SEMARAK ILMU PUBLISHING

Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943

A Computer-Based Advisory System for Motorcycle Safety at Campus

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ARTICLE INFO

Article history:
Received 11 October 2023
Received in revised form 14 May 2024
Accepted 15 June 2024
Available online 15 July 2024

Keywords:

Motorcycle safety; advisory system

ABSTRACT

There are various traffic issues that have been happening in the campus areas. The issues are such as the air and noise pollution, lack of road safety and regulation implemented by the campus communities, increasing number of road users and more. All these problems may lead to severe injuries when road accident happened especially among the motorcyclists. Therefore, initiatives and action need to be taken in order to reduce severe injuries due to road accidents. The objectives of this study are to gather knowledge regarding motorcycle safety as well as advisory system, and the information collected are then coded to develop the computer-based application advisory system. The method adopted in this study was divided into two major phases including data gathering and the development of the advisory system. Data gathering was by literature review while the system is built by using Microsoft Visual Studio with Visual Basic language. The developed advisory system is called as Motorcycle Safety Advisory System (MSAS) and it is useful for different categories of end users especially the students. Development of MSAS includes 4 main windows which are Homepage, Library, Advisory System and About. Each windows provides various buttons that are coded to its respective functions.

1. Introduction

Transportation assumes a pivotal role within contemporary societies, facilitating the mobility of individuals and goods, fostering economic advancement, and fostering the interconnection of communities [6]. In the year 2019, the transportation sector was accountable for approximately 27% of the global energy consumption, as documented by Khairi *et al.,* [5]. While the recognition of the benefits associated with non-motorized vehicles for the sustenance of our environment is unequivocal, it remains noteworthy that motorized vehicles persist as the predominant mode of transportation. Ladin *et al.,* [14], assert that the preference for private vehicles in daily endeavours is primarily attributed to the heightened level of comfort they afford in comparison to alternative

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https://doi.org/10.37934/araset.48.2.225234

transportation modes. Furthermore, the possession of automobiles and motorcycles escalates concomitantly with the intensification of transportation requirements. With the trajectory of urbanization on an ascendant course, the imperative for viable transportation solutions that espouse sustainability becomes progressively pronounced. Sustainable transportation, beyond addressing the deleterious implications of air and noise pollution, accentuates the holistic safety of road users. The recognition of the essentiality to cultivate a transportation ecosystem that embodies both enhanced safety and sustainability underscores the necessity to formulate strategies that abrogate environmental ramifications, whilst concurrently according precedence to the well-being of individuals who traverse these domains, as articulated by Amin *et al.,* [1]. It is underscored by Ladin *et al.,* [15], that the substantial surge in private vehicular usage assumes a preeminent role in exacerbating air pollution, thus engendering an extensive demand for finite resources such as fossil fuels.

The rapid increase in the number of vehicles on roads has raised concerns about road safety and the potential for accidents [3]. The growth in the service industry has led to an increase in the prevalence of motorcycles (Özkan *et al.,* [7]). In Malaysia, the most registered vehicles are motorcycles as shown in Figure 1 [19].

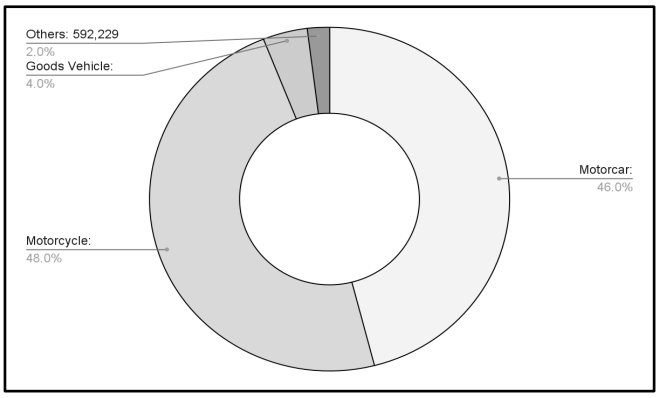

Fig. 1. Registered vehicles

This clearly shows that motorcycles have been the chosen medium of transport for most Malaysians. Moreover, by referring to the road traffic volume, MIROS [19] states that motorcycles and scooters (Type 6 vehicles) show the second highest of 20.9% as shown in Figure 2.

