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Smart Traffic Surveillance: Identifying Helmet-Less Riders and License Plate Recognition with YOLO andOCR Integration using Deep Learning

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Abstract: Currently, there are a number of issues with Indian traffic laws that can be resolved in a variety of ways. Riding a motorbike without a helmet is against the law and has increased the number of accidents in India. The current method mostly uses CCTV records to monitor traffic offences. When a rider is not wearing a helmet, traffic officers must zoom in on the licence plate and look into the frame where the infraction is occurring. However, because there are more and more traffic infractions and motorcycle ridership every day, this will take a lot of labour and time. What if there was a technology that would automatically search for traffic violations such as riding a motorbike without a helmet? hence, would automatically retrieve the number plate number of the bike. This study has been effectively completed by recent research using KNN, DNN-Classifier, etc. However, there are limitations to these works in terms of speed, accuracy, or efficiency in object identification and classification.

The goal of this research project is to develop a non-helmet rider detection system that can automatically identify and retrieve a vehicle's number plate number when a driver fails to wear a helmet. Three-level Deep Learning for Object Detection is the key idea at play here. The items found are a human, a motorcycle at level one using YOLO, a helmet at level two using YOLO, Licence plate at the last level using YOLO. Next, OCR is used to obtain the number plate registration number. All of these methods—especially the section where the number plate number is extracted—are subject to predetermined limitations and conditions. Because video is the work's input, speed of execution is essential. We have developed a comprehensive algorithm for both number plate number extraction and helmet detection using the above-mentioned approaches.

1. Introduction

Wearing a helmet is crucial to avoiding impact-related traumatic brain injuries and potentially averting death in a serious collision. If a motorcyclist is negligent and chooses not to wear a helmet for personal or other reasons, it could result in serious injury in the event of an accident. Bikers run a very high risk of suffering a head injury that might result in severe brain damage or even death. Bike riders should be urged to wear helmets for their own protection in order to lower the possibility of any kind of head injuries or even death from an accident. And those who don't comply will face harsh penalties from the legislation. It has been suggested to use deep learning to create an automatic helmet detecting system.

In India, bikers who do not wear a helmet are currently subject to manual fines. This involves the police pulling up riders at checkpoints and looking through their identifying documents, such as their license card, insurance, and registration book. After that, the officials question the rider about why they are not wearing a helmet. Since it is illegal to drive while wearing a helmet, their arguments would not be accepted. A receipt for the fee they were assessed for failing to wear a helmet will then be given to them. Additionally, they will have the option of paying the fee in person within a set time frame or immediately using cash, debit/credit card, or other payment mechanism. While others choose not to, the majority of consumers will opt to pay with cash on the moment. Thus, this suggested approach can be used to reduce the workload of traffic authorities and to enact tough legislation. in order to compel bikers to wear helmets when operating a vehicle. In addition to saving the traffic management department effort, this would safeguard motorcycle riders' safety.

The traffic management department can currently monitor traffic surveillance using this system. where bikers without helmets are automatically fined by the system upon detection. Additionally, tell the cyclist by SMS of the fine they have been assessed once it was discovered that they were not wearing a helmet.

2. Proposed System

Using deep learning-based neural networks, the suggested system can identify bike riders wearing helmets or not. This makes it useful for traffic management surveillance. and use ALPR (Automatic License Plate Recognition) to retrieve the license plate number in order to impose a fine on them. Artificial neural networks, also known as neural networks, are used in deep learning, a branch of machine learning techniques, to enable the machines to learn and make decisions on their own. Supervised learning is the most popular type of machine learning, where a sizable dataset is gathered and utilized to train the system. Deep-learning models use very deep neural networks—deeper than three layers—to attempt to learn the deep aspects of the input data hierarchically. Through unsupervised training, the network is transformed into a supervised fashion. For training, it makes use of both organized and unstructured data. It is employed in a variety of fields, including computer science and medicine.

