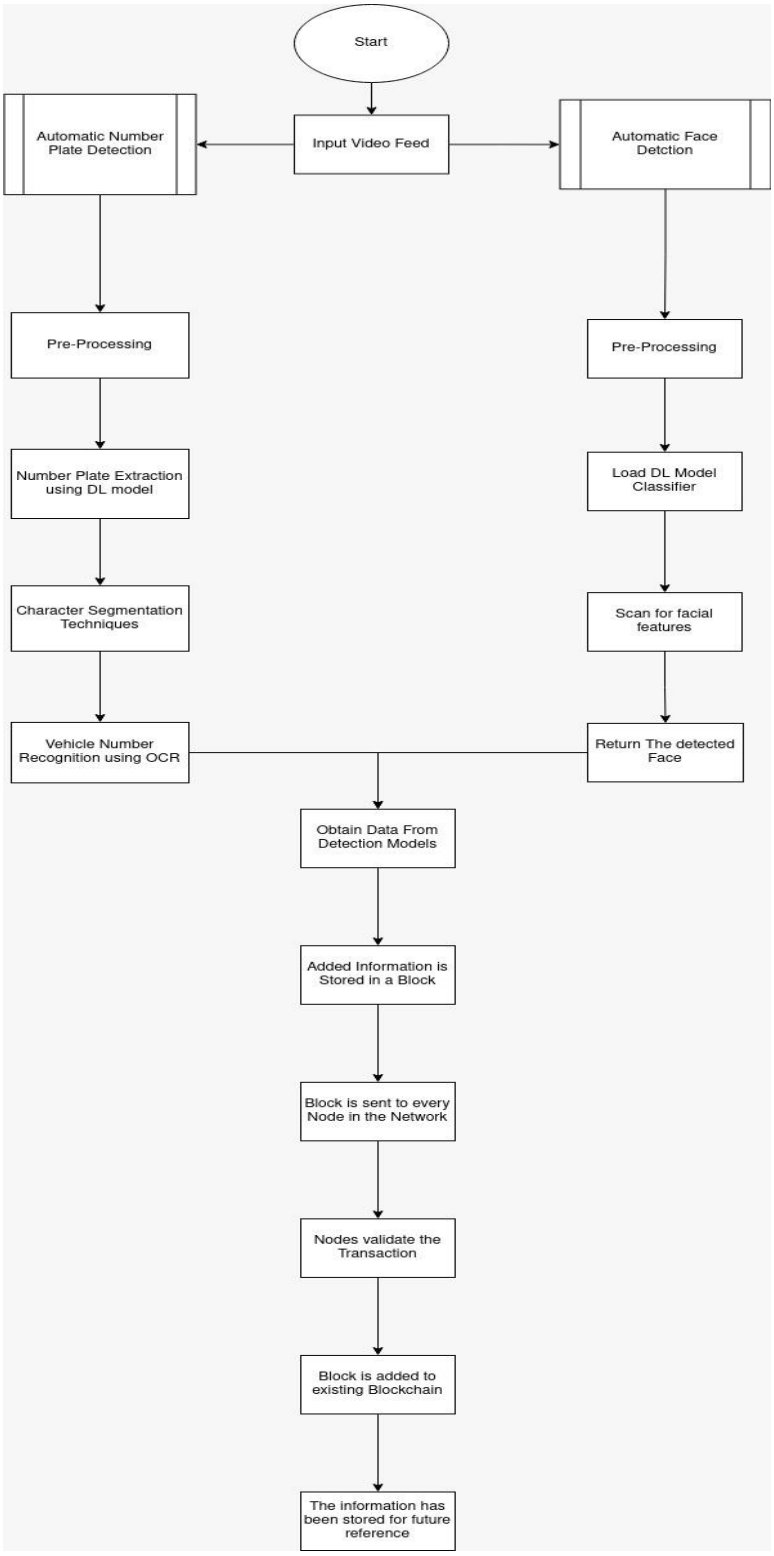
Project Description

Automatic number plate recognition (ANPR) and Facial Recognition System (FRS) employ computer vision and machine learning algorithms to identify and monitor vehicles and the persons associated with them. Automatic Number Plate Recognition (ANPR) in our project detects and recognizes vehicle number plates using TensorFlow Object Detection models whereas the Facial Recognition System (FRS) applies deep learning techniques such as the Haar Cascade and YOLO algorithms.

