TRAFFIC VIOLATION DETECTION SYSTEM

Enhancing Road Safety through Smart Technology

MINI PROJECT
Sem 6th -Spring (2024-25)

BRANCH
Information Technology

INDEX

INTRODUCTION

Road safety is a global concern, with common violations like riding without helmets and driving without seatbelts contributing to numerous Our system leverages machine learning and computer vision to automate the detection of such violations, improving enforcement and promoting safer roads. accidents. .

01 Automated Violation Detection: Uses computer vision and ML to identify traffic violations such as helmet-less riding and seatbelt neglect from video footage.

02 Limitations of Manual Monitoring: Traditional methods depend on human observation, which is often inconsistent and unable to monitor wide areas continuously.

03 Improved Safety Enforcement: Enhances the efficiency and accuracy of traffic rule enforcement, contributing to reduced accident rates and better compliance.

Objectives

Objective 1

Detect vehicles violating traffic rules

Objective 2

Extract license plate numbers from dashcam footage

Objective 3

Store violations with details in a centralized database

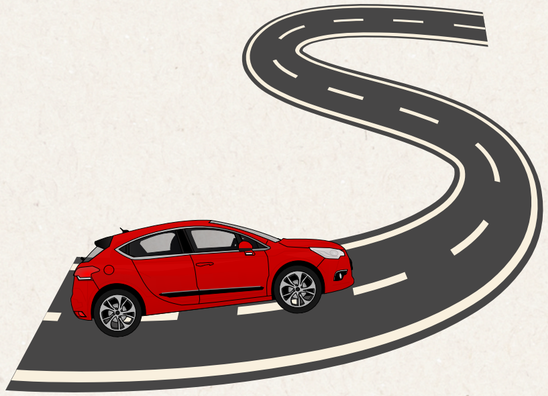
Objective 4

Develop a user-friendly interface for uploads and reports

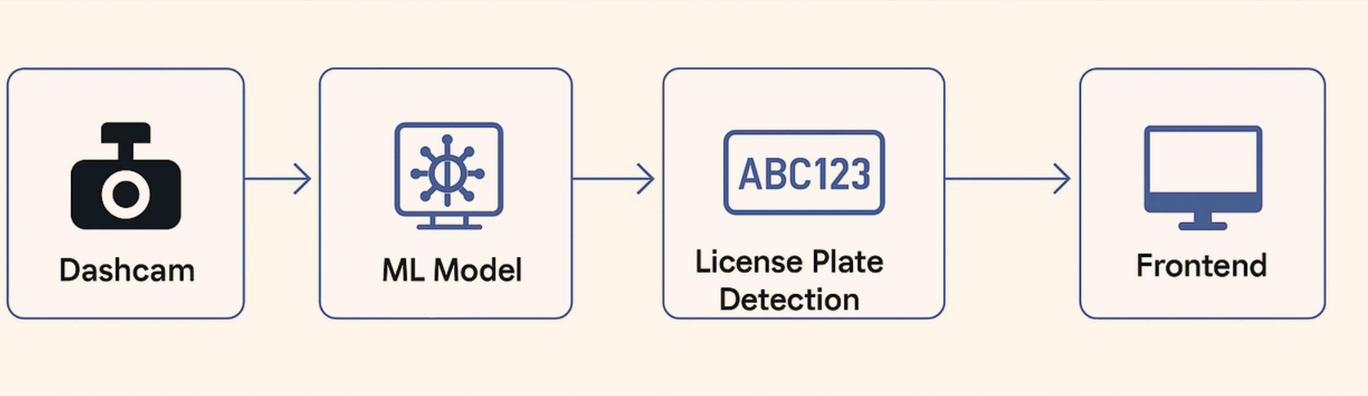
PROBLEM STATEMENT

Manual monitoring by traffic personnel is limited, error-prone, and not scalable for real-time, city-wide traffic surveillance. There is a need for an intelligent, automated system that can detect such violations accurately and consistently.