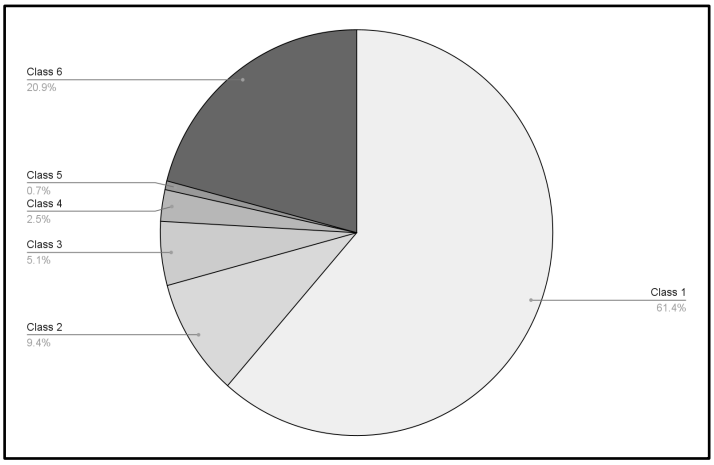

Fig. 2. Road traffic volume

Motorcycles are particularly prone to accidents compared to other forms of transportation, mostly because to their smaller size and higher vulnerability to traffic hazards [2]. Motorcycle accidents, which frequently lead to significant injuries, need immediate attention and effective interventions. The implementation of efficient management techniques for such incidents is of utmost importance in order to guarantee the safety and welfare of individuals utilising the road, particularly those operating motorcycles [22]. Powered two-wheelers (PTW) offer many benefits over cars, but they are also far more vulnerable in the event of an accident (Melcher *et al.,* [17]). Road accidents are considerably the most common cause of mortality. According to the World Health Organization (WHO) [21], road traffic injury (RTI) is the eighth leading cause of mortality globally and the leading cause of death among young people aged 15 to 29 [9].

Most of the Malaysian student studied at higher education (universities) are among the age of 18 to 23 years old. Enrolment in postsecondary education for the age cohort of 18-23 years old reached 48 percent in 2012, exceeding the universal target established by the World Bank and UNESCO (Chang *et al.,* [10]). Given that students make up the bulk of the campus population, motorcycle accidents among them are more likely to occur. Students on campus are considered as novice riders as Idris *et al.,* [4] mentioned that, in Malaysia, the minimum age for obtaining a motorcycle license is 16 years old and students aged 21 years and below have less experience in riding motorcycles and accounted to 34% of fatalities cases. Hence, more exposure of motorcycle safety among campus communities is necessary as it helps in reducing the accidents involving motorcycles. Chumpawadee *et al.,* [11] states that those with a better understanding of safe driving were more inclined to do so.

The main focus of this study is to develop a computer-based application advisory system for motorcycle safety at campus towards sustainable transportation. Motorcycle accidents, often resulting in severe injuries, demand urgent attention and proactive measures. Implementing effective management strategies for these accidents is paramount to ensuring the safety and well-being of road users, especially motorcyclists. In this context, the development of technology-driven solutions can play a pivotal role. One such promising initiative is the creation of a Motorcycle Safety Advisory System (MSAS), a computer-based application aimed at providing valuable guidance and information to users. By equipping students and other road users with this advisory system, equipped with real-time data and safety recommendations, the potential to reduce severe injuries resulting from motorcycle accidents becomes significantly higher. Such an approach not only fosters safer road behaviours but also harnesses the power of technology to actively prevent accidents and promote a culture of responsible transportation. This motorcycle safety advisory system is an engineering countermeasure that is intended to lessen the likelihood of motorcycle accidents and hence, resulted in sustainable transportation. Even though there are many studies related to this advisory system, there are still several gaps identified which includes lack of exposure on the safety of motorcycle users among student, no motorcycle advisory system developed specifically for the use of the student in campus and an increasing number of motorcycle accidents on campus.

2. Methodology

Motorcycle Safety Advisory System (MSAS) is a computer-based system that focuses on the safety of motorcyclists on campus. The system is expected to be useful for various users such as the young engineers, for them to have new ideas on how to improve traffic issues in campus especially the issues that are related to motorcyclists; the transport experts, by giving them a medium to channel their expertise and high level of knowledge; transport activist, for helping them in making decisions to solve the related issues; and universities communities, which include the students by exposing them the knowledge that they might not have known before especially about the safety of

motorcyclists. Therefore, all information and knowledge gathered are coded into this computer-based advisory system.

