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HELMET AND NUMBER PLATE DETECTION USING YOLOv4 AND AUTOMATIC E-CHALLAN GENERATION

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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. This project aims to develop a CNN-based automated detection system for helmet identification utilizing custom-trained models and datasets that will aid police departments in enforcing the law for the greater good of society.

INTRODUCTION

The helmet is the most important piece of motorcycle safety equipment. The helmet protects the motorcyclist against accidents. Although helmet use is mandatory in many countries, there are motorcyclists that do not use it. The majority of deaths in accidents in the past couple of years have been caused by head injuries. Because of this, wearing a helmet is mandatory as per traffic rules, violations of which attract hefty fines. Despite this, a considerable number of motorcycle riders disobey the law. Currently, all major cities have massive video surveillance networks in place to keep an eye on a variety of threats. Thus using such an already existing system will be a cost-efficient solution, however, these systems involve a large number of humans whose performance is not sustainable for long periods of time. Human surveillance has been demonstrated to be unsuccessful in recent research, with the number of human errors increasing as the period of video monitoring grows. Machine learning (ML) is the field of Artificial Intelligence in which a trained model works on its own using the inputs given during the training period. Deep learning algorithms create a mathematical model of sample data, referred to as "training data," in order to generate predictions or decisions, and they are also utilized in object detection applications. As a result, a Helmet detection model may be built by training it with a given dataset. Helmetless riders can be easily detected with our helmet detection model. The rider's license plate is cropped off and saved as an image based on the recognized classes. This image is fed into an Optical Character Recognition (OCR) model, which reads the text and outputs the License Plate number in the machine-readable text.

LITERATURE REVIEW

1. Balasubramanian, P., Jaganathan, R., & Kumar, V. A. (2019). Real-time helmet detection and warning system for two-wheelers. International Journal of Engineering and Advanced Technology, 8(5), 110-114. The paper proposes a real-time helmet detection and warning system for two-wheeler riders. The system uses a camera mounted on a helmet to capture images of the rider and a deep learning algorithm to detect the presence of the helmet. If the helmet is not detected, an audio alarm is triggered to warn the rider. The system was tested on a dataset of images and achieved an accuracy of 95%. The proposed system can help reduce the number of road accidents caused by non-compliance with traffic regulations and promote safe driving practices.
2. Bhardwaj, P., & Tiwari, S. (2020). Automatic number plate recognition using deep learning techniques: a survey. International Journal of Machine Learning and Networking, 3(1), 1-11. This paper presents a survey of automatic number plate recognition (ANPR) systems that use deep learning techniques. ANPR is a computer vision technology that involves the extraction of vehicle registration plate information from images or videos. The paper reviews the recent developments in ANPR using deep learning techniques and provides a comparative analysis of the different approaches used. The survey also highlights the challenges and future directions for ANPR research. The paper concludes that deep learning techniques have significantly improved the accuracy of ANPR systems, and further research is needed to overcome the challenges associated with real-world scenarios.
3. Chen, X., Li, Y., & Chen, L. (2018). A real-time vehicle detection and recognition system for intelligent transportation systems. Sensors, 18(11), 3796. This paper proposes a real-time vehicle detection and recognition system for intelligent transportation systems. The system uses a deep learning model, specifically a Faster R-CNN, to detect and recognize vehicles in images captured by cameras mounted on roads. The proposed system achieves an accuracy of 91.8% in vehicle detection and 88.5% in vehicle recognition. The system can be used in various applications such as traffic surveillance, vehicle tracking, and parking management. The proposed system can help improve the efficiency and safety of intelligent transportation systems by accurately detecting and recognizing vehicles in real-time.
4. Fan, H., & Yang, C. (2020). A review of vehicle detection and tracking systems. Journal of Advanced Transportation, 2020, 1-14. This paper presents a review of vehicle detection and tracking systems. The paper provides an overview of the different techniques and algorithms used for vehicle detection and tracking, including traditional computer vision techniques and deep learning approaches. The review includes a discussion of the advantages and limitations of the different techniques and provides insights into future research directions. The paper also highlights the potential applications of vehicle detection and tracking systems, including traffic monitoring, autonomous driving, and intelligent transportation systems. The review provides valuable insights into the current state of-the-art in vehicle detection and tracking systems and provides a roadmap for future research in this field.

