Mitigating Aggressive Driving in Malaysia: A Mobile Application for Real-Time Behavior Monitoring and Road Safety Education

Muhammad Ammar bin Muhamad Azrin1, b) and Kairulanuar Ab. Kadir1, 2, a)

1Centre for Innovative and Immersive Technology, COE for Immersive Experience. Multimedia University. Persiaran Multimedia, 63100 Cyberjaya, Selangor, Malaysia.

2Faculty of Computing and Informatics, Multimedia University, Persiaran Multimedia, 63100 Cyberjaya,

Selangor, Malaysia.

a) Corresponding author: kairulanuar@mmu.edu.my  
b) 1191102915@student.mmu.edu.my

**Abstract.** In Malaysia, over 500 thousand road accidents occur annually, and aggressive motorist behavior such as speeding, tailgating, sudden braking, and road rage are prominent causes due to overall carelessness and impatience while driving. This factor towards disrupted road safety has remained a major concern to the public. This project explores and addresses aggressive driving behaviors, their related factors, and their impact. Despite ongoing enforcement measures and awareness campaigns, aggressive driving remains prevalent, highlighting the need for a more effective approach to encouraging safer driving practices. Additionally, existing interventions and best practices to address this issue may be identified through literature review to propose the development of a mobile application solution aimed at promoting good driving behavior. The application is proposed to be built using Dart and Flutter, and may function as a real-time driving assistant, utilizing smartphone sensors to analyze driving patterns, providing instant feedback, and offer educational resources. The developed application may be a companion to the driver during commute to prevent the driver from distracted driving, encourage good behavior and warn against aggressive behavior. By integrating technology into road safety efforts, this research aims to support initiatives aimed at reducing aggressive driving in Malaysia. The insights gained from this study will guide the application’s design and assessment, ensuring its effectiveness in fostering responsible driving behaviors and improving overall road safety.

# Introduction

As of October 2024, it has been reported that over 530,000 road accidents have occurred in Malaysia. In 2023, there were 598,635 accidents, which was almost a 10% rate increase from the 545,585 accidents in 2022 and exceeded the previous national peak of 567,516 accidents in 2019. More importantly, these numbers unfortunately align in trend with the number of fatalities recorded. In a recent press conference led by the transport minister Anthony Loke, road accidents were the fourth-highest cause of deaths in Malaysia. Throughout the years, despite the downward trend of casualties from 2016 to 2019, an average of over 6000 tragic deaths are still recorded every year. In 2023 alone, there were 6,443 casualties documented which was a 5% increase from the 6,080 casualties in 2022. It was said to be roughly 18 deaths per day on average in 2022, which exceeded the number of COVID-19-related deaths. From an economic standpoint, the increase in road accidents also aligns with the rate of loss in economic value. As road accidents peaked nationally in 2023, there were estimated to be at least RM25 billion lost which represents a 35% increase compared to RM18 billion lost annually in 2010. The Ministry of Transport also estimates that for every death, RM3.1 million is lost [1].

Several factors contribute to the rise in number of road accidents, including the growing number of registered vehicles on the road, which have grown from 31 million in 2019 to over 36 million vehicles in 2023, recording an average of over one million new vehicles every year. Consequently, the higher number of vehicles being driven daily increases the chance of road accidents to occur. However, among these factors, aggressive driving behaviors also stand out as a significant and recurring contributor. This paper explores aggressive driving through its forms, factors, and impact, along with studying best practices and technological interventions to propose a mobile application that assists drivers in monitoring and improving their driving behavior in real time. The application will be utilising smartphone sensors to detect aggressive driving actions, notify instantly, and offer educational content on driving etiquettes tailored for Malaysians. By leveraging mobile technology, this research hopes to contribute to Malaysia’s Road Safety Plan 2030 which aims to reduce the number of accidents by 50% in 2030 [2].

Aggressive driving remains a serious contributor to road traffic accidents in Malaysia, despite ongoing enforcement efforts. Behaviors such as speeding, tailgating, and road rage continue to threaten public safety and strain national resources. While current interventions tend to focus on punitive measures, they often fail to address long-term behavioral change or broader contributing factors like poor road conditions, vehicle issues, and increasing driver stress from urban congestion. Public understanding of these interconnected causes is still limited. This project aims to tackle aggressive driving by identifying its root causes and impacts, and by developing a mobile application that promotes safer driving habits through education, monitoring, and behavioral change ultimately helping to reduce accident rates and improve road safety in Malaysia.