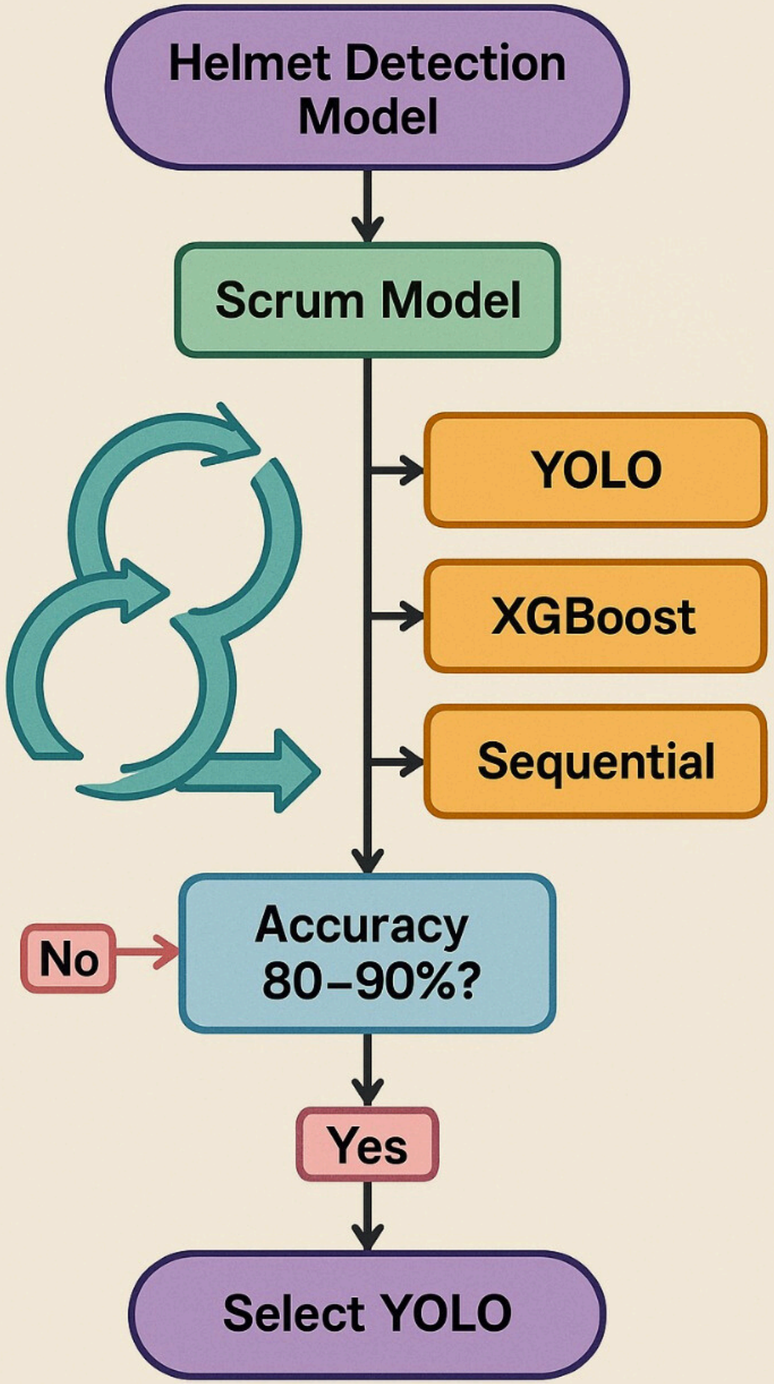
- Low Compliance with Safety Laws: Many drivers ignore helmet and seatbelt rules due to lack of strict, real-time enforcement.
- Manual Monitoring Challenges: Human-based observation is time-consuming, prone to errors, and can't cover all areas continuously.
- Need for Automation: A robust, automated system is required to detect violations accurately using real-time video feeds, reducing dependency on manual enforcement.