A. Architecture

Real-time video input is recorded, and each frame is examined for readings in between. Feature matching is the process of comparing extracted features with pre-defined or pre-trained datasets. The features of the item, such as the helmet, are extracted and cross-checked with the features retrieved from the pre-defined datasets. The final categorization of the item is then decided by the proposed system through the application of the DNN-classifier and feature descriptor technique. Helmet detected and no helmet are the two possible outcomes. The system indicates "helmet detected" on the output screen if it finds a helmet on the biker in the input video; otherwise, it displays "no helmet" on the output screen. The license plate extraction module, which uses the ALPR framework to detect and recognize the license plate and its characters, will then be used in the proposed system. Lastly, an email notification will be sent via the suggested system.

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B. Overview

The suggested system, which uses deep learning to automatically identify bike riders who are not wearing helmets, has a number of cutting-edge characteristics that make it dependable and effective for tracking traffic surveillance. Neural networks and deep learning are its foundation. when the system makes use of novel techniques, formulas, etc. Helmet detection is part of the system's design. When the system starts up, it looks for or detects an object. After that, the object's features are extracted and cross-checked against the reference databases, a pertained dataset. Real-time or test data is the term used to describe the extracted data. Using a feature descriptor—a method designed to characterize an object's features—the features are extracted. To generate the output, the test and reference data are cross-checked and processed. Feature Matchmaking is the process approach wherein the final classification of the item is determined by comparing its features with those of reference datasets, which are pre-trained datasets. Deep Neural Network-classifier performs the final classification by comparing the features of test data and pre-trained datasets. This is used to identify an individual (the cyclist) and the helmet (the object). This can be used to identify bikers both with and without helmets.

The system classifies the characters, or the numbers and letters, on a license plate using an algorithm

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Called ALPR(Automatic License PlateRecognition), which is employed for the license plate extraction procedure. The k-nearest neighbors (KNN) algorithm serves as the foundation for this ALPR system. That can be applied to resolve various regression and classification issues. An ALPR system consists of four stages, and each nation's license plate ALPR is unique. Image acquisition, license plate extraction, license plate segmentation, and character recognition are the four phases of an ALPR. When all four of them work together, the APLR process is completed. This allows the police to issue a fine to the rider for not wearing a helmet rather than having to manually create a receipted bill. An email notification will be sent.

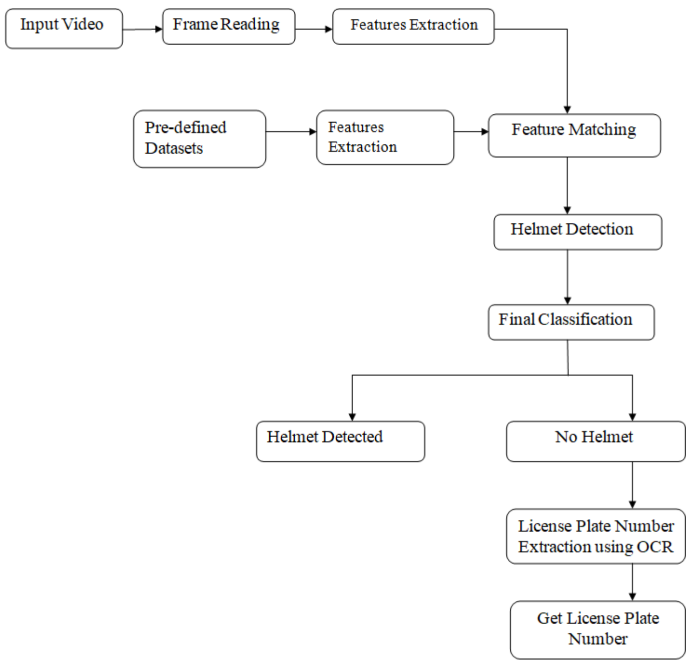

Fig. 1: Architecture and Algorithm Flow

C. Working of the Proposed System

The proposed system differs from the current approach due to its properties. There are distinct sections in the proposed system, which are as follows:

Helmet Detection

In this part, the proposed system recognizes a motorcyclist (person) and determines whether or not the rider is wearing a helmet by examining the biker's head region. The items of a rider and helmet are assessed in real-time from an input video. The system recognizes objects in the real-time input video using YOLOv3, taking into account both the object's name and its precision level. The suggested method is designed to employ 15 frames per second to analyze and detect the item in real-time. The YOLOv3 module detects objects in real-time, frame by frame. When a helmet is identified, a bounding box will display.All detected objects' features are extracted using a feature descriptor, and then the object is classified and the result is shown using DNN-classifier. The output would say "helmet detected" on the output screen if the system had identified the rider as wearing one. The output no helmet will appear on the output screen if the system detects that the rider is not wearing a helmet. The purpose of the feature descriptor algorithm is to extract the features of the objects that are detected, such as the helmet and rider. The item is classified as output by the DNN-classifier using the features that the feature descriptor has extracted. In order to decide the output, test data or extracted data are compared with pre-trained datasets, which are collections of data that the system has previously learnt to distinguish between things.

License Plate Character Extraction

Using ALPR, a technology for extracting license plate numbers, the biker's license plate can be retrieved in this portion of the suggested system. The KNN-algorithm, which has four stages or processes to extract the license plate number, is the basis for the ALPR in this suggested system. They are listed below. Character recognition, license plate extraction, thresholding, and input image processing.

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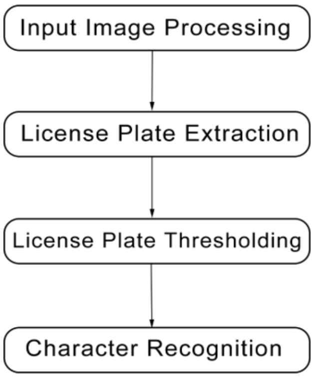

Fig. 2 : Stages in ALPR

The input image is manually taken using an IP cam (a mobile application) and saved in the system for processing during the input image processing step. Using a bounding box, the system locates the license plate during the license plate extraction stage and extracts a cropped image of the plate from the input image. During the license plate thresholding phase, the system transforms the clipped image of the license plate into a grayscale image, which it will use to extract the characters.

Using the pre-trained dataset found in the KNN-algorithm, the suggested system identifies the characters in the greyscaled image at the last stage of character recognition before displaying the results on the output screen. Here, the pre-trained datasets are used by the KNN-based ALPR to extract, identify, and categorize the characters on the license plate.

Email Notification

The system sends email regarding the issue of not wearing a helmet while driving in this final portion of the suggested system. The system would send out an email after extracting the license plate number.

3. Method of Approach

Three approaches are implemented in the suggested system, which is in charge of the system's identification and detection operations. The following are the techniques that were used:

Feature Descriptor

It is a technique and algorithm for categorizing an object or its characteristics. Using this, one can extract an object's features from an input image or video. The technique is engineered to precisely extract an object's features, pixel by pixel. The resulting data can be used as input, test, or extracted data by the system. This data is then utilized to compare later on with the system's pre-trained data. Therefore, this algorithm is in charge of identifying a person, such as a biker, and extracting the features of those two objects in real-time. It then uses that information as test or reference data, which the system will compare to pre-trained datasets in order to classify the output results. It is a component of machine learning's computer vision. To select the output, feature descriptors are utilized to accurately match extracted features with a huge feature database (pre-trained dataset).

DNN-Classifier

By comparing test data to a pre-trained dataset, a deep neural network classifier may identify an object and present the result. By comparing real-time video and object attributes that have been extracted from pre-trained data sets, Deep Neural Networks are used to classify things. With the use of a labelled dataset, this multi-layered neural network was trained to perform classification on related but unlabelled data. It is employed to show the result and classify the object. Deep neural networks, a subset of artificial neural networks that can train on their own from given data, are used in the creation of the DNN-classifier. This classifier quickly and precisely determines the object's identity in real time. This classifier is used by the proposed system to classify the items and show the results on the output screen. In order to identify the item in real time, the classifier compares or matches the extracted characteristics with the pre-trained datasets. The suggested system uses DNN-classifier to identify the item and displays the result on the output window after receiving input data for each frame of a real-time video.

KNN-Algorithm

The APLR, which is utilized in the process of extracting license plates, employs the KNN algorithm. It is a straightforward supervised machine learning approach that may be applied to regression and classification issues.

