UNIVERSITI TEKNOLOGI MARA

ASSESSMENT OF ROAD SURFACE CONDITION USING IPHONE LIDAR FUNCTION

NURUL NABILAH BINTI MOHD NOREZAN

MSc

September 2025

ABSTRACT

Roads are vital national assets that require regular maintenance to remain functional. Over time, pavements deteriorate due to traffic loads and environmental exposure, resulting in cracks, potholes, and surface wear. While manual inspection can identify these issues, it is often time-consuming, subjective, and inconsistent. Automated detection methods offer a more efficient and standardized alternative, but they vary significantly in accuracy, cost, and complexity. The method used in this study presents a cost-effective approach for detecting road distress by combining visual observation with an iPhone-mounted LiDAR sensor – focus on 300meter industrial road with variation types of road distress (potholes, alligator cracking, longitudinal cracking, patch deterioration, bleeding, ravelling and edge cracking) . The mobile LiDAR system captures high-resolution 3D surface data, enhancing the reliability of visual assessments while remaining portable and affordable. The objectives of the research is to compare the result of road distress from processed iPhone LiDAR data and conventional method (visual observation). Second, to evaluate the dominant road distress types such as at study area based on the frequency of occurrence in the study area. The findings shows that the comparison for processed iPhone LiDAR data and conventional method (visual observation) is dominated by high and severe level of road distress. The second finding shows that in terms of frequency of occurrence, potholes (8) and bleeding (8) is the most prominent road distress present in the study area while patch deterioration (1) is the least prominent road distress types. The results were used to produce a road distress plan, supporting data-driven maintenance decisions. The findings demonstrates that iPhone-integrated LiDAR can be a useful tool for quick, cost-effective road condition monitoring. The device successfully captured key surface distress features such as cracks, potholes, and rutting when used under controlled conditions. The point cloud data enabled analysis of pavement conditions and supported the classification of distress types based on frequency, contributing to better maintenance planning. Overall, this research highlights the potential of smartphone-based LiDAR as a scalable and accessible tool for road condition monitoring.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my deepest gratitude to Prof. Sr. Dr. Haji Abd Manan Samad, my supervisor, for his invaluable guidance, support, and encouragement throughout the course of this research. His expertise, constructive feedback, and patience were instrumental in shaping the direction and quality of this thesis.

I am also sincerely thankful to my co-supervisor, Prof. Madya Dr. Zaharah Mohd Yusoff, for her insightful advice, technical input, and consistent support. Her attention to detail and willingness to provide feedback greatly enriched the depth of this study.

I extend my appreciation to all faculty members, staff, and colleagues who contributed directly or indirectly to the completion of this research. Your assistance and camaraderie made this journey more meaningful.

Finally, I am forever grateful to my family especially my mother,
for the emotional support, financial support and for having faith in me. I would also like to thank my friends for their unwavering encouragement, understanding, and moral support throughout this academic endeavour.

Thank you all.

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CHAPTER 1
INTRODUCTION

1.1 Research Background

A well-designed and well-maintained road network is a system of interconnected roads that ensures safe, efficient, and accessible transportation for all users while supporting economic growth and minimizing environmental impact. It features an efficient layout with proper connectivity, safety-oriented design elements such as signage and pedestrian facilities, and sustainable construction practices. Hence, it can enhance a country's economic prosperity as well as its residents' well-being. A well-maintained paved surface also resulted in lower vehicle fuel usage. A good road network aids in reducing the traffic congestion, which helps to reduce pollution in the environment. The smooth and quick circulation of traffic on such a surface reduces travel time and helps to cut down on time spent on the road. Road transport is a critical component of each country's economy, and the road asset often represents a significant public investment in transportation infrastructure.

Since a huge number of facilities established half a century ago are still in use, society, owners, and government are fighting an uphill battle to keep the ageing infrastructure running. Especially when public safety is vital and the societal financial ramifications of a structure failure or reduced serviceability are severe (Wijnen & Stipdonk, 2016). However, this task can be greatly simplified by employing an appropriate "systems engineering" approach in combination with modern day "management" techniques (Burrow et al., 2016). The Global Economy.com has classified the quality of roads by country where points 1 (low) – 7 (high). The average for 2019 based on 141 countries was 4.07 points. The highest value was in Singapore (6.5 points) and the lowest value was in Chad (1.9 points). Malaysia ranks 21st with a score of 5.30 points. Finland, Germany, Namibia and Sweden also have the same score as Malaysia (*The Global Economy.Com*, 2023).

New information technologies have emerged as effective tools in addressing real-world challenges such as road accident monitoring. Technologies like LiDAR provide high-precision 3D mapping for analysing road conditions, while UAVs (drones) enable real-time aerial surveillance of traffic and accident scenes. Computer