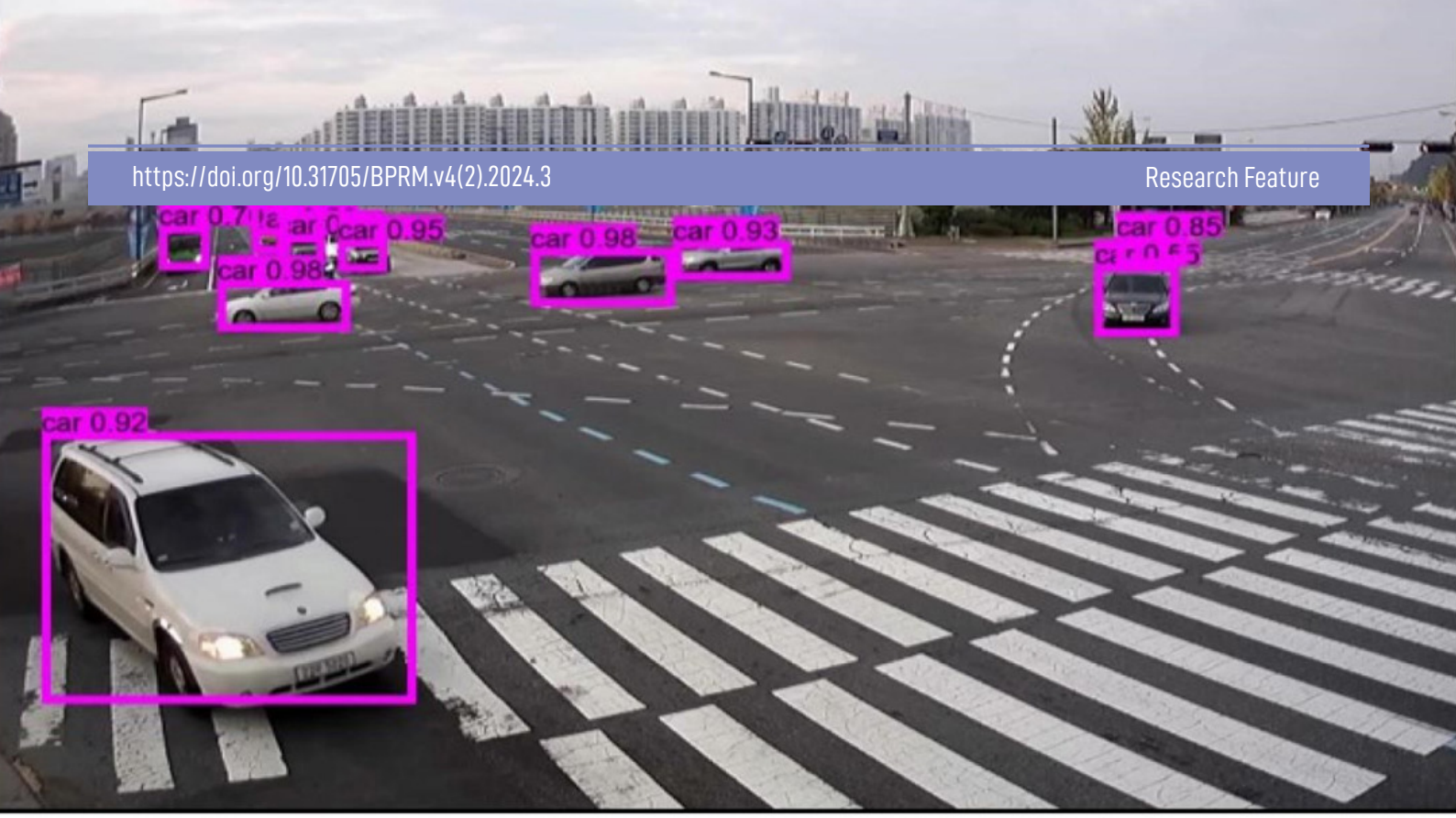
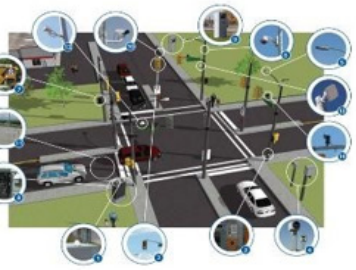
https://doi.org/10.31705/BPRM.v4(2).2024.3 Research Feature





Real Time Vehicle Classification and Vehicle Counting at Intersection Using Deep Learning Techniques

Fast suburbanization has resulted in more significant traffic backlogs demanding sophisticated traffic control solutions. This paper uses deep learning architecture to present a methodology for real-time vehicle classification and counting at intersections. Precise real-time vehicle classification and counting (RVCAC) at intersections are essential for efficient traffic management, especially in congested and heavy traffic mix conditions like those in Sri Lanka.

Deep learning models deliver outstanding efficacy in object detection tasks compared to traditional machine learning models. Also, deep learning is a subcategory of machine learning. This paper explores a model that uses deep learning to classify and count vehicles around intersections. Our goal is to enhance accuracy by training a deep learning model based on a localized dataset that is specified for the Sri Lankan context.

