The Pharma Innovation Journal 2019; 8(2): 860-864

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(2): 860-864

www.thepharmajournal.com
Received: 10-12-2018
Accepted: 16-01-2019

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Traffic automobile counter using open CV and YOLO

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DOI: https://doi.org/10.22271/tpi.2019.v8.i2n.25419

Abstract
This research paper presents a system for vehicle detection and classification using Open CV 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.

Keywords: Traffic, automobile, YOLO, system utilizes

Introduction
In recent years, the creation of intelligent transportation systems has grown in importance as a field of study. Real-time vehicle detection and classification accuracy is a crucial feature of these kinds of systems. This paper presents a YOLO and OpenCV based vehicle detection and classification system. In order to count the number of vehicles in both the incoming and outgoing lanes and classify them into three categories—cars, trucks, and buses—the proposed system seeks to produce accurate and dependable results [1].

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 [2].

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 [3].

Overall, by presenting a reliable and effective system for real-time vehicle detection and classification, this research paper advances the field of computer vision and may help to enhance transportation and traffic management.

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 [4].

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 [5].

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 [6]. 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 [7].

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 [8].

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 [9].

Table 1: Literature survey

Study	Objective	Methods	Results
"Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks"	This paper aims to propose a Faster R-CNN framework that is computationally efficient and achieves state-of-the-art performance in object detection.	A Region Proposal Network (RPN) is used in the Faster R-CNN framework to produce region proposals, and a Fast R-CNN network is used to categorize and enhance these proposals. Computationally efficient, the RPN shares convolutional layers with the Fast R-CNN network.	While being faster than earlier approaches, the Faster R-CNN framework achieves state-of-the-art results on multiple benchmarks.
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 aim of this paper is to address the issue of class imbalance in object detection by proposing a novel object detection algorithm that makes use of a focal loss function.	RetinaNet employs a feature pyramid network with a focal loss function, which enables the model to concentrate on challenging examples by down-weighting the loss assigned to examples that are well-classified.	Retina Net solves the issue of class imbalance in object detection while achieving cutting-edge accuracy on several benchmarks.
Mask R-CNN	This paper aims to propose a framework that allows instance segmentation in addition to object detection by extending Faster R-CNN with a segmentation branch.	By including a segmentation branch that creates a binary mask for each instance in the image, Mask R-CNN expands on the Faster R-CNN architecture. Computationally efficient, the mask branch shares the same feature map as the object detection branch.	On several benchmarks, Mask R-CNN achieves state-of-the-art performance in both object detection and instance segmentation.
CenterNet: Keypoint Triplets for Object Detection	This paper aims to propose an object detection algorithm that achieves state-of-the-art performance on multiple benchmarks by predicting object centers and size using key point triplets.	In order to determine the height, width, and center point of each object in the picture, CenterNet employs a key point triplet network. Because the key point triplet network and the detection network share convolutional layers, they are computationally efficient.	While being faster than earlier techniques, CenterNet achieves state-of-the-art performance on multiple benchmarks for object detection.