The KNN algorithm is utilized in the proposed system's license plate extraction process to facilitate the detection, identification, and classification of the license plate. It is used to extract and recognize the characters (number and letters) included in the threshold image of the extracted license plate picture, as well as to classify, identify, and extract the license plate from the input photographs used. In order to determine the output, it also uses the test or extracted data and compares it with the pre-trained datasets. The most widely used and precise technique for extracting license plates is this one. It is employed to show the final graphics for every step that the ALPR framework has. At last, it identifies and groups the characters on the license plate.

4. MODULES

There are three distinct modules in this suggested system. These are the modules for email notification, license plate character extraction, and helmet detection. Every module is made up of several techniques and smaller modules that are integrated into the system. The system's primary function is to identify cyclists who are not wearing helmets, utilize APLR to extract characters from their license plate, and then send an email to the violation of the traffic law.

Helmet Detection Module

This module implements a feature descriptor methodology and DNN-classifier method, and it consists of the YOLOv3 (You Only Look Once) module. The YOLOv3 module employs a YOLO algorithm to identify objects, such as helmets, in real-time when they are visible within a bounding box. YOLO is utilized in computer vision, machine learning, and other fields for real-time object tracking and detection. The OpenCV packages are utilized with the YOLOv3. The YOLOv3 is made up of the YOLOv2 and YOLOv1 versions from before. The most precise and accurate tool for object detection is YOLOv3. Compared to earlier YOLO detection networks, YOLOv3 is an improvement. It has a more powerful feature extractor, multi-scale detection, and minor adjustments to the loss function than earlier iterations. The purpose of this system is to identify helmets within a bounding box in real-time input video that was recorded using a camera. The system would identify a helmet for each frame that could be examined by your computer system based on the graphic card and RAM that were available. It would then show the object's accuracy level on the input video output screen in real time. Additionally, it tracks items in real time, including helmets.

The final classification of the object, or helmet, is accomplished by implementing a features descriptor and DNN-classifier. The feature descriptor extracts the features of the object, and the DNN-classifier uses it as input or test data and compares it with the pre-trained datasets to classify the object and display the output on the output window. YOLOv3 is used in the helmet detection module to detect and track helmet in real-time input video.

License Plate Module

The ALPR component of the license plate module uses the KNN algorithm. The license plate's characters are identified, categorized, recognized, and extracted using the ALPR module. Using optical character recognition (OCR), Automatic License Plate Recognition (ALPR) technology reads the characters on license plates. The most popular and accurate technique for extracting license plates is the APLR. The four stages of the ALPR framework are character recognition, license plate extraction, input picture processing, and license plate thresholding. These phases use the KNN algorithm to process the data. The proposed system uses the manually acquired license plate image as input during the input image processing stage. The image is obtained using an IP camera. The system locates the license plate

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within a bounding box and extracts a cropped image of the input license plate image during the license plate extraction stage. The cropped license plate image is then transformed into a greyscale image by the system during the license plate thresholding stage. And in the last step, known as the character recognition stage, the suggested system uses the implemented KNN-algorithm to identify the characters present in the threshold image of the license plate. It then extracts and displays the characters as output.

Email Notification Module

When the system detects a non-helmet rider and recognizes a license plate, it triggers an email notification. This notification includes details where the violation was detected such as the license plate number. To send email notifications, the system needs to be configured with the necessary email credentials, including the sender's email address, recipient's email address, SMTP (Simple Mail Transfer Protocol) server details, and authentication credentials. Once the violation is detected and processed, the system establishes a connection to the SMTP server using the provided credentials. It then constructs an email message with the relevant information, such as the license plate number of the violation and any additional details. Finally, it sends the email notification to the specified recipient.

Overall, the email notification module serves as an essential component of the system, providing timely alerts to relevant stakeholders whenever a non-helmet rider is detected and a license plate is recognized.

5. Real Time Object Detection and Classification

With a webcam serving as the input image or video footage, the suggested system is made to identify objects in real time. The system can identify several things in a scene or surroundings.