Real-time vehicle classification and counting, which are crucial for managing traffic conditions, detecting vehicle speed, identifying peak times, and more, have the potential to impact traffic management significantly.

Importance in improving the accuracy of real-time detection

- Monitoring traffic flow accurately and reliably is essential in maintaining active transportation.
- Able to increase the number of vehicle types that can be identified.

Why does Focus on an intersection in Sri Lanka?

- If it is an intersection, additional vehicle turning movement data can be captured.
- intersections are critical places that in crease congestion [1].

Reasons for using Deep Learning Techniques to classify and count vehicles

Manual methods and deep learning methods are used to capture those data. However, the manual method has some high-cost work, and that method causes human errors when collecting data [2]. To address those problems, systematic deep learning models come to vehicle classification and counting. Abilities of using deep learning algorithm:

- Mitigate human errors [2].
- It can be remotely accessed and installed

.

There is a notable gap in further model training to enhance accuracy in real-time vehicle classification and counting for various types of vehicles in congested, heterogeneous traffic conditions at intersections Using Deep Learning Techniques [1],[2]

The Research Question is, what are the potential techniques for enhancing the accuracy of Real-Time Vehicle Classification And Vehicle Counting at Intersections in Sri Lanka?

This research aims to train the model until satisfactory results are reached using specific datasets to enhance the accuracy of real-time vehicle classification and counting.

Methodology

The methodology of real-time vehicle classification is training deep learning according to the flow chart below. Also, we want to use a Virtual Detection Zone to improve classification and vehicle counting [3].

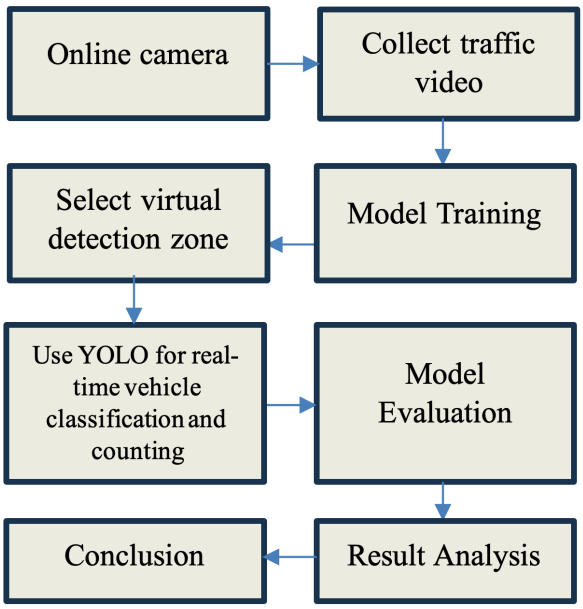


Figure 1: Flowchart of the vehicle counting and classification process[3]

Existing Algorithm comparison

Different algorithms have different purposes in deep learning. They are specific for specific tasks . in this research, we need to do a vehicle detection task. There are different algorithms for image processing: Autoencoders, Multilayer Perceptron (MLP), Generative Adversarial Networks (GANs) and Convolutional Neural Networks (CNN). GAN is an image-generating algorithm. Because of that, it is not suitable for this research. Among others, we should select the best algorithm for vehicle detection after a comparison.

After comparing algorithms, we can see that the best real-time vehicle detection and counting method is CNN [5].

Why does select YOLO (You Only Look Once)

- YOLO is an object real-time detection algorithm (Ultralytics, 2024)
- YOLOv8 version reached [4],
    - 96.58% average accuracy in vehicle detection
    - 97.54% average accuracy in vehicle counting
    - 96.325% average accuracy in vehicle classification

In this research, we decided to use Yolov10, the latest Yolo version. Due to architectural improvements, YOLOv10 outperforms YOLOv8, especially in detecting bicycles and trucks. These improvements are likely due to better capture of complex features and handling diverse shapes and sizes.

Supporting software for model development

There are multiple options for Supporting software for each task, although we have to focus on the smoothness of real-time object detection. For example, if the processing time of a live video feed takes longer than the video duration, that live video feed will start to drop FPS (frames per second). To avoid that, we can get support from Real-Time Data Streaming and Processing to. As an example, as Computer Vision Libraries, OpenCV can handle live video feeds. But to ensure the smoothness of the detection process and maintain a continuous video feed by sharing live video feeding tasks with Real-Time Data Streaming and Processing software. But that is optional.

Data Collection

Required Data - Clear Vehicle Images from different angles and CCTV footage of Vehicles that are similar to Sri Lankan vehicles and road conditions.

The dataset is divided into three parts .

- Training set
- Development set
- Test set

Consequently, enhancing vehicle classification precision facilitates the superior identification of opportunities to advocate for public transport while enhancing vehicle counting accuracy, which improves traffic control systems. Precisely detecting vehicle movements and velocities yields essential data that aid urban planners and policymakers in making factual traffic decisions.

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