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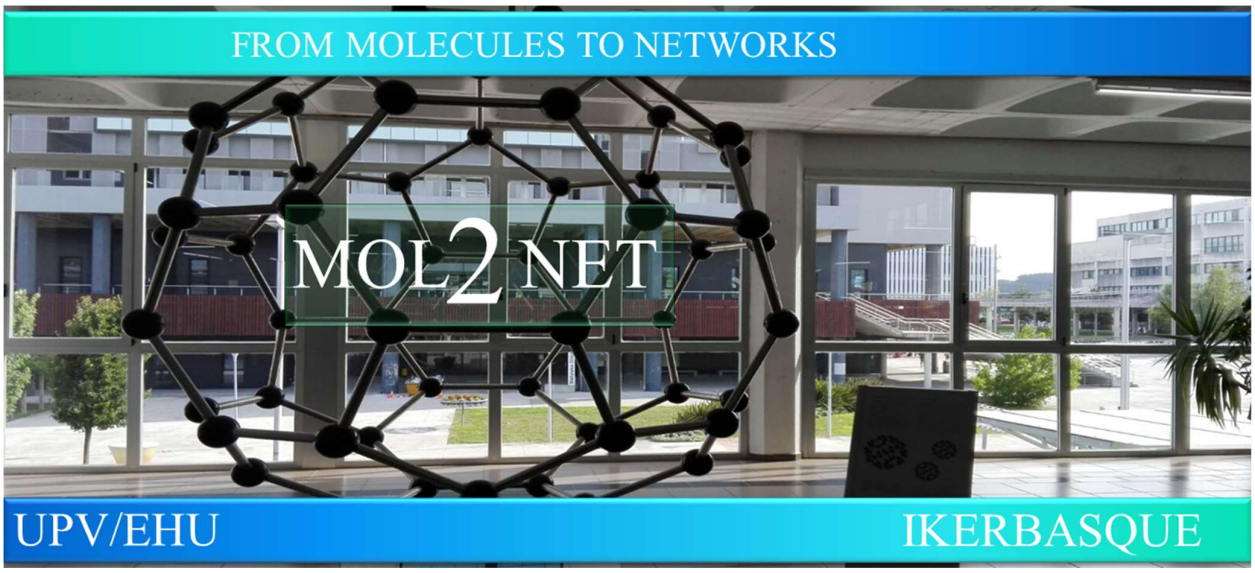

Real-Time Highway Abnormality Detection Using an Image Processing Algorithm

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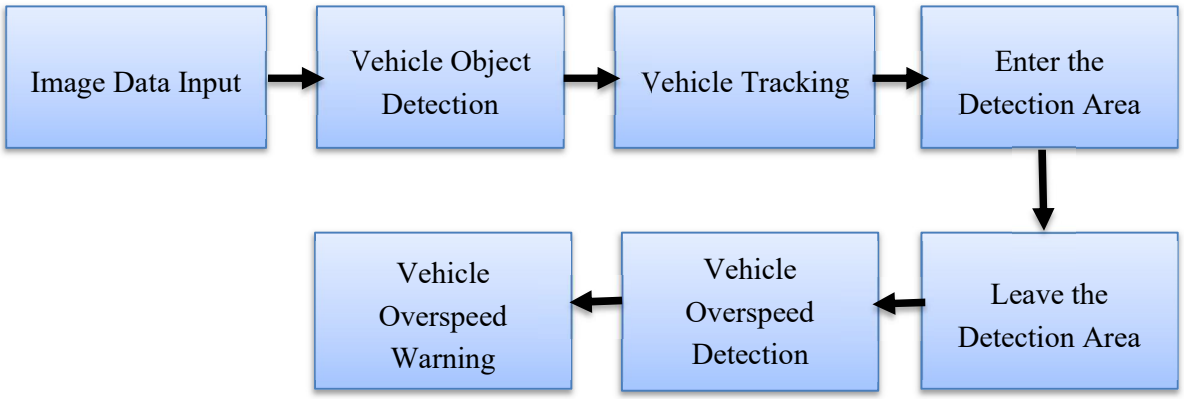
Abstract.

