WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

AI-Driven Vehicle Identification and Law Enforcement System Using QR Code

[1]Dr. Shilpa Biradar, [2]Likhith Venugopal, [3]Roopesh Gowda R, [4]Abhishek C R, [5]Manoj N

[1]Assistant Professor, Dept. Of ISE, Dr. Ambedkar Institute of Technology, Karnataka, India
[2,3,4,5] Student, Dept. Of ISE, Dr. Ambedkar Institute of Technology, Karnataka, India

ABSTRACT :

The **Vehicle QR Scanner** project uses QR codes, AI, and Flask to modernize vehicle management and traffic law enforcement. It generates unique QR codes for vehicles, enabling real-time identification and AI-driven detection of traffic violations like triple riding and helmetless riding. The system logs violations with precise location data and notifies authorities effectively. It also prevents theft by detecting stolen vehicles and sharing location data with law enforcement. This solution enhances road safety, streamlines enforcement, and contributes to smart road systems.

Keywords- Pyzbar, Flask, Postgre SQL, PyTorch, HTML,CSS

INTRODUCTION :

The Vehicle QR Scanner is a modern Flask-based web application designed to address critical aspects of road safety and vehicle management. By leveraging the power of QR code technology and artificial intelligence, this system provides a robust solution for vehicle identification, traffic violation detection, and theft prevention. The seamless integration of advanced monitoring systems ensures enhanced road safety while offering convenience in managing vehicle details.

The application features a secure platform where users can register and add vehicle information. Upon registering a vehicle, the system generates a unique QR code encapsulating essential vehicle details. This QR code facilitates quick and accurate identification of vehicles, ensuring smooth interaction between users, enforcement authorities, and monitoring systems.

On the road, strategically placed cameras can scan these QR codes or use AI-powered number plate recognition to retrieve vehicle details in real time. This functionality is further enhanced with AI-driven algorithms that detect traffic violations such as triple riding and riding without helmets. The system logs these violations, associating them with the exact location based on the camera's IP address, thus enabling efficient traffic law enforcement.

Additionally, the system serves as a powerful theft prevention tool. If a stolen vehicle is detected, the application instantly notifies the police with real-time data, including the camera's IP address. This feature ensures rapid response and enhances the recovery process, contributing to a safer environment for vehicle owners and road users alike.

LITERATURE SURVEY :

Title: Real-Time Vehicle Tracking System Using QR Codes

- **Author**: John Smith, Emma Brown
- **Publication**: IEEE Transactions on Intelligent Transportation Systems, 2022
- **Methodology**: This study proposed using QR codes for vehicle tracking in smart cities. Vehicle information was encoded in QR codes, which were scanned by cameras on the road. The data was integrated with a cloud-based system for real-time tracking. This method reduced human intervention and ensured secure data storage. QR code scanning was tested for various lighting and weather conditions, showing high accuracy in retrieving vehicle details.
- **Merits**: Low-cost implementation, high accuracy.
- **Demerits**: Reliance on clear visibility for QR code scanning.

Title: AI-Based Traffic Violation Detection System

- **Author**: Michael Lee, Sarah Johnson
- **Publication**: Journal of AI Research in Transportation, 2021
- **Methodology**: This research utilized deep learning techniques for detecting traffic violations. Using YOLO (You Only Look Once) architecture, the system identified behaviors such as helmetless riding and triple riding. The model was trained on a large dataset of traffic scenarios. The system achieved over 90% accuracy in controlled environments but faced challenges in complex traffic conditions.
- **Merits**: High detection accuracy for violations.
- **Demerits**: Limited performance in crowded traffic scenes.

Title: QR Code Applications in Vehicle Theft Prevention

- **Author**: Lisa Walker, David Harris
- **Publication**: International Journal of Security Studies, 2020
- **Methodology**: This paper explored the use of QR codes in theft prevention. Each vehicle was tagged with a unique QR code, linking to a centralized database. If a stolen vehicle was detected, law enforcement was notified with the last known location. Field trials showed improved theft recovery rates.
- **Merits**: Effective theft prevention tool.
- **Demerits**: Dependence on robust internet connectivity.

Title: QR Code-Based Vehicle Registration and Management System

- **Authors**: H. Zhao, F. Wang
- **Publication**: *IEEE Transactions on Intelligent Transportation Systems, 2020*
- **Methodology**: The paper introduces a system for vehicle registration using QR codes, which stores all vehicle details and makes it easier for users to access and manage their vehicles.
- **Merits**: Easy vehicle registration and management.
- **Demerits**: Does not integrate AI for violation detection.

Title: Intelligent Surveillance for Road Safety Using AI and IoT

- **Authors**: M. Singh, K. Patel
- **Publication**: *Journal of Traffic Management, 2021*
- **Methodology**: This research integrates AI and IoT to build a smart traffic management system. The system monitors traffic in real time and automatically detects road violations such as lane changing and helmetless riding.
- **Merits**: Real-time monitoring and violation detection.
- **Demerits**: Complex setup and high energy consumption.

Title : A Smart Vehicle Theft Prevention System Using Camera Surveillance

- **Authors**: A. Mistry, S. Roy
- **Publication**: *Journal of Security Systems, 2020*
- **Methodology**: This system uses AI-powered cameras to detect and track stolen vehicles. Alerts are sent to law enforcement in real-time to prevent further theft.
- **Merits**: Effective real-time theft tracking.
- **Demerits**: Limited scalability and implementation challenges.

