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NATIONAL SCIENCE FOUNDATION

Transport Research Forum

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DEPARTMENT OF CIVIL ENGINEERING
TRANSPORTATION ENGINEERING DIVISION

Transport Research Forum 2024

Proceedings from the 17th Transport Research Forum 2024

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Transportation Engineering Group

Department of Civil Engineering

University of Moratuwa

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Introduction

Transport Research Forum (TRF) is an annual conference organized by the Transportation Engineering Division of the Department of Civil Engineering, University of Moratuwa. The prime objective of this conference is to create a platform for researchers in the transportation field to build up their research careers and to share their research findings with other colleagues and the industry, researchers and academics, including several international experts in Highway Engineering, Transportation Engineering and Planning, are the participants in this event. In addition, representatives from the industry and related government institutions are also invited every year.

Department of Civil Engineering conducted the first-ever Sri Lanka Transportation Forum in 1983, and since the late 90's, the Transportation Engineering Group has organized many Transport Research Conferences at local and international levels. Later, the Transport Research Forum (TRF) was established; two conferences were held initially, and since 2010, TRF has been held consecutively every year., TRF 2024 is the 17th Transportation Research Forum conducted by the Transportation Engineering Division. Many of the research findings presented in Transport Research Forums have been put into practice, and one of the main objectives of the Transport Research Forum is to come up with solutions to address transport-related problems in the country and disseminate them to the industry. In 2020, TRF achieved a significant milestone by publishing its selected proceedings (full papers from

selected studies presented at TRF 2020) in the IESL 'The Engineer' journal as a special edition.

Message from the Conference Chair

Prof. H.R. Pasindu

University of Moratuwa

Dear Participants and Esteemed Colleagues

Welcome Address for the 17th Transport Research Forum 2024.
I extend a warm welcome to the 17th Transport Research Forum 2024, organized by the Transportation Engineering Division of the Department of Civil Engineering at the University of Moratuwa. This annual forum continues to be a key platform for knowledge sharing, discussion, and collaboration among academics, researchers, and professionals in Sri Lanka's transportation sector.

This year's conference features keynote speakers from TU Dresden and IIT Indore, two leading universities in transportation engineering research, along with technical paper presentations addressing critical issues in transportation, including sustainable mobility, advanced transport infrastructure solutions, and pavement technologies. We are also delighted to include presentations from members of the Location-Based Services to Intelligent Transport Systems Project, funded by the Erasmus+ grant scheme.

I wish to thank the Vice-Chancellor, Prof. Niranjan Gunawardana; the Dean of the Faculty of Engineering, Prof. Jagath Manatunge; the Dean of the Faculty of Graduate Studies, Prof. Ruwan Gopura; and Prof. Udeni Nawagamuwa, Acting Head of the Department of Civil Engineering, for their steadfast support for the conference. Their commitment has been instrumental in advancing our efforts.

I am also grateful to the organizing committee for their dedication in planning this forum and to our academic and industry reviewers for their careful evaluation of the submissions. To our keynote speakers, presenters, and participants, thank you for your contributions, which make this event a vibrant and meaningful exchange of ideas.

As we commence the discussions, I encourage you to actively participate, engage with your peers, and share your insights. This is an opportunity to explore solutions to current challenges and contribute to shaping the future of transportation in Sri Lanka.

On behalf of the organizing committee, I look forward to a productive and engaging forum. Let us make the most of this opportunity to learn, collaborate, and advance our shared goals in transportation research.

Thank you.

Message from the Chief Guest

Prof. J.M.S.J. Bandara

University of Moratuwa

Dear Participants and Esteemed Colleagues,

It is a great pleasure and honor to be part of the 17th Transport Research Forum (TRF 2024), organized by the Transportation Engineering Division of the Department of Civil Engineering, University of Moratuwa.

In recent years, Sri Lanka has faced significant challenges in maintaining and developing transport-related infrastructure, highlighting the critical need to maximize the efficiency and sustainability of our existing systems. With constrained resources, it is important that we prioritize innovative strategies to optimize the use of existing infrastructure while transitioning towards more sustainable transport systems. The integration of sustainable practices, efficient traffic management, and modern technologies is no longer a choice but a necessity.