# LITERATURE REVIEW

Road accidents in Malaysia stem from three primary factors: human behavior, environmental conditions, and vehicle-related issues. Among these, human behavior is the most significant contributor, encompassing risky driving practices and non-compliance with traffic laws [3]. Key behavioral risks include speeding, improper overtaking, driving under the influence, abrupt lane changes, and failure to maintain safe following distances. Notably, driving anger and aggressive behavior have been identified as critical predictors of accident risk among Malaysian drivers [3,4]. To assess driving anger, Deffenbacher developed the Driver Anger Scale (DAS) and the Driver Anger Expression Inventory (DAX), which evaluate emotional responses to various driving scenarios. The DAS categorizes anger-inducing situations into six domains: rudeness, hostile gestures, traffic obstruction, slow driving, police presence, and unlawful driving. The DAX further classifies expressions of anger into four types: Verbal Aggression (yelling, swearing), Physical Aggression (threatening gestures, physical confrontation), Vehicle-Based Aggression (tailgating, flashing headlights), and Adaptive/Constructive Responses (calming strategies and emotional regulation).

As a result, developing successful measures for reducing traffic accidents while enhancing road safety in Malaysia requires an understanding of these issues. To combat the rising trend of road accidents, this project has identified aggressive driving as a prominent contributor to this public health concern. Among the studies covered in the literature, most have also suggested interventions that can be considered by dedicated authorities to ensure better road safety in the future. Current interventions made by the government include the Malaysian Road Safety Plan 2014-2022 [2], the daily publishing of road accident numbers established by the Royal Malaysia Police [5,6], and the Commuting Safety Support Program (CSSP) which represents a collaboration between the Malaysian Institute of Road Safety Research (MIROS) and Social Security Organisation (SOCSO) aimed to reduce road traffic accidents and promote safer commuting practices [7]. According to the CSSP program, 76% of participating organisations have seen a 10% decrease in traffic accidents and a 21% decrease in reckless driving, both of which are positive outcomes for road safety [7].

How drivers choose to express their anger while driving influences their likelihood of being involved in a road accident [8], therefore some studies suggested to treat the underlying mental health disorders found in aggressive drivers. For example, cognitive-behavioral treatment methods have demonstrated the potential in reducing aggressive driving behaviors [9-12]. Moreover, personality screening tests along with strategic planning have been suggested to further mitigate and reduce road rage and aggressive driving [13-15].

Other than interventions focused on mental health, most studies also recommend efforts in public media campaigns and more strict enforcement of traffic laws by authorities. Ongoing initiatives to raise awareness of road safety, strict enforcement of traffic regulations, and infrastructure upgrades are crucial to reduce road accidents [16,17]. The government and authorities may focus more on minimising rude behavior among road users such as public campaigns that highlight good driving behavior, and warn against the downsides of aggressive driving [18,19,20], along with monitoring aggressive drivers and training new drivers to improve awareness on anger expression, journey planning and relaxed driving, avoiding engagements with other drivers [13,14].

Mobile applications such as Life360, Zenroad, DriveWell, and Sentiance have demonstrated the potential to monitor and improve driving behavior through real-time feedback and gamification. However, these apps lack localized content tailored to Malaysian drivers, highlighting the need for a more context-specific solution.

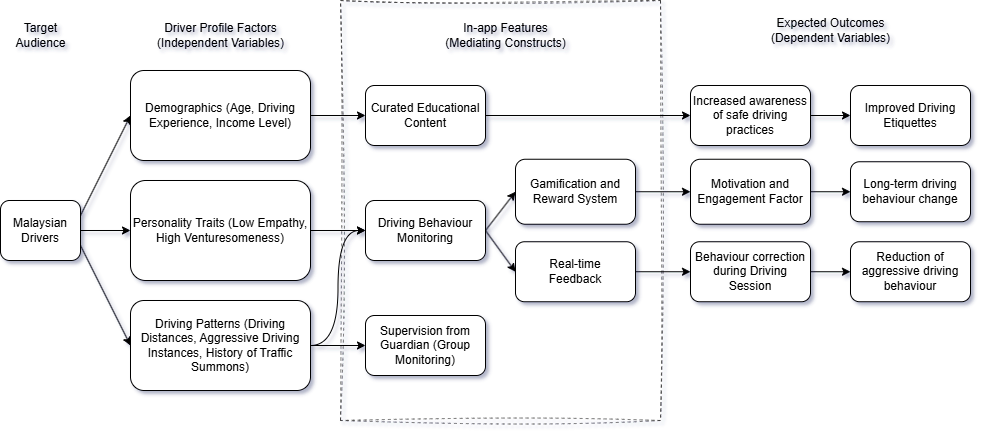
# METHODOLOGY

This study employs a qualitative document analysis approach to explore aggressive driving behaviors and identify user requirements for a mobile application aimed at mitigating such behaviors. Document analysis is a systematic procedure for reviewing and evaluating existing materials, including peer-reviewed literature, statistical data, government reports, and case studies of related mobile applications. This method enables the extraction of relevant themes, behavioral patterns, and technological features that inform both the feasibility and design of the proposed intervention.