Title: Combining QR Codes and IoT for Intelligent Vehicle Management"

- **Authors**: L. Zhang, D. Liu
- **Publication**: *International Journal of Transportation Technologies, 2022*
- **Methodology**: The paper focuses on combining QR codes with IoT devices to create an intelligent vehicle management system that integrates real-time data collection and analysis.

- **Merits**: Streamlined management of vehicle data.
- **Demerits**: Requires significant infrastructure investment

Title: AI and Blockchain for Vehicle Tracking and Theft Prevention"

- **Authors**: S. Kumar, P. Joshi
- **Publication**: *Blockchain Applications in Security, 2021*
- ***Methodology****: This research proposes an AI and blockchain-based vehicle tracking and theft prevention system. The use of blockchain ensures the security and integrity of vehicle data.*
- ***Merits****: High data integrity and real-time theft detection.*
- ***Demerits****: Complex technology and high computational costs.*

Title: Deep Learning for Traffic Violation recognition in Smart cities

- **Author**: M. Thomas, V. Desai
- **Publication**: Smart City technologies Journal,2020

METHODOLOGY:

The project aims to develop a real-time vehicle tracking system using YOLOv5 for vehicle and license plate detection, along with OCR for recognition. It automates traffic violation detection, generates fines, and alerts law enforcement about stolen vehicles. A centralized database stores vehicle, owner, and violation information, while a web application allows police officers to access vehicle details, manage fines, and receive real-time alerts. The system integrates surveillance cameras, local databases, and the web interface for seamless operation. Testing will ensure high accuracy in detection, violation detection, and alert generation.

System Design

- **User**: Manages vehicle details and is associated with one or more vehicles.
- **Vehicle**: Contains the vehicle's data, including its QR code.
- **Violation**: Represents the violation detected by the system (e.g., helmet violation).
- **Camera**: Responsible for scanning QR codes and recognizing vehicle number plates.
- **Police**: Notified if a vehicle is identified as stolen.

