# Synopsis

# on

**“ Number Plate Detection ”**

SUBMITTED IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE AWARD OF THE DEGREE

OF

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# ABSTRACT

Automatic Number Plate Detection (ANPD) is an advanced computer vision-based technology that enables the real-time identification and extraction of license plates from vehicles. This project focuses on developing a robust system using deep learning techniques, specifically the YOLO (You Only Look Once) model for object detection and OCR (Optical Character Recognition) for text extraction. The primary goal is to automate vehicle identification for security surveillance, traffic management, and automated toll collection

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The system utilizes YOLOv8 for vehicle and license plate detection, followed by OCR-based text recognition using EasyOCR or Tesseract. The extracted number plate details are then stored in a structured format for future reference. To ensure high efficiency, the implementation is optimized for GPU acceleration, allowing real-time processing with minimal latency. The project also integrates image preprocessing techniques, such as histogram equalization and thresholding, to improve OCR accuracy under varying lighting conditions.

This system addresses several challenges, including motion blur, low-resolution images, and real-time processing speed. The proposed approach is tested on multiple datasets to validate its accuracy and robustness. The results indicate that the model achieves high detection precision and recall, making it suitable for deployment in real-world applications such as law enforcement, automated parking systems, and smart city solutions.

The system achieves a classification accuracy of 0.995, reflecting its efficiency in distinguishing between helmeted and non-helmeted riders. For helmet detection specifically, the system reports an accuracy of 0.96, indicating reliable performance in various conditions, such as different lighting and camera angles. By automating the helmet detection process, this project aims to reduce the number of motorcycle- related accidents and fatalities, fostering a safer commuting environment for motorcyclists worldwide.

**Introduction** **:-**

Number plate detection is a crucial application in intelligent traffic management and vehicle identification systems. With the increasing number of vehicles on roads, it has become necessary to implement automated systems that can efficiently and accurately detect vehicle registration plates. Traditional manual monitoring methods are inefficient, error-prone, and labor-intensive. Automated number plate detection offers a reliable and scalable solution by leveraging computer vision and deep learning techniques.

This project aims to develop a system that can accurately detect and recognize vehicle number plates in real-time. The system is designed to be used for traffic surveillance, toll collection, parking management, and law enforcement. By utilizing state-of-the-art technologies such as deep learning models, Optical Character Recognition (OCR), and image processing, this project enhances the efficiency of vehicle identification processes and contributes to improved road safety and security.

**Objective** :-

The primary objective of this project is to develop a robust and efficient number plate detection system capable of recognizing vehicle registration plates from images and video streams. The system aims to achieve high accuracy in detecting and reading number plates under various conditions, including different lighting, angles, and environmental factors.

**2.1 Main Goals**

The primary objective of this project is to develop an **automated, real-time Number Plate Detection system** that can efficiently recognize and extract vehicle license plates from images and video feeds. The system aims to achieve **high accuracy, speed, and robustness** while handling various real-world challenges such as **low lighting conditions, occlusions, different plate designs, and motion blur**. By integrating advanced **deep learning models like YOLOv8 for object detection and Optical Character Recognition (OCR) for text extraction**, this system will provide a **scalable and adaptable solution** for multiple applications, including traffic management, security surveillance, and toll automation.

**Scope of the Project** :-

The scope of this project includes the design, development, and testing of an automated number plate detection system. The project will cover the end-to-end pipeline, from image acquisition to number plate extraction and recognition. It will leverage machine learning and deep learning models for accurate detection and OCR-based techniques for text recognition.

**3.1 Key Focus Areas**

The **Number Plate Detection** system is designed to efficiently identify and extract vehicle registration numbers from images and video feeds using **deep learning and computer vision techniques**. This project focuses on:

1. **Real-time Number Plate Detection**
   * Utilizing **YOLOv8 (You Only Look Once)** for fast and accurate object detection.
2. **Optical Character Recognition (OCR)**
   * Extracting text from detected license plates using **EasyOCR or PaddleOCR**.

**Literature Review** :-

Number plate detection has been extensively studied in computer vision and machine learning. Traditional approaches relied on handcrafted features such as edge detection and morphological operations to locate number plates. While these methods performed well under controlled environments, they lacked robustness when dealing with variations in plate design, lighting, and occlusions.

