

International Journal of
Engineering Research and Science & Technology



ISSN:2319-5991

www.ijerst.org

E-mail: editor@ijerst.org or ijerst.editor@gmail.com

Automatic Number Plate and Helmet Detection Using Yolo

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Abstract: The use of a helmet in the operation of a motorcycle is a necessary safety measure that significantly reduces the likelihood of fatal cranial injuries in the event of accidents. The automation of the helmet identification has become a critical and comprehensive effort in intelligent supervision systems of transport to comply with the road safety laws. This research is a strong deep architecture of learning to identify a helmet in real time and an extraction of license plates. The technology combines descriptors of elements with a deep neural network classifier (DNN) to distinguish between cyclists on each other and those who do not. The methodology uses a systematic workflow that includes pre-processing images, extraction of elements using convolution operations and classification through a trained deep neural network model. The system is trained using a marked data set, including a diverse photo of a motorcycle rider in a real world taken in various circumstances of lighting and surrounding circumstances to guarantee generality. After identifying offenses, the system uses algorithms to optical character recognition (OCR) to load the vehicle license plate for possible intervention of coercive organs. Experimental findings indicate the accuracy, accuracy and recall of the model, which is to verify the effectiveness of the proposed strategy in various circumstances. This platform provides a scalable and efficient method for expanding urban traffic rights and supporting road safety through automated observance monitoring.

“Index Terms - *Helmet detection, DNN classifier, Traffic surveillance, Feature extraction, License plate recognition, Deep learning”.*

1. INTRODUCTION

Helmets are necessary to reduce the likelihood of serious head injuries and death in motorcycle collisions. Despite extensive knowledge, many motorcyclists cannot dress helmets, leading to an increased occurrence of traumatic brain and death injuries. The World Health Organization states that the proper use of a helmet can reduce the probability of death by 42% and brain injuries by 69% [1]. In India, the implementation of helmet regulations is often manual and irregular, which requires that the traffic police stop motorcyclists at the checkpoints, confirmed their documentation and imposes

sanctions. This manual method is time-consuming, working demanding and often inadequate in solving all traffic offenses [2]. Incorporating the algorithms of deep learning into systems for monitoring traffic has made it easier for automated helmet identification systems that allow monitoring and real-time recovery [3].

Recent improvements to computer vision and DNN, especially for models like Yolo (you only look once), significantly increased the accuracy and speed of object identification tasks, including helmet recognition and license plates. These systems analyze video feeding from security cameras, search

for motorcyclists, determine the use of a helmet and recognize numeric plates by OCR [6]. After detection of violations, the system can autonomously create e-charging and alert the perpetrators of SMS and therefore avoid the need for physical connection [7]. This automation minimizes the burden for transport officials, guarantees more uniform enforcement of law and improves public security [8].

The proposed method uses systematic pipeline, including pre-processing, extraction of elements and classification to correctly identify the help of helmet. Integration with automatic number plate recognition (ANPR) provides a scalable solution for city management and law enforcement [9]. This method facilitates proactive supervision and tries to cultivate the culture of safety between motorcyclists by ordering the wear of the helmet using advanced supervision systems.

2. RELATED WORK

The automatic helmet detection and identification of the license plate were prominent study domains in computer vision and intelligent transport systems. These devices are designed to detect motorcyclists who violate the helmet restriction and facilitate the effective enforcement of the Traffic Laws by the authorities. The procedure of deep learning, especially through convolutional neural networks (CNN) and frames of object recognition, such as Yolo, increased the accuracy, speed and scalability of these systems. Many research has advanced to develop and improve helmet detection and recognition detection systems, which demonstrates their efficiency in real traffic situations.

Recent study Rao et al. [10] They examined the automated identification of the numeric board for cyclists without a helmet. Their approach served

helmet detection and recognition of license plates in the cohesive framework, which made it suitable for monitoring systems in the urban environment. The technology has effectively detected and recognized the perpetrators of operation using algorithms of computer vision on live video stream. Suvarna and Pavan [11] designed a deep learning model for identifying helmet and license plates using CNN and OCR to identify cognitive numbers. Their methodology emphasized the need for increased detection accuracy under fluctuating transport conditions, indicating the feasibility of systems in real time per metropolitan passages.