This conference comes at a critical moment, providing an opportunity to explore solutions that can strengthen the resilience and sustainability of our transport systems. Discussions on sustainable mobility, smart infrastructure, and innovative planning methods will play a crucial role in

shaping the future of transportation in Sri Lanka and the region. It is through knowledge sharing and collaborative efforts that we can address the challenges of today while building systems that cater to the needs of future generations.

I congratulate the organizing committee for creating this platform, which brings together leading experts and researchers from around the world. I am confident that TRF 2024 will stimulate impactful discussions, foster valuable collaborations, and generate actionable insights to guide our path forward. I wish the conference great success and hope you leave inspired to drive change in your respective fields.

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Dr. Varuna Adikariwattage	Department of Civil Engineering, University of Moratuwa
Dr. Nalaka Jayantha	Department of Civil Engineering, University of Moratuwa

Keynote Speech 01:

How strategic mobility systems planning can benefit from location-based travel surveys

Dipl.-Ing. Jonas Krombach
Research Associate
TUD Dresden University of Technology, Germany

Jonas Krombach is a research associate at the Chair of Mobility System Planning at TUD Dresden University of Technology (TUD) (Germany). Before joining TUD in 2022, he worked as a traffic engineer at the consultancy Rosinak & Partner ZT GmbH in Vienna (Austria) and studied transportation engineering at TUD. His research interests focus on strategic mobility planning with a special focus on sustainable urban mobility. Based on empirical data collection, insights on cities' understanding and priorities in terms of sustainable mobility are generated as the basis for developing evidence-based strategies to promote environmentally friendly travel behavior.

Dipl.-Ing. Johannes Weber
Research Associate
TUD Dresden University of Technology, Germany

Johannes Weber is a research associate at the Chair of Mobility System Planning at TUD Dresden University of Technology (TUD) (Germany). He is a member of the Chair since 2020 and dedicates his PhD project to both opportunities and challenges of smartphone GPS-based travel surveys. This relates to testing new ways of sampling and recruitment strategies, assessing user experience and motivational concepts, and analyzing data quality and its potentials for different use cases.

Keynote Speech 02:
Investigation of Horizontal Alignment Data Extraction Methodologies in Terms of Cost and Time

Dr. Gourab Sil
Assistant Professor
IIT Indore, India

Dr. Gourab Sil, an expert in Transportation Systems Engineering, specializes in road safety, driver behavior, and intelligent transportation systems. With a Ph.D. from IIT Bombay, he leads groundbreaking research on road design and safety supported by prestigious grants. An active contributor to academic journals and conferences, Dr. Sil's work drives innovation in creating safer and smarter transportation systems globally.

Development of an Economical Driving Cycle for 3-Wheelers: A Framework for Emission Estimation Studies

Sankha Jayawardhana[1], Kushan Aponsu[2], Sajana Gamage[3] and Loshaka Perera[4]

Abstract

A driving cycle reflects typical driving behavior within a specific area, considering factors such as road infrastructure, traffic flow, vehicle mix, and driving conditions with its primary purpose being the measurement of emissions and fuel consumption. Driving cycles also aid in designing traffic control systems and simulating traffic flows. This study develops a driving cycle for 3-wheelers, which are widely used across the South Asian region. Sri Lanka serves as a case study, where on-board driving data was collected as GPS data in urban and suburban areas during peak hours. The cycle was developed using a micro-trip-based construction method, with data analyzed through programming techniques. The results include an average speed of 15.12 km/h, an average running speed of 19.73 km/h, an average acceleration of 0.285 m/s², and an average deceleration of 0.3236 m/s². The driving mode percentages for acceleration, deceleration and cruising or idling were 40.58%, 33.84% and 25.58%, respectively.

This driving cycle can be tested on a chassis dynamometer to obtain emission levels for 3-wheelers, offering an economical approach to emission estimation. The methodology is adaptable across South Asia and provides insights for policymakers to regulate 3-wheeler emissions.