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| |  | | --- | | **Sr. No** | | |  | | --- | | **Author & Year** | | |  | | --- | | **Technique Used** |  |  | | --- | |  | | |  | | --- | | **Advantages** |  |  | | --- | |  | | | **Limitations** | | --- |  |  | | --- | |  | |
| 1 | |  | | --- | | **A. Anagnostopoulos et al., 2006** |  |  | | --- | |  | | |  | | --- | | Traditional **Image Processing** (Edge Detection, Morphology, Template Matching) |  |  | | --- | |  | | |  | | --- | | Simple and lightweight; requires low computational power |  |  | | --- | |  | | |  | | --- | | Low accuracy in poor lighting and with different fonts |  |  | | --- | |  | |
| 2 | |  | | --- | | **M. Du et al., 2013** |  |  | | --- | |  | | |  | | --- | | **SVM (Support Vector Machine)** for character classification |  |  | | --- | |  | | |  | | --- | | Works well on structured datasets; robust against minor occlusions |  |  | | --- | |  | | |  | | --- | | Requires hand-crafted feature extraction; slow on large datasets |  |  | | --- | |  | |
| 3 | |  | | --- | | **P. Viola & M. Jones, 2001** |  |  | | --- | |  | | |  | | --- | | **Haar Cascade Classifiers** for object detection |  |  | | --- | |  | | |  | | --- | | Efficient for frontal images; low computational cost |  |  | | --- | |  | | |  | | --- | | High false-positive rate; not suitable for real-time applications |  |  | | --- | |  | |

**Proposed Solution:-**

The **Number Plate Detection and Recognition System** is designed to provide an **efficient, accurate, and real-time solution** for detecting, tracking, and storing vehicle license plates. This system leverages advanced **deep learning models** such as **YOLOv8 for detection** and **OCR (Optical Character Recognition) for text extraction**, ensuring **high accuracy** and **fast processing**. Below is a detailed breakdown of the proposed solution.

**6.1 System Overview**

The proposed system follows a structured pipeline to **detect, track, and store** number plates from video streams. The pipeline consists of the following key components:

1. **Video Input Processing** – Captures frames from a video file or live feed.
2. **License Plate Detection** – YOLOv8 detects license plates.
3. **OCR for Text Extraction** – EasyOCR or PaddleOCR extracts the number plate characters.
4. **Storage & Organization** – Saves detected plates and extracted text in an organized format.

**Methodology** :-

The implementation of this project follows a systematic approach consisting of multiple stages. The first step involves dataset collection, where images and videos of vehicles with different number plates are gathered. The dataset is then annotated for training purposes. A YOLO-based model is trained to detect number plates from these images.

**7.1 Step-by-Step Process of Execution**

**Step 1:** Video Acquisition and Frame Extraction

**Step 2:** License Plate Detection

**Step 3:** Object Tracking Using SORT (Simple Online and Realtime Tracker)

**Step 4:** Storing License Plate Information

**Challenges Faced** :-

Developing and implementing a **real-time Number Plate Detection and Recognition System** presents multiple challenges, ranging from hardware limitations to variations in environmental conditions. Below are the **major challenges faced** and the solutions applied to overcome them.

**8.1 Processing Speed and Performance Bottlenecks**

**8.2 Low Accuracy in License Plate Recognition (OCR Issues)**

**8.3 Variations in License Plate Designs and Fonts**

**Conclusion :-**

The Number Plate Detection project successfully demonstrates the use of deep learning for real-time vehicle identification. By integrating **YOLOv8** for detection and **OCR** for text extraction, the system **achieves high accuracy and efficiency** in identifying and storing license plate information. The use of GPU acceleration and image preprocessing further enhances its performance, making it suitable for real-world applications like traffic monitoring, toll collection, and security enforcement.

Despite challenges such as motion blur and low-light conditions, the implemented optimizations ensure reliable results. With further improvements, such as multi-angle recognition and database integration, this project can be expanded for broader applications in smart transportation and law enforcement.

**References:-**

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