Since the system's purpose is to detect things in real-time, speed and accuracy are expected. The system uses a number of techniques that improve performance in a precise and quick manner. The following are the two primary objects to which the system has assigned high priority for real-time identification and classification:

Detection of Helmet

The suggested methodology makes use of several techniques to instantly identify helmets. The method modules YOLOv3, feature descriptor, and DNN-classifier with the output are in charge of the real-time helmet detection. The primary algorithm among these techniques for detecting, tracking, and displaying the result in real-time with minimal delay is YOLOv3.

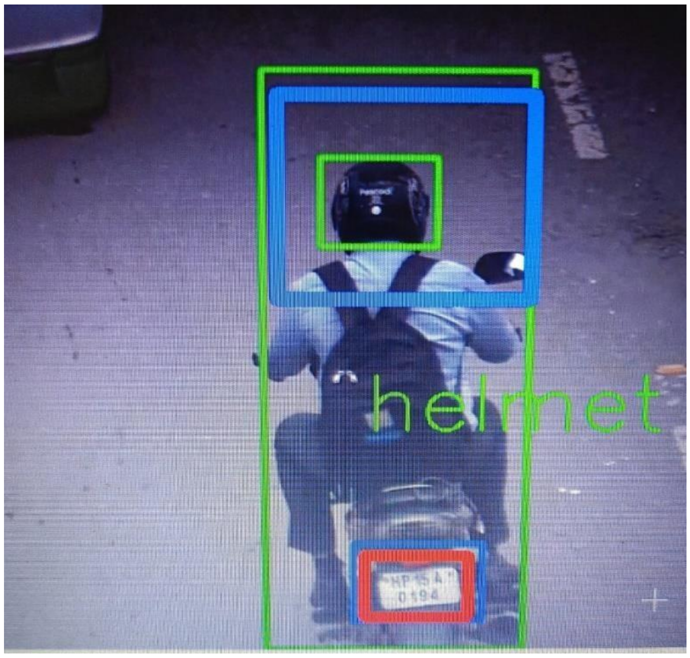

Fig. 3: Bounding boxes – Helmet Detection

Detection of the License Plate

The suggested system uses the KNN algorithm to perform ALPR (Automatic License Plate Recognition). Because the ALPR system is built on KNN, the suggested system made use of the KNN-classifier and KNN-descriptors that are already included in the ALPR system. It makes use of the pre-trained dataset found in the ALPR framework's KNN section. This may be used to extract the license plate, identify it, turn it into a threshold image, and then use it to identify characters.

Optical character recognition (OCR) is used. The fastest algorithm available for extracting or identifying license plate data is this one. It has the ability to quickly identify things from the learned dataset. If properly trained, the extraction of a specific object is accurate.

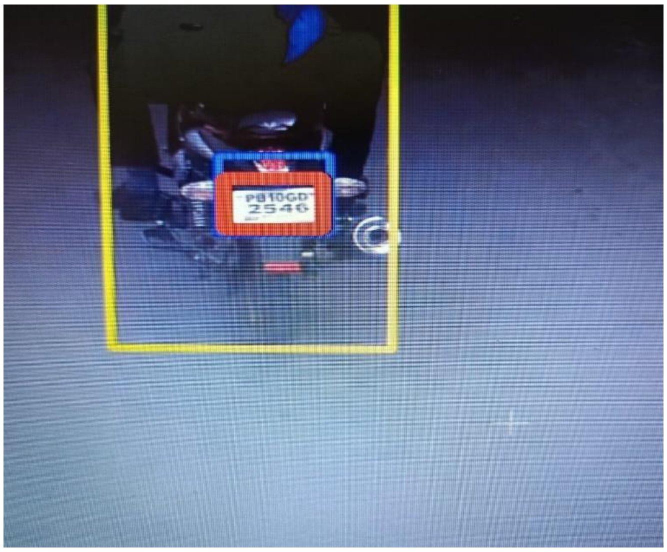

Fig. 4: License Plate Extraction

Email Notification

The framework's ALPR section incorporates an email notification method as part of the proposed system. An email would be generated by the system upon completion of the ALPR process.