The analysis focuses on two core dimensions:

1. Behavioral Insights: Understanding the psychological and situational factors contributing to aggressive driving in Malaysia.
2. Technological Requirements: Identifying functional and non-functional requirements from existing mobile applications that address driver behavior, safety, and engagement.

To guide the research, Figure 1 presents the Conceptual Model, which illustrates the interrelationship between driver profile factors, mobile application features, and expected behavioral outcomes. This framework serves as a foundation for assessing the feasibility of the proposed solution and aligning it with user needs and contextual realities.



**FIGURE 1.** Conceptual framework

Driver profile factors including demographics, personality traits, and driving patterns are identified as key contributors to aggressive driving. These independent variables are addressed through the proposed mobile application's core features, namely curated educational content, driving behavior monitoring, supervision through groups, gamification and rewards, and real-time feedback during driving sessions. These features act as mediating constructs designed to increase awareness, correct unsafe behaviors in real-time, and motivate sustained engagement. The expected outcomes of these interventions include improved driving etiquette, long-term positive behavioral changes, and a significant reduction in aggressive driving behavior, contributing to enhanced road safety in Malaysia.

# PROPOSED DESIGN

The proposed mobile application is designed with a user-centric interface that emphasizes simplicity, accessibility, and engagement. The system architecture integrates three core functional modules aimed at promoting safer driving behaviors:

1. Educational Platform: This module delivers curated content on safe driving practices, traffic regulations, and behavioral strategies to reduce aggression on the road. It serves as a knowledge base to enhance driver awareness and etiquette.
2. Driving Behavior Analysis: Utilizing sensor data and user input, this module monitors driving patterns and provides real-time feedback. Metrics such as speed, braking intensity, and lane discipline are analyzed to identify aggressive tendencies and suggest corrective actions.
3. Gamified Rewards System: To encourage sustained behavioral change, the application incorporates a gamification layer that rewards users for consistent safe driving. Points, badges, and progress tracking are used to reinforce positive habits.

Additionally, the application includes a group monitoring feature, enabling guardians or supervisors to oversee the driving behavior of dependents. This feature supports accountability and promotes safer driving within family or organizational contexts. To visualize the system and its stakeholder interactions, Figure 2 presents a Rich Picture Diagram. This diagram illustrates the key components of the mobile application, the various stakeholders involved (e.g., drivers, guardians, traffic authorities), and their respective motivations. It highlights the interconnectedness of system features and user roles within the broader framework of reducing aggressive driving behavior application.

A diagram of a mobile application

Description automatically generated

**FIGURE 2.** Rich picture diagram

The proposed mobile application's user interface (UI) design prioritises intuitiveness and simplicity. The layouts are made to make sure that users can use the app's features and navigate it with ease, especially since users would mostly want quick access to setup before driving. The welcome screen, dashboard, and educational page are among the important interface designs highlighted in this section. Figure 3, Figure 4 and Figure 5 below depict these accordingly.

# CONCLUSION

This study presents the design of a mobile application aimed at mitigating aggressive driving behaviors among Malaysian motorists through the integration of smartphone sensor data, real-time behavioral feedback, and gamified engagement strategies. Grounded in a comprehensive document analysis and aligned with the conceptual framework developed in this research, the proposed system addresses key behavioral determinants such as stress, low empathy, income level, and driving experience. The application’s architecture, as detailed in the system design section, incorporates three core modules: an educational platform, a driving behavior analysis engine, and a rewards system, all supported by a group monitoring feature. These components are designed to work synergistically to promote safer driving habits, in line with the objectives of Malaysia’s Road Safety Plan 2030.

A comparative review of existing applications such as Life360 and Zenroad revealed functional and contextual gaps, particularly in localized behavioral interventions and user engagement strategies. The proposed application addresses these gaps by tailoring features to the Malaysian driving context and incorporating culturally relevant behavioral insights. The technical design phase has been completed, including interface mock-ups, use case scenarios, and system architecture planning. Flutter and Dart have been selected as the development framework to ensure cross-platform compatibility and efficient deployment. The next phase of the project will involve prototype development and iterative user testing to validate usability, functionality, and behavioral impact. Ultimately, this study contributes a practical, research-informed solution to the challenge of aggressive driving, offering a scalable and educational tool that supports safer roads and healthier driving cultures in Malaysia.

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| A screenshot of a login form  Description automatically generated | A screenshot of a phone  Description automatically generated |
| **FIGURE 3.** Register page UI | **FIGURE 4.** Educational content page UI |
| A screenshot of a phone  Description automatically generated  **FIGURE 5.** Dashboard UI | |

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