Keywords: *Driving Cycle, Three wheelers, Emission estimation.*

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Evaluation of Machine Learning Models for Bus Travel Time Prediction

M P V P Medawatte[1], H.L.K Perera[2], A.B Jayasinghe[3], K A S N Sumathipala[4]

Abstract

Accurate real-time bus arrival information is essential for an efficient public transport network, as it significantly impacts passenger experience, system reliability, reduced waiting times, dwell times, and operational efficiency. In Sri Lanka's public transport system, current bus arrival time computations primarily rely on static data, neglecting real-time information and critical factors influencing travel times. This highlights the need to identify the unique variables affecting bus arrival times within the Sri Lankan context and to develop robust prediction models that account for these influences. While traditional methods such as Historical Average Models, Regression, Time Series Analysis, and Kalman Filtering have been used in previous research for short-term travel time predictions, Machine Learning (ML) approaches have proven to deliver superior accuracy. ML models are regarded as the most effective for heterogeneous, lane-less traffic conditions with varying traffic volumes, such as those found in Sri

Lanka. ML techniques excel in processing large, high-quality datasets and provide accurate predictions by accounting for all relevant variables influencing travel times.

Although research has been conducted on developing various basic ML models for travel time prediction, there is a noticeable gap in studies comparing these models to determine the most suitable one for the Sri Lankan context. A Long- Short Term Memory (LSTM) neural network is a deep learning model that is capable of handling long-term dependencies. In the context of bus travel time prediction, LSTMs can leverage historical traffic and travel data to capture temporal patterns and fluctuations that influence travel times. By evaluating LSTMs against basic machine learning models, this study seeks to explore the advantages of applying deep learning techniques to transportation forecasting, ultimately contributing to more accurate and efficient predictive systems in transit planning. The ML models selected in this study include two basic traditional models K- Nearest Neighbours (KNN) and Support Vector Regression (SVR) and four advanced models that utilize ensemble techniques and advanced optimization as Random Forest Regression (RFR), Ada Boost, XG Boost and Gradient Boosting Machine (GBM). The performance of these models was compared with the LSTM model to identify the gap in their accuracies.

GPS data for the Moratuwa to Colombo bus route (Route 100) was gathered over 30 days for this study, covering weekdays, weekends, and public holidays, using five GPS

devices at various times throughout the day. This data set included information from 335 bus trips, totalling over 17,500 GPS data points. The route has 53 bus stops, and data filtering was applied based on GPS coordinates relative to each stop to calculate the travel times between them. To enhance accuracy, the route was divided into segments according to the number of bus stops, allowing for more precise travel time predictions by capturing speed variations in each segment. A literature review helped identify key factors influencing bus travel time. Feature analysis was conducted to identify the importance of each feature in the model. By doing this feature selection we could separate the most effective features and select them for the model instead of making it more complex. Those were identified as the road section, day of the week, hour of the day, availability of bus lanes, travel distance, weather conditions, and the number of signalized intersections and number of signalized crossings. Data collection accounted for all these variables. After data cleaning and preprocessing, they were fed into the models. In this study, the performance of various machine learning models was compared based on two key metrics: Mean Absolute Error (MAE) and R-Squared (R^2). Among the models tested, when analysing the results it was identified that the LSTM model stands out as the best performer by a significant margin. The LSTM model achieved a Mean Absolute Error of 3.826, which is much lower than the other models. The LSTM model achieved a significantly lower MAE of 3.826, outperforming all other models by a

wide margin. The next closest model, SVR, recorded an MAE of 17.717. Other models, including RFR with an MAE of 17.283, AdaBoost with 17.458, XGBoost with 17.446, and GBM with 17.397, all had higher MAE values. KNN Regression showed the highest error, with an MAE of 18.145. This indicates that LSTM makes far fewer errors in its predictions, showing greater accuracy. Furthermore, the R^2 for LSTM is 0.983, meaning it explains 98.3% of the variation in the data, which is considerably higher than the other models. The SVR model had an R^2 value of 0.618, while RFR achieved 0.651. KNN Regression recorded an R^2 of 0.616, AdaBoost had 0.642, XGBoost showed an R^2 of 0.640, and GBM had 0.647. This demonstrates that LSTM not only predicts more accurately but also provides a better fit to the data. Therefore, the study concludes that the LSTM model outperforms all other ML models discussed in both MAE and R^2 and is 78.5% more accurate than the next closest model, SVR, making it the most reliable and effective model for this task.