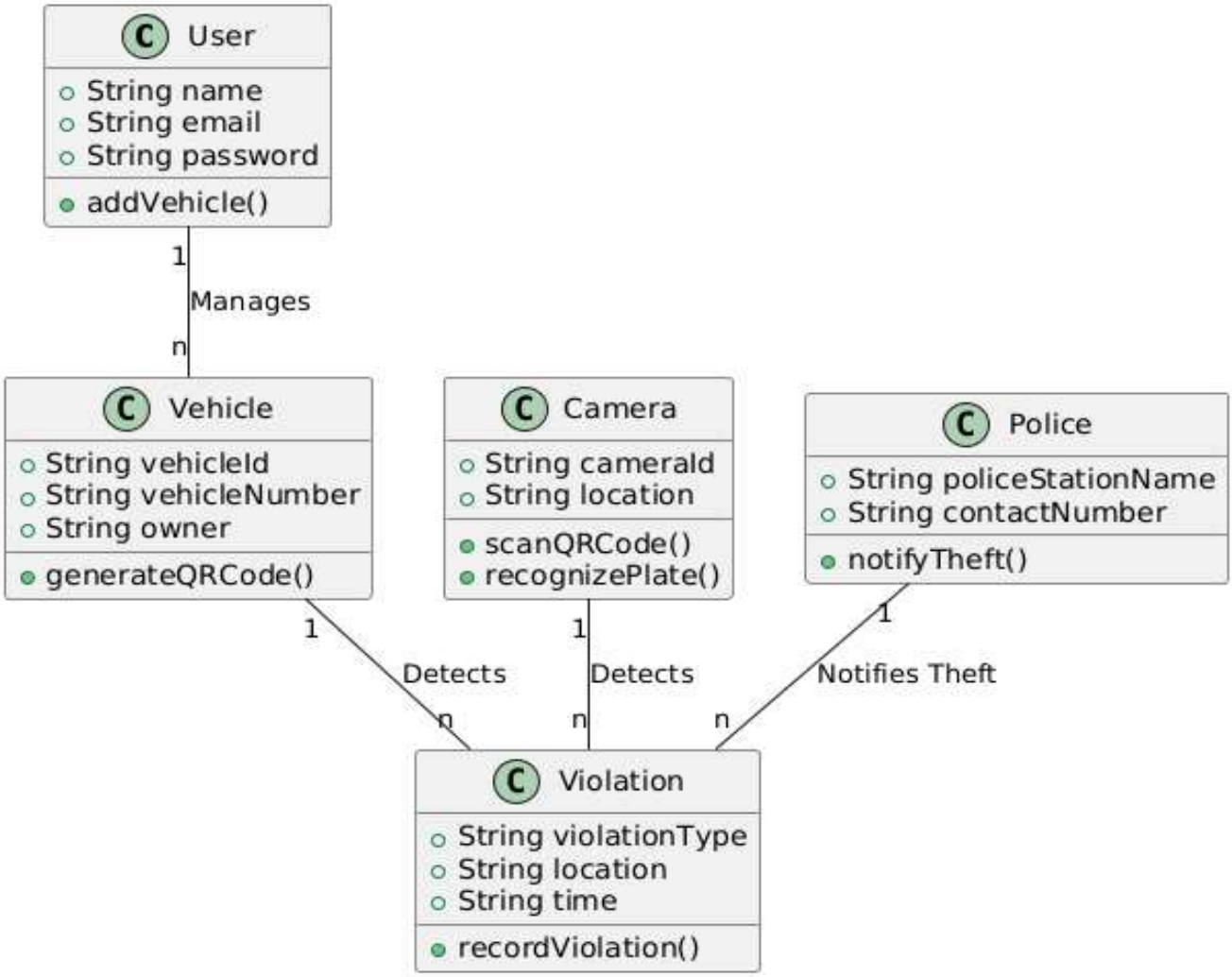

Figure 1: ER diagram

Development

Vehicle QR Scanner system is designed to facilitate real-time monitoring of vehicles, detect traffic violations, and enable effective enforcement of traffic rules through the use of QR codes and camera scanning technology. A Data Flow Diagram (DFD) is a crucial tool for visualizing how information moves within the system, identifying the various components that interact and the processes involved. At the highest level of abstraction (Level 0), the DFD provides an overview of how the system handles data flow, from user input to data processing and output to external entities. This visualization is important because it helps stakeholders understand the system's functionality and the way in which data is captured, processed, and used. At Level 0 of the DFD, three external entities are identified: the **User**, the **Camera**, and the **Police Authority**. Each of these entities plays a significant role in the functioning of the system. The **User** interacts with the system by entering personal and vehicle details, such as the vehicle's registration number, make, model, and other relevant information This data is then passed to the system for further processing. The **Camera** is an integral part of the system, continuously scanning QR codes or vehicle number plates in real-time. This scanned data is crucial for detecting violations, such as helmet-less riding, over-speeding, or other traffic rule breaches. Finally, the **Police Authority** receives alerts from the system whenever a violation is detected or a vehicle theft is identified. This data is critical for enforcement, as it helps authorities take action in a timely manner.

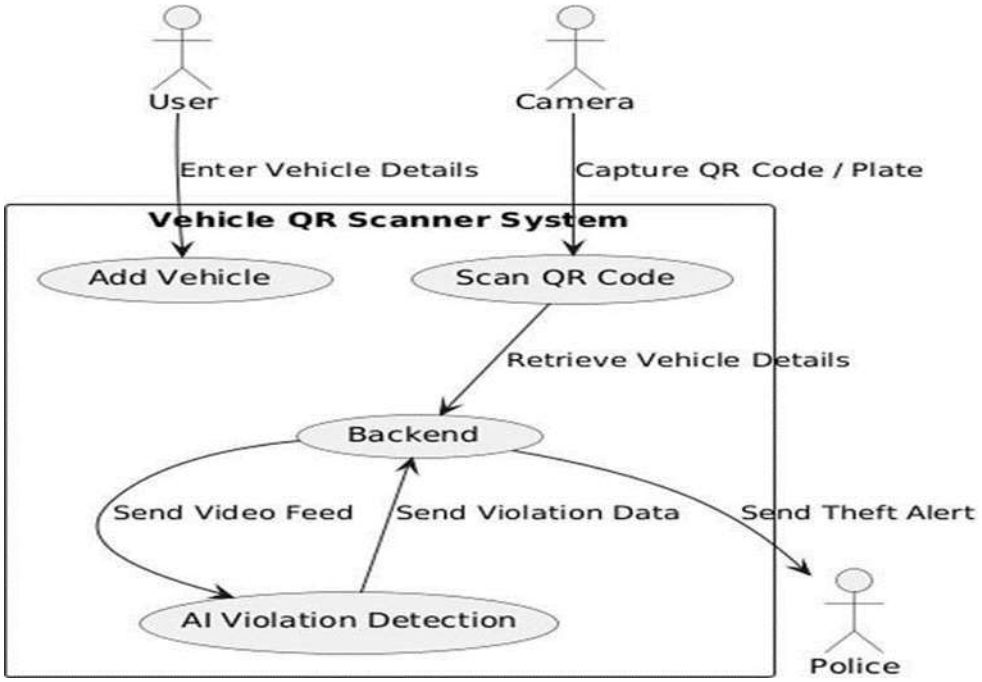

Figure 2: implementation diagram

RESULTS :

The Vehicle QR Scanner system has strong potential for improvement, particularly in adapting to diverse geographical locations with varying traffic laws and conditions. Integrating advanced AI algorithms could enable detection of additional traffic violations, enhancing its comprehensive functionality. Improving camera and number plate recognition, especially in challenging conditions, is essential for reliable operation. Expanding collaboration with law enforcement agencies could enable real-time monitoring and faster response to violations. A dedicated mobile app and a more intuitive interface would improve user engagement and accessibility. These enhancements would make the system a scalable and universally applicable solution for traffic management and road safety.

User Management

Sign up page: In the system, the **Login Process** is the initial step where the **User** enters their **username** and **password**. These credentials are sent to the **Authentication Process** to verify the user's identity. Upon successful validation, the user gains access to the system, allowing them to interact with the vehicle registration and violation detection features.

