IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

HELMET DETECTION AND NUMBER PLATE RECOGNITION BY USING MACHINE LEARNING

Nimbalkar Abhijit Kishor
Department of Computer Engineering
Pune, Maharashtra

Jadhav Aniket Ramesh
Department of Computer Engineering
Pune, Maharashtra

Shirale Nikhil Rajesh
Department of Computer Engineering
Pune, Maharashtra

Gadekar Niraj Sanjay
Department of Computer Engineering Pune, Maharashtra

Prof..Bhosale.S.B
Assistant Professor
Department of Computer Engineering Pune, Maharashtra

Abstract: In many developing countries, motorcycles are one of the most common modes of transportation. Unfortunately, the number of motorcycle-related accidents has been increasing in recent years, with the lack of helmet usage being a major contributor to fatalities. Traditionally, helmet enforcement is carried out manually by traffic police at road junctions or by reviewing CCTV footage to identify violators. However, these methods are labor-intensive and require continuous human involvement. To overcome these challenges, this paper proposes an automated system that detects motorcyclists who are not wearing helmets and identifies their vehicle registration numbers from CCTV footage. The system begins by classifying moving objects as either motorcycles or non-motorcycles. Once a motorcycle is detected, it analyzes the rider's head region to determine whether a helmet is present. If a helmet is not detected, the system proceeds to locate the motorcycle's number plate and uses Optical Character Recognition (OCR) to extract the characters for further.

Keywords—Helmet Detection; Machine Learning; OpenCV; OCR.

I. INTRODUCTION

In addition to other safety measures, wearing a helmet is one of the most critical steps motorcycle riders can take to protect themselves. Riders and passengers who wear helmets significantly increase their chances of surviving an accident compared to those who don't.

Although wearing a helmet is legally required for all motorcyclists, many still choose to ride without one, ignoring the potential dangers. While police officers have made efforts to enforce helmet laws manually, these measures have proven to be inadequate in practice. As helmets are the primary safety equipment for riders in developing countries, the continued neglect of their use has contributed to a steady rise in fatalities year after year.

II. OBJECTIVES

study aims to:

The aim of this study is to compare the effectiveness of traditional machine learning (ML) models, such as Support Vector Machines and Random Forests, with deep learning (DL) models like Convolutional Neural Networks and Autoencoders in accurately detecting various types of fabric defects.

The study will assess each model's performance based on key metrics—accuracy, precision, recall, and F1 score—across different defect types, including holes, stains, misweaving, and irregular patterns, to identify which models are most reliable for defect detection.

Additionally, it will evaluate the scalability and generalization ability of deep learning models in handling complex and diverse fabric textures, especially given their advantage of not requiring manual feature extraction, unlike traditional ML models.

Finally, the research will analyze the strengths and weaknesses of each model in terms of computational efficiency, ease of deployment, and their practical applicability in real-world manufacturing environments.

III. MOTIVATION

The methodology outlines the various stages of system development, detailed in Section A. Section B describes the system architecture and includes both the development stages and a flow diagram for better visualization. The complete methodology also covers the software design and development of the automated system.

A. Stages of Development:
The system was developed through five key stages:

Data Collection and Classification: Images were collected and categorized into positive and negative samples. Machine Training: The system was trained using the OpenCV library, leading to the creation of HAAR cascades. Text Extraction: Optical Character Recognition (OCR) was used to extract text from number plates.

Challan Generation: The extracted number plate text was used to generate traffic challans.

User Interface Development: A user-friendly application was developed to allow users to view and pay their fines from anywhere in the world.

IV. ARCHITECTURE

The architecture of the helmet detection and number plate recognition system combines deep learning-based object detection, classification, and optical character recognition (OCR) techniques. The system is designed to automatically detect whether motorcycle riders are wearing helmets and to identify vehicle number plates from images or video feeds.

1.System Architecture Overview

The system is organized into two main functional modules:

- **Helmet Detection Module** – Identifies motorcycles and determines whether the rider is wearing a helmet.
- **Number Plate Recognition Module** – Detects the vehicle's number plate and extracts the alphanumeric characters for identification.

2.Detailed Architecture Breakdown Step 1: Input Image/Video Stream

- **Input Source**: The system can process both live video feeds from traffic surveillance cameras and individual still images.
- **Preprocessing**: Before analysis, the input data is preprocessed through techniques such as resizing, color adjustment, and normalization to enhance model performance.

Step 2: Helmet Detection Module

This module detects motorcycles and evaluates whether the rider is wearing a helmet.