Advisory system is chosen as the medium in one of the initiatives to reduce the motorcycle issues in campus towards sustainable transportation because it is easier to access, convenient to be used by the user and it can store wide materials and advance knowledge. In order to produce MSAS, it has to go through several stages of development for the best outcomes. Figure 3 shows the process of MSAS development.

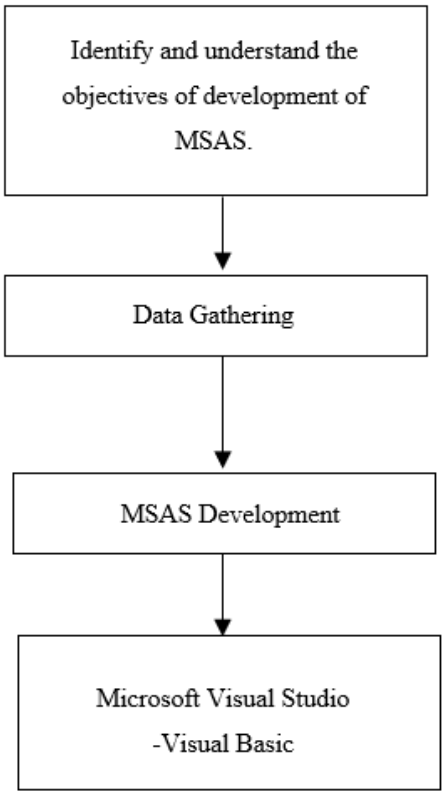

Fig. 3. The development process of MSAS

2.1 Data Gathering

All reviewed papers were published in 2010 and above. Past paper types are among the journal articles, encyclopaedia articles, conference proceedings and book sections. These papers were sorted in Mendeley software for systematics arrangement and most importantly to enable the researcher to gain important and precise related information regarding motorcycle safety.

2.2 MSAS Development

Microsoft Visual Studio was used to develop the MSAS through Visual Basic. Visual Basic is one of the programming languages other than Python, JavaScript, C++ and more. Through Visual Basic, a systematic system was built which includes the user interface, operational flow, data processing and finally the output. Therefore, it is vital for the developer to learn and understand the programming language which in this study, Visual Basic was used.

3. Results and Discussions

3.1 Motorcycle Safety

Improvement of motorcycle safety can be achieved through exposure of its knowledge. The collected knowledge through literature review includes three elements which are the road conditions, the quality of the vehicles itself and also the users. Road conditions are one of the factors that affect the rise in number of motorcycle accidents. Potholes, slippery road surfaces due to weather, narrow roads and many other poor road conditions are the causes of road accidents that may lead to severe injuries. Therefore, guidelines are necessary in designing and maintaining the road conditions. According to MIROS [19], the Public Works Department has issued two guidelines for motorcycle facilities which are NTJ 33/2015 Guidelines for Motorcycle Facilities and ATJ 35/2018 Geometric Guideline for Exclusive Motorcycle Lane.

One of the alternatives in order to reduce the occurrence of motorcycle accidents in campus is by providing sufficient motorcycle facilities such as motorcycle lanes. Two types of motorcycle lanes include exclusive motorcycle lane and non-exclusive motorcycle lanes. According to Le and Nurhidayati [16], exclusive motorcycle lanes are intended to remove or isolate motorcyclists from mixed traffic, and it may help in reducing conflict between riders and other road users. The risks of having severe injuries after an accident will be low as the chances of one motorcycle to collide with other type of road users such as car is low. Non-exclusive motorcycle lane on the other hand is motorcycle lanes that are totally divided from mixed traffic by painted markings or shading on the road, which may include symbols, words, letters, arrows, lines, and other markings that provide direction and attract motorcyclists [16]. The presence of road marking to split the road for motorcycle lane can increase the motorcyclists' safety as it gives them the sense to reduce the speed.

In order to make sure that the motorcycle's condition is at its top condition, there are several components on the motorcycle that need to be checked before riding it to reduce the risk of getting into a severe motorcycle accident. Table 1 shows the checklist along with its description provided or suggested by the Motorcycle Safety Foundation (MSF).