The flowchart illustrates how our ANPR and FRS system operates.

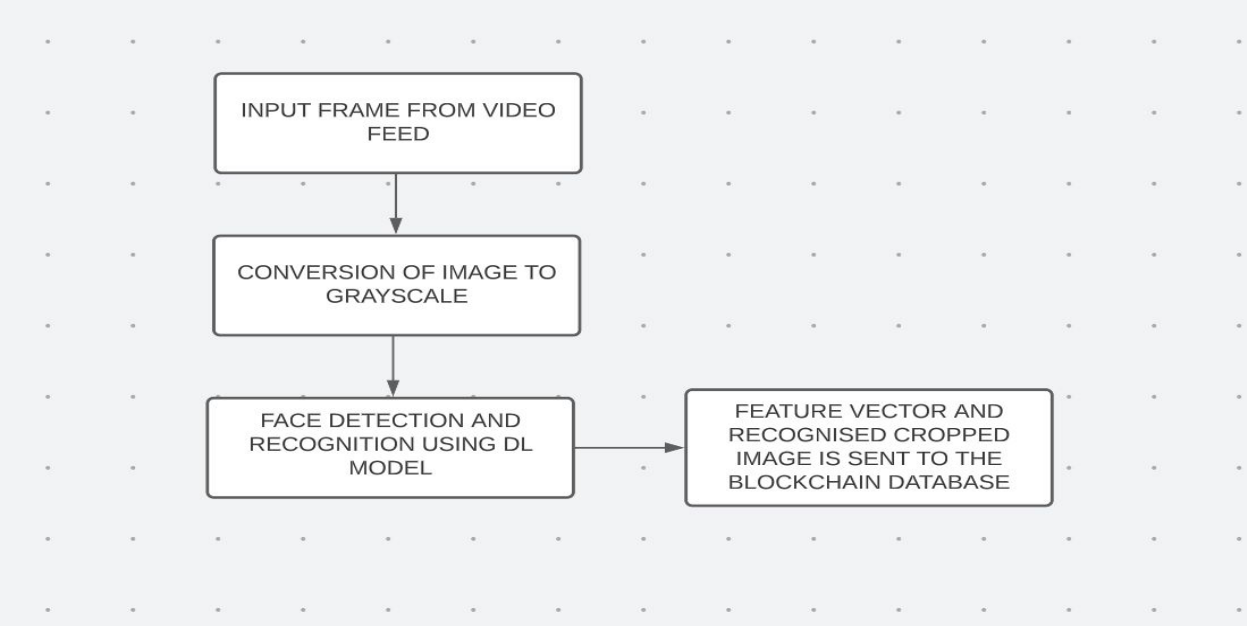


Automatic number plate recognition (ANPR) has the following implementations

- The Automatic Number Plate Recognition (ANPR) system using TensorFlow object detection model is a computer vision-based solution that detects and recognizes vehicle number plates. When combined with the OCR functionality (which can extract text from license plates), it can be used to detect number plates using CCTV Camera Feeds.
- More precisely it may use a Google OCR API, Microsoft Vision OCR API, AWS OCR, or EasyOCR for effective extraction of text from images.
- This solution enables us to recognize number plates that are written in typical non-standard ways using varying font styles, sizes, designs, symbols, languages.
- You Only Look Once (YOLO) proposes using an end-to-end neural network that makes predictions of bounding boxes and class probabilities all at once

