

**University**

**Of the Punjab**

**Gujranwala**

**Campus**

**COMPUTER VISION**

**PROJECT: Helmet & Number Plate Detection**

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# Project Report

**Helmet & Number Plate Detection Using Computer Vision**

# Abstract

The Helmet and Number Plate Detection system is a computer vision-based project designed to improve road safety by automatically detecting motorcyclists who are not wearing helmets and recognizing vehicle number plates. This system uses deep learning techniques, specifically YOLOv3 for object detection and a CNN model for helmet classification. The project aims to assist traffic authorities in enforcing helmet-wearing regulations and monitoring vehicles.

# Introduction

Road safety is a major concern, and the lack of helmet usage among motorcyclists contributes to severe injuries in accidents. Manual monitoring is inefficient and prone to errors. This project leverages computer vision and deep learning to automate helmet and number plate detection, ensuring efficient and accurate monitoring.

# Objectives:

* Detect motorcycles and identify their riders.
* Classify whether the rider is wearing a helmet.
* Detect and recognize number plates for identification.
* Generate real-time alerts for violations.
* Provide statistical analysis on violations to assist authorities in decision-making.

# Literature Review

Several studies have explored traffic monitoring using computer vision. Techniques like Haar cascades, HOG + SVM, and deep learning have been applied. YOLO-based models have shown high accuracy in object detection tasks. Our system combines YOLOv3 for object detection with a CNN-based helmet classifier to improve efficiency.

# Methodology

## **1. System Architecture**

The system consists of the following components:

* Image/Video Input: Live video feed or pre-recorded footage.
* YOLOv3-based Object Detection: Identifies motorcycles and number plates.
* Helmet Classification (CNN Model): Determines if a rider is wearing a helmet.
* Result Processing & Alert Generation: Stores violations and displays results.
* Data Logging & Analysis: Tracks violations over time to generate reports.

## **2. Technologies Used**

* Programming Language: Python
* Libraries: OpenCV, NumPy, TensorFlow/Keras, imutils, Pandas
* Models Used: YOLOv3 for object detection, CNN for helmet classification
* Hardware Requirements: GPU-enabled system for faster inference

# 3. Implementation

The project is implemented in Python, leveraging OpenCV and deep learning frameworks. The key steps include:

### **Loading Pretrained Models:**

* + YOLOv3 model for object detection.
  + CNN model (helmet-nonhelmet\_cnn.h5) for helmet classification.

### **Video Processing:**

* + Read input video and preprocess frames.
  + Perform object detection using YOLOv3.
  + Extract the helmet region and classify it using CNN.

### **Annotation & Output:**

* + Annotate detected objects with bounding boxes.
  + Save results and generate alerts.

### **Data Analysis & Reporting:**

* + Store violation records in a database.
  + Generate statistical reports for authorities.

# Results & Discussion:

The system was tested on real-world video footage. The results showed:

* High accuracy in detecting motorcycles and number plates.
* Effective helmet classification, distinguishing between helmet and non-helmet cases.
* Real-time processing, making the system suitable for live monitoring.
* Statistical insights, allowing authorities to track violation trends over time.

# Challenges encountered:

* Lighting conditions affecting detection accuracy.
* Blurred images leading to false negatives.
* Small-sized number plates being hard to detect.
* Real-time performance limitations due to hardware constraints.

# Conclusion & Future Work

This project successfully implemented an automated helmet and number plate detection system using computer vision and deep learning. The system can aid traffic authorities in enforcing helmet laws and monitoring road safety.

# Future Enhancements:

* Improving number plate recognition with OCR techniques.
* Expanding the dataset for better generalization.
* Deploying the system on edge devices for real-time processing.
* Integrating cloud-based reporting for authorities to access data remotely.
* Implementing AI-driven analytics to predict high-risk areas.

# References

* Redmon, J., & Farhadi, A. (2018). YOLOv3: An Incremental Improvement.
* Chollet, F. (2017). Deep Learning with Python.
* OpenCV Documentation.
* TensorFlow Documentation.