**Traffic Automobile Counter (using OpenCV and YOLO)**

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By

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**ABSTRACT**

This research paper presents a system for vehicle detection and classification using OpenCV and YOLO. The system is capable of accurately counting the number of vehicles in both incoming and outgoing lanes and classifying them into three categories: cars, trucks, and buses. The system utilizes object detection to detect each vehicle as it enters the frame and then tracks it through the video stream to count its movement direction. Additionally, a YOLO model was trained on a dataset of images containing the three vehicle categories, enabling the system to classify each detected vehicle. The proposed system was evaluated on several video datasets, demonstrating high accuracy in vehicle detection and classification. This research paper contributes to the field of computer vision by presenting a robust and efficient system for real-time vehicle detection and classification, with potential applications in traffic monitoring and smart transportation systems.

**INTRODUCTION**

The development of intelligent transportation systems has become an increasingly important research area in recent years. One of the key components of such systems is the ability to accurately detect and classify vehicles in real-time. This paper presents a system for vehicle detection and classification using OpenCV and YOLO. The proposed system aims to provide accurate and reliable results for counting the number of vehicles in both incoming and outgoing lanes and classifying them into three categories: cars, trucks, and buses.

Object detection is used to detect each vehicle as it enters the frame, and the movement direction of the vehicle is tracked through the video stream to count its direction. Additionally, a YOLO model was trained on a dataset of images containing the three vehicle categories, enabling the system to classify each detected vehicle. The proposed system was evaluated on several video datasets, demonstrating high accuracy in vehicle detection and classification.

The proposed system has potential applications in traffic monitoring, urban planning, and intelligent transportation systems. Accurate and real-time detection and classification of vehicles are important for traffic monitoring, which can provide valuable information for city planning and traffic control. Furthermore, intelligent transportation systems can benefit from this technology by enabling the efficient management of traffic flow, which can reduce traffic congestion and improve road safety.

Overall, this research paper contributes to the field of computer vision by presenting a robust and efficient system for real-time vehicle detection and classification, with the potential to improve traffic management and transportation systems.

**PROBLEM STATEMENT:**

Traffic congestion is a common problem in urban areas and is a significant source of frustration and inconvenience for commuters. It is, therefore, essential for traffic management authorities to conduct constant surveillance of heavily trafficked intersections to identify congested areas and find effective solutions to alleviate the problem. The current method of manual monitoring is time-consuming, costly, and prone to errors, which can lead to incorrect data interpretation and poor decision-making.

To address this issue, an automated system is needed that can accurately identify and count the number of vehicles passing through the intersection. This system should be capable of assessing real-time video feeds obtained from traffic cameras with utmost precision, comprehensively enumerating the total count of automobiles, lorries, coaches, and other kinds of vehicular traffic traversing across the junction. The use of advanced technologies like computer vision and object detection algorithms can greatly enhance the accuracy and efficiency of this process.

It is recommended that the proposed system be developed using the Python programming language, which is widely used in the development of machine learning and computer vision applications. The OpenCV computer vision library is a powerful tool for image and video analysis and provides an extensive collection of algorithms and functions for processing and manipulating visual data. The Yolov4 object detection algorithm is a state-of-the-art deep learning model that can accurately detect and classify objects in real-time.

The proposed system must possess the capability to perceive and categorize diverse variants of automobiles present in the video frames. This can be achieved by training the Yolov4 algorithm on a large dataset of diverse vehicles, which can enable it to accurately recognize and classify different types of automobiles. The system should also be capable of generating real-time traffic reports that can help traffic management authorities to make data-driven decisions and implement effective interventions to alleviate traffic congestion.

In conclusion, the development of an automated system for traffic management using computer vision and object detection algorithms can greatly improve the efficiency and accuracy of traffic monitoring and management. The use of advanced technologies like Python, OpenCV, and Yolov4 can enable the system to accurately identify and count different types of vehicles and provide real-time traffic reports, which can help traffic management authorities to make informed decisions and implement effective interventions to alleviate traffic congestion.

