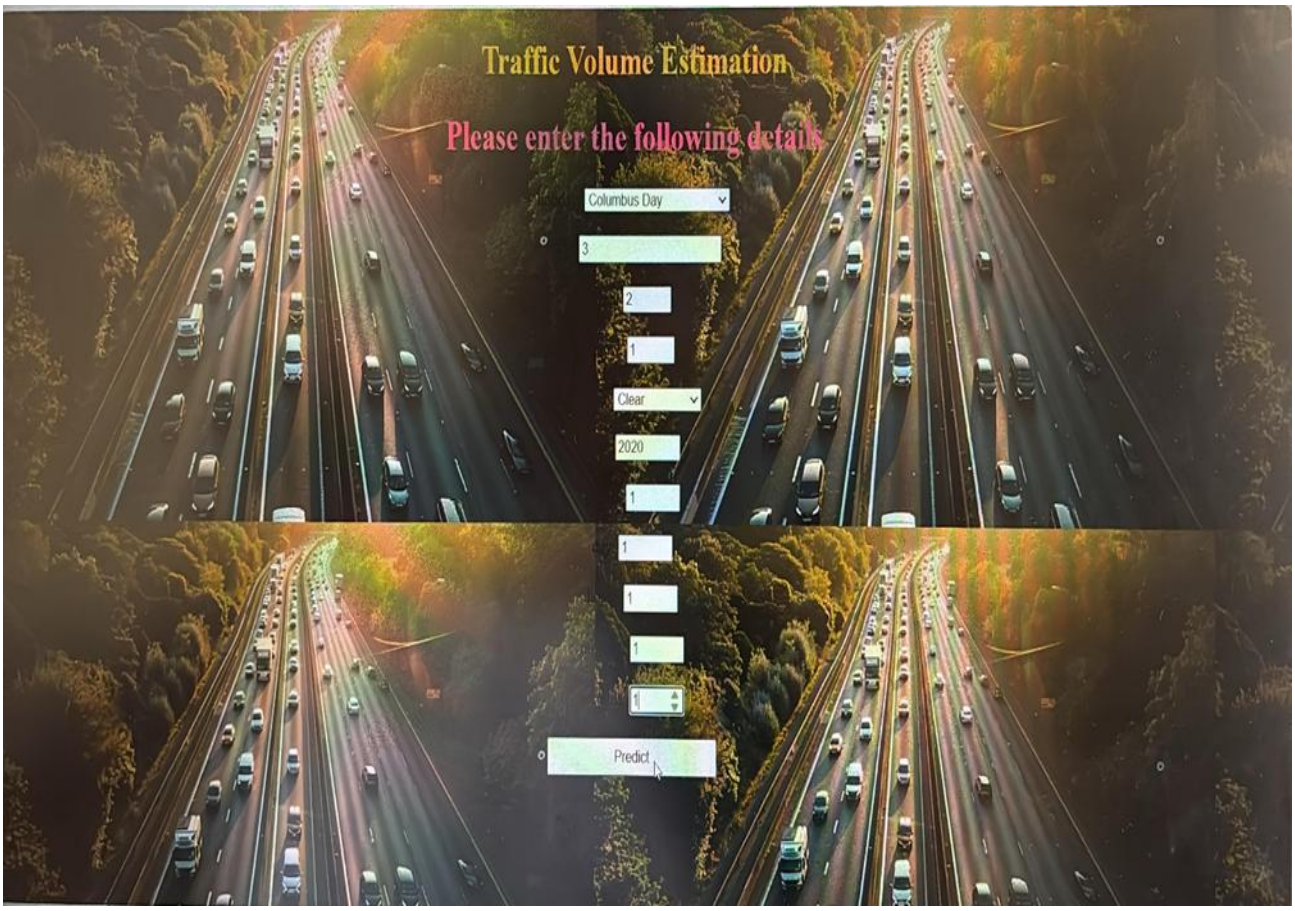
7. RESULT

The system successfully predicts traffic volume from road images using the VGG16 model. The output includes a traffic level classification (Low, Medium, High) with a confidence score.


Traffic Volume Estimation
Please enter the following details
Columbus Day
3
2
1
Clear
2020
1
1
1
1
Predict


Estimated Traffic Volume is 2012

8. ADVANTAGES & DISADVANTAGES

Advantages:

- • Fast and automated traffic volume estimation
- • Easy-to-use for authorities with minimal training
- • Scalable for integration into smart traffic systems
- • Reduces dependency on expensive infrastructure
- • Open for future extension with live camera feeds

Disadvantages:

- • Requires good image quality for accurate results
- • Internet needed to access the web tool
- • Model accuracy depends on training data variety
- • Not a full replacement for traffic sensors in all scenarios

9. CONCLUSION

Our project, 'Trafficelligence: Advanced Traffic Volume Estimation With Machine Learning', provides an AI-driven solution to estimate traffic congestion levels using road images. With the integration of the VGG16 model and a simple interface, authorities can make informed decisions faster. The system is cost-effective, scalable, and user-friendly, particularly beneficial for cities with limited monitoring infrastructure. Future enhancements will focus on improving model accuracy, supporting video input, and integrating real-time alerts.

10. FUTURE SCOPE

Our project lays the foundation for smart traffic volume estimation using AI. In the future, it can be enhanced and expanded in several impactful ways:

- ◇ 1. Expand Traffic Categories

Currently, the model classifies traffic as low, medium, or high. In the future, more granular levels (e.g., very low, moderate, very high) can be added by using a larger and more diverse dataset.

- ◇ 2. Mobile Application Development

A dedicated mobile application can be created to make the tool accessible on smartphones. This would help on-field traffic personnel and planners to get real-time insights without needing a computer.

- ◇ 3. Multilingual Interface

The web interface can be upgraded to support multiple regional languages such as Hindi, Telugu, Tamil, and Bengali. This will ensure wider usability for government staff across India.

- ◇ 4. Offline Functionality

An offline version of the system could be deployed that allows predictions without an active internet connection. This is especially helpful in areas with poor network connectivity.

- ◇ 5. Live Camera Feed Integration

Integrating the tool with live camera feeds or surveillance systems can automate real-time traffic volume estimation without needing manual image uploads.

- ◇ 6. Improved Model Accuracy

The model performance can be enhanced by using advanced CNN architectures like ResNet50, EfficientNet, or custom CNNs, and training with traffic data under diverse lighting and weather conditions.

- ◇ 7. Integration with Smart City Systems

This tool can be integrated into smart traffic management platforms operated by municipal corporations. This enables dynamic traffic control, alerts, and future data analytics.

- ◇ 8. Expansion to Vehicle Type Detection

Along with volume estimation, the model can be upgraded to detect types of vehicles (e.g., cars, buses, two-wheelers), enabling richer traffic analytics and public transport planning.

11.APPENDIX

Dataset link:

https://drive.google.com/file/d/1iV5PfYAmI6YP0_0S4KYy1ZahHOqMgDbM/view?usp=sharing

GitHub link:

https://github.com/nithyaaddada04/Trafic_volume_estimation_project

Project Demo Link:

https://drive.google.com/file/d/1JQ-zeGeFR_tG2fxQFymbcDX9-35Ei8p8/view?usp=sharing