Anilkucar et al. [12] He designed a concept for automatic identification of license plates focused on non-massive motorcyclists using Yolo and OCR technologies. They have proven that Yolo-based models can effectively identify and extract areas of interest (helmet and numerical boards) from complex backdrops. Desai et al. [13] They improved the accuracy and speed of the helmet identification and license plates using YOLOv8. Their approach has achieved an increased detection rate in various circumstances of environmental circumstances such as poor lighting and obstruction, so it contributes significantly to intelligent tracking systems.

Bolukond et al. [14] He designed an integrated system that served deep learning techniques to identify helmet and detect a license plate. Their program analyzed a traffic video to detect helmet offenses and load information about the license plate for the release of automatic fines. The OCR system interface has enabled effective identification of licensing numbers, applicable to the backend legal processing and generating a fine. Gorak and Reddy [15] performed a comparative analysis of YOLOv5 and YOLOv8 in connection with the tasks of

identifying helmet and numeric board. They found that YOLOv8 surpassed YOLOv5 in accuracy of detection and speed of processing, which is more suitable for real-time applications.

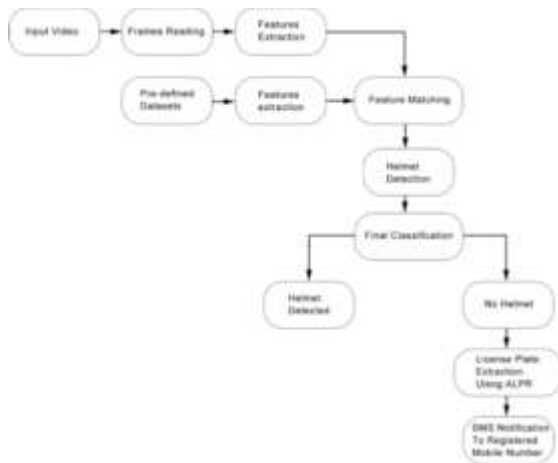
Swapna et al. [16] They focused on identifying the license plates for non-compliant cyclists using standard image processing and deep learning methodologies. Their hybrid approach used edge detection, contour analysis and CNN classification to identify cognitive brands of perpetrators. They emphasized the need for strict pre-processing methods to improve image quality before identifying the boards. Kuriakose [17] invented a comprehensive system using YOLO to detect objects, CNN for categorizing helmet and OCR for interpretation of numeric boards. The amalgamation of these components has created a unified system capable of operating in real time, so it is suitable for enforcement of law in strongly populated regions.

Anusuya and Vashishtha [18] examined automatic number of numeric boards using YOLO algorithms, especially in connection with the enforcement of helmet right. They emphasized the importance of accurate localization of numerical plates and difficulties resulting from inconsistencies in the design of plates, fonts and lighting conditions. Their findings indicated that well-trained deep learning models can be generalized across different types of vehicles and transport conditions. Bhise et al. [19] They introduced a comprehensive model of supervision using integrated deep learning frames to identify the helmet and recognition of the license plate. Their approach showed scalability with extensive data sets and permanently operated in traffic circumstances with high density, which solved obstacles video analysis in real time.

Pisa et al. [20] They examined the use of YOLOv5 to detect helmet and numerical boards, which emphasized the need for training on data sets for specific conditions of local traffic. Their studies have shown that data sets specific to the region increased the efficiency of the model in identifying numerical boards with local formats and distinguishing helmet of different forms and colors. Their finding indicated that training increases the resistance of the model and recommended further exploration of domain adaptation to expand the usability of the system across different geographical areas.

3. MATERIALS AND METHODS

The proposed method intends to create an automated model of deep learning to identify cyclists without the helmet and extract their cognitive mark numbers to impose sentences via SMS notifications. It includes a helmet detection using YOLOv3, which is by far recognizes objects in video-time in real time [13]. After identifying a motorcyclist without a helmet, the system initiates the identification of the license plate using the ALPR (Automatic License Plate Recognition) based on the K-Nearest Neighbors (KNN), which performs segmentation and character recognition [12]. The confirmed license number is then connected to the registered mobile phone number of the biker and the SMS message is sent via SMS API, minimizing the involvement of a person and ensuring strict enforcement of law [11]. The aim of this technology is to help the operation management department in automation of the supervision and enforcement of helmet regulations, then improve road safety and reduce the human stress monitoring of helmet offenses.