Due to highway real-time monitoring issues, manual monitoring cannot quickly detect abnormalities. Incorrect detection and costly monitoring make it hard to determine traffic's operating state. Experiments show that the YOLOv3 algorithm has improved. Real-time detection improves accuracy. Improving the deep-sort vehicle feature description can speed up vehicle tracking. The system now detects vehicle speeding and congestion in real-time utilizing an upgraded vehicle object recognition, tracking algorithm, and expressway traffic monitoring picture. First, the highway corporation's monitoring system was inspected. After monitoring highway footage in various places, lighting, weather, and other conditions, a comprehensive vehicle data set was developed. A deep learning model for vehicle target detection is built on this data. Second, the labeling tool divides the data set and

labels each sample. YOLOv3's border regression loss function increased with the enhanced vehicle detection algorithm. This was achieved through vehicle target identification algorithm research. Build a model of accurate vehicle detection, test the algorithm model, and use the results of the experimental examination of the various loss functions and training data to improve target identification performance and speed. After discussing target tracking, the real-time multi-target monitoring-based deep-sort algorithm will be explained. Trials assess the improved algorithm. If the detection impact is the same, increasing the tracking speed will improve the anomaly detection system's real-time performance. This is true even without boosting tracking speed. Anomaly detection was developed from vehicle target identification and tracking studies. Debugging and analyzing an abnormal event detection system may automatically recognize the speed and congestion of the video vehicle during abnormal occurrences, such as those in expressway surveillance video. It accurately detects real-time anomalous events. Thus, this technology can better track vehicle traffic and predict and identify emergencies. It also supports timeliness and on-site rescue, ensuring lane traffic flows as planned and improving highway business service.

Keywords: Real-time anomaly detection, Highways, Vehicle identification, Video, and YOLOv3.

Graphically Abstract



Introduction

Most expressway management centers implement manual monitoring and handling strategies in response to the daily congestion events and anomalous vehicle speeds that result in traffic accidents [1]. Its main drawbacks are

- The sluggish rate at which abnormal event data is collected,
- The inability to evaluate movies, and
- The high operating expenses of this technology.

Question. The expressway surveillance system is heavily tasked with ensuring the safety of people and their property as they move. The expressway management division has been steadily using the available intelligent traffic information detection technology in recent years to regulate the lane's traffic condition in real-time and avoid secondary traffic accidents. Enhance service and administration of expressways [2].

Transportation Highway transportation is a crucial assurance for the rapid growth of the national economy in my country. Without question, expressways are a necessary component of the transportation system and are essential to the overall transportation network. Our nation has understood road transportation's essential and crucial relevance in the national economy from the early stages of reform and opening up. The government and the Ministry of Communications have not let go of this connection in road building. Since my nation's reform and opening up in the late 1990s, there have been steadily more industrial, commercial, and civic cars on the road. The Chinese government sees the improvement of transportation, particularly roads, as an integral part of the strategic and overall growth of the country's economy. The objective of high quality and urgency allowed for the quick advancement of road building. According to the Ministry of Transport's "2020 Statistical Bulletin on the Development of the Transportation Industry" [3], the national expressway mileage hit 172,600 kilometers at the end of 2020, an increase of 6,100 kilometers over the previous year. Highway lane mileage increased by 29,000 kilometers from the previous year to 743,300 kilometers. National roadway length has increased by 3,400 kilometers to 107,800 kilometers. Expressway firms have also benefited greatly from the recent steady progress of urbanization and the quick expansion of the car sector in my nation. The major rail lines' transit capacity impacts railways, and certain regions do not have accessible entrances and exits [4].

Expressways play a significant role in transportation due to the impact that aircraft expenses, the cost of building airport infrastructure, and the cost of transit capacity have on shipping [5]. As a result, the expressway sector is now experiencing growth, prosperity, and progress. Already essential tools for ensuring safe and efficient traffic, expressway safety, and information technology. Currently, domestic expressway abnormal event detection mainly uses manual monitoring techniques. The highway firms' monitoring staff works 24-hour shifts to inspect the expressway lane monitoring displays. Report. The manual-based monitoring system is essential since it assists in comprehending information about the expressway's current road conditions and serves as an input interface for the dispatching system to address abnormal situations. However, most of China's monitoring systems still

depend on humans to identify abnormal occurrences, making it difficult to manage and monitor expressways with high real-time performance, accuracy, and efficiency [6].