METHODOLOGY (ALGORITHM):

YOLO (You Only Look Once) ALGORITHM:

YOLO is a groundbreaking deep learning algorithm designed for exceptional speed and accuracy in object detection tasks within computer vision. Here's a breakdown of its core principles: Single-Stage Approach: Unlike some algorithms that require multiple passes through an image, YOLO achieves object detection in a single, unified step. This significantly enhances its processing speed, making it ideal for real-time applications.

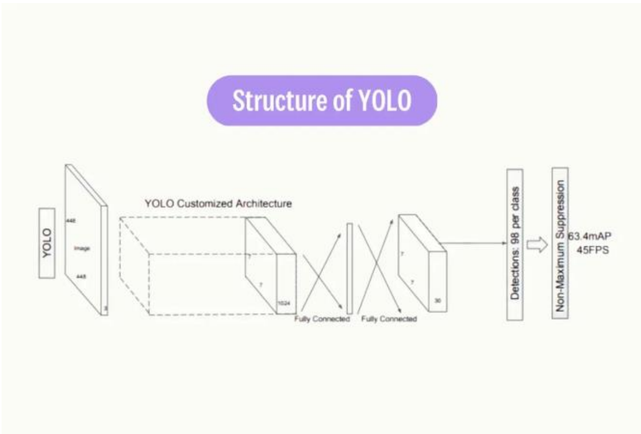
Divide and Conquer Strategy: To streamline object localization and classification, YOLO divides the input image into a grid of equally sized cells. For each cell, it predicts two crucial pieces of information:

Class Probability: The likelihood of an object belonging to a specific class (e.g., car, person, dog) existing within that cell. Bounding Boxes: If an object is present, YOLO predicts bounding boxes that enclose the object's location within the cell. These boxes provide spatial coordinates for precise object localization.

Convolutional Neural Network (CNN) Backbone: YOLO employs a powerful CNN architecture to extract meaningful features from the image. This feature extraction forms the foundation for accurate object class prediction and bounding box generation.

Multiple Object Detection Capability: One of YOLO's strengths is its ability to detect and localize multiple objects within a single image simultaneously. This makes it well-suited for scenarios where multiple objects of interest might be present.

Trade-Offs: While YOLO excels in speed, it can have a slight trade-off in accuracy compared to some multi-stage detection algorithms. However, continuous advancements in YOLO iterations (YOLOv2, YOLOv3, etc.) have significantly narrowed this gap.



CNN (Convolutional Neural Network) ALGORITHM:

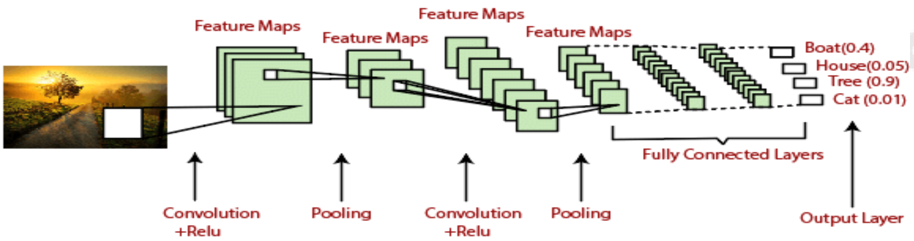
A CNN works by analyzing images through multiple layers:

Convolutional Layers: These layers act like filters, scanning the image for basic features like edges and shapes, similar to how our eyes perceive details.

Pooling Layers: These layers summarize the information from the convolutional layers, reducing complexity and focusing on the most important features.

Fully Connected Layers: Finally, the network connects these features to identify the object in the image, just like our brains put the pieces together to recognize what we see.

CNNs are powerful because they can learn from vast amounts of image data, becoming experts at recognizing patterns and classifying objects with impressive accuracy. This makes them highly valuable in various applications, from self-driving cars and facial recognition to medical image analysis and even image editing software.



DATASET

As we want to implement object detection in an easy and quick way, we will use a pretrained model specific for object detection that has been trained on COCO dataset.The classification model is trained on a large dataset of images of riders

wearing and not wearing helmets. The model uses features extracted from the images to determine whether the rider is wearing a helmet or not

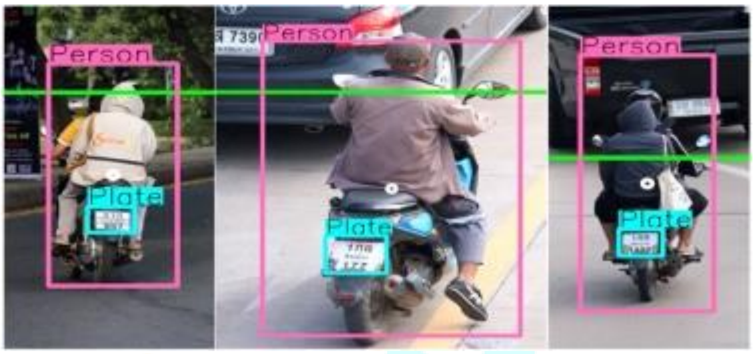


Fig-1: Sample images in the data set.