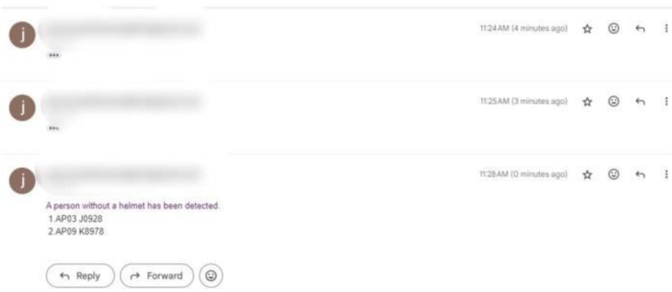

Fig. 5: Email Notification

6. Significance and Enhancements

To automate the process of managing traffic rules, this framework can be implemented on primary thoroughfares and traffic crossing locations. If it is made better, it also automates the process of creating penalty forms when rules are broken.

The primary significance of this project lies in its potential to improve road safety. By detecting non-helmet riders, authorities can take corrective actions, such as issuing fines or warnings, to ensure compliance with safety regulations. Additionally, recognizing license plates enables tracking and enforcement of traffic laws, contributing to overall road safety.

7. Conclusion

The traffic management department can be changed in the safest and most effective manner with the help of the suggested method for automatically detecting bike riders who are not wearing helmets. This suggested approach will significantly lower the number of bike-related deaths and injuries that result from riding without a helmet.

The efficiency of the system and the processes was improved by using distinct approaches for each process. Although the suggested system operates as anticipated, there are certain shortcomings that have an impact on the results. Both the license plate recognition and helmet detection processes may be impacted by factors like as weather and illumination. The license plate module, notification module, and helmet detection module all cooperated to precisely produce the intended result. The suggested system performs better thanks to the application of deep learning for tasks including detection, classification, and identification, as well as a framework that primarily focuses on the methods used to determine the output.

References

[1]. Aleksa Ćorović, Velibor Ilić, Siniša Đurić, Mališa Marijan, and Bogdan Pavković, “The Real-Time Detection of Traffic Participants Using YOLO Algorithm,” TELFOR, pp. 1-4, 2018.

[2]. Duy-Nguyen Ta, Wei-Chao, Chen Natasha Gelfand, and Kari Pulli, “SURFTrac: Efficient Tracking and Continuous Object Recognition using Local Feature Descriptors,” CVPR, pp. 1-8, 2009.

[3]. Hugo Larochelle, Yoshua Bengio, Jérôme Louradour, and Pascal Lamblin, “Exploring Strategies for Training Deep Neural Networks,” Journal of Machine Learning Research, pp. 1-40, 2009.

[4]. Jie Li, Huanming Liu, Tianzheng Wang, Min Jiang, Kang Li, and Xiaoguang Zhao, “Safety Helmet Wearing Detection Based on Image Processing and Machine Learning,” ICACI, pp. 201-205, 2017.

[5]. Kang Li, Xiaoguang Zhao, Jiang Bian, and Min Tan, “Automatic Safety Helmet Wearing Detection,” Cyber Technology in Automation, Control, and Intelligent Systems, pp. 1-6, 2017.

[6]. Rattapoom Waranusast, Nannaphat Bundon, Vasan Timtong Chainarong Tangnoi, Pattanawadee Pattanathaburt, “Machine Vision Techniques for Motorcycle Safety Helmet Detection,” IVCNZ, pp. 1-6, 2013.

[7]. Romuere Silva, Rodrigo Veras, and Kelson, R. T. Aires, “Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers,” SIBGRAPI, pp. 1-25, 2014.

[8]. Shan Du, Mahmoud Ibrahim, Mohamed Shehata, Wael Badawy, “Automatic License Plate Recognition (ALPR): A State-of-the-Art Review,” IEEE Transactions on Circuits and Systems for Video Technology, vol. 23, no. 2, pp. 311-325, 2013.

[9]. Shyang-Lih Chang, Li-Shien Chen, Yun- Chung Chung, and Sei-Wan Chen, “Automatic License Plate Recognition,” IEEE Transactions on Intelligent Transportation Systems, vol. 5, no. 1, pp. 42-53, 2004.

[10]. Yushi Chen, Zhouhan Lin, Xing Zhao, Gang Wang, Yanfeng Gu, “Deep Learning-Based Classification of Hyperspectral Data,” IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol.7, no. 6, pp. 2094- 2107, 2004.