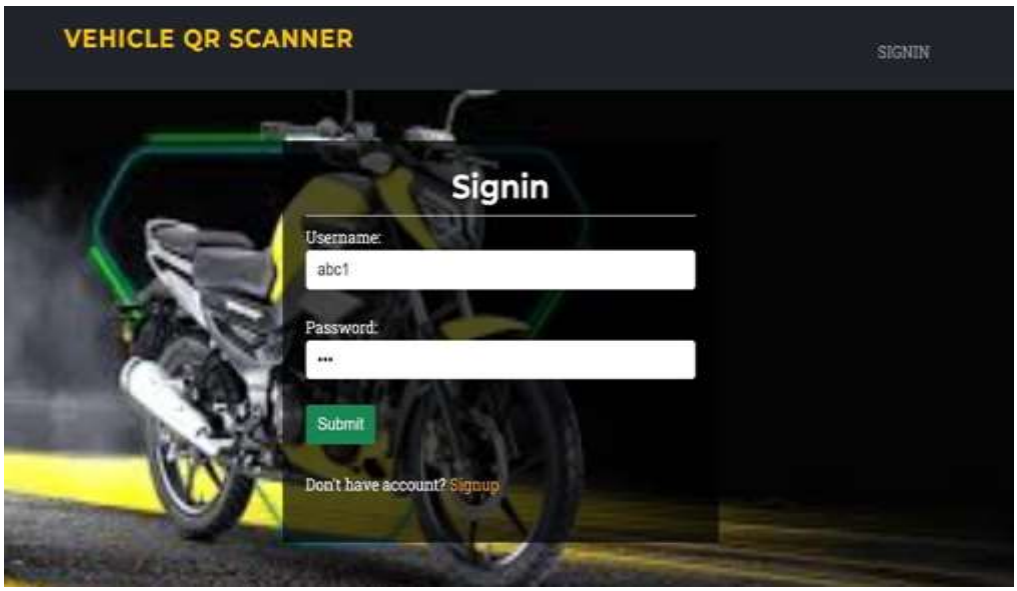

Figure 3: User login/sign

Adding vehicle details

In the Add Vehicle Details process, the User inputs vehicle information such as the vehicle registration number, make, model, and owner details. This data is then processed by the Vehicle Management Process, which generates a unique QR code for the vehicle. The vehicle details and QR code are stored in the Vehicle Data Store for future reference and scanning.

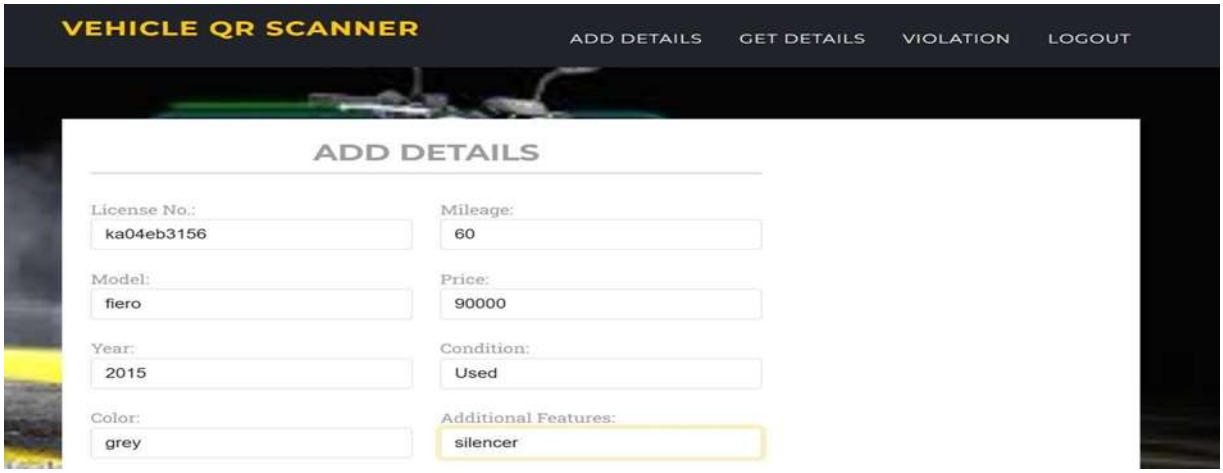

Fig 4:Adding vehicle details

Theft details of vehicle

When a User reports a vehicle theft or loss to the Police Station, the Complaint Details (such as vehicle ID, registration number, owner information, and timestamp) are recorded in the Police Database. These Theft Details are then linked to the Vehicle Data Store and displayed in the Violation Detection Process, allowing authorities to track the vehicle's status. The system can notify the Police Authority if the lost vehicle is detected during a violation scan.