Keywords: *Machine Learning, Bus travel time Long-Short-term Memory Model*

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Development of an Intelligent Road Safety Mobile Navigation Application Using Machine Learning for Real-Time Accident Hotspot and Severity Prediction: ACase Study in Sri Lanka

JMCT Jayamanna[1] and Pradeep Kalansooriya[2]

Abstract

In Sri Lanka as well as other countries, traffic accidents are a leading cause of fatalities. Many factors contribute to the high mortality rate in developing countries. One of the reasonsthat road accidents occur is that people are unaware of common accident locations. The government has already enforced other tactics, like traffic signals and fines, to reduce these incidents, but they have been ineffective. But if people have a way to change their driving patterns based on the common accident locations, so-called hotspots, we can decrease the road traffic accidentsthat happen on a daily basis. This study focuses on improving road safety by developing an intelligent road safety mobile navigation application that provides real-time alerts on accident hotspots and severity levels to drivers during their journey on the road. This system uses supervised machine learning for building a most suitable model for accident hotspots and severity prediction that is tailored for Sri Lankan accident data by conducting an in-depth review of existing machine

learning techniques and analysis of historical accident data. According to the re- view, comparison, and evaluation, the final predictive machine learning model was implemented using an XGBoost regression model for the prediction of accident hotspots and a random forest classification model for accident severity prediction. By integrating the implemented predictive model, this study proposes a mechanism to gather real-time accident data and the development of the mobile application, which provides the foundation to revolutionize road safety and enables drivers to make safer decisions on the road.

Keywords*: Machine Learning, Supervised Learning, Regression Algorithms, Classification Al -gorithms, Predictive Analytics, Hotspots Identification, Severity Analysis*

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Dynamic Speed Advisory Systems for Signalized Intersections: Enhancing Fuel Efficiency

ADKH Aluthge[1] and Pradeep Kalansooriya[2]

Abstract

Signalized intersections serve as the most crucial nodes in the urban transportation system. Major issues associated with these intersections include unnecessary fuel consumption due to sudden accelerations or decelerations, high idling time at the intersections, and accidents that may occur with the sudden decision-making. As a solution to these problems, this research pro- poses a dynamic speed advisory system. This study presents a comparative analysis of existing systems and explores an adaptive speed management system designed to reduce fuel consumption through real-time speed recommendations. By integrating kinematic modeling into the SUMO simulation platform, the proposed system dynamically adjusts vehicle speeds based on real-time traffic conditions. The key outcomes of this research include the selection of the most suitable simulation platform and methods for speed calculation, as well as identifying the factors that influence speed adjustments and incorporating equations for estimating fuel efficiency. Simulation results indicate that the proposed system can achieve between 9% and 10% fuel savings. Future work will focus on refining the system for real-world

implementation, ensuring it can effectively reduce fuel consumption at signalized intersections.

Keywords: *Signalized junctions, Simulation environment, Speed guidance*

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Development of Road Safety Management System for the Road Network at National Level

L.M.K. Rathnayaka, H.R. Pasindu

Abstract

Road safety holds immense significance as it directly impacts the preservation of human lives, public well-being, and socioeconomic development. The inadequate attention given to road maintenance management and the insufficient actions taken regarding safety concerns poses significant challenges in ensuring road safety. Local authorities in Sri Lanka face significant challenges in effectively selecting the most critical safety issues, prioritizing road sections, and implementing targeted measures to address them within the constraints of allocated budgets. This study aims to develop an evidence-based framework for prioritizing road safety interventions on Sri Lanka's national road network, focusing on A and B-class roads. By addressing gaps in current road maintenance practices and enhancing decision-making tools, the study seeks to enable more effective identification of high-risk segments and targeted safety improvements.