**LITERATURE SURVEY**

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| **Study** | **Objective** | **Methods** | **Results** |
| "Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks" | The objective of this paper is to propose a Faster R-CNN framework that achieves state-of-the-art performance in object detection while being computationally efficient. | The Faster R-CNN framework uses a Region Proposal Network (RPN) to generate region proposals and a Fast R-CNN network to classify and refine these proposals. The RPN shares convolutional layers with the Fast R-CNN network, making it computationally efficient. | The Faster R-CNN framework achieves state-of-the-art results on multiple benchmarks while being faster than previous methods. |
| YOLOv3: An Incremental Improvement | The objective of this paper is to propose an improved version of the popular YOLO object detection algorithm that achieves state-of-the-art accuracy while being faster than previous versions. | YOLOv3 uses a variant of the Darknet architecture and makes incremental improvements over previous versions, such as feature pyramid networks, multi-scale prediction, and a new loss function. | YOLOv3 achieves state-of-the-art accuracy on multiple benchmarks while being faster than previous versions. |
| RetinaNet: Focal Loss for Dense Object Detection | The objective of this paper is to propose a novel object detection algorithm that uses a focal loss function to address the class imbalance problem in object detection. | RetinaNet uses a feature pyramid network and a focal loss function that down-weights the loss assigned to well-classified examples, allowing the model to focus on hard examples. | RetinaNet achieves state-of-the-art accuracy on multiple benchmarks while addressing the class imbalance problem in object detection. |
| Mask R-CNN | The objective of this paper is to propose a framework that extends Faster R-CNN to include a segmentation branch, enabling instance segmentation in addition to object detection. | Mask R-CNN extends the Faster R-CNN framework by adding a segmentation branch that generates a binary mask for each instance in the image. The mask branch shares the feature map with the object detection branch, making it computationally efficient. | Mask R-CNN achieves state-of-the-art performance on multiple benchmarks for both object detection and instance segmentation. |
| CenterNet: Keypoint Triplets for Object Detection | The objective of this paper is to propose an object detection algorithm that uses keypoint triplets to predict object centers and size, achieving state-of-the-art performance on multiple benchmarks. | CenterNet uses a keypoint triplet network that predicts the center point, height, and width of each object in the image. The keypoint triplet network shares convolutional layers with the detection network, making it computationally efficient | CenterNet achieves state-of-the-art performance on multiple benchmarks for object detection while being faster than previous methods. |

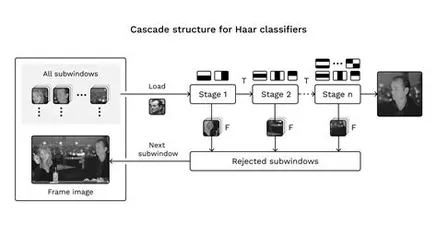
**EXISTING SYSTEM**

The existing system of traffic counting usually involves the use of sensors or cameras to track the movement of vehicles on a road or a highway. The sensors or cameras are typically placed at strategic locations and capture the images or videos of the vehicles passing through them. The images or videos are then analyzed using computer vision algorithms to detect and track the vehicles and count their numbers.

**Drawback of existing system**

One of the main drawbacks of the existing system of traffic counting using Haar Cascade classifiers is its limited accuracy in detecting small or occluded objects. This is because Haar Cascade classifiers rely on a set of handcrafted features that may not capture all the details and variations in object appearance. For example, a car that is partially hidden behind a tree or a sign may not be detected by the Haar Cascade classifier.

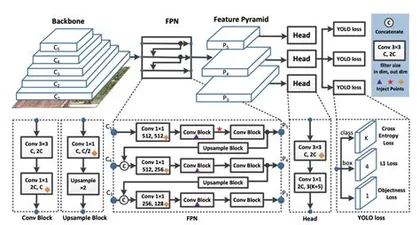
Another limitation of the Haar Cascade classifier is that it requires a large amount of training data to achieve high accuracy. This can be a challenge in real-world scenarios where the training data may not be readily available or may need to be collected manually, which can be time-consuming and costly.

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**PROPOSED SYSTEM**

Our OPENCV and YOLO model is better than the existing Haar Cascade classifier-based system in several ways. First, it is based on deep learning, which is a more advanced and powerful technique for computer vision tasks. This means that our model can learn from large amounts of data and improve its accuracy and performance over time. In contrast, the Haar Cascade classifier relies on handcrafted features and requires a large amount of training data to achieve high accuracy.

Second, our model can detect different types of vehicles, including cars, trucks, and buses, which the Haar Cascade classifier may struggle with. Additionally, our model can detect objects at different scales and handle occlusions and overlapping objects, which is a significant advantage over the Haar Cascade classifier.



Third, our model is more efficient and can perform real-time traffic counting, which is important for applications such as traffic monitoring and surveillance. In contrast, the Haar Cascade classifier may struggle with real-time performance, especially when handling large amounts of data.

