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Automatic Number Plate Recognition

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Abstract - The Automatic Number Plate Recognition (ANPR) system is designed to detect and recognize vehicle number plates efficiently. Using a custom-trained YOLOv8 model, the system accurately detects number plates in various conditions, including low-light and partially obscured environments. For character recognition, the project leverages PaddleOCR, ensuring precise text extraction even in blurred or challenging scenarios. The system operates independently without requiring requests to external websites, making it more efficient and secure. Detected data such as number plate characters, date, and time are stored in a MySQL database for easy access and management.

***Key Words*:** ANPR, vehicle, Plate detection, Accuracy, MySQL, YOLOv8, AI, OCR, Image Processing, Computer Vision, Advanced, Number-plate Recognition, Camera,

1. INTRODUCTION

The Automatic Number Plate Recognition (ANPR) system is an innovative solution designed to address vehicle identification challenges in both public and private sectors. With the increasing number of vehicles on roads, ensuring security, managing traffic flow, and monitoring vehicle movement have become crucial. The ANPR system is developed to automate this process by accurately identifying and recognizing vehicle number plates. The system integrates artificial intelligence (AI) techniques to improve detection efficiency, making it a reliable solution for real-time applications such as parking management, toll collection, and security monitoring.

This project leverages the powerful YOLOv8 model, known for its fast and accurate object detection capabilities. The custom-trained YOLOv8 model efficiently detects number plates even in challenging conditions such as low lighting, poor visibility, or blurred visuals. This ensures that the system maintains a high success rate in diverse environments. For character recognition, the project employs PaddleOCR, a robust optical character recognition tool that excels at extracting text from images, including distorted or low-quality plates. Together, these technologies provide an effective combination for detecting and recognizing number plates with minimal errors.

Unlike traditional systems that rely on cloud-based services or third-party APIs for recognition, this ANPR solution is designed to operate independently. By processing data locally without requiring external web requests, the system ensures enhanced speed, privacy, and security. This approach is particularly useful in sensitive environments like government facilities, military zones, or remote parking systems where internet access may be restricted or unreliable.

2. Objectives

The primary objective of this project is to develop an efficient **Automatic Number Plate Recognition (ANPR)** system that accurately detects and recognizes vehicle number plates using **YOLOv8** and OCR techniques. The system aims to automate the process of vehicle identification by capturing number plate data and securely storing it in a **MySQL database** for easy access and management. Additionally, the project focuses on ensuring fast processing, improved accuracy in various conditions (such as low light), and providing a scalable solution that can be integrated into security, traffic monitoring, and automated gate systems.

3. ANALYSIS & FEASIBILITY

3.1 Technical Feasibility:

The ANPR system is built using Python and integrates YOLOv8 for plate detection and PaddleOCR for text recognition. The system requires moderate hardware resources, including a 720p USB camera and a Raspberry Pi 4 with 4GB RAM, ensuring compatibility with common devices. The implementation leverages efficient algorithms to ensure fast detection and recognition while maintaining accuracy in real-time processing. Integration with a MySQL database ensures smooth data storage and retrieval, making the solution technically viable for continuous operation.

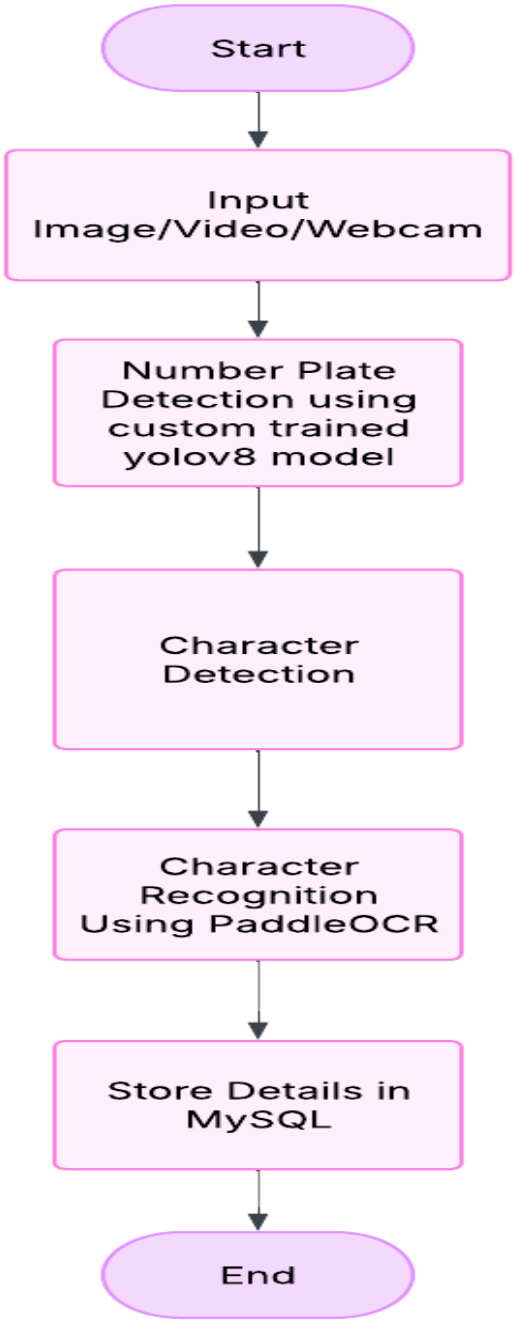
3.2 Financial Feasibility:

The project minimizes costs by utilizing open-source tools such as YOLOv8 and PaddleOCR, reducing licensing expenses. Hardware expenses are limited to essential components like a USB camera and a Raspberry Pi 4, both of which are cost-effective options for this application. Additionally, since the system does not require paid API services or cloud resources for recognition, ongoing operational costs are minimized, making it financially sustainable.

3.3 Resource Feasibility:

The project utilizes widely available resources such as Python libraries, open-source AI models, and standard hardware components. Training the YOLOv8 model requires sufficient labeled data for optimal performance, which can be sourced from publicly available datasets or collected independently. PaddleOCR's ease of integration simplifies the implementation process, reducing the need for complex model training. The use of a MySQL database ensures efficient data storage without additional software requirements, making the solution practical and achievable within the project's scope.

- DFD Diagram:



4. Advantages of ANPR

- Real Time Number-plate Detection & Recognition
- Vehicle Tracking
- Traffic Management
- Works 24/7
- Cost-Effective

5. Applications

- Parking Systems
- Toll Collection
- School & College Security

6. Working

- Detection(YOLOv8)

Purpose: Identify and crop the number plate from the input image or video frame.
The YOLOv8 model (best.pt) is a custom-trained AI model designed to detect number plates.
The model predicts bounding boxes around detected plates with coordinates like (x1, y1, x2, y2).
Using these coordinates, the number plate region is cropped for further processing.

- Recognition :
  Purpose: Extract the text from the detected number plate.
  PaddleOCR is a powerful text recognition model that reads text directly from images.
  It automatically handles blurry, tilted, or dirty number plates without additional training.
  The extracted text is returned as a string.
  e.g. 23bh4962b

- Storing (MySQL Database)
  Purpose: Save the recognized data for future reference.
  The extracted text is saved in your MySQL database under appropriate fields like:
  - date — Date of detection
  - time — Time of detection
  - number_plate — Extracted plate number
  - speed — Vehicle speed (if integrated)

  The data is stored in your anpr_rc table for easy retrieval and management.

7. CONCLUSIONS

The **Automatic Number Plate Recognition (ANPR)** system effectively utilizes **YOLOv8** for accurate vehicle and number plate detection, combined with an OCR-based method for text extraction. By integrating image preprocessing techniques such as noise reduction and edge detection, the system enhances recognition accuracy even in challenging conditions. The captured data is efficiently stored in a **MySQL database**, ensuring organized record-keeping for easy access and management. This solution offers a reliable, fast, and cost-effective approach to automated vehicle identification, making it suitable for security systems, parking management, and traffic monitoring applications.

8. ACKNOWLEDGEMENT

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I extend my heartfelt thanks to my **group members** and **family** for their constant motivation and assistance during this project. Lastly, I acknowledge the efforts of the **open-source community** behind libraries such as **YOLOv8**, and **OpenCV**, whose resources greatly contributed to the successful completion of this project.

9. REFERENCES

- **YOLOv8 Documentation** – https://docs.ultralytics.com
- **OpenCV Documentation** – https://docs.opencv.org
- **Python v3.11.6(best for ANPR)** – https://docs.python.org
- Online tutorials on **Automatic Number Plate Recognition (ANPR)** for enhancing extraction accuracy.