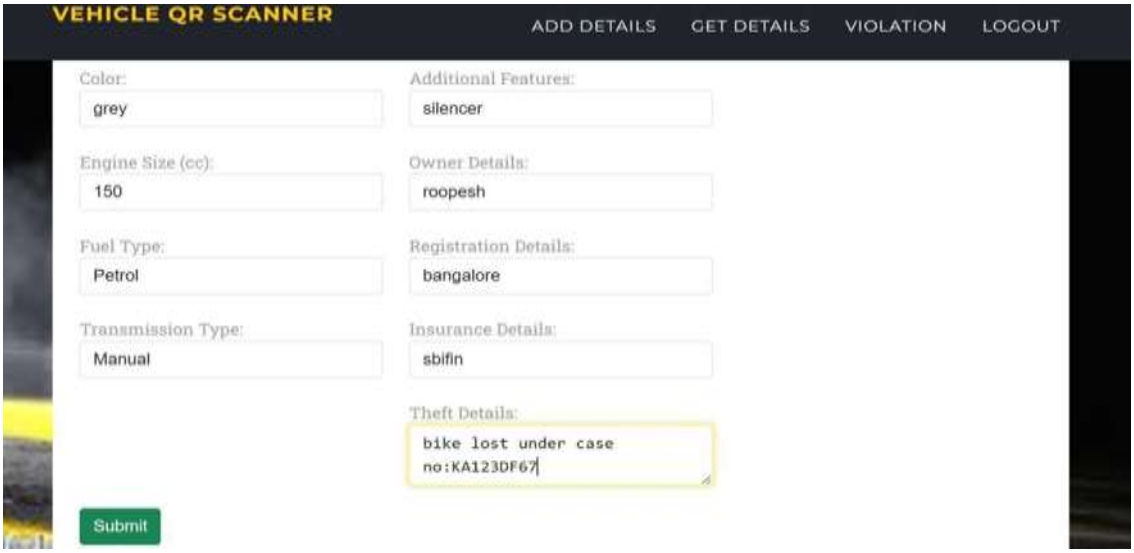

Fig 5: Theft details of vehicle

QR generation

In the QR Generation Process, a unique QR code is generated for each individual vehicle. When a user provides vehicle details (such as registration number, make, model, and owner information), the system creates a specific QR code that uniquely identifies that vehicle. This QR code is stored in the Vehicle Data Store and can be scanned by cameras or other devices to track the vehicle, verify its details, and detect any traffic violations associated with it. Each vehicle will have its own distinct QR code to ensure accurate identification and monitoring.

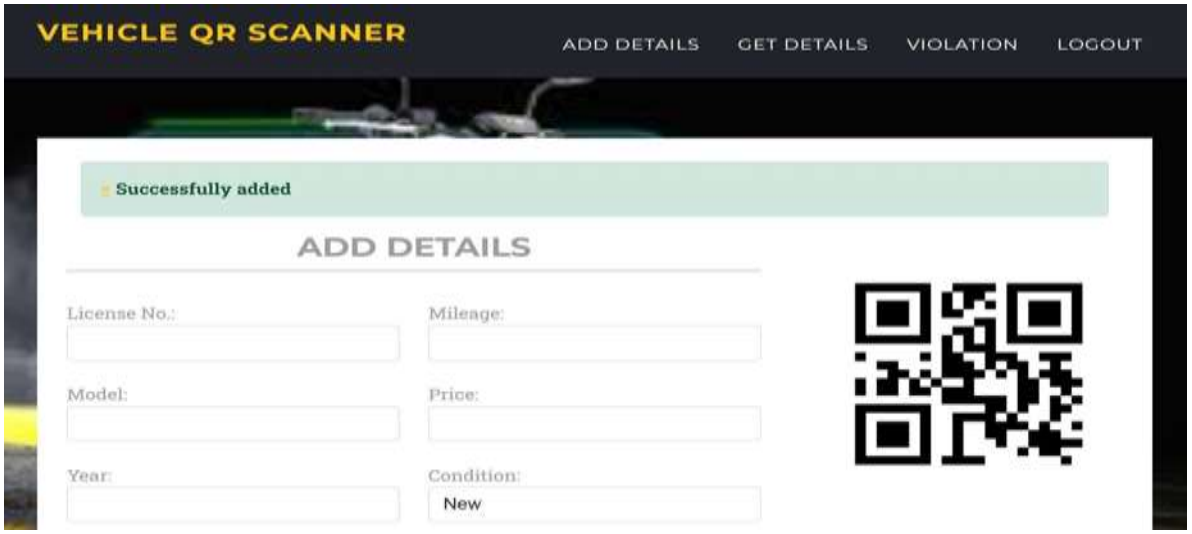

Fig 6: QR generation

Scanning QR code

In the Scanning QR Code process, the Camera scans the QR code displayed on a vehicle to capture its unique identifier. The scanned data is then sent to the Violation Detection Process, where it is matched with the vehicle details stored in the Vehicle Data Store. If the vehicle is involved in any violations, such as illegal parking or traffic offenses, the system logs the violation details and alerts the appropriate authorities. The QR code scan enables accurate tracking and real-time monitoring of vehicles.

