

Vehicle type validation for highway entrances using convolutional neural networks

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Abstract

Vehicle type validation for Highway entrances using convolutional neural networks is an approach taken to automate the highway toll systems of Sri Lanka. Available automated highway toll systems in the world use sensor-based validation systems to validate the vehicles that are entering the highways. Maintenance cost of these systems is high. A vision-based validation system has not been implemented, as yet. This paper introduces a vision-based method to validate vehicles for highway systems which can reduce the cost while increasing the efficiency and safety. A Convolutional Neural Network (CNN) model was developed to achieve this objective. The CNN model employed here uses a binary classification to categorize vehicles as allowed vehicles and non-allowed vehicles for entering the highway. The model developed here showed 86.69% accuracy. The model was manually tested for different vehicle types using a GUI based application and all the test images were successfully classified into their classes.

Keywords: Convolutional neural networks, Image classification, Machine Learning, Vehicle classification, Vehicle validation

Introduction

In Sri Lanka, the entrance to the toll booths for highways are manned by workers and by police officers. This use of human resources is costly for the Road Development Authority (RDA) of Sri Lanka and may not offer the service levels expected from users of the highway, due to worker fatigue and the monotonousness of the task. Past incidents have proved that it is also dangerous for workers inside the toll booths, due to drunkard and sleepy drivers. As a solution, processing of vehicles entering the highway can be automated. Therefore, the RDA can use these workers for alternate work at other RDA projects. In order to facilitate, the automation process this study provides a vision-based method for validating the vehicle types that are entering through the individual booths or terminals.

As shown in Figure 1, Sri Lanka does not allow bikes, motorbikes, carts, three-wheelers, and tractors to enter the highway system. Hence it is needed to identify prohibited and non-prohibited vehicles for the highways. Therefore, it requires a validation procedure for vehicles if the entrance system of the highways is to be automated. The Convolutional Neural Network (CNN) model introduced in this research can be used to achieve this goal by reducing the cost compared to present manual system. The model only requires images of vehicles to be validated as inputs. One of the most helpful feature in CNNs is we can use them for vehicle classification without taking help of image processing to identify features. Therefore, there is no need to specify how an object looks like. With CNNs the researchers only need to concern about how they can do the classification with minimum requirement of