Materials and Methods

Vehicle target identification and tracking, together with the accompanying vehicle speeding and congestion detection algorithms, are the primary problems that need to be resolved in the video image-based expressway abnormal event detection system. This essay will examine the following four factors in order to address the issues above:

- Processing of data sets. The design of the gathering technique for various motor vehicle image data sets on the expressway is done after analyzing the expressway monitoring system's natural functioning. Based on this system, research and provide a production standard for the vehicle picture data set. Accurate vehicle target identification and tracking depend heavily on the data set's creation and labeling outcomes. The size ratio is appropriately chosen, and the training, verification, and test sets are precisely split before building the deep learning model.
- Detection of vehicle targets. In order to address the issue of vehicle target recognition, various regularization techniques are added, the data is improved, the frame regression method in the YOLOv3 loss function is improved, and the results of various convolutional neural network structures for vehicle target image recognition are studied. The "early termination" strategy is utilized both during and after training to guarantee the best model outcomes and lessen the likelihood of overfitting [17].
- Real-time monitoring of vehicle targets. Based on research into the detection of moving targets, DEEP-feature SORT's description method has been upgraded to the HOG feature method. This has significantly increased tracking speed while maintaining a high level of matching accuracy, giving the system a strong guarantee of real-time performance.
- Recognizing abnormal events. Investigate and provide the methodology for measuring congestion and vehicle speed. Utilize the vehicle tracking technique to compute the vehicle's travel distance in a certain amount of time. Next, calculate the driving time and vehicle speed. Finally, decide if the traffic is congested.

Results and Discussion

The technology can identify anomalous occurrences like traffic jams and vehicle speeding in real-time using automated real-time analysis of highway surveillance video feeds. Quickly identify potential traffic problems during expressway operation, and provide sophisticated detection methods for the

expressway's safe and effective operation. The use of this technology may significantly increase monitoring effectiveness, decrease the effort associated with human monitoring, and increase the timeliness and accuracy of traffic data collection.

The system should be able to identify speeding cars in real-time by the traffic department's regulations on the speed limits of various road segments. Traditionally, traffic information detectors position the vehicle to detect vehicle speed. It may be categorized into many categories based on how it was installed:

- Under the expressway lane, pressure, geomagnetic, and other pass-through sensors are implanted. Vehicles traveling over the lane activate the sensors to gather positional data for traffic parameter collection.
- No-touch to gather and compile data on passing cars, sensors are set up above the expressway lane or on the monitoring pole. Methods based on sound waves and video pictures are already very prevalent.

Python is a programming language that the system utilizes to create unit codes for things like model training and evaluation accuracy. A deep learning model for vehicle target identification is developed after several training iterations. C++ implements the system unit codes for target tracking, image reasoning, and alarm information interface presentation.

Conclusions

After studying the vehicle target detection method, the attention shifts to implementing the vehicle multi-target tracking approach, the goal of vehicle tracking is to identify a particular vehicle object that repeatedly occurs in a row throughout some time and to compute the item's velocity subsequently. The future of vehicle monitoring technology is diverse. An enhanced DEEP-SORT technique is presented, which employs HOG features instead of deep convolutional neural networks to suggest picture features after integrating the highway usage scene and analyzing the backdrop difference and the tracking approach based on deep learning target recognition. Thus, the experimental verification concludes that the vehicle tracking speed has significantly increased, provided that the vehicle's multi-target tracking effect is essentially the same. Finally, the abnormal event detection algorithm for traffic congestion and vehicle speeding is built using the vehicle information characteristics gained from the project's investigation of target identification and tracking techniques. System debugging was done using the actual abnormal event video from the highway as an example, and then the system client's monitoring screen presented the alarm information in real-time.

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