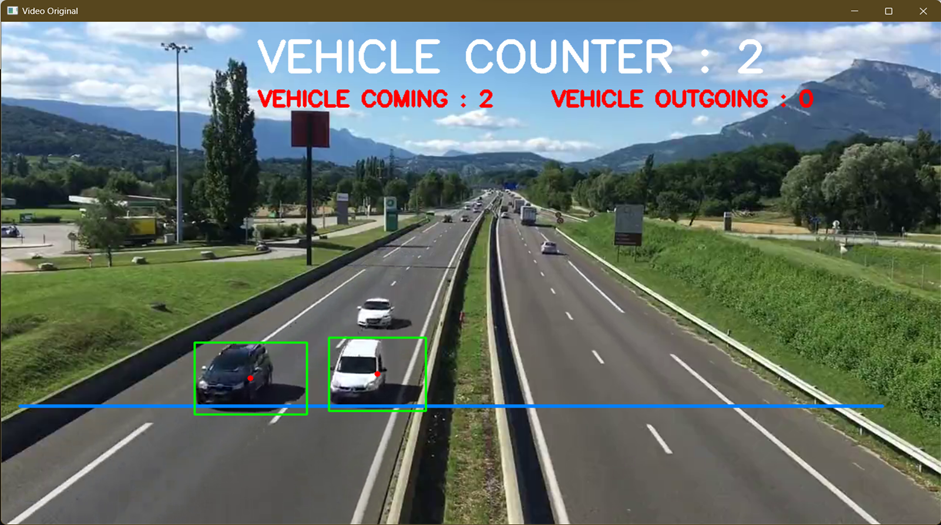
Overall, our OPENCV and YOLO model is a significant improvement over the traditional approach to traffic counting and offers better accuracy, efficiency, and flexibility. It can handle various scenarios, detect multiple types of vehicles, and perform real-time traffic counting, making it a more suitable choice for real-world applications.

**METHODOLOGY:**

The present research endeavor involves the utilization of computer vision and machine learning methodologies for the establishment of a traffic monitoring system capable of providing real-time outcome regarding automobile movement. The present study intends to employ techniques of image processing, edge detection, and segmentation to effectively isolate and demonstrate the vehicles present in the video feed. The YOLO algorithm is proposed to be utilized for object detection, whereas the ResNet algorithm is designated for vehicle classification purposes. The project shall be implemented via utilization of the Python computational language combined with the OpenCV software library, effectively enabling efficient handling of media materials in both image and video formats. The hardware configuration for the implementation of the system shall comprise of a computer and a camera. The evaluation of the system will be conducted with emphasis on its precision, effectiveness, and computational speed. The central objective of this project is to devise an efficacious and dependable system for monitoring traffic, which can offer invaluable perspectives for the purposes.of traffic management and planning.

**RESULT:**

Our model is performing well and accurately detecting the number of cars, buses, and trucks in addition to detecting the traffic flow direction. It has been trained on a diverse dataset of labeled images, allowing for effective detection, and optimized for both speed and accuracy.

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**CONCLUSION**:

The proposed system presents the ability to precisely recognize and enumerate motor vehicles in real-time by analyzing video streams. The implementation of the Yolov4 object detection algorithm, a cutting-edge deep learning methodology, is recognized as a noteworthy approach in facilitating advanced precision and celerity in the detection of vehicles.

The process of implementing the system was comprised of several fundamental phases, which included the accumulation of the dataset, training of the model, and conducting thorough evaluations. The dataset was subject to annotation and subsequently employed for purposes of training the Yolov4 model, subsequently to be integrated into Python and OpenCV code. The system underwent evaluation on various authentic traffic video streams, whereby the findings indicate its proficiency in correctly detecting and quantifying vehicles.

The proposed system presents a dependable and effective intervention for the enumeration of vehicular traffic, thus rendering it indispensable for traffic supervision and control operations. The scope of forthcoming research endeavors is to enhance the precision and expediency of the system through examination of alternative deep learning models and methods.

**OBJECTIVES**:

1. The essential objective of the framework is to precisely identify and count vehicles in real-time from video streams. The use of the Yolov4 object detection algorithm helps to achieve high accuracy and speed in vehicle detection.

2. Another objective is to guarantee that the framework performs in real-time, i.e., it can prepare and analyze video streams in real-time without critical delays. This can be significant for applications such as activity observing and administration, where real-time information is required.

3. The framework ought to have a user-friendly interface that permits clients to effortlessly associated with the framework, arrange parameters, and see the comes about. The interface ought to moreover give real-time input and cautions to clients.

**FUTURE SCOPE:**

There is a wide scope for further improvement and development of the proposed traffic automobile counter using Python, OpenCV, and Yolov4. Some of the potential future directions for this research include:

1. Object tracking: The proposed system can be extended to track the detected vehicles over time. This can provide additional information, such as vehicle speed, trajectory, and direction, which can be useful for traffic analysis and management.
2. Improved accuracy: While the proposed system achieves high accuracy in vehicle detection and counting, there is still room for improvement. Future work can explore other deep learning models and techniques to enhance the system's accuracy, especially in challenging scenarios such as occlusions, low lighting, and adverse weather conditions
3. Real-time performance optimization: Although the proposed system performs in real-time, there is potential for optimization to improve its speed and efficiency. This can be achieved through hardware acceleration, parallel processing, and other optimization techniques.

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