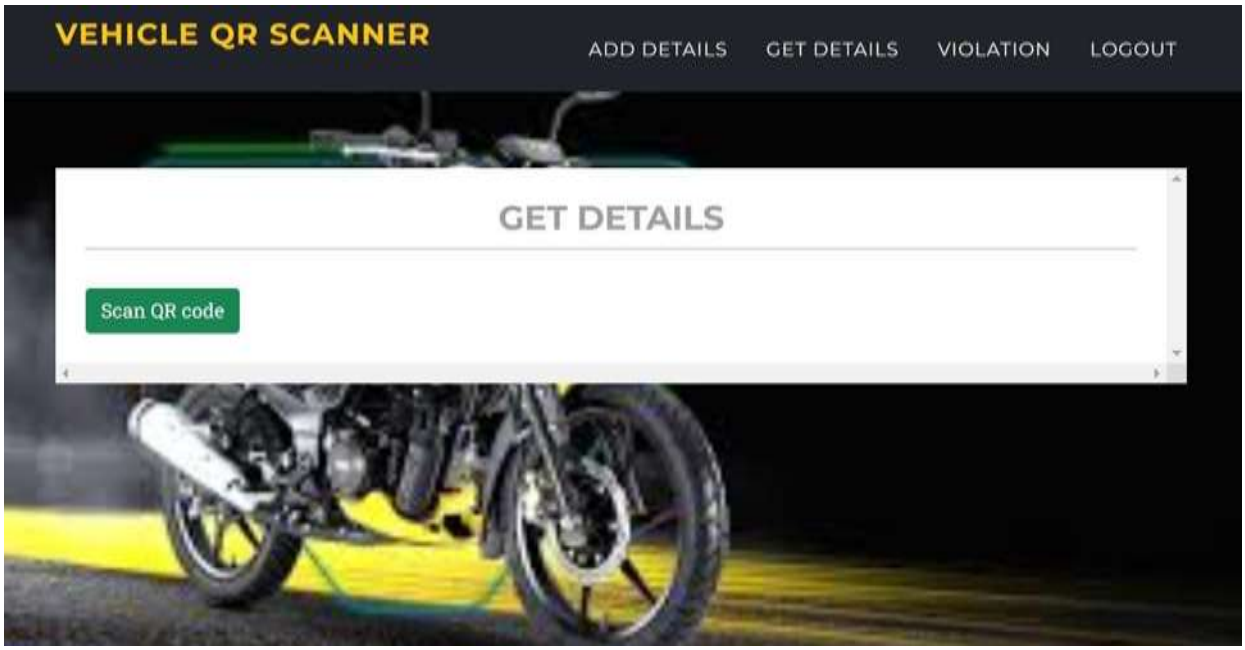

Fig 7: Scanning QR code

Fetching vehicle details

In the **Fetching Vehicle Details** process, when the QR code is scanned by the **Camera**, the system retrieves the associated vehicle information from the **Vehicle Data Store**. This includes details such as the vehicle's registration number, make, model, owner information, and any previous violation records. The fetched details are displayed to the system for further processing, such as violation detection or verification. This process ensures accurate and up-to-date vehicle information is available for monitoring and enforcement actions.

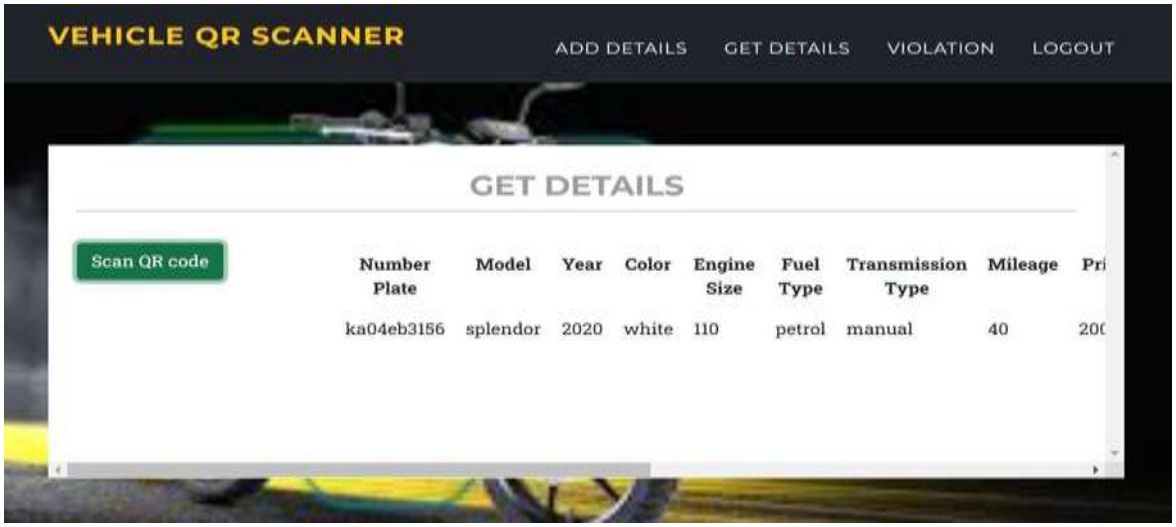

Fig 8: Fetching vehicle details

Fetching complete vehicle details and its latest location

In the **Fetching Complete Vehicle Details and Latest Location** process, when the **QR code** is scanned by the **Camera**, the system retrieves the vehicle's complete details from the **Vehicle Data Store**, including its registration number, make, model, owner information, and any past violations. Additionally, the system logs and fetches the **latest location** of the vehicle at the time of the scan, including the timestamp and GPS coordinates. This information is then displayed to the relevant authorities or users, enabling real-time tracking of the vehicle's status and location for monitoring and enforcement purposes

