Smart Traffic Management System

An Engineering Project in Community Service

Phase – II Report

Submitted by

Madanapalli Janak Sumedh-21BAI10282

Mrunmayee Ketkar-21BCE10013

Chaitanya Mathur-21BCE10047

Pranjal Rai-21BCE10125

Mansi Vidyarthi-21BCE10578

Tanishq Kolhatkar-21MIM10025

Siddharth Jaiswal-21MIP10008

Prince Choudhary-21MIP10031

Shivam Shukla-21MIP10033

Kunal Mishra-21MIP10040

in partial fulfillment of the requirements for the degree of

Bachlore of Engineering and Technology

VIT®
BHOPAL
www.vitbhopal.ac.in

VIT Bhopal University
Bhopal
Madhyapradhesh

May, 2024

Bonafide Certificate

Certified that this project report titled **"Smart Traffic Management"** is the bonafide work of "**21BAI10282 Madanapalli Janak Sumedh, 21BCE10013 Mrunmayee Ketkar, 21BCE10047 Chaitanya Mathur, 21BCE10125 Pranjal Rai, 21BCE10578 Mansi Vidyarthi, 21MIM10025 Tanishq Kolhatkar, 21MIP10008 Siddharth Jaiswal, 21MIP10031 Prince Choudhary, 21MIP10033 Shivam Shukla, 21MIP10040 Kunal Mishra**" who carried out the project work under my supervision.

This project report (Phase II) is submitted for the Project Viva-Voce examination held on 10th May 2024

Supervisor

Comments & Signature (Reviewer 1)

Comments & Signature (Reviewer 2)

We, hereby declare that this report entitled **"Smart Traffic Management System"** represents our original work carried out for the EPICS project as a student of VIT Bhopal University and, to the best of our knowledge, it contains no material previously published or written by another person, nor any material presented for the award of any other degree or diploma of VIT Bhopal University or any other institution. Works of other authors cited in this report have been duly acknowledged under the section "References".

Date Reg No & Name

Acknowledgement

We, the members of Group-108, would like to extend our deepest gratitude to everyone who contributed to the success of this project. This journey has been one of collaboration, learning, and mutual support, culminating in a project that we are proud to present.

First and foremost, we express our sincere thanks to our project supervisor, Dr. Geeta Singh and reviewer, Dr. Vijay Kumar Patel and Dr. P Narendra Babu, whose guidance, expertise, and patience were instrumental in steering this project towards its completion. Their insights and feedback were, invaluable, and their encouragement motivated us to excel.
We are also deeply grateful to VIT Bhopal faculty and staff, particularly those in the Computer Science department, for providing us with the resources and environment conducive to our research and development efforts. Their assistance in navigating academic and logistical challenges was crucial.

Special appreciation goes to our classmates and peers who participated in our surveys, interviews, and testing phases. Their willingness to contribute their time and thoughts added depth and authenticity to our work. We would also like to acknowledge the support of our families and friends, who provided encouragement, understanding, and motivation throughout the duration of this project. Their belief in our abilities fueled our determination and commitment.

Lastly, we extend our gratitude to each other, the members of Group -108. This project was a collaborative effort that required dedication, compromise, and teamwork. We have grown individually and collectively through this experience. This project report is not only a reflection of our hard work but also a testament to the support and guidance we received from all those mentioned above. Thank you for making this journey memorable and our project a success. (21BCE10578) Mansi Vidyarthi, (21BCE10013) Mrunmayee Ketkar, (21BAI10282) Madanapalli Janak Sumedh, (21BCE10047) Chaitanya Mathur, (21MIM10025) Tanishq Kolhatkar, (21MIP10008) Siddharth Jiaswal, (21MIP10031) Prince Chaudhary, (21MIP10033) Shivam Shukla, (21MIP10040)Kunal Mishra
10/05/2024

Abstract

This project proposes a Traffic Management System (TMS) aimed at optimizing traffic flow and enhancing road safety. The system employs a combination of hardware and software components to monitor, analyze, and control traffic conditions in real-time. Key features include traffic light optimization, vehicle detection and classification, congestion detection, and adaptive traffic signal control. The TMS aims to reduce congestion, minimize travel time, and improve overall efficiency of the transportation network. This abstract outlines the architecture, functionalities, and potential benefits of the proposed Traffic Management System.

1. INTRODUCTION (1 page)-

In the dynamic urban environment of today, we grapple with issues like traffic jams, accidents, and environmental degradation. The Smart Traffic Management System emerges as a transformative technological solution designed to overhaul traffic control. This initiative combines state-of-the-art technologies and advanced data analytics to streamline traffic patterns, bolster safety measures, and mitigate environmental repercussions. Our aim is to revolutionize urban transportation through digital ingenuity and strategic traffic management solutions, encouraging the active involvement of stakeholders in building a more sustainable and streamlined future. Our suite of services will include cutting-edge features such as lane detection, intelligent lane recommendations, camera-based speed limit checks, identification of high-traffic pathways and traffic violation detection system.

Lane detection involves leveraging advanced technology to precisely identify and monitor the lanes on roads, contributing to enhanced traffic management and safety. The intelligent lane recommendation system provides real-time suggestions for drivers to optimize their route, suggesting the most efficient lane for smoother navigation.

Our speed limit checking service will ensure that vehicles adhere to prescribed speed limits, promoting safer driving practices and reducing the risk of accidents. Additionally, our system will excel in detecting busier paths or roads, allowing for proactive measures to be implemented, such as traffic rerouting or adjustments to traffic signals, to optimize the overall flow and alleviate congestion in high-traffic areas. These services collectively will contribute to a more efficient, secure, and streamlined urban mobility experience.

The surge in urban car numbers leads to traffic congestion, property damage, and accidents. To mitigate these risks, real-time traffic violation detection systems are essential. These systems enforce regulations continuously, aiding authorities in swiftly identifying and addressing violations like signal, parking, and wrong-direction infractions. Equipped with user-friendly interfaces, they streamline monitoring and intervention processes for safer roads.

1.1 Motivation

The motivation behind the Smart Traffic Management System project stems from the urgent need to address pressing challenges in today's urban landscapes. Rising levels of traffic congestion, frequent accidents, and escalating environmental pollution have underscored the necessity for innovative solutions to transform the way we manage urban mobility. This project is driven by a commitment to harness cutting-edge technologies and data analytics to optimize traffic flow, enhance safety measures, and reduce the environmental impact associated with urban transportation.

The overarching goal is to revolutionize the traditional approach to traffic control by integrating digital innovation and strategic management solutions. By doing so, the project aspires to reshape urban mobility, making it more sustainable, efficient, and conducive to a higher quality of life for residents. Ultimately, the Smart Traffic Management System seeks to create a smarter and more responsive urban infrastructure that adapts to the evolving needs of modern cities, promoting a safer, greener, and more seamless transportation experience.

The motivation behind implementing real-time traffic violation detection systems lies in the urgent need to address the negative consequences of urban car proliferation. By proactively identifying and managing traffic violations such as signal disregard, illegal parking, and wrong-way driving, these systems aim to enhance road safety, minimize property damage, and reduce the occurrence of accidents. With user-friendly interfaces facilitating efficient monitoring and

intervention, authorities can enforce traffic regulations more effectively, ultimately creating safer roadways for all users.

1.2 Objective

The primary objective of our comprehensive project is to integrate various advanced features, including lane detection, intelligent path optimization, object detection (specifically cars) on the road, speed limit monitoring, efficient traffic control and ensure that traffic rules are followed. By amalgamating these cutting-edge technologies, our aim is to create a unified system that actively contributes to the reduction of traffic congestion, improved traffic management, and a decrease in environmental pollution.

The project envisions a holistic approach to urban mobility, where the detection of lanes ensures orderly traffic flow, and intelligent path optimization suggests the most efficient routes, minimizing bottlenecks and congestion. Object detection, specifically for cars, enhances safety by providing real-time awareness of vehicles on the road. Simultaneously, speed limit monitoring through advanced camera systems encourages adherence to traffic regulations, reducing the likelihood of accidents. The primary objective of a traffic violation system is to ensure the smooth and safe movement of traffic by preventing rule violations. By enforcing traffic regulations effectively, such systems contribute to enhancing road safety and minimizing the risk of accidents, ultimately promoting the safety and well-being of all road users.

