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Automatic Helmet and Number Plate Detection System

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Abstract –
Automatic helmet and number plate detection systems are at the forefront of modern traffic management and law enforcement. Leveraging cutting-edge computer vision and machine learning technologies, these systems offer real-time identification and tracking of helmets worn by motorcycle riders and number plates on vehicles. This abstract provides an overview of their significance, working principles, and implications for road safety. These systems are designed to enhance road safety by swiftly identifying and addressing violations. For helmets, they detect instances where riders are not wearing protective headgear, allowing authorities to enforce safety regulations. On the other hand, number plate recognition supports law enforcement by aiding in vehicle identification, tracking, and incident investigation. The efficiency of automatic detection systems lies in their real-time operation, reducing response time and the risk of human error. Furthermore, they facilitate data collection that can be invaluable for traffic analysis, monitoring, and decision-making. Challenges include ensuring high accuracy, robustness under varying conditions, and adaptability to different scenarios. Continuous research and development efforts aim to improve the reliability and effectiveness of these systems. As technology advances, automatic helmet and number plate detection systems are poised to play an increasingly vital role in enhancing road safety and traffic management. Their ability to contribute to safer roadways and more effective law enforcement is of paramount importance in the modern world.

KEYWORDS: *Helmet Detection, Number Plate Detection, Motorcycle, convolutional neural networks (CNNs), Safety, Deep learning*

I. INTRODUCTION

Motorcycle Accidents have been rapidly growing throughout the years in many countries. The helmet is the main safety equipment of motorcyclists. However, many drivers do not use it. The main goal of helmet isto protects the riders head in case of an accident. In such a case, if the motorcyclist does not use a helmet, it can be fatal. It is not possible for traffic police force to watch every motorcycle and detect the person who is not wearing a helmet. There was need to propose an automated system that monitors motorcycles and detects the persons wearing helmet or not and a system to detect number plates. In India, road accidents are increasing very rapidly and lots of deaths occur due to head injuries as number of people does not wear helmets. Currently all major cities have a CCTV surveillance system that requires lots of resources and also personnel that cannot sustain the efficiency and productivity for a long time. Thus, there was a need for a system that would do all these things automatically. This system works exactly on these terms it automatically detects the people who are not wearing a helmet and a system that detects number plates of the motorcycles and extracts the vehicle number which would help find the motorcyclist to be penalize. By doing this we propose that rate of accidents will reduce and many lives will be saved.

II. RESEARCH METHODOLOGY

Proposed Model: Our Proposed model takes user input as real-life traffic images and processes it to find motorcycles riders from it.It then checks whether the riders are wearing helmet or not and classifies them into two categories as to be further processing or to be discarded. Then it detects the number plate of the motorcycle and then using OCR algorithm it identifies the number plate and extracts its vehicle number. YOLO: It is a real time object detection algorithm that is used to identify specific objects from video, photos and live feeds.

YOLO is a Convolutional Neural Network (CNN) for performing object detection in real-time. CNNs are classifier-based systems that can process input images as structured arrays of data and recognize patterns between them (view image below). YOLO has the advantage of being much faster than other networks and still maintains accuracy. It allows the model to look at the whole image at test time. so, its predictions are informed by the global context in the image. YOLO and other convolutional neural network algorithms "score" regions based on their similarities to predefined classes. High-scoring regions are noted as positive detections of whatever class they most closely identify with. For example, in a live feed of traffic, YOLO can be used to detect different kinds of vehicles depending on which regions of the video score highly in comparison to predefined classes of vehicles This algorithm is used in the initial step for detecting motorcycle riders.OCR: Optical character recognition is a technology that converts typed or handwritten text and printed images containing text into machine-readable digital data format. OCR algorithms help turn large amounts of paper documents into digital files, facilitating text storage, processing, and searching. A modern OCR training workflow follows a number of steps:

1: Acquisition Obtaining non-editable text content from scanned documents of all types, from flatbed scans of corporate archival material through to live surveillance footage and mobile imaging data.