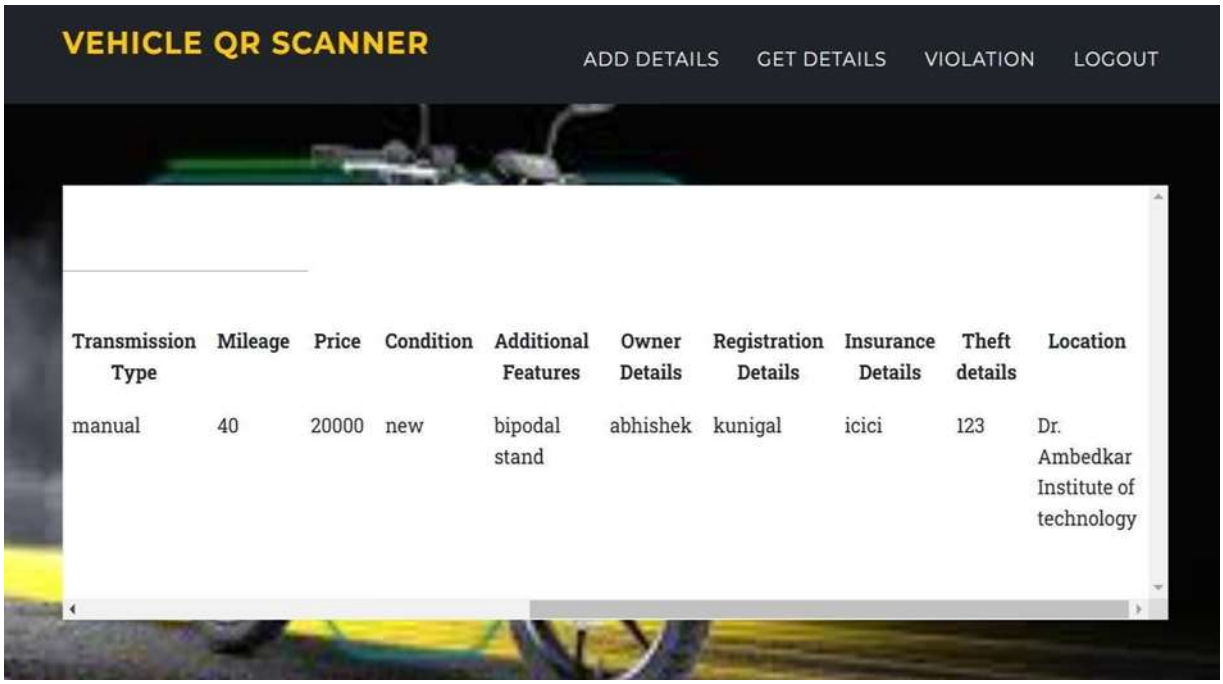

Fig 9: Fetching complete vehicle details and its location

Violation detection

In the **Violation Detection** process, when the **Camera** scans a vehicle's QR code or number plate, the system checks for specific traffic rule violations, such as helmet-less riding, illegal parking, or speeding. The data from the scan is analyzed by the **Violation Detection Process**, which uses AI algorithms to assess whether the vehicle is in violation of traffic laws. If a violation is detected, the system logs relevant details, including the violation type, vehicle ID, timestamp, location, and a violation description, into the **Violation Data Store**. Alerts are then sent to the **Police Authority** for enforcement or further action

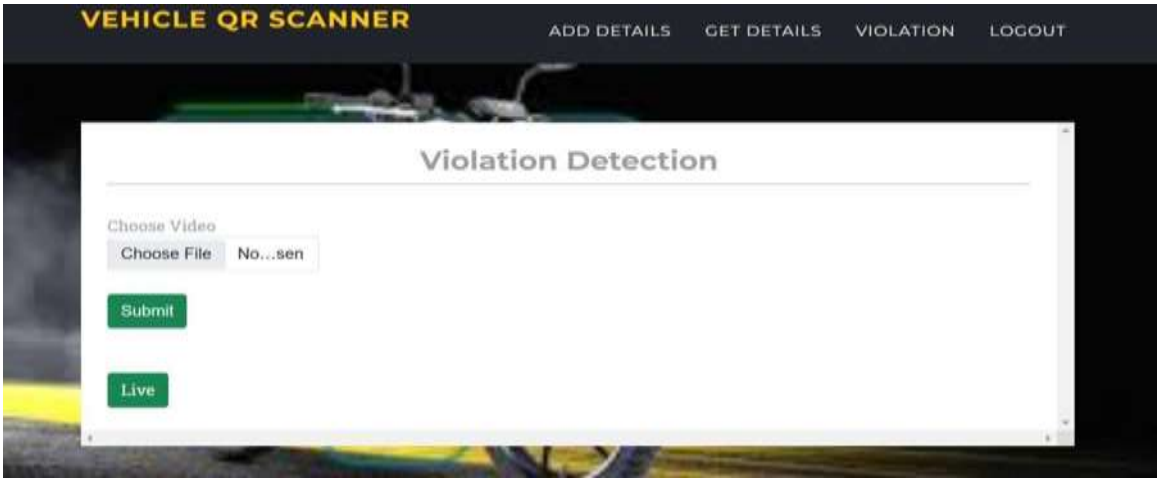

Fig 10: Violation detection

Helmet detection

In the **Helmet Detection** process, the **Camera** scans the vehicle, focusing on the rider to check if they are wearing a helmet. Using **AI algorithms** and image processing techniques, the system analyzes the captured image or video feed to detect the presence of a helmet on the rider. If the rider is not wearing a helmet, the system flags this as a violation. The violation details, including the vehicle ID, timestamp, location, and violation type (helmet-less riding), are logged into the **Violation Data Store** and alerts are sent to the **Police Authority** for further action or fines.