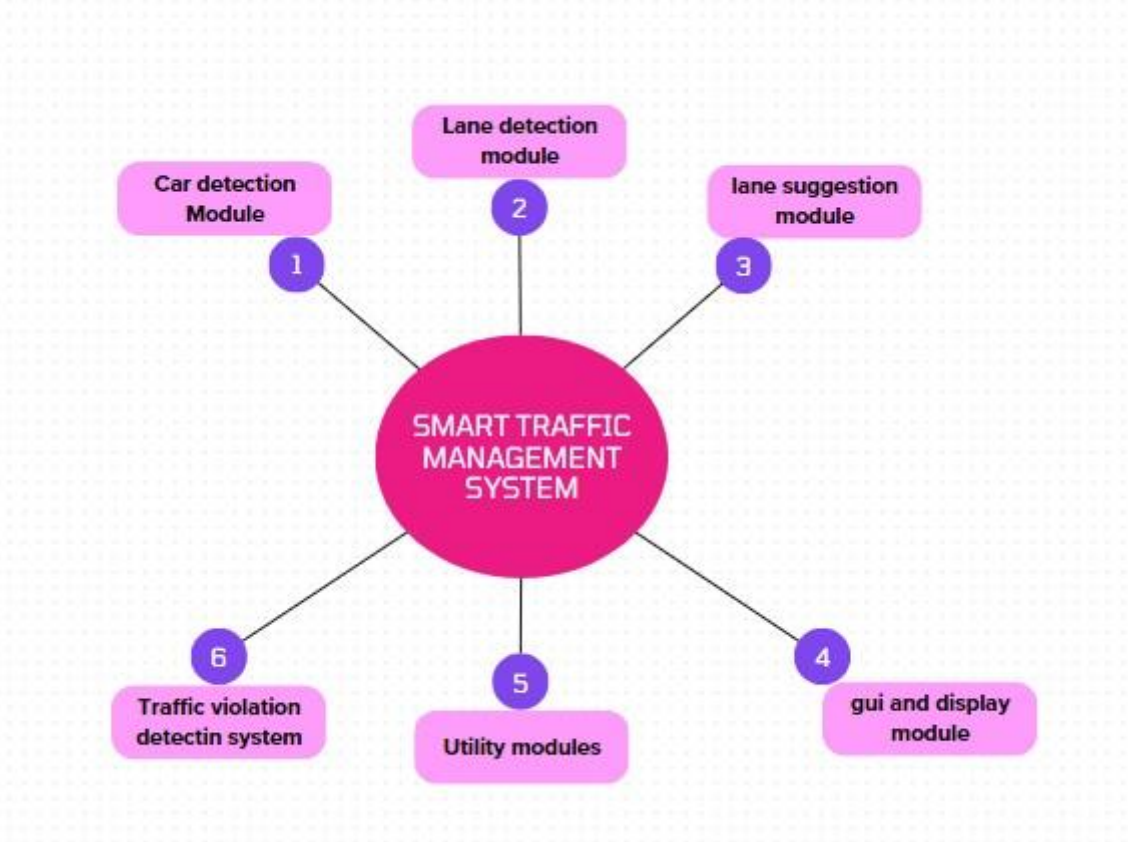
By combining these elements into a single, cohesive project, we strive to create a smarter, more responsive urban transportation system. The overarching goal is to promote a more sustainable and efficient future, where traffic is managed effectively, pollution is minimized, and residents experience a smoother and safer commuting environment. Through this integration, our project seeks to contribute significantly to the overall improvement of urban mobility, making cities more livable and environmentally friendly.

2. Existing Work / Literature Review

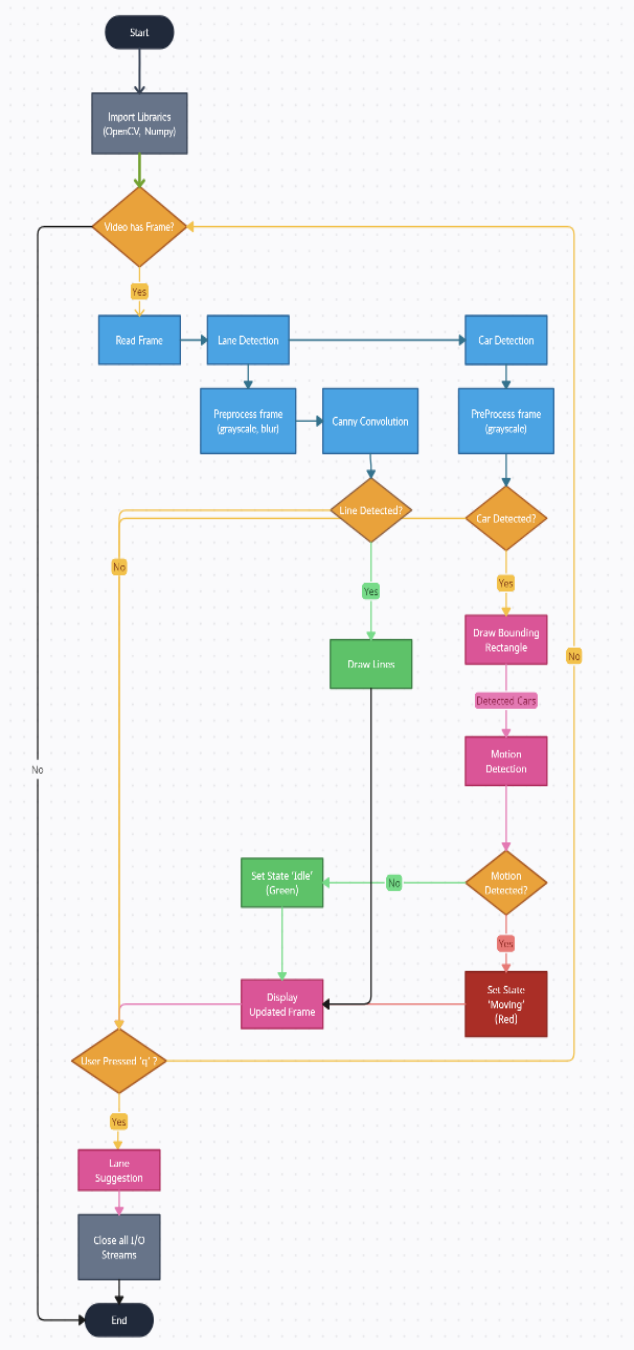
The long-standing integration of artificial intelligence and computer vision in traffic management has significantly improved systems. AI algorithms analyze real-time data for optimized traffic flow, adaptive signal control, and enhanced safety measures. Computer vision aids in object detection and tracking, allowing for efficient vehicle monitoring and proactive responses to traffic conditions. These technologies collectively contribute to the ongoing improvement of urban transportation systems, making them more responsive, safer, and capable of addressing the challenges of modern traffic management.

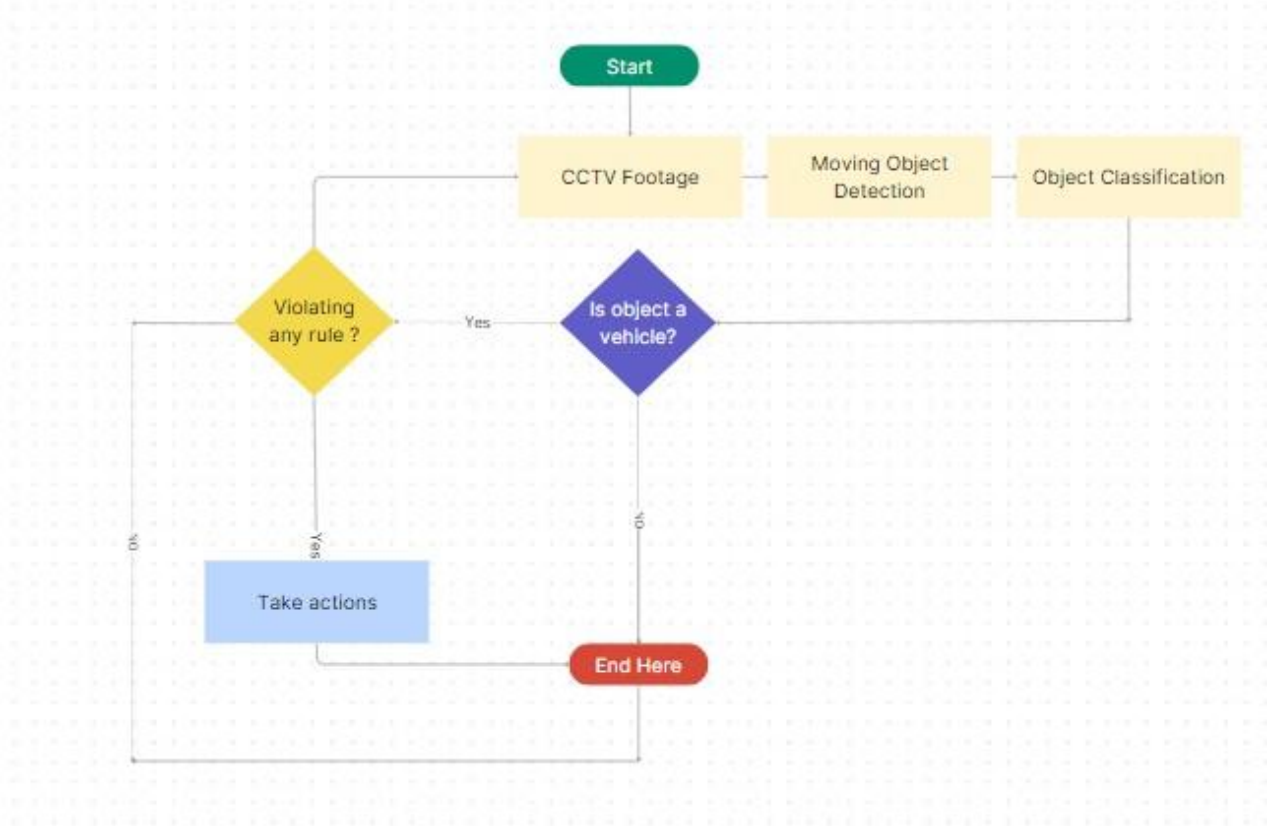
3. Topic of the work

a) System Design / Architecture



b) Working Principle (Add Necessary images by Specifying Figure Numbers, ex: Fig. 1 Architecture)





