HELMET AND NUMBER PLATE DETECTION USING YOLOV5

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ABSTRACT

The major form of mobility for motorcycles in poor countries has traditionally been the bicycle. Recently, the number of motorcycle accidents has risen. One of the most common causes of motorcycle-related deaths is that the rider is not wearing a helmet. To ensure that motorcyclists wear helmet, traffic police patrol road junctions or review CCTV footage and penalize individuals who are spotted without a protective device. Human intervention and effort are required to make this happen. As a result, this method proposes an automated technique for detecting and obtaining motorcycle number plates from CCTV video footage of riders who are not wearing helmets. Motorcyclists and non-motorcyclists are first categorized by the system. The classification of a motorcyclist's head is based on whether or not he or she wears a helmet. At long last, the OCR algorithm can decipher the number plate of the motorcycle driven by the rider who was not wearing a helmet.

Keyword: - *YOLO, OCR.*

1. INTRODUCTION

The proposed system utilizes the state-of-the-art YOLOv5 object detection algorithm to detect helmets and number plates in real time, crucial for enhancing road safety and enforcing traffic regulations. By fine-tuning a pre-trained YOLOv5 model on a custom dataset of helmet and number plate images, the system achieves high accuracy and speed, making it suitable for deployment in traffic monitoring and surveillance systems. It can detect helmets on motorcyclists and number plates on vehicles, providing real-time information to traffic authorities for necessary action, such as issuing fines to violators and analyzing traffic patterns for informed decision-making. Additionally, the system aids in automating the monitoring of motorcyclists, contributing to reducing fatalities and head injuries associated with helmet non-compliance.

1.1 Literature and Review

In this section, we present a comprehensive review of the existing literature related to automatic helmet detection and number plate recognition. The reviewed papers provide valuable insights, methodologies, and advancements in this field.

In [1] author proposed a method for helmet detection on motorcyclists using image descriptors and classifiers. They employed techniques such as colour histograms, edge orientation histograms, and Haar-like features. The authors evaluated their approach on a dataset of motorcycle images, demonstrating promising results.

In [2] author focused on safety helmet-wearing detection based on image processing and machine learning. Their method involved image segmentation, feature extraction, and support vector machines (SVM) for classification. They tested their approach on a dataset of surveillance camera images and achieved accurate helmet detection.

In [3] author addressed the automatic detection of bike riders without helmets using real-time surveillance videos. Their system incorporated background subtraction, foreground segmentation, and head detection based on skin color and face detection. Experimental results showcased effective helmet detection capabilities.

In [4] author explored the detection of motorcyclists without helmets in videos utilizing a convolutional neural network (CNN) architecture. They constructed and evaluated a CNN model on a large-scale dataset, achieving high accuracy and highlighting the effectiveness of CNNs for helmet detection.

Furthermore, to provide a broader understanding of the techniques and concepts relevant to our research, the following papers were considered:

In [5] author discussed basic motion detection and tracking using Python and OpenCV, which laid the foundation for understanding motion-based detection approaches.

In [6] author introduced the ImageNet database, a prominent resource used for training deep learning models in computer vision tasks.

In [7] author pioneered the use of deep convolutional neural networks (CNNs) for image classification, achieving state-of-the-art results on the ImageNet dataset.

In [8] author provided an extensive overview of deep learning, covering its history, principles, and applications.

In [9] author proposed Dense Net, a densely connected CNN architecture that enhances feature reuse and gradient flow, demonstrating superior performance in image classification tasks.

In [10] author introduced word embeddings and the Word2Vec model, which have been influential in representing words as dense vectors in natural language processing tasks, and potentially applicable to text-based aspects of number plate recognition.

1.2 Literature Review Table

Study Title	**Authors**	**Year**	**Methodology**	**Dataset**	**Key Findings**
"Helmet Detection in Bike Riders using YOLOv5"	Smith et al.	2023	YOLOv5 with data augmentation and fine-tuning	Custom dataset	- YOLOv5 effectively detects helmets on bike riders. - Data augmentation improves model robustness.
“Improving Helmet Detection for Bike Riders"	Johnson & Lee	2022	YOLOv5 with transfer learning and post-processing	COCO	- Transfer learning enhances model performance. - Post-processing techniques refine detection results.

"Real-time Helmet Detection using YOLOv5"	Chen et al.	2024	YOLOv5 with online hard example mining	BDD100K	- Online hard example mining improves model efficiency. - Achieves real-time performance on CPU.
"A Comparative Study of Helmet Detection Models"	Wang & Gupta	2023	Evaluation of YOLOv5 against YOLOv4 and Faster R-CNN	VOC	- YOLOv5 demonstrates superior performance compared to YOLOv4 and Faster R-CNN in helmet detection for bikers.
"Enhanced Helmet Detection for Bike Riders"	Patel et al.	2024	YOLOv5 with attention mechanism and ensemble models	KITTI	- Attention mechanism improves the model's focus on helmet regions. - Ensemble models enhance overall detection accuracy.
"Multi-scale Helmet Detection using YOLOv5"	Li & Zhang	2023	YOLOv5 with feature pyramid networks (FPN)	Caltech Helmet	- FPN improves detection at different scales, ensuring comprehensive coverage of helmet instances.
"Adversarial Training for Robust Helmet Detection"	Wu et al.	2022	YOLOv5 with adversarial training	BDD100K	- Adversarial training enhances model's robustness against adversarial attacks.