System Architecture



- Real-time video is captured from vehicle-mounted dash cameras.
- Users upload footage through a simple and accessible web portal
- Video frames are processed using the YOLO model to detect number plates.
- EasyOCR extracts text from detected plates with high accurac.
- All violation data—plate number, timestamp, and snapshot—is securely stored.
- Clean UI displays detected violations for review and tracking.



Machine Learning Model

- **YOLOv8 Implementation**

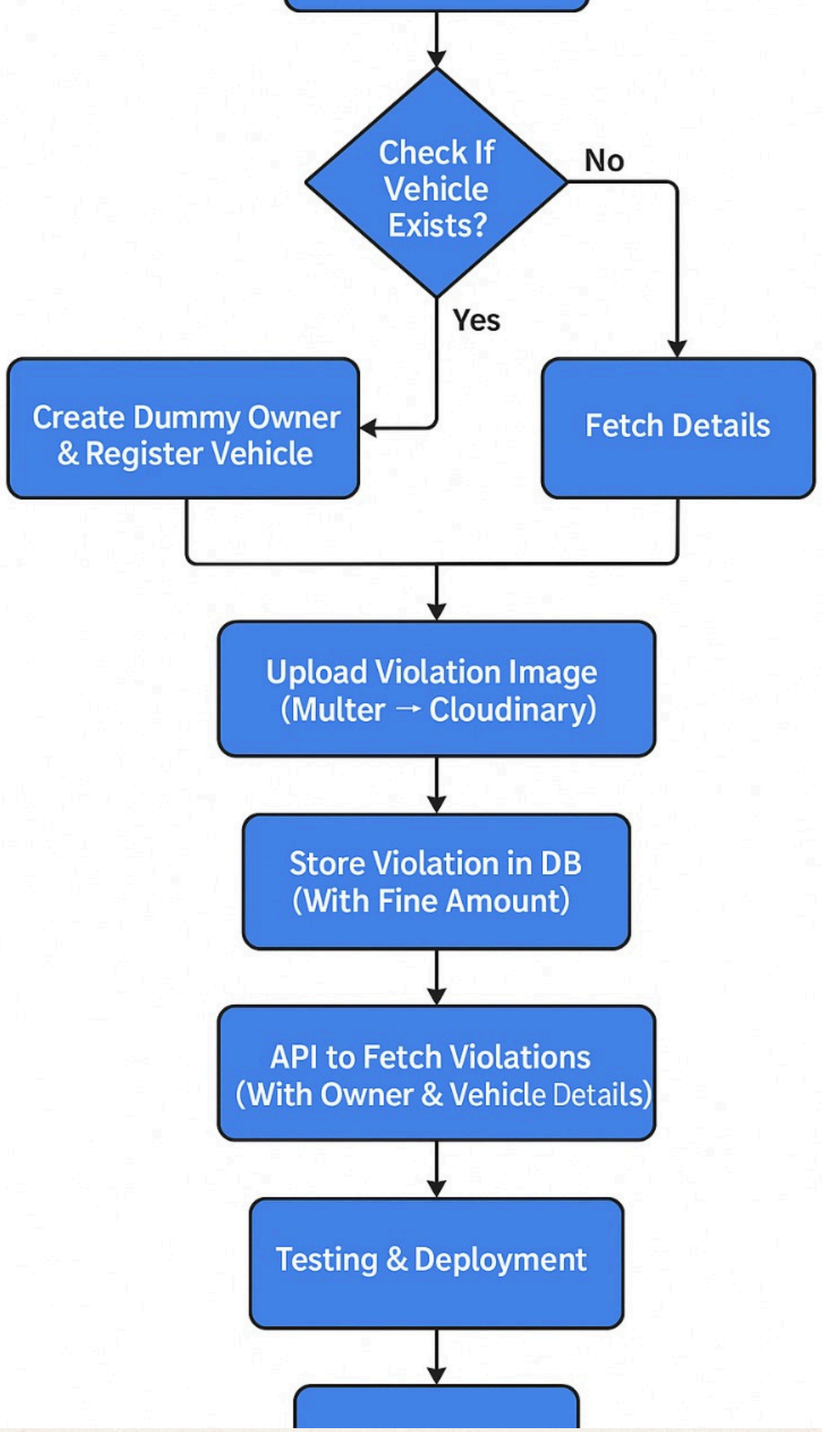
Customized YOLOv8 models trained on datasets containing images of motorcyclists with/without helmets and car occupants with/without seatbelts.Data augmentation techniques applied: random flip, rotation, brightness adjustment