- **Vehicle Detection**:
  - Pre-trained deep learning models like YOLOv5, Faster R-CNN, or SSD are used to locate motorcycles in the image.
  - These models are trained on datasets with labeled motorcycles to ensure high detection accuracy.
- **Rider and Helmet Detection**:
  - After identifying a motorcycle, the system isolates the rider using bounding boxes and checks for the presence of a helmet.
  - Classification models such as MobileNet, VGG, or ResNet are then used to determine if the detected region (typically the rider's head) contains a helmet.
  - This is framed as a binary classification task, where the result is either "helmet" or "no helmet."

Step 3: Number Plate Recognition Module

This module handles the detection and character recognition of vehicle number plates.

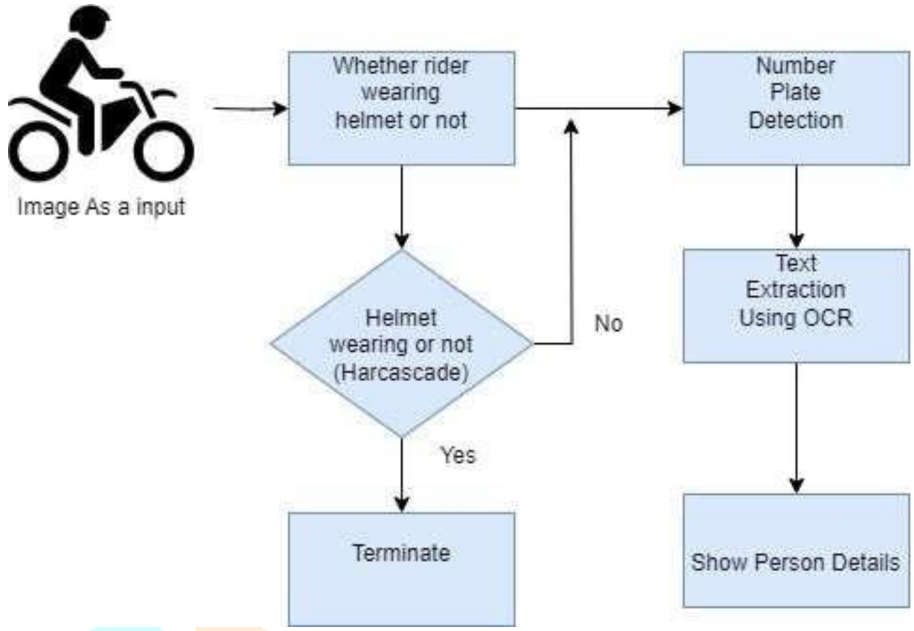
- **Number Plate Detection**:
  - Models like YOLO, SSD, or EfficientDet are trained specifically to detect rectangular number plate regions.
  - Non-Maximum Suppression (NMS) is applied to select the most accurate

bounding box and eliminate duplicates.

- **Character Segmentation and Recognition**:
  - **Segmentation**: Image processing techniques (e.g., thresholding or edge detection) are used to segment the number plate into individual characters.
  - **OCR**: A neural network-based OCR system (such as Tesseract OCR or a CRNN – Convolutional Recurrent Neural Network) is used to recognize characters from the segmented image.
  - **Sequence Processing**: In some cases, LSTM (Long Short-Term Memory) models are employed to read the entire number plate as a sequence, improving recognition accuracy for connected or distorted characters.

Step 4: Post-Processing and Validation

- **Validation Rules**:
  - The recognized number plate is checked against standard formatting rules (e.g., length, character types).
  - Helmet detection is also cross-validated if a motorcycle is identified.
- **Error Handling**:
  - Confidence scores from the detection and recognition models are used to assess the reliability of the results.
  - Frames with low confidence scores are flagged for manual review or further processing.



3. Workflow Diagram

The architecture can be represented in a workflow format:

1. **Image/Video Input →**
2. **Preprocessing →**
3. **Motorcycle and Rider Detection →**
    - Motorcycle detected?
    - Yes: **Helmet Detection** → Helmet Present?
    - Yes: Proceed to **Number Plate Detection**
    - No: Flag Violation → Proceed to **Number Plate Detection**
    - No: Ignore frame
4. **Number Plate Detection →**
    - **OCR and Validation** → Store Results in Database / Trigger Alert

V. PROBLEM STATEMENT

The proposed approach begins by capturing real-time images of road traffic and identifying two-wheelers among the other vehicles on the road. It then checks whether both the rider and pillion rider are wearing helmets. The system also detects unsafe or non- standard helmets, which should be treated as traffic violations. Additionally, riders wearing caps instead of helmets are flagged as violating traffic safety rules.