Table 1
Motorcycle checklist

Checklist	Description
Tires and Wheels	- Check the pressure in the tires, as well as the treadwear and overall condition of the sidewalls and tread surface. - Try the front and rear brake levers one at a time. When fully applied, make sure each feels firm and holds the motorcycle.
Controls	- Make that the clutch and throttle are in good condition. When the throttle is released, it should snap back to its fully closed position. The clutch should have a firm grip and perform smoothly. - Try the horn. Make sure it works
Lights and Electrics	- Check both headlight and taillight. Test the switch to make sure both high and low beams work. - Turn on both right and left-hand turn signals. Make sure all lights are working properly. - Try both brakes and make sure each one turns on the brake light. - Clean and adjust mirrors before starting. It's difficult to ride with one hand while trying to adjust a mirror. Adjust each mirror so that the lane behind and the beside can be seen. When properly adjusted, a mirror may show the edge of motorcyclist arm or shoulder – but it's the road behind and to the side that are important.
Oil and other liquids	- Check engine oil and transmission fluid levels. - Check the brake hydraulic fluid and coolant level, if equipped, weekly. - Be sure the fuel valve is open, if equipped, before starting out. With the fuel valve closed, the motorcycle may start with only the fuel that is still in the lines but will stall once the lines are empty. - Look underneath the motorcycle for signs of an oil or fuel leak.

Chassis	- Check the front suspension. Ensure there is no binding. The rear shocks and springs should move smoothly. - If there is a chain or belt, adjust according to the manufacturer's specifications, and check the sprockets for wear or damage
Stands	- Ensure the side stand operates smoothly and that the spring holds it tightly in the up position. If equipped, the centre stand should also be held firmly against the frame whenever the motorcycle is moving.

According to Operating a Motorcycle,[20], the best approach to avoid an accident is to avoid it in the first place, and motorcyclists can take steps to lessen their risk of being involved in one. Hence, it is important to plan out a strategic trip planning before riding a motorcycle. There are three evaluations that can be applied while planning for the trip which includes self-condition evaluation, driving condition evaluation and vehicle used evaluation [20]). Each of these elements are further described as in Table 2.

Table 2
Trip planning evaluation

Evaluation	Description
Self-condition	- Health (sick/injured) - Feelings or emotions (tired/angry/stressed) - Any substances (drugs/medicine/alcohol) consumed that may affect the motorcyclist's faculties
Driving condition	- Weather (rainy/windy/very hot) - Route conditions - Any construction in progress - Heavy traffic - Rough roads
Vehicle used	- Check for mechanical condition that may jeopardize safety. - Any extra load (passenger/goods)

3.2 Advisory System

As for the advisory system, it was found that it offers advice and assistance in the resolution of problems that are typically tackled by human expertise [13]. There is no one single and direct solution provided by the advisory system, instead, it helps in supporting unstructured decisions. Advisory System consists of three main processes namely knowledge acquisition, cognition and interface [13]. Figure 4 shows the flow of how the advisory system works.