- **Sequential Model Testing:**

Implemented alternative CNN architectures for comparative analysis
Evaluated based on precision, recall, and F1-score metrics

- **Model Selection:**

YOLOv8 chosen for its superior balance between speed (30+ FPS) and accuracy
Final model achieved 92% accuracy for helmet detection and 88% for seatbelt detection



BACKEND

The backend system followed a structured development approach:

1. Data Modeling:

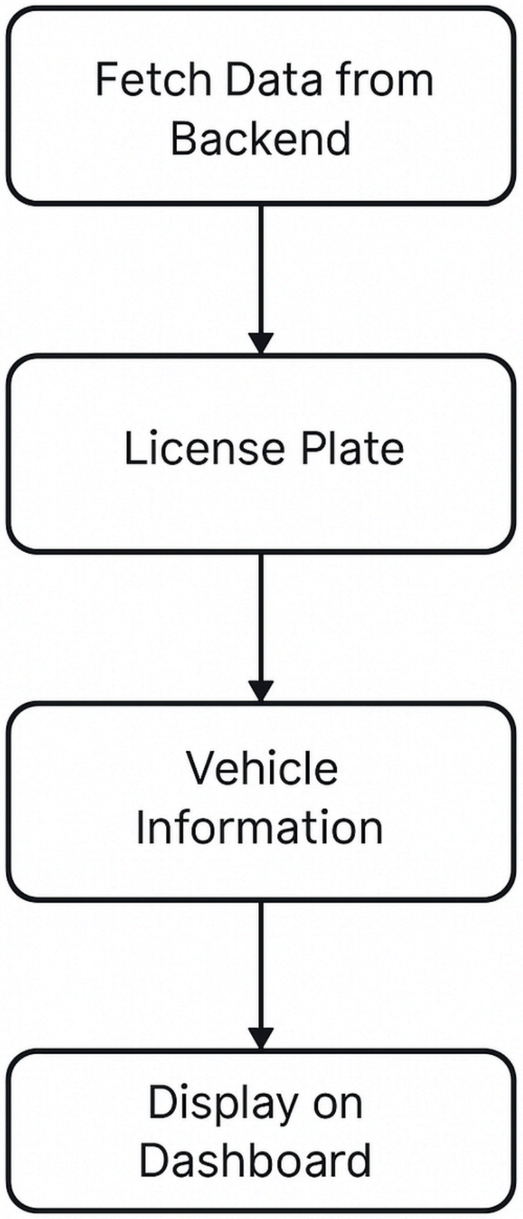
- Three primary entities: Owner, Vehicle, and Violation
- Relationships defined: Vehicle belongs to Owner, Violation linked to Vehicle
- MongoDB schemas implemented using Mongoose

2. API Development:

- RESTful endpoints created for core operations:
- /api/violation/create: Processes new violations
- /api/violation/getViolations: Retrieves violation records

3. Integration with ML Model:

- Backend deployed on render
- Allowed both Frontend and model to integrate with backend



FRONTEND

The frontend implementation followed the workflow illustrated in the provided flowchart:

1. Component Design
   - Home.js: Project introduction and overview
   - Reports.js: Violation data display in tabular format
   - About/Contact.js: Additional information and feedback options