“Fig.1 System Architecture”

The development diagram shows an experimental research framework to detect and warn a helmet. It begins "input video" and "predefined data set", both subjected to "extraction of functions". The collected functions are further processed for "comparison of elements", resulting in "helmet detection". Subsequently, the "final classification" detects the presence of either "detected helmets" or "without a helmet". If the helmet is not worn, the " License Plate Extraction using ALPR" is made, followed by "SMS for a registered mobile number".

i) Helmet Detection and Classification using YOLOv3 and DNN:

The system uses video data in real time from the camera, analyzed the frame after identifying cyclists and helmets. Yolov3 is used for quick and accurate recognition of objects, recognition and delimitation of things such as helmets and cyclists using border boxes. The descriptor method loads the visual attributes of these items. The attributes are then input to the DNN classifier, which evaluates them against pre -trained data files to determine whether the identified rider wears the helmet. These merger guarantees accurate, immediate detection of helmet

violations under various light and environmental situations.

ii) License Plate Recognition and SMS Notification using KNN and SMS API:

After identifying the rider without a helmet, the system initiates the Module ALPR. The obtained image is subjected to preliminary processing, localization of the license plate, threshing and segmentation of characters. The KNN method detects alphanumeric characters on cognitive features by comparing test data with existing data sets. The identified characters are aggregated to form a license number. Subsequently, the SMS API module is activated. Customized SMS notifications are sent to the registered mobile phone number of a biker, which warns them of regulating the helmet and the related fine, so that the completion of the complex automated process.

iii) Modules:

The proposed system has three primary modules: helmets detection, license plate extraction and SMS notifications. Each module is designed with different technologies for efficient automation of helmet recognition, identification of vehicles and fines.

Helmet Detection Module: This module uses the Yolov3 algorithm to detect helmet in real time from video recordings. Yolov3 segment the input image to the grids and predicts the bounding boxes for objects, making it easier to determine whether the cyclist is wearing a helmet [13]. The element descriptor captures the attributes of the object from each image, which are then identified using the DNN compared to pre -trained data. This merger guarantees increased accuracy and immediate performance, facilitates immediate helmet

identification and evaluation of control of regulation. Yolov3 is optimal for traffic supervision applications aimed at promoting road safety.

License Plate Module: The license plate module integrates the ALPR with the KNN algorithm. The procedure has four phases: input image processing, insert extraction, image thresholding and character recognition [12]. The images are obtained using an IP camera from which the license plates are extracted and converted to Greyscale for increased clarity. The KNN uses the comparing patterns of test data with a marked data file to recognize and extract alphanumeric characters from the plate. This module is necessary for automated identification of the perpetrators and their connection to the registered owners of vehicles.

Notification Module: The notification module uses the API SMS to provide real -time notifications to riders who violate helmet regulations. After identifying the numerical board, the system creates an SMS describing a fine that is sent to the registered number of a mobile phone by a biker via SMS service provider [11]. The server starts this process and the client gets a message and therefore creates a complete communication loop. This technology alleviates the workload of transport officials and improves compliance with the regulations by immediately reminding the perpetrators. The SMS APIs provide reliable and scalable communication solutions that make it suitable for public security systems.

iv) Algorithms:

YOLOv3 Algorithm: Yolov3 (you only look once, version 3) is a real -time object technique that uses a singular convolution neural network to identify numerous items in the image by splitting into grids and predicting box limitation and class probability

[13]. It is used in your system detection system from video sources in real time. Yolov3 is selected for its excellent accuracy and speed, which is suitable for real -time applications such as supervision and monitoring of traffic.

Feature Descriptor Algorithm: Function descriptor is a technique used to extract visual attributes (eg edges, corners, texture) from photos for object recognition [16]. Your method identifies the key characteristics of helmet and riders from video images. Characteristics are then sent to the classifier for purposes appropriate. The aim is to transform image areas into quantifiable vectors that provide accurate categorization of objects, essential for distinguishing between helmet and unpainted cyclists in different environments.

Deep Neural Network (DNN) Classifier: The DNN is a multilayer nerve architecture designed to assign input data (functions) with specified output classes [15]. Your system classifies things such as helmets and cyclists based on attributes derived from descriptor. DNN contrasts extracted real -time functions with pre -trained data sets for final categorization. The goal is to increase the capacity of the system for accurate real -time decision - making based on complex visual input formulas.