To achieve this, the national road network is evaluated using a comprehensive approach involving three key

assessments: roadway environment (considering urban and rural contexts), road infrastructure (utilizing risk assessment tools and road safety indices), and crash severity (severity level of historical crash). For the purpose of analysis, the national road network will be segmented into 0.5 km sections using a static segmentation method and available crash data. High-risk road segments will be identified based on the frequency of accidents and the number of casualties. The analysis will utilize crash data from the Sri Lankan Accident Database System, covering the last five years. This data will be processed and analyzed using advanced machine learning techniques, specifically an extended version of the sliding window method, to determine the location and length of these high-risk segments. Subsequently, the three road safety risk assessments will be conducted on the selected high-crash sections, and the level of service (road safety performance) for each segment will be graded using a performance matrix. Based on the results of the three safety assessments (roadway environment, road infrastructure, and crash severity), a macro-level decision-making matrix will be developed to prioritize safety improvements across the national road network.

This matrix will categorize road segments by their risk levels and safety performance, enabling road development agencies to make informed decisions about resource allocation. It will also help to identify which segments need

immediate attention, ensuring that critical areas are addressed with greater priority.

Keywords: *Road Safety, National Road, Crash data, Road Segmentation, Risk Assessment, Safety Prioritization*

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Identification of Traffic Hotspots in CMC Area and Study of Flow Dynamics around them Using GIS & RS Techniques

L.H.M.K. Kumarasinghe[1], T.D.C. Pushpakumara[2]

Urban environment is an important part of any country that largely sustains its economy. It evolves day by day undergoing rapid changes. In such an environment, transportation is an essential activity that links the important urban centers and masses. Transportation in an urban environment is a complex activity associated with many challenges. Nowadays urban environment facing complex and multidimensional challenges such as Traffic congestion, Efficiency of public transportation, Safety management, Limited Transport infrastructure capacity (parking issues), Environmental concerns (Air, Nosie and heat island effects), Accessibility and equity of transportation systems.

Traffic analysis relies on limited, localized, and outdated data from ground sensors and surveys. This approach struggles to effectively manage congestion in dynamic urban environments. Lack of comprehensive understanding of spatiotemporal factors, congestion dynamics across the city becomes reactive and ineffective. Advance technologies such as GIS and

Remote Sensing help to understand the dynamic urban environment more effectively. Therefore, it is imperative to formulate more effective traffic planning through studies of dynamics of traffic flow using modern technologies.

This research aims to illustrate the possibility of successfully using GIS and RS for Urban Transport Planning. Moreover, with the objectives of use of GIS and RS to illustrate the dynamics of traffic flow andpropose the effective transportation plan by incorporating GIS and RS.

A mixed method combining qualitative and quantitative approaches used in the study. Primary data will be gathered through questionnaires and interviews to identify congestion hotspots. Advanced drone-basedRS systems will be deployed to capture high-resolution traffic flow data within 1km radius of identified hotspots during peak and off-peak hours. The drone data collection will utilize RTK/PPK GPS systems and strategic ground control points for precise spatial accuracy. This data will be integrated into a GIS environment, enabling sophisticated spatial analysis and traffic pattern visualization.

The significance of the research lies in its potential to transform urban transportation planning practices through the integration of advanced technologies. By providing a comprehensive framework for data collection, analysis, and visualization, this study will enable urban planners to

develop more effective, evidence-based transportation solutions. The outcomes will contribute to reducing traffic congestion, improving environmental conditions, and enhancing the overall quality of urban life through better-informed transportation planning decisions. The findings will serve as a valuable reference for urban planners, transportation authorities, and policymakers in developing sustainable, efficient urban transportation systems.