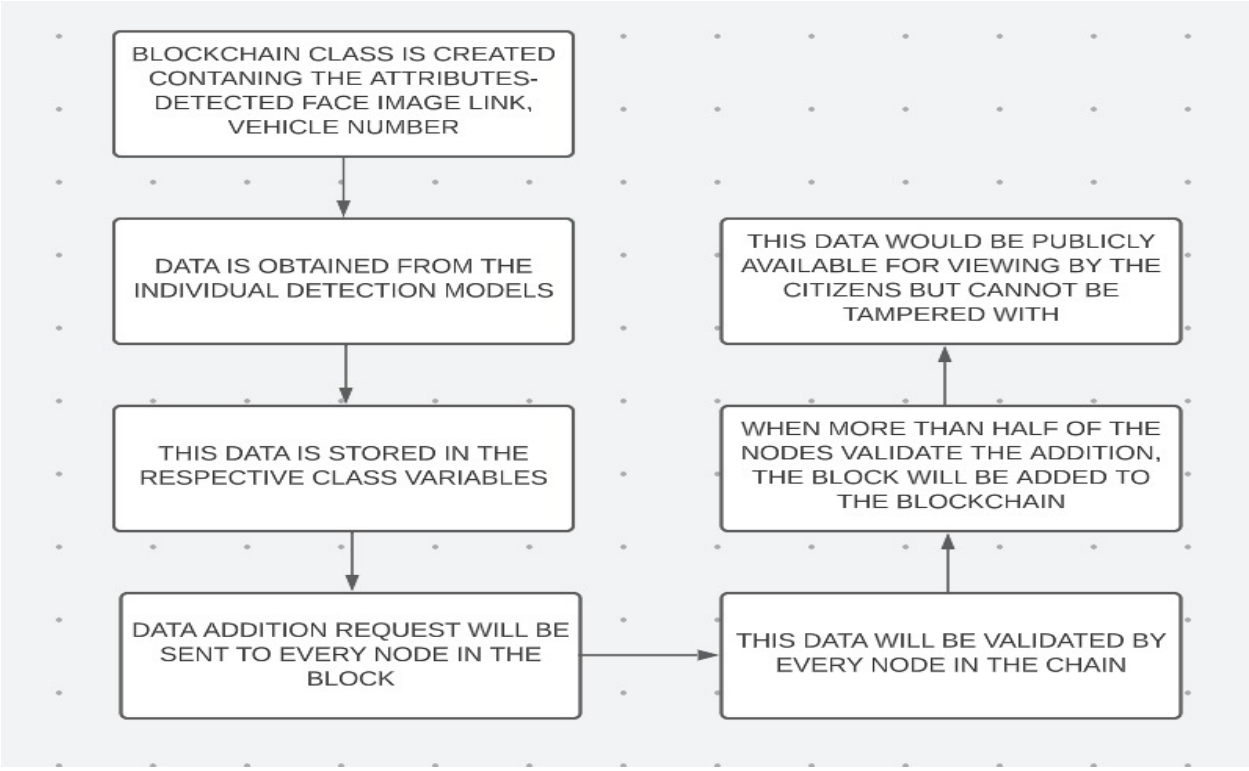
The Facial Recognition System (FRS) is implemented in the following way

- The model uses Haar Cascade to detect the face of the vehicle driver.
- We also tried using the YOLO-Tiny algorithm for facial recognition. However, the boundary box results were inconsistent and it was also slow to run on the CPU.
- Though there wasn't enough time for implementation, we have also researched about the MTCNN and BlazeFace algorithms. We hope to understand these better before integrating them into our system. We then plan to create a system that would provide us with the best accuracy while consuming the least processing time.
- It can detect faces in images, irrespective of their scale in image and location. This algorithm is not very complex and should run in real time.



Blockchain Technology has the following implementation

- The data collected by both models will be stored in a blockchain-based database. It provides a secure and transparent way to display the collected data.
- Intelligent Contracts using the Ethereum platform can be implemented in the blockchain database to automate the E-Challan facility using an API linking the system to an E-Wallet.



Importance of User Interface

- A User interface provides better visualization so a **website** can be created to display the collected data. This will allow a user to get information about specific license plates.
- Focusing on security, the website can be integrated with authentication mechanisms like two-factor authentication, login restriction.
- Users can be granted access based on their roles and permissions.
- The website can generate reports and analytics that provide insights about traffic patterns and vehicle ownership and even predict accident-prone areas.

Implementation of Hardware to scale the model

- The practical usage of the model can be achieved with input from CCTV feeds.
- It can be collected using wireless communication, which can be fed to the user interface.

Challenges and need of ANPR in India

ANPR technology can help to reduce the high rate of traffic fatalities by monitoring speeding and automatically issuing fine tickets to vehicles that exceed the speed limit. It can be used to manage parking by automatically reserving parking spots for vehicles with registered license plates and requiring unregistered vehicles to pay during check-in and check-out. Parking tickets can be paid directly from the user's account using the ticket number produced and linked to the vehicle owner's mobile phone. It can also offer a cloud-based platform for parking pre-booking, making parking easier and more convenient for Indian drivers. Finally, ANPR can be used to track stolen vehicles, which is a major issue in India.