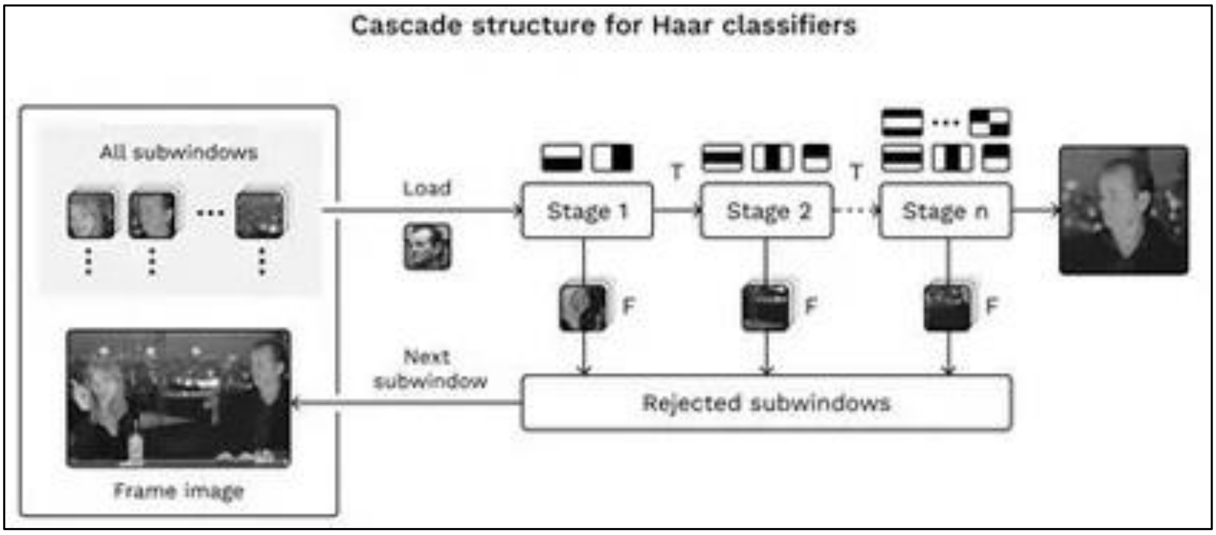
Existing system

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 [10].

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.

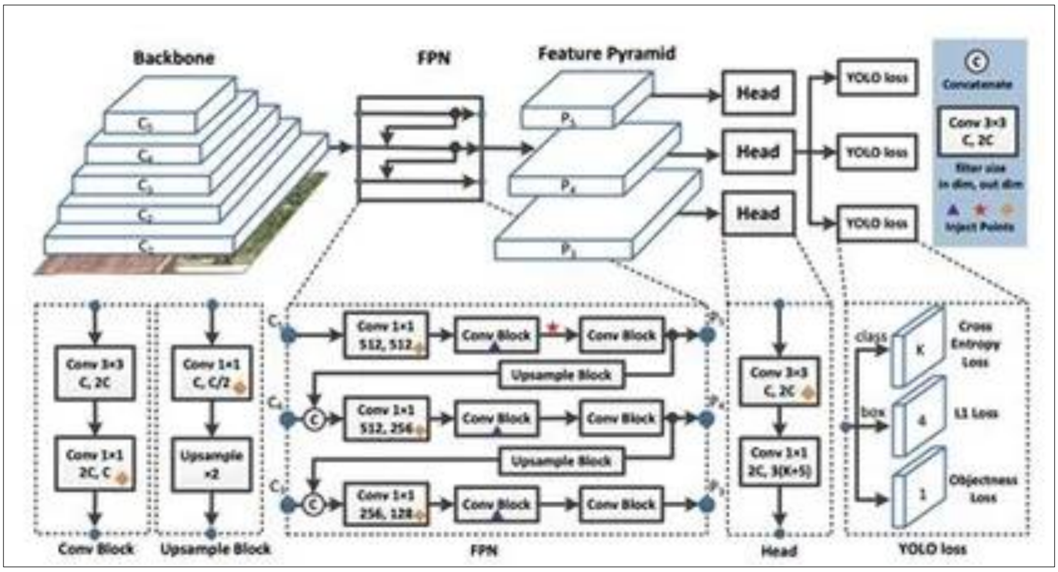
Another limitation of the Haar Cascade classifier is that it requires a large amount of training data to achieve high accuracy. This can be a challenge in real-world scenarios where the training data may not be readily available or may need to be collected manually, which can be time-consuming and costly.



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 an advanced and highly efficient traffic monitoring system capable of providing real-time outcomes regarding automobile movement. The aim of this study is to leverage cutting-edge techniques in image processing, edge detection, and segmentation to effectively isolate and demonstrate the vehicles present in the video feed, enabling accurate and comprehensive traffic analysis.

To achieve this objective, the proposed approach will utilize state-of-the-art algorithms such as YOLO (You Only Look Once) for object detection and the ResNet (Residual Network) algorithm for vehicle classification purposes. By employing YOLO, the system will be able to detect and localize vehicles with exceptional speed and accuracy, ensuring that no vehicles are missed in the monitoring process. The subsequent classification of vehicles using ResNet will provide further insights into the types of vehicles present in the traffic flow, enabling a more detailed analysis of the overall traffic composition.

The implementation of this project will be carried out using the versatile and widely adopted Python computational language, combined with the powerful OpenCV software library. Python's extensive range of libraries and tools, along with OpenCV's rich functionalities for image and video processing, will facilitate the seamless handling and manipulation of media materials in various formats. This integration will ensure that the system operates with high efficiency and enables real-time processing of the traffic feed, providing up-to-date information for traffic management and planning purposes.