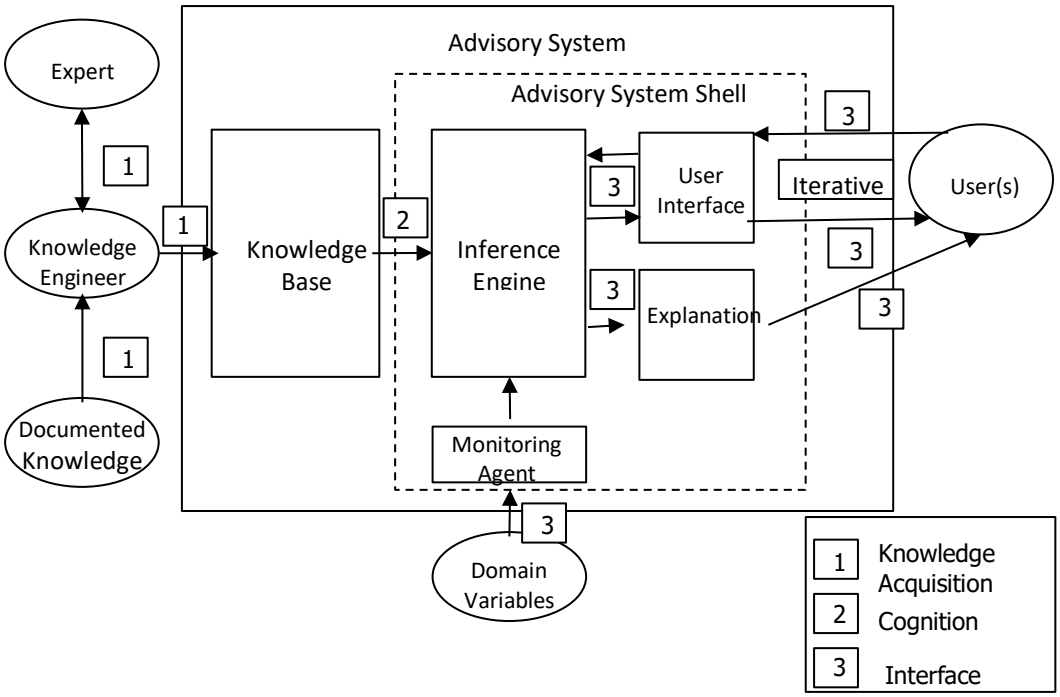

Fig. 4. Advisory system architecture

3.3 Architecture of Motorcycle Safety Advisory System (MSAS)

Advisory System consists of three main processes namely knowledge acquisition, cognition, and interface 5. Three buttons appear on the Homepage window which direct it to Library for button 1, Advisory System for button 2 and about for button 3 when user simply clicked on it. In general, Library window contents of several topics such as Road Safety, Motorcycle Safety and Sustainable Transportation. The Advisory System window includes the explanation to factors contributing to motorcycle accident and the suggestion to reduce severe injuries due to the accident. About window on the other hand content information about this advisory system.

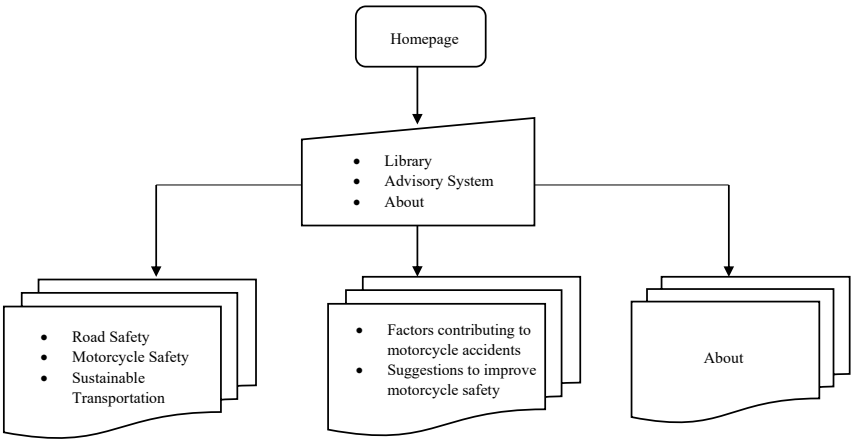

Fig. 5. Four main windows of MSAS

3.3.1 MSAS's library page

When the Library button is clicked, a new window appears namely as Library Page as shown in Figure 6. On this page, several buttons and a link are provided. The buttons consist of three topics based on the literature review and a home button. The topics are information about Road Safety, Motorcycle Safety and Sustainable Transportation. The Home button will close the Library Page window and bring back the Homepage window. All Home buttons available in other windows will have the same function.