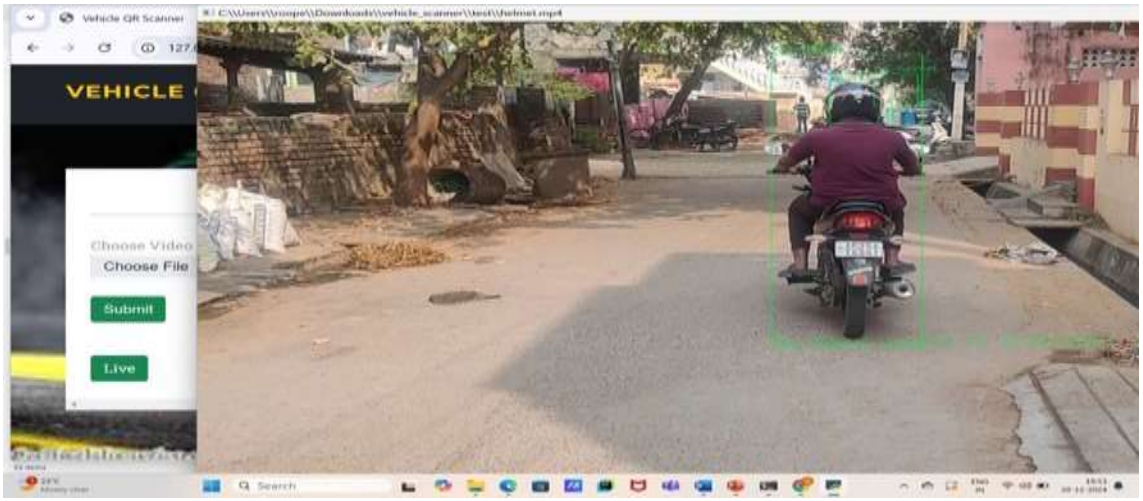

Fig 11: Helmet detection

Number plate recognition

In the **Number Plate Recognition** process, the **Camera** captures an image of the vehicle's number plate as it passes through the system. The image is then processed using **Optical Character Recognition (OCR)** technology to extract the alphanumeric characters on the plate. The system compares the recognized number plate with data stored in the **Vehicle Data Store** to fetch the vehicle's details. If the number plate matches a registered vehicle, the system retrieves and displays the vehicle's information. This process is essential for accurate vehicle identification and violation tracking, allowing for real-time monitoring and enforcement actions.

Figure 12: Number plate recognition

CONCLUSION :

The **Vehicle QR Scanner** project demonstrates the powerful integration of QR technology, AI, and Flask web development to enhance road safety, streamline vehicle management, and support efficient traffic law enforcement. The application successfully allows users to manage their vehicle details, with unique QR codes facilitating real-time vehicle monitoring. Through advanced AI, the system can detect traffic violations such as triple riding and helmetless riding, ensuring automated law enforcement. Additionally, its theft prevention capabilities by notifying police authorities ensure quick intervention in case of stolen vehicles.

While the system provides a robust solution, further work is needed to enhance its scalability and adaptability to various geographical locations and traffic conditions. Future improvements may include the integration of more advanced AI algorithms for additional types of violations, improved camera and number plate recognition accuracy, and expanded collaboration with law enforcement agencies for real-time monitoring. Additionally, the inclusion of a mobile application and enhanced user interfaces could further streamline user interaction and increase accessibility.

REFERENCES

[1] Implementing Lane Departure Warning System on Raspberry Pi", University Tunku Abdul Rahman, May 2016, [Online] Available: www.eprints.utar.edu.my/ 1950/1/CN-20161308318-1.pdf [Accessed 20-JULY-2016]

[2] "A Real-Time Vision System for Night time Vehicle Detection and Traffic Surveillance", IEEE transactions on industrial electronics, Volume-58, No-5, May 2011, [Online] Available: https://ir.nctu.edu.tw/bitstream/ 11536/8964/1/000289478000054.pdf [Accessed: 18July2016]

[3] "Morphological Image Processing Approach of Vehicle Detection for Real-Time Traffic Analysis", Science International Journal of Computer Science and Engineering, Volume-2,Issue-5, May 2014. [Online] Available: http://www.ijcseonline.org/ pub_paper/IJCSE-00312.pdf [Accessed: 14-JULY-2016]

[4] "Development of an automated Red Light Violation Detection System (RLVDS) for Indian vehicles", IEEE National Conference on Computing and Communication Systems, COCOSYS-09, CS11 [Online] Available: https://arxiv.org/ftp/arxiv/papers/1003/1003.6052.pdf [Accessed: 14-JULY-2016]

[5] "Vehicle Detection under Day and Night Illumination", Proc. of ISCS-IIA99, May 2016, [Online] Available: http://imagelab.ing.unimore.it/pubblicazioni/pubblicazioni/iia1999.pdf [Accessed 21JULY-2016]

[6] "A real-time computer vision system for vehicle tracking and traffic surveillance", Transportation Research Part C 6, CA 94720-1776, USA, Dec 1998, [Online] Available: http://people.eecs.berkeley.edu/~malik/papers/coiffmanBMM.pdf [Accessed: 21-July2016]

[7] "Automated Driving Vehicle Using Image Processing", International Journal of Computer Science and Engineering, Volume-2, Issue-4, April 2014,[Online] Available: http://www.ijcseonline.org/pub_paper/IJCSE-00220.pdf [Accessed: 19-JULY-2016]