K-Nearest Neighbors (KNN) Algorithm: The KNN is a machine learning technique under supervision that classifies data by linking to the nearest training samples inside the function space. It is used in the Module of the ALPR system for recognizing and classification of characters on the license plates. KNN makes it easier for alphanumeric characters from the license plates to compare fresh inputs with the most popular previous data. The aim is to provide accurate and efficient

identification of the character using a simple but effective distance -based methodology.

SMS API (Application Programming Interface):

API SMS API allows software applications to transmit text messages using a third -party SMS gateway. Your system draws attention to unlimited cyclists by sending automatic fine messages. The API interface serves as an intermediary between the detection system (on the server side) and a mobile motorcycle (on the client side). The aim is to automate communication and guarantee quick and efficient transmission of alerts of violations of the rules to the specified recipient.

4. RESULTS AND DISCUSSION

Figures 2 and 3 illustrate that the proposed system takes real-time video, using YOLOv3, a feature descriptor, and a DNN classifier to identify the absence of a helmet, subsequently displaying the result "No Helmet."



“Fig.2 Real-Time Input Video without Helmet”

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Python Shell 3.9.1
File Edit Shell Debug Options Window Help
Python 3.9.1 (tags/v3.9.1:1e3d33e, Dec 2020, 64
)) on v2n32
Type "help", "copyright", "credits" or "license()"
>>>
===== RESTART: C:\Users\Acer\Videos\project
No helmet
No helmet
No helmet
No helmet

```

“Fig.3 No Helmet Detected”

According to Fig. 4 and Fig. 5, the proposed system acquires real-time video, employs YOLOv3, a feature descriptor, and a DNN classifier to identify and categorise the helmet, presenting an output of "Helmet Detected."



“Fig.4 Real-Time Input Video with a Helmet”

```

Python Shell 3.9.1
File Edit Shell Debug Options Window Help
Python 3.9.1 (tags/v3.9.1:1e3d33e, Dec 7 2020, 1
64) on win32
Type "help", "copyright", "credits" or "license()"
>>>
===== RESTART: C:\Users\Acer\Videos\project
No helmet
No helmet
No helmet
No helmet
No helmet detected
detected
detected
detected
Helmet detected

```

“Fig.5 Helmet Detected”

According to Fig. 6, the suggested system employs ALPR with a KNN algorithm in four phases to

extract, threshold, recognise, and categorise license plate characters, properly presenting them on the output screen.



“Fig.6 License Plate Characters Extracted”

Following the extraction of number plate characters shown in Fig. 8, the system employs an SMS API to transmit a real-time fine notice to the biker's registered cellphone number via an SMS service provider.



“Fig.7 Outputs According To ALPR Stages”



“Fig.8 SMS Notification Received”

5. CONCLUSION

The proposed method for automated identification of cyclists without helmets is a transformation approach to control traffic by improving road safety and ensuring compliance with regulations through automation. The system uses strong deep learning methodologies, such as Yolov3 to identify helmet in real time and KNN for automated recognition recognition, to accurately identify helmet offenses and delivery of fines via SMS alerts using SMS API. The transition from manual to automated monitoring significantly reduces human disability and therefore increases the accuracy, consistency and efficiency in promoting traffic regulations. Amalgamation of object detection, extraction of elements and classification ensures reliable results in typical settings. However, the system encounters certain limitations, such as difficult lighting, unfavorable weather and unrecognized or altered cognitive marks, which can affect accuracy detection. In addition, network reliability affects the rapid transmission of SMS messages. Regardless of these limitations, these three interconnected modules - helmet detection, license plate recognition, and SMS notifications - synergically provide functions intended. The proposed method means significant progress in intelligent traffic monitoring, with the ability to reduce the degree of accidents and promote compliance with the regulations between cyclists, which increases road safety for all.

In the future, the system can be extended by the inclusion of sophisticated algorithms adapting weather and infrared images to increase the accuracy of the helmet detection in weak or poor weather situations. The identification of the license plate can be increased by deep OCR methodologies based on learning for more efficiently modified or counterfeit plates. In addition, the integration of cloud storage

of data and dashboards in real time for authorities can increase the efficiency of monitoring and recovery. The extension of the algorithm to identify other offenses, such as triple horseback riding or use a mobile phone, can further expand the coercive authorities.

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