2. Data Retrieval
   - Axios library used for API communication
   - Violation data fetched from /api/violation/getViolations endpoint

3. User Interface
   - Tabular display of violation data including owner details, vehicle information, violation type, and images
   - CSS styling for enhanced readability

Tech Stack

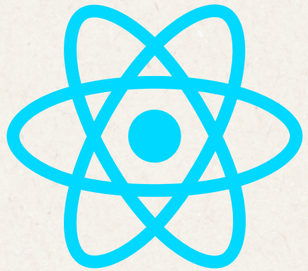
Frontend: ReactJS

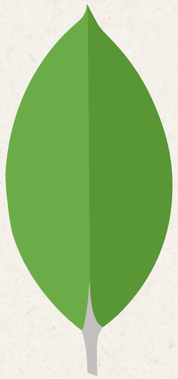
Backend: NodeJS, ExpressJS

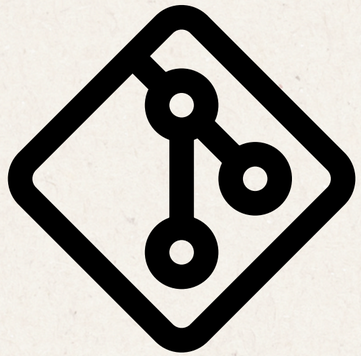
Machine Learning: YOLO, EasyOCR

Database: MongoDB

Others: Google Colab, GitHub





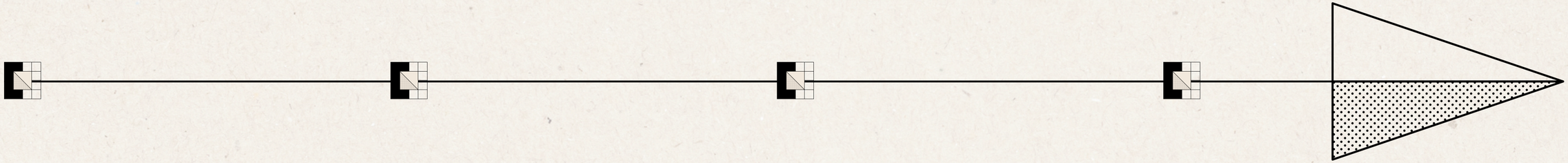


FUTURE SCOPE

- Use real vehicle registration APIs for owner details
- Extend to actual dashboard images
- Add analytics dashboard for authorities
- Improve ML model accuracy

Timeline

Timeline summarizing how team moved forward with the traffic violation detection project



Initial Planning & Task Division

The team began by deciding on the objective

Data Pipeline & Backend Setup

The ML model was developed to process violation images and extract license plate numbers.

Frontend Integration & Real-Time Data Display

Frontend was designed using ReactJs and CSS

Final Testing & Presentation Prep

Final testing included ensuring that images from the ML model reached the backend correctly and violations appeared in frontend

Our team

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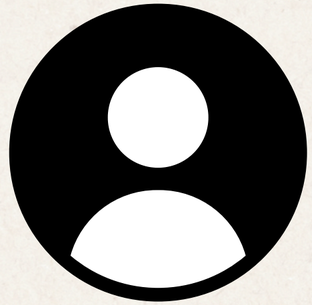

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CONCLUSION

The Traffic Violation Detection System presents a robust and scalable solution to the growing problem of traffic rule violations. By integrating machine learning and computer vision, the system automates the detection of critical violations such as helmet-less riding and seatbelt non-compliance. This reduces the burden on traffic personnel and minimizes the errors associated with manual monitoring. With real-time data processing, automated alerts via SMS, and a user-friendly dashboard, the system enhances the efficiency and effectiveness of enforcement mechanisms. Moreover, its modular design allows for future integration with real-time surveillance systems and government databases. Overall, this project contributes meaningfully to road safety initiatives by promoting accountability, improving compliance, and potentially reducing traffic-related injuries and fatalities.

Thank You