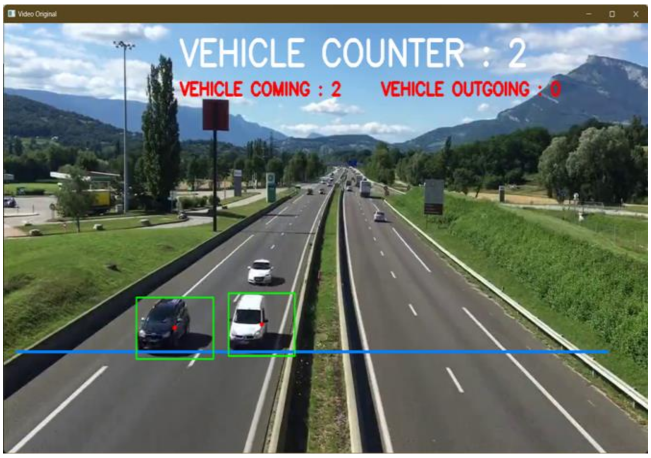
In terms of hardware configuration, the system will require a computer equipped with sufficient processing power to handle the computational requirements of the image processing and machine learning algorithms. Additionally, a camera will be necessary to capture the video feed for analysis. By employing a well-configured computer and a reliable camera, the system will be able to process the traffic data efficiently and ensure accurate and timely monitoring of the traffic flow.

The evaluation of the developed system will focus on several key aspects, including precision, effectiveness, and computational speed. Precision refers to the system's ability to accurately detect and classify vehicles in the video feed, minimizing false positives and false negatives. Effectiveness involves assessing the system's overall performance in capturing and analyzing the traffic data, providing valuable insights for traffic management and planning. Computational speed will be a critical factor, as the system should be capable of processing the video feed in real-time or near real-time, ensuring timely and up-to-date traffic information.

By successfully implementing this project, the central objective of devising an efficacious and dependable system for monitoring traffic will be achieved. The resulting system will offer invaluable perspectives for traffic management and planning, facilitating informed decision-making and enabling proactive measures to enhance traffic flow, reduce congestion, and improve overall road safety. The integration of computer vision and machine learning techniques will revolutionize the field of traffic monitoring, ushering in a new era of intelligent transportation systems with far-reaching benefits for both urban and interurban areas.

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.



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.
4. Integration with traffic flow management systems: The developed traffic monitoring system can be integrated with existing traffic flow management systems. This

integration would enable the system to provide real-time data and insights to traffic controllers, allowing them to make informed decisions and implement effective strategies for optimizing traffic flow and reducing congestion.

5. Multi-camera setup and multi-view analysis: Currently, the proposed system utilizes a single camera for traffic monitoring. Future research can explore the use of multiple cameras placed at different locations to capture different views of the traffic. This multi-camera setup would enable a more comprehensive analysis of the traffic, including the ability to track vehicles across multiple camera views, providing a holistic view of the traffic conditions.
6. Anomaly detection and incident identification: Building upon the vehicle tracking capability, the system can be further enhanced to detect anomalies and identify traffic incidents. By leveraging machine learning techniques, the system can learn patterns of normal traffic behavior and identify abnormal events such as accidents, traffic jams, or vehicles driving in the wrong direction. This feature would enable prompt incident detection and appropriate response by traffic authorities.
7. Integration with smart city infrastructure: As cities continue to embrace smart city initiatives, the proposed traffic monitoring system can be integrated with other smart city infrastructure components. For example, it can be linked with intelligent traffic signal systems to optimize signal timings based on real-time traffic conditions. Integration with smart parking systems can provide valuable information on parking availability, enabling efficient parking management.
8. Data analytics and visualization: The collected traffic data can be analyzed using advanced data analytics techniques to derive meaningful insights. This can involve identifying traffic patterns, predicting traffic congestion, and optimizing traffic management strategies. Furthermore, visualizing the analyzed data through interactive dashboards and maps can provide a user-friendly interface for traffic managers and city planners to monitor and analyze traffic conditions effectively.
9. Continuous model training and adaptation: To improve the system's performance over time, continuous model training and adaptation can be implemented. By incorporating mechanisms for automatically retraining the deep learning models using new labeled data, the system can adapt to changes in traffic patterns and improve its accuracy and robustness.

By exploring these future directions, the proposed traffic automobile counter can evolve into a sophisticated and intelligent system that not only monitors traffic but also contributes to proactive traffic management, safety enhancement, and the overall development of smart cities.

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