Specific regions in India have unique license plate formats and certain generations of vehicles have peculiarities that add to the complexity of the task. The quality of cameras deployed in India poses another challenge, as low-cost cameras often have limited visual coverage, less acute motion and object detection sensors, and limited night vision capabilities.

Scalability and corresponding problems

The scalability of the Automatic Number Plate Detection (ANPD) system and Facial Recognition System (FRS) depends on various factors like the number of cameras, size of the database, cost of hardware. However, with the use of cloud computing and distributed systems, the scalability of these systems can be significantly improved.

Business Potential

This system has a vast range of applications, some of which are listed below:

- Traffic, parking and toll management
- Security in public places

Blockchain technology is integrated into ANPR and FRS systems to offer an extra layer of protection and transparency that appeals to potential customers.

Cloud computing and distributed systems can be used to improve scalability of ANPR and FRS systems, allowing for the efficient processing and storage of large amounts of data.

Conclusion:

ANPR and FRS technologies have revolutionized the field of surveillance and law enforcement. The benefits of both ANPR and FRS technologies need to be balanced against concerns about privacy and potential misuse. There is a need for appropriate regulatory frameworks to ensure the responsible use of these technologies. These should protect the privacy rights of citizens. It is crucial to ensure their ethical and responsible use while balancing the benefits with privacy concerns.

Our solution combines ANPR and FRS to accurately recognize number plates with non-standard font styles, sizes, designs, symbols, and languages. The system is trained on a wide range of variations and can capture facial images for further analysis.

The development of this technology is an ever-growing activity and needs to be updated regularly to avoid the attacks by malicious users and increasing the accuracy of the program.

ABSTRACT

Automatic Number Plate Detection (ANPR) and Face Recognition are two distinct but related computer vision applications that aim to automatically identify licensed number plates and faces in images or videos using Deep learning algorithms to analyze and interpret images.
These algorithms are generally linked to a large dataset to effectively train the modules and hence increase the accuracy of the output.

The tech stack for ANPR and Face Detection project involves a combination of:-
Hardware: This mainly includes the **CCTV cameras**,
Image Processing Library (OpenCV) for image processing which is the real-time optimized Computer Vision Library and supports model execution for Machine Learning,
Machine Learning Framework and Algorithms like **TensorFlow,Pytorch** to detect the live input feed using various object detection algorithms like YOLO, Haar Cascade, Convolutional Neural Networks (CNN),
Blockchain Technology (Ethereum with Smart Contracts) to provide additional security.

The project starts with the reception of the CCTV input which is then passed on to two independent detection platforms for Number Plate and Facial Recognition to process the live input. The following is their implementation:
ANPR (Automatic Number Plate Recognition) :
The Automatic Number Plate Recognition (ANPR) system using TensorFlow object detection model and OCR functionality is a computer vision-based solution that detects and recognizes vehicle number plates, and extracts alphanumeric characters from them to identify vehicles. The system uses CCTV cameras as input sources to capture the video feed of passing vehicles and analyze them in real-time to detect and recognize license plates. The ANPR system can be integrated with CCTV cameras installed at various locations, such as toll booths, parking lots, and public roads, to monitor the movement of vehicles and enhance the security of public spaces. The system also employs blockchain technology to store the ANPR data (license plate number, vehicle make and model, data and time of detection) securely. This ensures that the data is tamper-proof and cannot be altered or deleted.
FRS (Facial Recognition System): We have mainly applied models such as YOLO and OpenCV's own Haar Cascade algorithm for facial recognition. Training these models would require a large number of face and non-face pictures which would eventually increase the accuracy of detection and recognition of said data.
Blockchain integration: To provide security and integrity of the data, Ethereum is used with smart contract functionality which can automatically deduct the fine amount from the culprit's account and thus improve the current E-Challan facility. We plan to implement an E-Wallet functionality using an Application Programming Interface for an existing E-Wallet system. This is to reduce the complexity for constructing the system.

The implementation and demonstration of results achieved in this primitive version of the project can be found here: https://github.com/R-V-J/Advanced-ANPR-FRS-solution.