Methodology:

1) Grayscaling and blurring: As the part of preprocessing the input frame got from the CCTV footage, the image is grayscaled and blurred with Gaussian Blur method. ** Background Subtraction.
2) Background subtraction : method is used to subtract the current frame from the reference frame to get the desired object's area. equation (1) shows the method. dst(I) = saturate(|scr1(I) − scr2(I)|).
3) Binary Threshold : Binarization method is used to remove all the holes and noises from the frame and get the desired object area accurately. equation (2) shows how the binary threshold works. dst(x, y) = maxVal if scr(x, y) > thresh else 0
4) Dilation and find the contour : After getting the thresholded image, it is dilated to fill the holes and the contour is found from the image. drawing rectangle box over the contours desired moving objects are taken.

Vehicle Classification :

From the preprocessed image moving objects are extracted. A vehicle classification model is used to classify those moving objects into three class - Car, Motobike and Non-vehicle. The classifier model is built with mobilenet v1 neural network architecture.

Type / Stride	Filter Shape	Input Size
Conv / s2	3 x 3 x 3 x 32	224 x 224 x 3
Conv dw / s1	3 x 3 x 32 dw	112 x 112 x 32
Conv / s1	1 x 1 x 32 x 64	112 x 112 x 32
Conv dw / s2	3 x 3 x 64 dw	112 x 112 x 64
Conv / s1	1 x 1 x 64 x 128	56 x 56 x 64
Conv dw / s1	3 x 3 x 128 dw	56 x 56 x 128
Conv / s1	1 x 1 x 128 x 128	56 x 56 x 128
Conv dw / s2	3 x 3 x 128 dw	56 x 56 x 128
Conv / s1	1 x 1 x 128 x 256	28 x 28 x 128
Conv dw / s1	3 x 3 x 256 dw	28 x 28 x 256
Conv / s1	1 x 1 x 256 x 256	28 x 28 x 256
Conv dw / s2	3 x 3 x 256 dw	28 x 28 x 256
Conv / s1	1 x 1 x 256 x 512	14 x 14 x 256
Conv dw / s1	3 x 3 x 512 dw	14 x 14 x 512
Conv / s1	1 x 1 x 512 x 512	14 x 14 x 512
Conv dw / s2	3 x 3 x 512 dw	14 x 14 x 512
Conv / s1	1 x 1 x 512 x 1024	7 x 7 x 512
Conv dw / s2	3 x 3 x 1024 dw	7 x 7 x 1024
Conv / s1	1 x 1 x 1024 x 1024	7 x 7 x 1024
Avg Pool / s1	Pool 7 x 7	7 x 7 x 1024
FC / s1	1024 x 1000	1 x 1 x 1024
Softmax / s1	Classifier	1 x 1 x 1000

Fig-2: Trainning hyperparameters. Transfer learning approach is used to training the model with our dataset.The dataset consists of 500 images per class. The training parameters are mentioned in table (2).

Violation detection

After detecting the vehicles three violation cases arises-

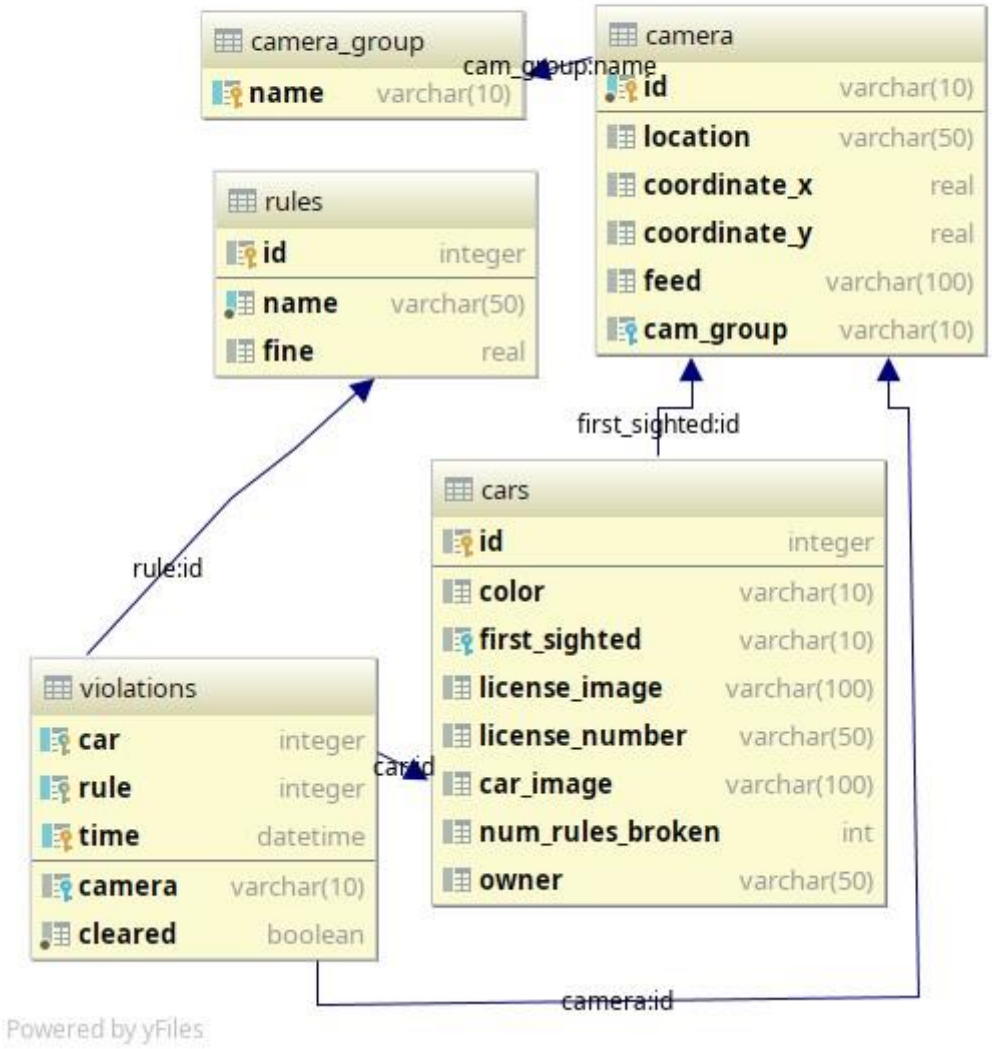
- Signal violation: if a vehicle crosses a predefined line on the road while there is red signal, it is detected as a signal violation.
- Parking violation: if a vehicle stands still in no parking zone for a predefined time, it is detected as a parking violation.

- Direction violation: when a vehicle comes from a wrong direction,it is detected by tracking the vehicle. The direction of the vehicle is determined using its current position and previous few positions.

Database Structure

We have used SQLite database with python to manage the whole data of our application. Here, in the relational database we have used BCNF of 5 tables. The tables are:

1) Cars
2) Rules
3) Cameras
4) Violations
5) Groups



** Here are the descriptions of each tables: **

- Cars: This table will hold the recorded cars by the camera. A car entity is a car with a unique identifier(id), color(color), license-number of the car(license), where the car is first sighted (first_sighted), an image of the license number (license_image), an image of the car(car_image), number of rules broken so far(num_rules_broken) and the owner of the car (owner).
- Rules: This table holds all the rules, their description(name) and fine for breaking that rule (fine).

- Camera: Camera table holds a unique identifier for the camera(id), location description(location), the longitude(coordinate_x) and the latitude(coordinate_y) of the location of the camera, where the camera will feed its data video(feed) and in which group the camera is in(group).
- Camera_group: This table simply holds the unique group names of the camera groups(name). Violations: This table takes all the ids of other tables as foreign key and creates a semantic record like this: A car with this id has broken that rule at this time, which is captured by this camera.