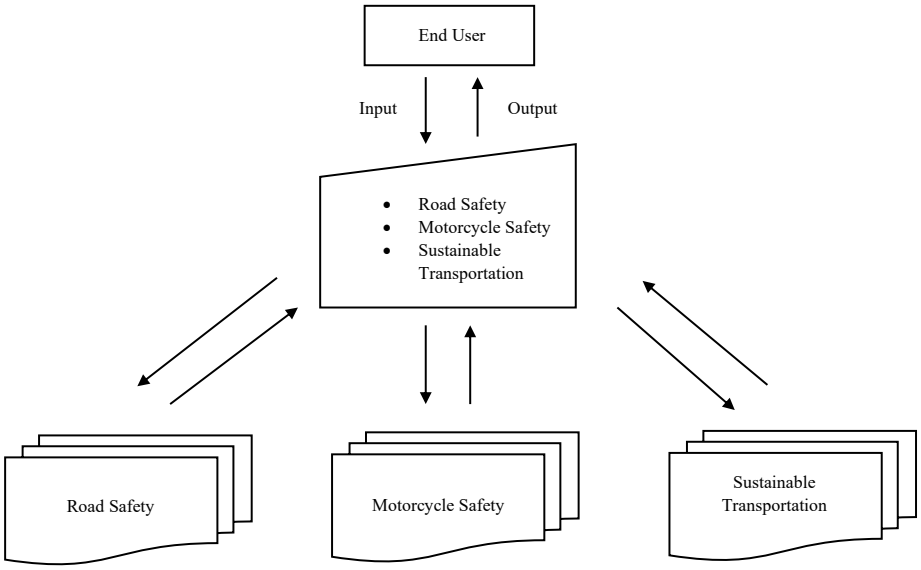

Fig. 6. MSAS's library major page

3.3.2 MSAS's advisory system page

By clicking on the Advisory System button on the Homepage, this will lead to the Advisory System Page as shown in Figure 7. On this page, there are two main choices of button namely Factors contributing to motorcycle accidents and Suggestions to improve motorcycle safety.

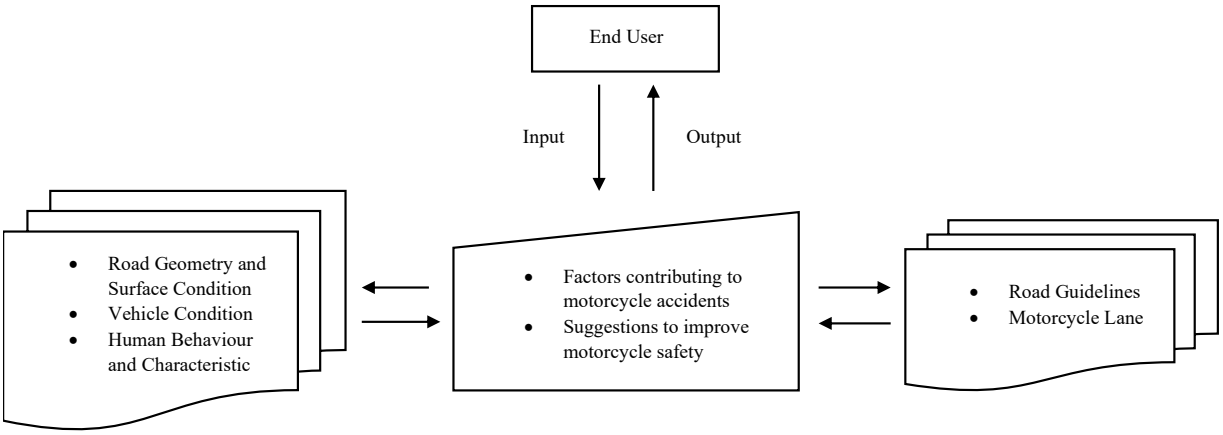

Fig. 7. MSAS's advisory system major page

4. Conclusion

The primary focus of this study revolves around the conceptualization and creation of a computerized advice framework specifically designed for the field of motorcycle safety. The primary motivation for this undertaking is the improvement of severe injuries resulting from accidents involving motorcycles. The intended recipients of this project mostly consist of students, while the geographical range is limited to the educational institution's surroundings. It is important to recognize that this study has several limitations, such as its sole focus on motorcycle safety and its restricted geographical scope limited to the campus area. Despite these constraints, the stated objectives have been demonstrated to be achieved in a noteworthy manner.

At the core of promoting sustainable mobility lies the essential task of reducing the occurrence of severe injuries resulting from motorbike accidents. The constructed system functions as an instructional tool, aimed at enlightening end-users, namely those who engage with the field of motorcycling. The method functions as a proficient channel for fostering a sense of accountability among those using the roadways, with a specific focus on those who engage in motorbike riding. Through the use of this system, individuals are able to engage with a platform that provides them with a comprehensive collection of valuable information and insights. These resources serve to clarify and illuminate various techniques that may be employed to effectively augment the level of safety during the many stages of motorcycle operation, including the pre-ride, ride, and post-ride phases. The comprehensive strategy emphasizes the integrated development of safety knowledge and practices, promoting a culture of responsible motorbike use and so supporting the broader goal of sustainable mobility.

Acknowledgement
This research was not funded by any grant.

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