2: Pre-processing Cleaning up the source imagery at an aggregate level so that the text is easier to discern, and noise is reduced or eliminated.

3: Segmentation and feature extraction Scanning of the image content for groups of pixels that are likely to constitute single characters, and assignment of each of them to their own class. The machine learning framework will then attempt to derive features for the recurring pixel groups

III. OBJECTIVE

- Ensuring helmet usage improves road safety, reducing head injuries in accidents, while number plate detection enforces traffic regulations and security
- Automation reduces the burden on law enforcement, making policing more efficient and cost-effective.
- Automated systems save money by eliminating the need for additional personnel and reducing corruption opportunities.

The primary objective of a helmet is to protect the driver's head in case of an accident or fall from a bike. It should try to identify whether the motorcyclists wearing a helmet or not in real- time.

IV. LITERATURE REVIEW

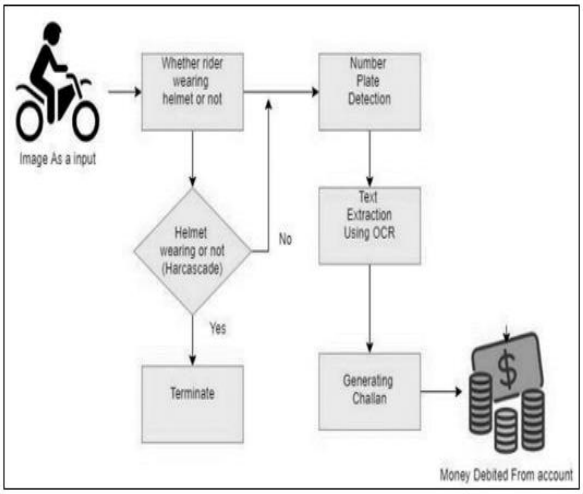
[1] J. Chiverton , "Helmet presence classification with motorcycle detection and tracking" IET, 2012 This paper J. Chiverton proposed system such that the past few years, many algorithms and models have been used for helmet detection, but this paper is used the background subtraction method to separate the background of the bikers and then isolate the head of the biker and identify the features of the helmet. It uses Referred following Techniques : 1.HelmetDetection. 2. Motorcycle detection and tracking. This system only detect helmet and number plate but does not sending alert to the motorcyclist.

[2]. DETECTION OF HELMET USING YOLOV4 AND GENERATION OF AN E-CHALLAN Authors: Anirban Ashok Rudra, Shrish Kiran Vaidya, Kaushal Rajbahadur Singh Abstract: Motorcycle accidents have been on the rise in several countries over the years. Any smart traffic system must include automated detection of offenders of traffic rules. Motorcycles are one of the main ways of transportation in a country like India, where population density is considerable in all major cities. Over 37 million people in India ride two-wheelers. Most motorcyclists do not wear helmets in the city or even on highways, according to reports. In most motorcycle accident scenarios, wearing a helmet can lower the likelihood of a biker suffering a head or severe brain injury. As a result, a technology for automatically detecting helmets is required for road safety. As a result, using a CNN-based algorithm (YOLOv4), custom object detection models are built. The License Plate is retrieved and the License Registration number is recognized using an OCR whenever a Helmetless rider is detected.

[3]. HELMET DETECTION AND LICENSE PLATE RECOGNITION USING YOLO MODEL Authors:Prof. Muneshwar R. N., Miss. Pote Pranavi Vijay, Mr. Bhawar Shivam Ashok, Miss. Jadhav Pratiksha Sitaram, Miss. Gite Nikita Rajendra. Abstract: In today's world, the increasing use of Motorcycles has prompted increment in road accidents and injuries. Helmet not used by the motorcycle rider is one of the major causes. Currently, one procedure is to

physically check use of helmet at the pavement junction or through the CCTV footage video, which requires human energy to detect motorcyclists without helmet. The object detection and tracking are the important steps of computer vision algorithm. The robust object detection is the challenge due to variations in the scenes. Another biggest challenge is to track the object in the occlusion conditions. Hence in this approach, the moving objects detection using OpenCV object detection API. Further the location of the detected object is pass to the object tracking algorithm. A YOLO object tracking algorithm is used for robust object detection. The proposed approach is able to detect the object in different illumination and occlusion. The system extracts objects class based on feature extracted. The system uses You Only Look Once (YOLO)-Darknet deep learning framework which consists of Convolutional Neural Networks trained on Common Objects in Context (COCO) and combined with computer vision.