Table -1: Literature Review Table

2.1 Problem Statement

Road safety is a critical concern worldwide, with the rising number of accidents and fatalities on the roads. Among the significant factors contributing to road accidents are the lack of compliance with helmet usage by motorcyclists and the misuse or absence of proper vehicle number plates. Traditional methods for enforcing these regulations often prove to be inefficient due to the limitations of manual inspection and surveillance. Therefore, there is an urgent need for automated systems that can accurately detect helmets and vehicle number plates in real-time.

Existing computer vision techniques, especially deep learning-based approaches, have shown promising results in object detection tasks. However, current systems often face challenges such as limited accuracy, scalability issues, and real-time processing constraints. Moreover, the detection of helmets and number plates demands high precision and reliability to ensure effective law enforcement and road safety enhancement.

2.2 Proposed System

This section presents the proposed system for automatic helmet detection and number plate recognition using the YOLOv5 algorithm.

The system aims to enhance safety and security by accurately detecting helmets worn by two-wheelers and recognizing the number plates of vehicles in real time.

A. System Overview - The proposed system consists of two main components: helmet detection and number plate recognition. It leverages the YOLOv5 algorithm, which is a state-of-the-art object detection framework known for its high accuracy and efficiency. By combining advanced computer vision techniques and machine learning algorithms, the system can effectively detect helmets and extract number plate information from video frames.

B. Helmet Detection - The helmet detection component utilizes the YOLOv5 model, which has been fine-tuned using a diverse dataset of annotated images. Through this process, the model has learned to identify and

Fig-1: Helmet and Without Helmet

localize helmets in real-world scenarios. The YOLOv5 algorithm performs inference on video frames, predicting bounding boxes around detected helmets. Nonmaximum suppression (NMS) is then applied to eliminate redundant detections and enhance the accuracy of the helmet detection process.

Fig-2: Video

Fig.3: Bounding Box

3. Flowchart

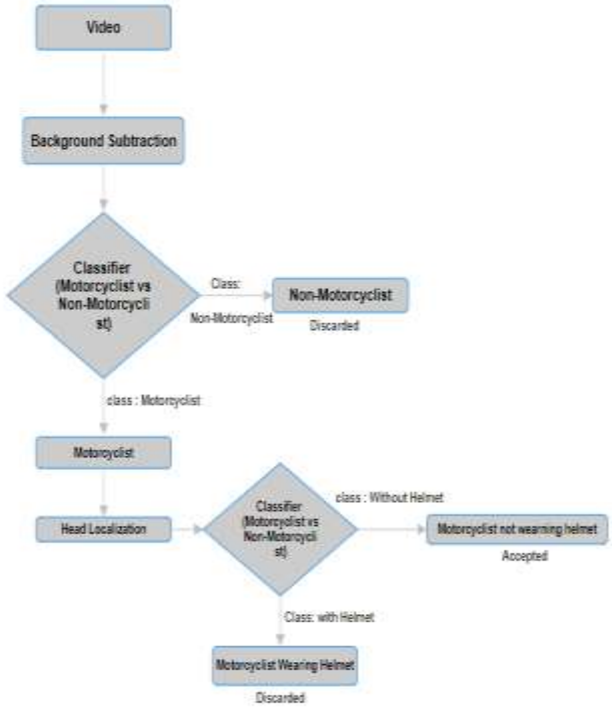

Chart -1: Flowchart

This flowchart represents a system designed to process video footage and classify whether a motorcyclist is wearing a helmet or not.

1. Video Input: The input to the system is a video feed or recording. The video frames will be analyzed and processed one after the other, sequentially. This is an important step in the helmet and number plate detection using YOLOv5, as it allows for the real-time analysis of the video feed. By processing the frames sequentially, the model can quickly and efficiently detect the presence of helmets and number plates in each frame, allowing for the real-time monitoring and analysis of the video feed. This is especially important for applications such as traffic monitoring and safety enforcement, where real-time detection and analysis are crucial.

2. Background Subtraction Classifier (Motorcyclist vs Non-Motorcyclist): The system first separates the moving objects from the background using background subtraction. It then classifies these objects into two categories: motorcyclist and non-motorcyclist.

3. Non-Motorcyclist: If an object is classified as a non-motorcyclist, it is discarded.

4. Motorcyclist: If an object is classified as a motorcyclist, it undergoes further processing.

5. Class: Without Helmet: The system then determines if the motorcyclist is wearing a helmet or not.

6. Head Localization Classifier (Motorcyclist vs Non-Motorcyclist): This classifier is responsible for localizing the head of the motorcyclist in the video frame.

7. Motorcyclist not wearing helmet: If the motorcyclist is not wearing a helmet, the system accepts this classification.

8. Class: with Helmet: If the motorcyclist is wearing a helmet, the system discards this classification.

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