

Development of a Green Driving Model for Buses Using Machine Learning Techniques

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Abstract

Green driving, also known as eco-driving, encompasses a set of practices and technologies aimed at reducing the environmental impact of driving. This approach seeks to minimize fuel consumption, lower greenhouse gas emissions, and reduce wear and tear on vehicles which will make transportation more sustainable. Driving approach is a key element in green driving and smooth acceleration and braking, maintaining steady speeds, use of cruise control, avoiding idling, and proper gear use are the key decisive practices. This study has investigated the bus driver behaviour aimed at the development of a green driving model for Sri Lankan bus drivers. Time vs geographical location data were collected using a GPS device from buses covering many routes, both short and long-distance, and geographical areas. Machine learning techniques were used to analyze the data. With the objective of emission reduction and lowering fuel consumption, threshold values are selected for major parameters considered in the eco-driving concept. Namely, hard acceleration greater than 2.74 ms^{-2} hard deceleration less than -2.74 ms^{-2} hard

cornering greater than 6° with speed greater than 30 km/h, over speeding greater than 50 km/h and idling speed less than 5 km/h are the selected threshold values for this study.

Using above threshold values, Primary data such as Local Date, Local Time, Speed, Latitude, Longitude, Distance extract from the GPS device and Secondary data derived from the Primary data such as Acceleration, Angle degree change of the vehicle used to find the suitable machine learning model using SPSS Modeler software. Software shows C5.0 machine learning model is the best fit model with accuracy 99% to evaluate the green driving status as per the GPS data. Analysis shows that a 55 to 45 ratio exists between non- green driving vs green driving in long-distance buses and a 60 to 40 ratio for short-distance buses.

As per the past research done by Rodrigo et al. in 2023 found that Diesel liters consumed for bus transportation in Sri Lanka is 381.9 Million liters per year and Huang et al. in 2018 found that Eco driving is relatively immediate and low cost, improving fuel efficiency by up to 45% then Fuel consumption saving due to eco-driving is 171.85 Million liters per year, when consider Lanka Auto Diesel price in Sri Lanka is 317 LKR then Expenditure Cost Saving due to Bus Eco Driving in Sri Lanka is 54 Billion Rupees per year. Therefore, this study has estimated that adaptation of green driving could save up to 54 billion rupees per year for Sri Lanka from the Buses, in addition

to other inherited benefits and improved road safety. However, it is important to note that the impact on travel time due to green driving has not been considered in this study. Finally, this study proposes a green driving model for bus drivers to assess driver behavior to achieve significant emission reduction.

Keywords: *Green driving, GPS, Machine learning, Bus*

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