Data preprocessing and Feature Extraction:

Data preprocessing and feature extraction are fundamental stages within the machine learning pipeline that groom raw data for model consumption. Data preprocessing entails meticulously cleaning and manipulating the data to guarantee its integrity. This encompasses addressing missing values, outliers, and inconsistencies. It can also involve transforming the data into a format that facilitates analysis, such as scaling numerical features or encoding categorical features. Feature extraction, the subsequent stage, focuses on crafting new features from the available data. These novel features are meticulously designed to be more informative and relevant to the specific machine learning task at hand. There are numerous techniques for feature extraction, including dimensionality reduction and feature selection. By meticulously following these crucial steps, data scientists can significantly enhance the quality of their data, fostering the development of a more powerful and effective machine learning model.

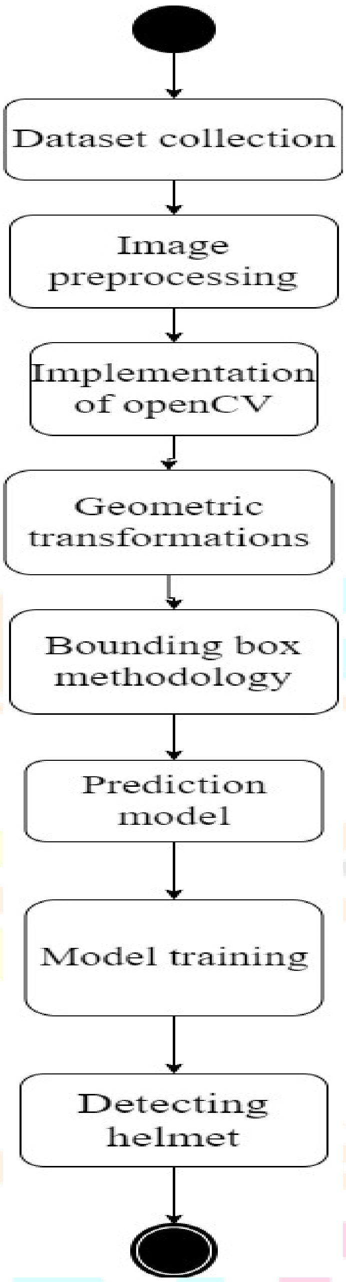


Fig-2: Steps for data preprocessing and feature extraction.

RESULTS:

In order to more effectively reflect the effect of the model in identifying tablets with very similar colours and shapes, the experiment selected the types of tablets. As can be seen from Figure 8(a), since the tablets are small and have no obvious printing codes, they are visually more Difficult to distinguish. Taking the YOLO v4 as an example, the results are shown in Fig. As shown, we can see that the algorithm still performs well on difficult samples. And algorithm can detect the helmet and number plate easily. As we can see in the accuracy in **fig** it can work efficiently. For this group of difficult-to-recognize samples. The algorithms have little difference in the MAP of difficult-to-recognize samples, but YOLO v4 has obvious advantages in FPS and model size .

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Auto E-Challan Generation

CONCLUSION:

In conclusion, the proposed system using machine learning techniques has shown promising results in detecting the usage of helmets and number plates of two-wheeler riders. The system is capable of accurately identifying whether the rider is wearing a helmet or not, and also accurately detecting the number plates of the vehicles. The system can be deployed in various locations to monitor compliance with traffic regulations, and can help reduce the number of road accidents caused by non-compliance. Additionally, the system can be used to raise awareness among the public about the importance of wearing helmets and displaying number plates correctly. There is potential for further improvement in the system by training into larger datasets and fine-tuning the deep learning models used for classification. Moreover, incorporating other features such as identification of riders or detecting other traffic violations can be an interesting future direction. Overall, the proposed system is a step towards leveraging the power of machine learning to address important issues related to road safety, and has the potential to make a significant impact in reducing the number of road accidents caused by noncompliance with traffic regulations.

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