VI. EXISTING SYSTEM

Existing systems for helmet detection and number plate recognition using machine learning have shown great potential. Many of these systems rely on models like YOLO (You Only Look Once), with versions like YOLOv5 and YOLOv8 proving effective for real-time detection of helmets and vehicles. These models work by identifying key areas, such as motorcycles and their riders, and then classifying whether a helmet is being worn. They also extract the vehicle's license plate using Optical Character Recognition (OCR) for text recognition. This approach has delivered accurate results even in challenging lighting and environmental conditions, achieving high precision and recall in real-world scenarios.

VIII. RESULTS

- The system successfully detects two-wheeler riders on the road.
- It accurately identifies whether the rider is wearing a helmet. If the rider is not wearing one, the system automatically detects the vehicle's number plate. An image of the number plate is then processed using Optical Character Recognition (OCR) to extract the vehicle's registration number. Based on this information, a challan is generated for the respective vehicle.

IX. CONCLUSION

The system has successfully achieved its primary goal of detecting two-wheeler riders. It can determine whether a rider is wearing a helmet, and if not, it proceeds to identify the vehicle's number plate. This image is then processed using Optical Character Recognition (OCR) to extract the registration number, and a challan is generated for the corresponding vehicle.

- To improve the system's accuracy and readiness for real-world deployment, several additional features can be considered:
- Detecting and flagging helmets that do not meet safety standards, as they should also be treated as traffic violations.
- Identifying riders wearing caps (as shown in Fig. 4), which should be classified as non-compliant.
- Recognizing turban-wearing individuals as a special case that may require specific handling.

Considering these special cases will make the system more robust and suitable for real-life application. With these enhancements, the project would be fully prepared for commercial use and could represent a major step forward in traffic law enforcement and automation.

X. ACKNOWLEDGMENT

We would like to convey our heartfelt gratitude towards the Department of Computer Engineering at Jaihind College of Engineering, Kuran for providing us with every tool and resource possible, assistance, and guidance necessary to complete this research.

XI. REFERENCES

[1] News Mobile, ' Chill your head while riding bike with AC helmet' , 25- Dec-2017. [Online]. Available: http://newsmobile.in/articles/2017/12/25/chill-headriding- bike-helmet/. [Accessed: 30- Nov- 2019]

[2] The Times of India, ' Helmet must for pillion riders in Karnataka from Jan 12' , 08-Jan-2016. [Online]. Available: https://timesofindia.indiatimes.com/city/bengaluru/Helmetmust- forpillion-riders-in-Karnataka-from-Jan- 12/articleshow/50499061.cms. [Accessed:30- Nov- 2019]

[3]G. Sasikala, K. Padol, A. A. Katekar and S. Dhanasekaran, " Safeguarding of motorcyclists through helmet recognition, " 2015 International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM), Chennai, 2015, pp. 609-612.

[4]N. Boonsirisumpun, W. Puarungroj and P. Wairotchanaphuttha, " Automatic Detector for Bikers with no Helmet using Deep Learning," 2018 22nd International Computer Science and Engineering Conference (ICSEC), Chiang Mai, Thailand, 2018, pp. 1-4.

[5]L. Chen, W. Chang, J. Su and Y. Chen, " i-Helmet: An intelligent motorcycle helmet for rear big truck/bus intimation and collision avoidance," 2018 IEEE International Conference on Consumer Electronics (ICCE), Las Vegas, NV, 2018, pp. 1-2.

[6] M. A. V. Forero, " Detection of motorcycles and use of safety helmets with an algorithm using image processing techniques and artificial intelligence models," MOVICI-MOYCOT 2018: Joint Conference for Urban Mobility in the Smart City, Medellin, 2018, pp. 1-9.

[7] C. A. Rohith, S. A. Nair, P. S. Nair, S. Alphonsa and N. P. John, " An Efficient Helmet Detection for MVD using Deep learning," 2019 3rd International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India, 2019, pp. 282286.

[8] HelmetSaves, ' Riding rules you must follow without fail' , 05-Oct2017. [Online]. Available: https://helmetsaves.life/ridingrules-youmust-follow-withoutfail- 2903dee05ab3. [Accessed: 30- Nov- 2019]

[9] Live Mint, ' Helmet regulation: who will take the responsibility to protect riders' head?' , 28-Apr-2016. [Online]. Available: https://www.livemint.com/Politics/HXMRx9DqMu1v46hGyIzv1O/elmet-regulation-who-will-take-the-responsibility-to prote.html. [Accessed: 30- Nov- 2019]

[10] India Today, ' Two-wheeler riders, you could soon face heavy penalties for using helmets

without the ISI mark' , 24-Jun- 2017. [Online]. Available:

https://www.indiatoday.in/story/isihelmets-two-wheelers-ministry-of-road-transport-andhighways984453- 2017-06-2.