Keywords: *Traffic flow dynamics, Remote Sensing, Geographic Information Systems, hotspots area*

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A Study on the Contemporary Insights of Traffic Signal Design under Heterogeneous Conditions: A Literature Review

Salawavidana S.A.S.T[1]

Abstract

Traffic signal design is usually carried out based on one or other design guideline. While the developed countries like UK, USA, Canada and Australia have come up with their own guidelines, developing countries are still using these guidelines developed in the western world with very different traffic conditions. While the conventional guidelines are formed based on lane-based homogeneous car dominant traffic regimes, developing countries have their own traffic characteristics like non-lane based traffic, heavy presence of two wheelers, three wheelers and non-motorized vehicles. Driver behavior in the developing countries are significantly different from that of the developed countries. Recently various researchers have addressed this issue by observing the traffic patterns in such situations and proposing various methods to fine tune the signal design guidelines. Deviations from near homogeneous conditions happen basically due to the heterogeneous nature of the traffic. Heavy presence of

motorcycles in the traffic stream has contributed to a distinct behavior in the signalized intersections resulting initial surge and grouping. They also tend to creep between the larger vehicles to occupy the available spaces resulting noncompliance to lanes and making it difficult to model their behavior. This is because most of the contemporary methods for PCU estimation is based on the systematic discharge of vehicles in a queue where a reasonable headway can be observed. Noncompliance to lanes challenges this methodology. When the traffic streams are composed of non-motorized traffic and three wheelers, their impact cannot be compensated through a constant PCU assigned to them. It is observed that PCU values in an intersection under heterogeneous traffic is not a constant but become dynamic based on various factors such as level of saturation, vehicle composition and type of facility. Proof for this phenomenon is strong in heterogeneous traffic conditions. The effects of bicyclists and red violating pedestrians are also having a detrimental effect on the assumptions used in classical design manuals developed in the developed world. Geometrical considerations like shared left lanes, shared right lanes, upstream short lanes and downstream lanes drops also have a significant impact on the performance of intersections under heterogeneous traffic. Therefore, this literature review concludes the necessity of a tailor made method of traffic signal calculations under heterogeneous traffic, especially when reaching saturation levels as witnessed in the developing countries.

Keywords: *PCU, Signal design, Heterogeneous Traffic,*

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

P K B T H Karunarathna[1], H L K Perera[2]

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 deacceleration less than -2.74 ms^{-2} hard

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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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Developing and Evaluation Criterion to Assess First and Last Mile Walkability for Daily Commuters

HLSS Lunuwila[1] and Dr TWKIM Dias[2]

Abstract

The study focuses on the first and last-mile walkability through the perspective of a daily commuter. Traditional walkability measures include different parameters such as scenic routes and other amenities, daily commuters may have different priorities. This study aimed to find the parameters that are most important for the first and last-mile walkability for daily commutes while the connection between public transport and walking infrastructure are interconnected, addressing commuter-specific walkability necessities could serve as an attempt to increase public transport usage. Key parameters that influence walking and walking patterns, encompassing multiple key areas including environmental factors, social aspects (security and community interactions), and infrastructural elements (sidewalk quality, maintenance, and pedestrian amenities) were identified through a stated preference survey of daily commuters. The responses for the stated preference survey were obtained from commuters including government employees at public transport hubs through simple random

sampling aiming for a sampling size of 150 responses using simple random sampling. The assessment also examines safety features (street lighting and buffer between pedestrians and motorists), and comfort factors (availability of shade and seating areas), that contribute to the overall walking experience. Furthermore, a weighted parameter system was then developed that assigns relative importance to each identified factor based on user preferences and practical significance. Responses for the stated preference survey showed that parameters such as the availability of drinking water facilities and public toilets, and the aesthetics of surrounding environments have been given less importance by daily commuters. Hence less weighted averages are assigned to them in the walkability score. According to the literature, there are several walkability assessment criteria. This research only proposed a walkability assessment criterion to evaluate the road segments around public transport hubs: bus terminals and railway stations. Data analysis was done according to the results of the stated preference survey and weighted averages were assigned to determine the importance given for each parameter by commuters. Relevant authorities can use this walkability tool to identify the issues faced by daily commuters and improve the road linking to the public transport hubs for a better user experience.