V. BLOCK DIAGRAM AND WORKING



Designing an automatic helmet and number plate detection system using a Raspberry Pi 5 can be a complex project, involving hardware components, software development, and machine learning. Below is a detailed design for such a system. Please note that this is a high-level overview, and you may need to adapt and expand upon it based on your specific requirements and expertise. Image / Video Input: Capture images or video streams from surveillance cameras, CCTV, or other sources.

Preprocessing: image preprocessing to enhance quality and reduce noise and frame extraction from video for analysis Feature Extraction: Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to
more manageable groups. So, when you want to process it will be easier. Classification: Classification is a supervised machine learning approach, in which the algorithm learns from the data input provided to it and then uses this learning to classify new Helmet Detection: utilizing deep learning model (eg: CNN) for real time helmet detection. Detecting the Presence or Absence of helmets on motorcycle riders. Number Plate Recognition: implementing Optical Character Recognition (OCR) for number plate recognition. Extracting alphanumeric characters from detected number plates. Handles Variations in Fonts, Sizes and lighting conditions.

VI. HARDWARE COMPONENTS

1. Raspberry Pi 5: This will serve as the core processing unit for the system.
2. Camera Module: Use a compatible camera module for capturing images and video. Raspberry Pi Camera Module V2 is a popular choice.
3. Helmet Detection Sensor: You can use ultrasonic or infrared sensors to detect the presence of helmets.
4. Number Plate Recognition Camera: A high-resolution camera for capturing number plates.
5. Motor/Actuator (optional): If you want to automate actions like barrier opening (e.g., in parking lots), you may need a motor or actuator.
6. LEDs/Buzzers (optional): For visual or auditory alerts.
7. Power Supply: Ensure you have an adequate power supply for the Raspberry Pi and all connected peripherals.

Software Components:

1. Raspberry Pi OS: Install the Raspberry Pi OS on your Raspberry Pi.
2. Python: Most of the software development can be done in Python.
3. OpenCV: For image and video processing.
4. Tensor Flow/Keras: For machine learning tasks like helmet detection and number plate recognition.
5. YOLO (You Only Look Once): A deep learning framework for object detection, including helmet detection.
6. ANPR (Automatic Number Plate Recognition) Library There are open-source ANPR libraries available. You may choose one based on your needs.

VII. SYSTEM ARCHITECTURE

1. Capture Helmet Status:
- Use the helmet detection sensor to check if a person is wearing a helmet.
- Interface the sensor with Raspberry Pi (e.g., via GPIO pins).
- Capture an image when a person approaches.

2. Helmet Detection:
- Process the captured image using OpenCV and YOLO to detect the presence of a helmet.
- If a helmet is detected, proceed to the next step; otherwise, issue an alert (e.g., turn on an LED or sound a buzzer).

3. Capture Number Plate:
- Use the number plate recognition camera to capture the number plate of the vehicle.
- Process the image to isolate the number plate.

4. Number Plate Recognition:
- Use a pre-trained ANPR model to recognize and extract the number plate characters from the image.
- Verify the number plate against a database, if needed, for authentication.

5. Action (Optional):
- Depending on your application, you can trigger an action, such as opening a barrier or sending alerts, based on the results of helmet detection and number plate recognition.

6. User Interface (Optional):
- Create a web-based or GUI-based interface to display the results, log data, and provide user interaction.

7. Logging and Data Storage:
- Log the detected helmet status and number plates along with timestamps for record-keeping and analysis.