The core working principle of our project is centered on leveraging advanced technologies to address key challenges in urban transportation, ultimately leading to reduced congestion, pollution, and accidents. Here's how our project achieves these goals:

1. Traffic Flow Optimization:

- Our system continuously monitors real-time traffic conditions by utilizing AI algorithms and computer vision.

- The collected data is analyzed to identify congestion points and traffic patterns.

- Intelligent decision-making processes, guided by AI, dynamically optimize traffic signal timings and lane configurations to alleviate congestion and enhance overall traffic flow.

2. Efficient Route Planning:

- Our project incorporates intelligent path optimization based on real-time data.

- By recommending the most efficient routes, it minimizes bottlenecks and guides drivers to less congested lanes, reducing overall traffic on busy roads.

3. Safety Measures and Accident Reduction:

- Object detection through AI-driven algorithms enables the identification and tracking of vehicles on the road.

- This real-time monitoring allows for the swift detection of potential safety hazards and proactive measures to prevent accidents.

- Improved traffic flow and adherence to speed limits, facilitated by the system, contribute to overall road safety.

4. Environmental Impact Mitigation:

- Efficient traffic management reduces idling time and smoother traffic flow, directly addressing pollution concerns.

- By minimizing congestion and optimizing traffic patterns, our project aims to lower vehicle emissions and contribute to a cleaner urban environment.

5. Dynamic Speed Limit Monitoring:

- Computer vision capabilities monitor vehicle speeds.

- AI algorithms analyze the data to ensure that vehicles adhere to prescribed speed limits, promoting safer driving practices and reducing the risk of accidents.

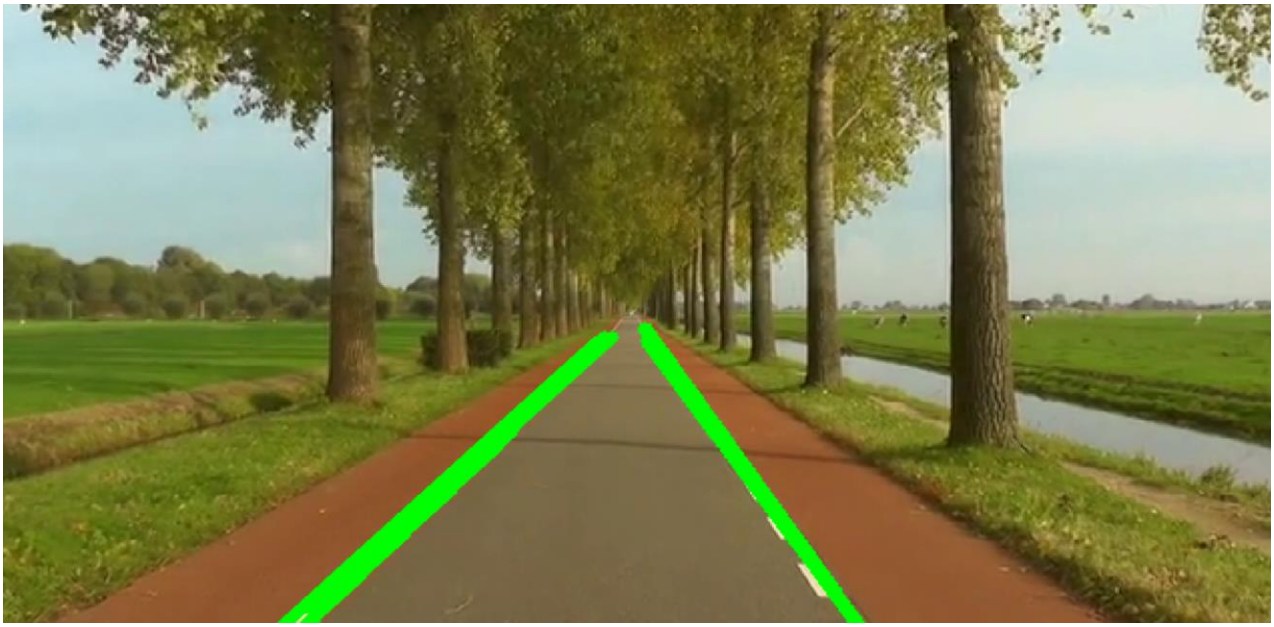
- They help check the speed of a vehicle and also tell if the vehicle is overspeeding.

In essence, our project combines the power of AI, and computer vision to create a holistic and responsive traffic management system. By actively addressing congestion, pollution, and accidents, our solution strives to enhance the overall efficiency, safety, and sustainability of urban transportation.

c) **Results and Discussion**

➔ Lane detection:

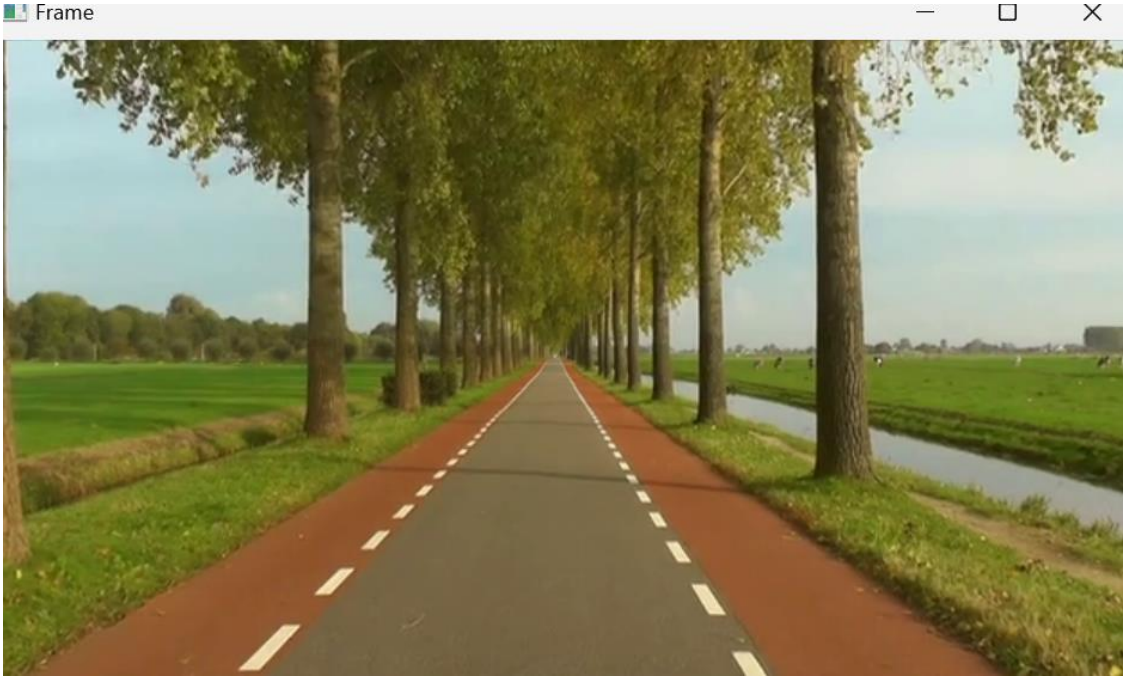
Result:



➔ Lane Suggestion module:

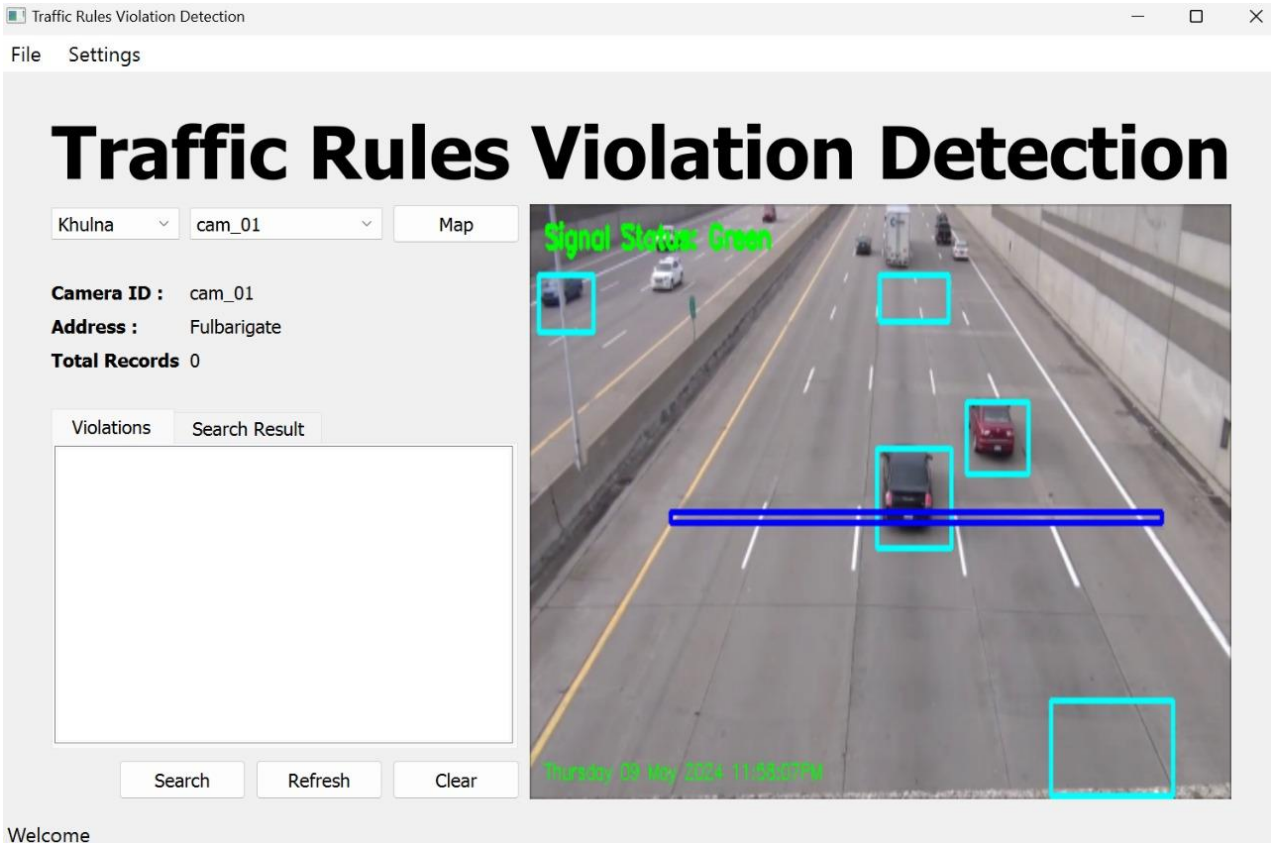
```
PS C:\Users\HP\Downloads\Epics_Project> python -u "c:\Users\H
Suggested lane: Lane 2
PS C:\Users\HP\Downloads\Epics_Project>
```

➔ Video Processing:

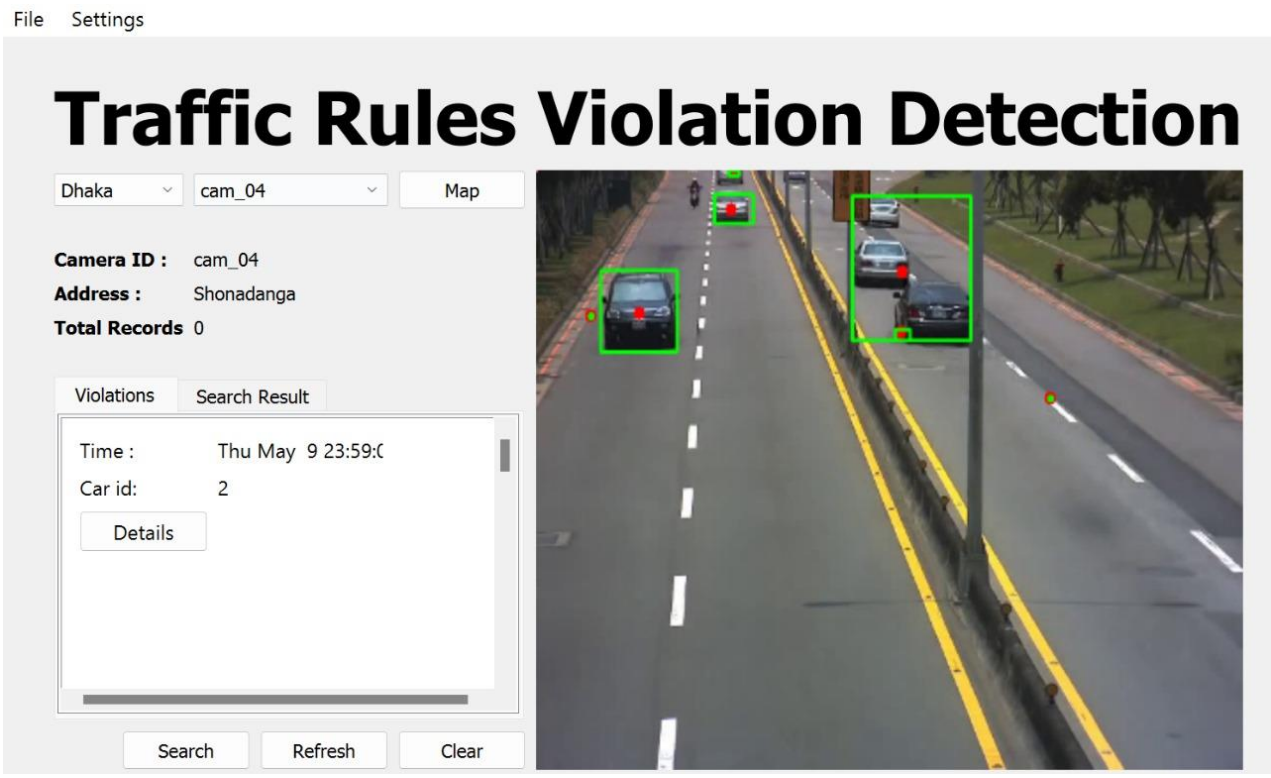


➔ Car Detection Module:

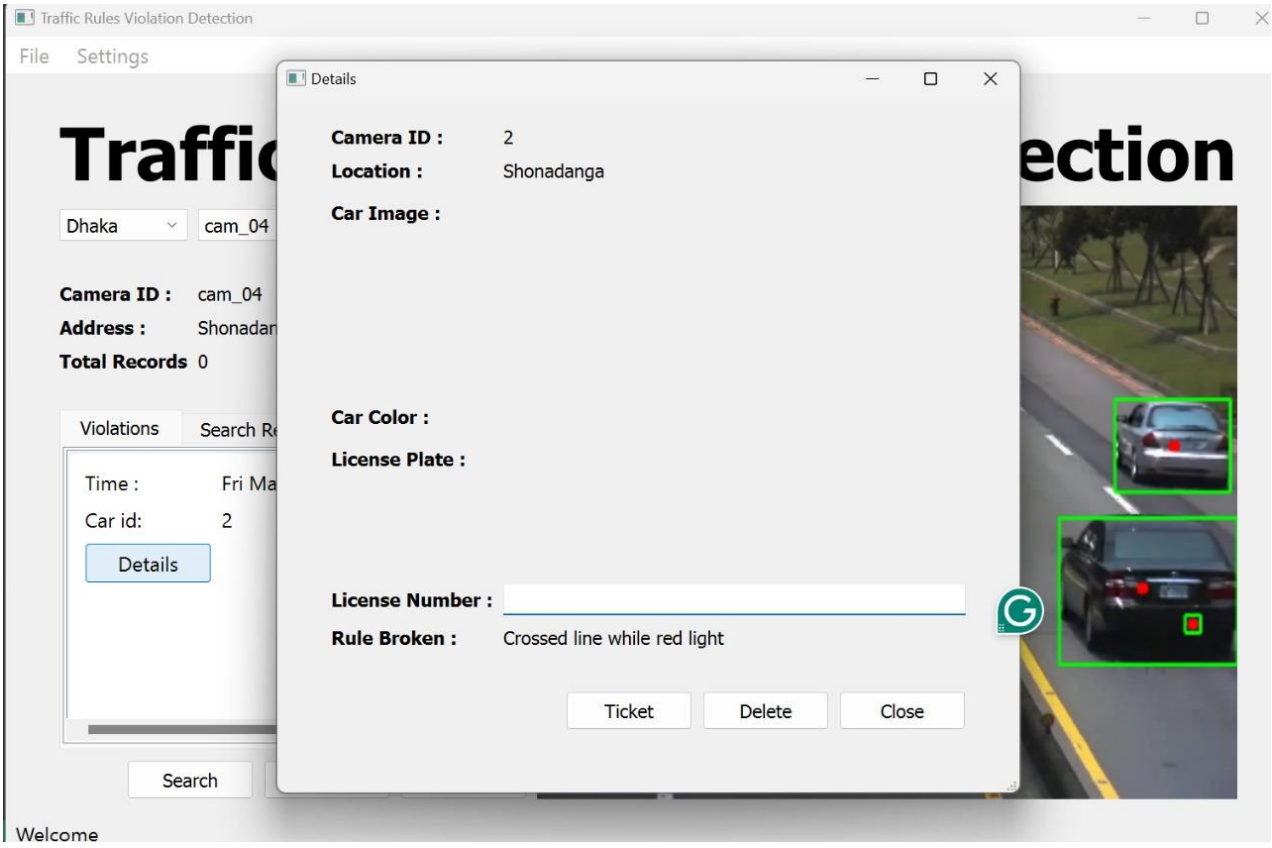
➔ Basic UI for rules violation detection:



➔ Violation detected:



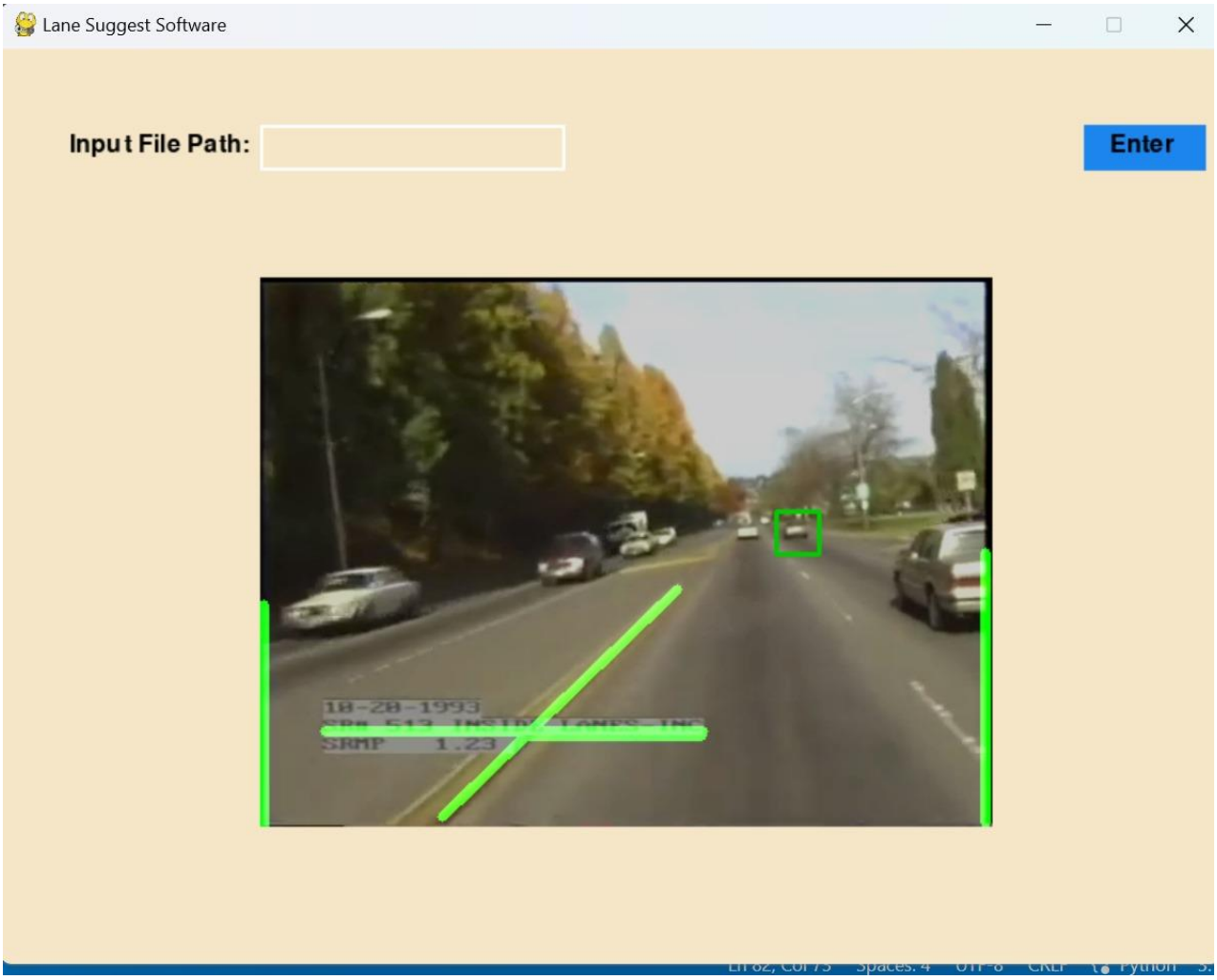
➔ Violation type description:

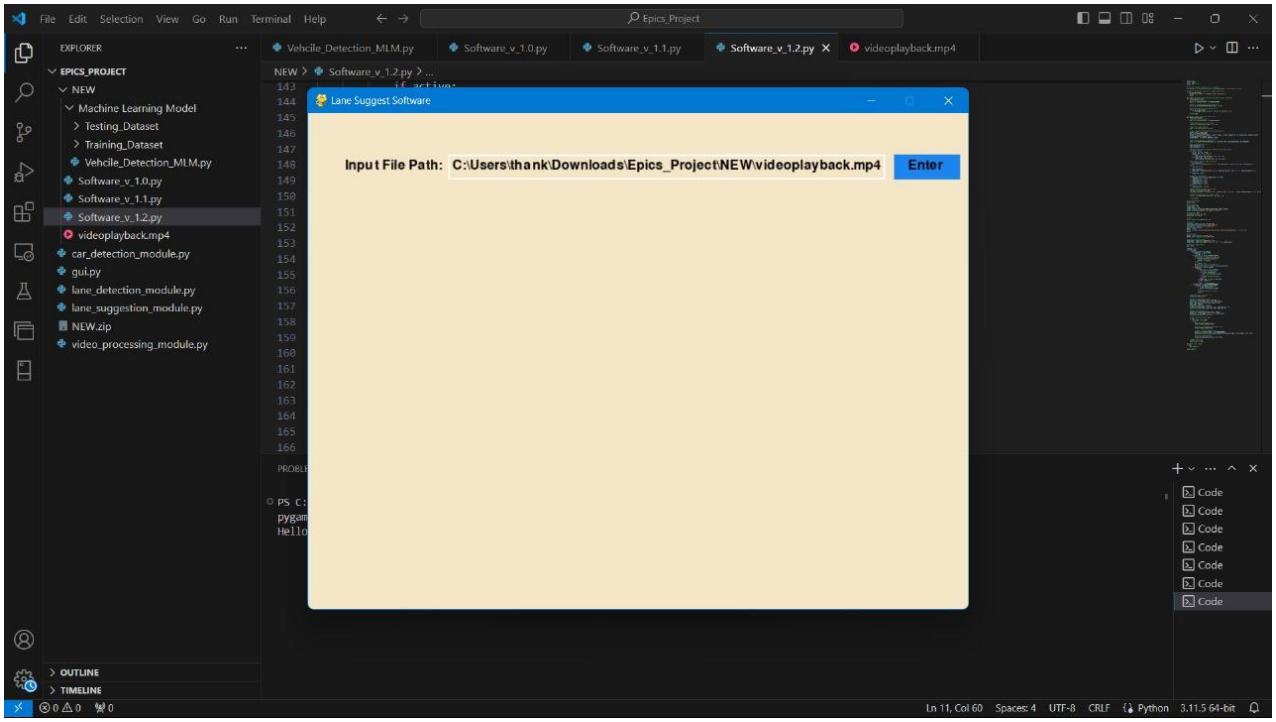


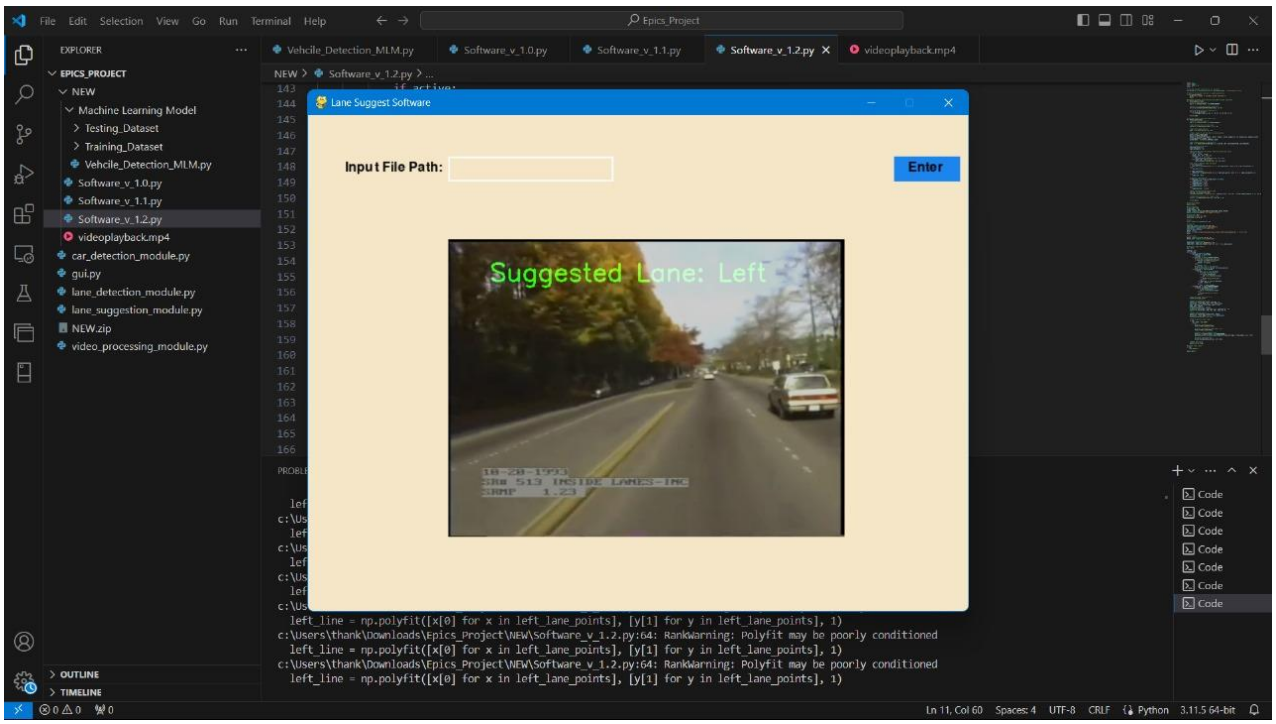
➔ Generic UI:


Lane Suggest Software
Input File Path:
C://Users//HP//Downloads//Traffic-Rules-Violation-Detection-System-r
Enter

➔ Lane and object detection:




Lane Suggest Software
Input File Path:
C:\Users\thank\Downloads\Epics_Project\NEW\videoplayback.mp4
Enter


Lane Suggest Software
Input File Path:
Enter
Suggested Lane: Left

d) Individual Contribution by members:

1) --Mrunmayee Ketkar (21BCE10013)

→ Contribution: Debugging Process and Testing

In the project, I focused on debugging and testing to enhance code reliability and functionality. Key contributions include:

1) **Bug Identification and Resolution:**
   - ➔ Actively participated in pinpointing and resolving code issues through collaborative efforts and systematic debugging methods.
2) **Testing Strategy:**
   - ➔ Designed and executed comprehensive testing procedures, covering unit and integration testing, to ensure code robustness. Developed test cases for various scenarios and performed regression testing post-fixes.
3) **Documentation and Reporting:**
   - ➔ Documented debugging processes and testing outcomes, facilitating knowledge sharing and maintaining project transparency.
4) **Continuous Improvement:**
   - ➔ Contributed insights from debugging experiences to refine development practices and prevent future issues.

5) **Providing UI for traffic violation detection system:**

   - ➔ Created a comprehensive application for managing surveillance cameras, detecting violations and maintaining records of cars and violations.

2) *--Mansi Vidyarthi (21BCE10578):*

1) **Documentation:**

- ➔ I took the responsibility of documenting our project's progress, methods, and outcomes meticulously. This involved keeping track of all the tasks we completed, the challenges we encountered, and how we addressed them.
- ➔ I maintained detailed records, including meeting notes, research findings, experimental data, and any changes made to our project plan.

2) PowerPoint Presentation Creation:

- ➔ I was responsible for creating PowerPoint presentations for various project-related activities, such as progress updates and final presentations.
- ➔ To make technical concepts easier to understand, I included visuals like charts, graphs, and diagrams in the presentations.
- ➔ I focused on structuring the presentations in a logical manner, ensuring that each slide flowed smoothly into the next and that the overall message was clear.
- ➔ I also paid attention to the design of the presentations, choosing appropriate fonts, colours, and layouts to make them visually appealing and easy to follow.

3) Testing:

- ➔ In terms of testing, I led the efforts to ensure that our project worked as intended and met the specified requirements.
- ➔ I created test plans outlining the different types of tests we needed to conduct, including unit tests, integration tests, and system tests.
- ➔ As part of the testing process, I executed test cases, recorded the results, and identified any issues or discrepancies that arose.
- ➔ Working closely with the development team, I played a crucial role in troubleshooting and fixing bugs, ensuring that our final product was reliable and met the needs of our users.

3) - *Madanapalli Janak Sumedh-21BAI10282:*

1) Scope of the Traffic Dataset Research:

- ➔ Explored diverse data sources, including real-time traffic data and historical records.
- ➔ Analyzed traffic patterns to identify peak hours, congestion hotspots, and variations.
- ➔ Assessed the potential impact of traffic dynamics on the Smart Traffic Management System.

2) Data Cleaning and Preprocessing:

- ➔ Meticulously cleaned and preprocessed collected data.
- ➔ Implemented robust strategies to maintain data quality and relevance.
- ➔ Addressed missing or erroneous data, handled outliers, and standardized formats.

➔ Normalized and transformed data for improved suitability in machine learning algorithms.

4) --Prince Choudhary-21MIP10031:

1) Collaboration and Communication:

➔ Actively engaged with team members to foster collaboration.
➔ Facilitated seamless communication channels for effective information sharing.
➔ Shared findings and insights to enhance overall project understanding.
➔ Ensured a cohesive team dynamic by promoting open communication.

2) Impact on the Project:

➔ Played a pivotal role in advancing the Smart Traffic Management System.
➔ Provided valuable insights derived from the Traffic Dataset research.
➔ Addressed key challenges in the development process.
➔ Contributed to informed decision-making within the project team.
➔ Enhanced overall project progress through impactful contributions.

5) --Kunal Mishra-21MIP10040:

1) Challenges and Solutions:

➔ *Data Quality Challenges: Faced issues related to inconsistencies and inaccuracies in the collected data.*
➔ *Data Availability Issues: Encountered limitations in the availability of certain critical data points.*
➔ *Addressing Challenges:*
- *Implemented rigorous data validation processes to mitigate inconsistencies.*
- *Collaborated with relevant stakeholders to identify alternative data sources.*

- *Applied data imputation techniques to fill missing values and maintain dataset completeness.*
- *Utilized quality assurance measures to enhance the overall reliability of the Traffic Dataset.*

2) . Future Recommendations:

➔ *Extended Research: Propose conducting further research to expand the dataset with more diverse and granular data sources.*

➔ *Continuous Monitoring: Suggest implementing ongoing monitoring systems to promptly identify and rectify data quality issues.*

➔ *Integration of Emerging Technologies: Explore the integration of emerging technologies such as IoT sensors for real-time data enrichment.*

➔ *User Feedback Incorporation: Advocate for incorporating user feedback mechanisms to enhance the dataset's relevance and accuracy.*

➔ *Adaptive Algorithms: Recommend exploring adaptive machine learning algorithms to dynamically adjust to evolving traffic patterns.*

4) -- Shivam Shukla-21MIP10033:

1) Researching Pre-trained Models:

➔ *Explored pre-trained models such as [Example 1: YOLO (You Only Look Once)] and [Example 2: EfficientDet], known for their real-time object detection capabilities.*

➔ *Emphasized YOLO's ability to process images rapidly, making it suitable for real-time traffic monitoring.*

➔ *Highlighted EfficientDet's efficiency in balancing accuracy and computational resources, potentially optimizing our system's performance.*

2) Reviewing Existing Projects:

➔ *Investigated projects like [Example 1: CityFlow], an open-source platform for traffic management, emphasizing its modular design and adaptability.*

➔ *Explored [Example 2: Singapore's Smart Nation Traffic Management], focusing on their use of AI for predictive traffic analysis and dynamic signal control.*

7) *--Siddharth Jaiswal-21MIP10008*:

1) Comparative Analysis:

➔ YOLO's Real-time Capabilities:

- Recognized YOLO (You Only Look Once) as a pre-trained model with remarkable real-time processing capabilities, allowing for the instantaneous detection and tracking of objects in images and video streams.
- Acknowledged the alignment between YOLO's strengths and the project's crucial need for timely traffic insights, emphasizing the importance of rapid data processing for effective traffic management.

2) CityFlow's Modular Design:

- Explored CityFlow, an existing project known for its open-source platform with a modular design tailored for traffic management.
- Identified CityFlow's modular architecture as a potential source of inspiration for our system, recognizing its capacity to enhance scalability and flexibility.
- Emphasized the value of modular design principles in facilitating seamless updates, expansions, and adaptability to evolving requirements.

8) --Tanishq Kolhatkar-21MIM10025:

1) Collaboration with the Team:

➔ Integration of YOLO's Capabilities:

- Actively collaborated with the development team to integrate YOLO's real-time object detection capabilities into our system's architecture.

- Conducted thorough testing and validation to ensure a smooth integration process, addressing any compatibility issues and optimizing performance.

2) **Adaptation of CityFlow's Modular Approach**:

- Engaged in discussions with colleagues to explore the potential adaptation of CityFlow's modular approach within our system.
- Facilitated collaborative brainstorming sessions to identify specific elements of CityFlow's architecture that could be incorporated to enhance scalability and flexibility in our traffic management system.
- Worked closely with software architects and developers to devise a plan for integrating modular components inspired by CityFlow, considering the project's current structure and future expansion goals.

9) -- *Chaitanya Mathur-21BCE10047*:

1) Lane Detection Module:

➔ Development Approach:

- Implemented a computer vision-based approach for lane detection using algorithms like Hough Transform and Convolutional Neural Networks (CNN).
- Utilized image processing techniques to enhance lane visibility under various lighting and weather conditions.