Keywords: *Walkability, First and Last mile walkability, Daily commuters*

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Real-Time Tracking Data and Machine Learning Approach for Assessing Pedestrian Walking Patterns – Impact of Spatial Dynamics at the University of Moratuwa

Harini Sawandi[1] and Amila Jayasinghe[2]

Abstract

Understanding the key elements that affect pedestrian walking patterns is vital for enhancing transportation systems in urban environments. This experimental study tackles important gaps in current literature, especially the insufficient examination of walking behavior concerning land use characteristics and spatiotemporal factors. By focusing on walking patterns in connection to these aspects, this study intends to provide insights that can help improve urban transportation planning and policy. This study employs real-time tracking data and machine learning to evaluate the intricate dynamics of walking behavior using GPS-enabled location-based services and mobile accelerometer data. The investigation utilizes k-means clustering to identify walking patterns and the eXtreme Gradient Boosting (XGBoost) machine learning algorithm to evaluate the influence of spatial factors on pedestrian movement. The primary objective is to assess the influence of land use attributes on walking patterns,

offering quantifiable information regarding how spatial design could promote or impede walking behavior. The study is predicated on a case analysis performed at the University of Moratuwa, providing a concentrated examination within a campus setting that embodies educational and mixed-use attributes. Identified key components encompass tree views, mean depth, and choice—elements demonstrated to influence land use planning in a manner that improves walkability. Tree views enhance visual appeal and offer shade, promoting walking by fostering a more pleasant pedestrian experience. Mean depth, denoting the spatial connection and accessibility of various areas, defines the navigability and simplicity of a space for pedestrians. Furthermore, the presence of "choice," or the availability of alternative routes, enhances navigational flexibility, motivating individuals to traverse the area on foot. These findings underscore the necessity of integrating these spatial dynamics into urban transportation strategy. By comprehending the influence of land use features on pedestrian behavior, transportation planners and urban designers can formulate specific methods to enhance walkability. These solutions may include incorporating shaded walkways, optimizing spatial layouts to minimize walking effort, and providing several route options to cater to pedestrian preferences. Moreover, these elements facilitate the alleviation of automotive congestion, encourage active transportation, and enhance sustainable urban mobility objectives. This study employs machine

learning and real-time data collecting to analyze pedestrian movement patterns, offering insights that surpass conventional survey-based methodologies. The findings highlight the necessity for evidence-based, data-driven urban design and planning methodologies to develop pedestrian-friendly environments that enhance health, accessibility, and sustainable mobility. Policymakers and urban planners are urged to utilize these findings to develop strategies that emphasize pedestrian requirements in transportation systems, guaranteeing that metropolitan areas are both walkable and supportive of efficient and resilient urban transport networks.

Keywords: *Pedestrian behavior, Land use characteristics, Walkability, Machine learning, Urban transportation planning*

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Study on Soil Stabilization Using Fly Ash & Rice Husk Ash in Roadway Embankment

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Abstract

In Sri Lanka, there is a shortage of suitable embankment material for road construction due to the country's increasing demand for highways and economic crisis. Meanwhile, industrial waste products such as fly ash and rice husk ash, generated in large quantities by rice mills and coal power plants, are considered valueless by-products. Improper disposal of these by-products in landfills poses a significant environmental threat. The purpose of this study is to assess the stability of an embankment that was constructed using inappropriate embankment material and stabilized using a mixture of fly ash and rice husk ash. The research adopts an exploratory approach to investigate this alternative solution.

In the experimental work, different proportions of fly ash (0%, 20%, 40%, and 60%) and 5% ricehusk ash by dry weight will be mixed with the soil. This range of proportions allows for a comprehensive evaluation of the

impact of the ash mixture on stabilization. To determine the required material parameters for numerical analysis, various tests will be conducted, including standard proctor compaction. These tests will provide essential data on the compaction characteristics and other relevant properties of the stabilized soil samples.

The obtained material parameters will be used in subsequent numerical analyses to assess the stability of the embankment. This analysis will involve evaluating the embankment's resistance to deformation, load-bearing capacity, and potential failure mechanisms.

***Keywords**: Embankment material, Fly ash: Rice husk ash, Road Construction*

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