8. Networking (Optional):
- If needed, configure the Raspberry Pi for network communication to enable remote monitoring and control.

9. Power Management:
- Ensure proper power management and backup systems to prevent data loss in case of power failures.

10. Security:
- Implement security measures to protect the system from tampering or unauthorized access.This is a high-level design, and you'll need to delve into specific libraries, sensors, and components in more detail, as well as fine-tune the machine learning models for helmet detection and number plate recognition. Developing and testing each component incrementally is essential to ensure the system's accuracy and reliability.

VIII. PERFORMANCE PARAMETERS

Accuracy:
This measures how well the system correctly identifies helmets and number plates. It's usually expressed as a percentage.
Precision:
Precision indicates the proportion of true positives (correctly identified helmets and number plates) among all positive detections. It helps assess the system's ability to avoid false alarms.
Robustness:
The system's ability to perform reliably under different lighting conditions, weather, and scenarios.
Hardware Requirements:
The hardware resources needed to run the detection system efficiently, including CPU, GPU, or specialized hardware.
Processing Speed:
This parameter refers to the system's ability to process video frames or images in real-time or near-real-time, which is critical for practical applications, especially in traffic monitoring.

IX. ADVANTAGES

• Improved safety: Helmet detection ensures that motorcyclists and scooter riders wear helmets, reducing the risk of head injuries in case of accidents.
Properly worn helmets can save lives, and automatic detection ensures compliance with safety regulations.
• Traffic management: Number plate detection helps in monitoring and managing traffic by identifying and tracking vehicles more efficiently. It aids in
Enforcing traffic rules, such as identifying and penalizing vehicles with expired registrations, outstanding fines, or stolen plates.
• Enhanced law enforcement: These systems assist law enforcement agencies in identifying and tracking vehicles involved in criminal activities. They
can quickly identify stolen or suspect vehicles by scanning their number plates. Increased automation: Reduces the need for manual monitoring and
Enforcement, saving time and resources. Allows law enforcement personnel to focus on more critical tasks.
• Real-time data collection: These systems can provide real-time data on the number of vehicles on the road, traffic flow, and safety compliance.
This data can be used for traffic management, urban planning, and accident analysis.

X. CONCLUSION

Automatic helmet and number plate detection systems offer significant benefits for traffic management, law enforcement, and safety. These systems leverage advanced computer vision and machine learning technologies to accurately identify helmets and number plates in real-time. Their performance is crucial for improving road safety and ensuring compliance with regulations

XI. REFERENCES

[1].Helmet detection and license Plate Recognition using YOLO model Authors: Prof. Muneshwar R. N.Miss. Pote Pranavi Vijay Mr. Bhawar Shivam Ashok
Miss. Jadhav Pratiksha Sitaram Miss. Gite Nikita Rajendra.
[2]. Helmet Detection and Number Plate Recognition using Machine Learning Author: Gauri Marathe1, Pradnya Gurav2, Rushikesh Narwade3, Vallabh Ghodke4, Prof. S. M. Patil5
[3]. DETECTION OF HELMET USING YOLOV4 AND GENERATION OF AN E-CHALLAN
Authors: Anirban Ashok Rudra Shrish Kiran Vaidya Kaushal Rajbahadur Singh
[4]. Automatic Number Plate Detection in Vehicles using Faster R-CNN Authors: N. Palanivel Ap T. Vigneshwaran
[5]. R. R. V. e. Silva, K. R. T. Aires and R. d. M. S. Veras," Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers,"
[6]. P. Doungmala and K. Klubsuwan," Helmet Wearing Detection in ThailandUsing Haar Like Feature and Circle Hough Transform on Image Processing,"
[7]. Li, J., Liu, H., Wang, T., Jiang, M., Wang, S., Li, K., Zhao, X. (2017, February). Safety helmet wearing detection based on image processing and machine learning.
[8]. C. Vishnu, D. Singh, C. K. Mohan and S. Babu," Detection of motorcyclists without helmet in videos