➔ Challenges and Solutions:

Faced challenges in robustly detecting lanes in complex scenarios, addressed through the integration of adaptive algorithms that dynamically adjusted to varying road conditions.

2) Car Detection Module:

➔ Detection Techniques:

- Employed a combination of Haar cascades and deep learning techniques for accurate and real-time car detection within the traffic environment.
- Integrated a pre-trained model for object detection and fine-tuned it to suit the specific requirements of our project.

➔ Optimizations:

- Introduced optimizations to minimize false positives and enhance the speed of car detection, ensuring timely and reliable results.

10) --Pranjal Rai-21BCE10125:

1) Lane Suggestion Module:

➔ Logic and Algorithms:

- Designed a lane suggestion module to guide drivers effectively through lane changes based on real-time traffic conditions.
- Integrated decision-making algorithms considering factors such as traffic density and road speed limits.

➔ User-Centric Features:

- Implemented user-friendly features such as audible alerts and visual cues to enhance the driver's experience and improve adherence to suggested lane changes.

2) . Video Processing Module:

➔ Efficient Processing:

- Developed a video processing module capable of handling real-time video feeds from traffic cameras.
- Employed parallel processing techniques to ensure efficient and timely analysis of video data.

→ Performance Considerations:

- Addressed performance considerations by implementing frame skipping strategies during low-traffic periods, optimizing computational resources.

3) GUI Development:

➔ Design Principles:

- Led the design and development of the GUI, focusing on a user-centric approach and intuitive navigation.
- Incorporated principles of responsive design to ensure seamless functionality across various devices.

→ User Experience Enhancements:

- Introduced interactive visualizations, real-time updates, and customization options to enhance the overall user experience.

CONCLUSION

The Smart Traffic Management System project endeavors to address critical challenges in urban transportation through innovative technological solutions. By leveraging advanced technologies such as AI, computer vision, and data analytics, our project aims to optimize traffic flow, enhance safety measures, and reduce environmental impact. Through features like lane detection, intelligent path optimization, and dynamic speed limit monitoring, our system seeks to create a more efficient, safer, and sustainable urban mobility experience. The successful implementation of this project holds the potential to revolutionize the way we manage traffic in cities, contributing to a smarter and more responsive urban infrastructure.

Reference:

- *Gollapudi, S., & Gollapudi, S. (2019). OpenCV with Python. Learn Computer Vision Using OpenCV: With Deep Learning CNNs and RNNs, 31-50.*
- *Bodhani, A. (2012). Smart transport. Engineering & Technology, 7(6), 70-73.*
- *Javaid, S., Sufian, A., Pervaiz, S., & Tanveer, M. (2018, February). Smart traffic management system using Internet of Things. In 2018 20th international conference on advanced communication technology (ICACT) (pp. 393-398). IEEE.*
- *Lanke, N., & Koul, S. (2013). Smart traffic management system. International Journal of Computer Applications, 75(7).*
- *Rizwan, P., Suresh, K., & Babu, M. R. (2016, October). Real-time smart traffic management system for smart cities by using Internet of Things and big data. In 2016 international conference on emerging technological trends (ICETT) (pp. 1-7). IEEE.*
- *Lingani, G. M., Rawat, D. B., & Garuba, M. (2019, January). Smart traffic management system using deep learning for smart city applications. In 2019 IEEE 9th annual computing and communication workshop and conference (CCWC) (pp. 0101-0106). IEEE.*
- *Sharif, A., Li, J., Khalil, M., Kumar, R., Sharif, M. I., & Sharif, A. (2017, December). Internet of things—smart traffic management system for smart cities using big data analytics. In 2017 14th international computer conference on wavelet active media technology and information processing (ICCWAMTIP) (pp. 281-284). IEEE.*

1. **Biodata with Picture:**

1) Prince Choudhary:

Hello! I'm Prince Choudhury, a passionate third-year student aspiring to become a Data Scientist. Proficient in languages like C++, Python, and currently exploring R and Scala, I contribute my skills to the ever-evolving field of Data Science. My journey involves crafting Large Language Models (LLM) and developing interactive chatbots. I've created impactful dashboards like Amazon, Netflix using tools like Tableau. Currently, my focus is on delving into the intricacies of Deep Learning.

2) Kunal Mishra:

Hello, I am Kunal Mishra, an aspiring data scientist with a passion for leveraging Python programming and advanced machine learning techniques to extract insights from data. Proficient in Python, machine learning, and deep learning, I am dedicated to developing predictive models and algorithms to solve complex business problems. Currently, I am exploring the intersection of data science and artificial intelligence to drive innovation and enhance decision-making processes. In addition to my professional pursuits, I am an avid reader, delving into diverse topics ranging from technology to philosophy. I also enjoy the strategic

challenges of chess, as it fosters analytical thinking and problem-solving skills. Committed to continuous learning, I stay updated with the latest advancements in the field of data science, always seeking opportunities to expand my knowledge and expertise.

3) Mansi Vidyarthi:

I am a MERN Stack developer with many esteemed projects like uploading photos and videos on Cloudinary and emailing user regarding the same, Study Notion- a full-fledged project on making courses and assigning it to students. Students can buy these courses. I have contributed in 2 projects Coin cave, a currency value predictor and currency to currency changer. And Neo vax lab, an online website that books children's vaccine on portal at hospitals and clinics near you. I have a deep understanding of problem solving as well.

4) Tanishq Kolhatkar:

Hello! I'm Tanishq Kolhatkar, a passionate third-year student aspiring to become a Data Scientist. Proficient in languages like Python, and currently exploring fields like product management and AI. I will contribute my skills to the ever-evolving field of Data Science. Currently, my focus is on delving into the intricacies of Deep Learning, Natural Language Processing, Computer Vision, remote sensing applications, Blockchain etc.

5) Chaitanya Mathur:

I'm Chaitanya Mathur, a Computer Science Engineering student at Vellore Institute of Technology. With an insatiable curiosity for technology, I've immersed myself in a myriad of disciplines, from machine learning to artificial intelligence. Guiding teams through ambitious projects like the Facial Emotion Detector and Algorithm Visualizer, I've honed my expertise in Java and Python. Beyond the realm of academia, I'm deeply committed to social causes, actively participating in initiatives like cleanliness drives. I'm not only passionate about technology but also enjoy immersing myself in a diverse array of hobbies like reading, unleashing creativity through sketching and 3D modeling, and strategic games like chess.

6) Shivam Shukla:

Hello! I'm Shivam Shukla, a dedicated third-year computer science student. My expertise includes languages like C++, Java, and Python, with ongoing learning ventures in Scala

and R. Currently delving into Data Structures and Algorithms (DSA) and Data Science, I strive for continuous growth. I've also ventured into Tableau projects, adding a practical touch to my skills.

7) Siddharth Jaiswal:

I'm Siddharth Jaiswal, a third-year student aspiring to become a Data Scientist. Proficient in languages like C++, Python, and currently exploring Data Structures and Algorithms and Data Science. My journey involves academic excellence and projects such as Twitter-Sentiment-Analysis, Online-Payment-Fraud-Detection, etc. Apart from academics, I am having a keen interest in cooking, Exploring World and listening Music.

8) Madanapalli Janak Sumedh:

As an AI ML (Artificial Intelligence and Machine Learning) Engineer, I am a seasoned professional with a strong background in computer science and a focus on cutting-edge technologies. I possess a comprehensive understanding of machine learning algorithms, deep learning architectures, and natural language processing. My expertise includes designing and implementing scalable and efficient AI solutions, with a proven track record of successful project delivery. I am proficient in programming languages such as Python and have hands-on experience with popular ML frameworks like TensorFlow and PyTorch. My bio showcases a commitment to staying abreast of the latest advancements in AI and ML, coupled with a passion for solving complex problems through innovative and data-driven approaches. I have a history of collaborating with

cross-functional teams and bringing a strategic mindset to the development of AI applications that make a positive impact in various domains.

9) Pranjal Rai:

I'm Pranjal Rai, currently pursuing my Bachelor's in Computer Science Engineering at Vellore Institute of Technology. My journey has been marked by a blend of academic excellence and hands-on projects, such as developing a Patient Management System and leading a team in a Face Recognition project. Beyond the realms of coding, you'll find me engrossed in a diverse range of hobbies. From immersing myself in books to enjoying the rush of video games, I believe in striking a balance between work and leisure.

10) Mrunmayee Ketkar:

I am a third-year computer science scholar at VIT Bhopal, where my passion lies in exploring new and exciting technologies. Photography is a personal hobby that I enjoy, and I approach my work with enthusiasm and thoughtfulness. Within various clubs, I serve as a core team member, contributing actively. Additionally, I have been involved in building several group projects and have participated in web development hackathons.