A COMPUTER-BASED APPLICATION ADVISORY SYSTEM FOR MOTORCYCLE SAFETY AT CAMPUS TOWARDS SUSTAINABLE TRANSPORTATION

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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 which is then verified, validated and evaluated in order to reflect the acceptance of the end-user. The method adopted in this study was divided into several phases such as data gathering, development of computer based advisory system and the verification, validation and evaluation of the advisory system. Two methods of gathering data which are by literature review and through domain experts. The system is built by using Microsoft Visual Studio with Visual Basic language. The verification phase is a process in determining whether the system confirms a specification, while validation phase inspects the system to see if it meets the specifications and expectations of users. As for the evaluation phase, the system is evaluated by the non-expert human user. 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. The system is considered to be verified when the knowledge engineer satisfy on the programming works and the system's design. MSAS is considered valid when the suggestions in MSAS present in the answers provided by the expert evaluators and the result shows that the suggestions for factor 1 and factor 3 from both MSAS and expert evaluators are similar by 67% and 50% similarities for the second factor which is vehicle condition. The validation phase is done through Google Form and the result shows that most of the ratings are four and five. Out of all six aspects, none of the aspects rated below than 4. Overall, more than 60% of the respondents strongly agrees that this system is satisfactory to be used.

ABSTRAK

PEMBINAAN SEBUAH 'ADVISORY SYSTEM' BERASASKAN KOMPUTER UNTUK KESELAMATAN MOTOSIKAL DI KAMPUS KE ARAH PENGANGKUTAN LESTARI

Terdapat pelbagai isu lalu lintas yang berlaku di kawasan kampus. Isu-isu tersebut adalah seperti pencemaran udara dan bunyi, kekurangan keselamatan dan peraturan jalan raya yang dilaksanakan oleh komuniti kampus, peningkatan bilangan pengguna jalan raya dan banyak lagi. Kesemua masalah ini boleh mengakibatkan kecederaan parah apabila berlaku kemalangan jalan raya terutamanya dalam kalangan penunggang motosikal. Oleh itu, inisiatif dan tindakan perlu diambil bagi mengurangkan kecederaan parah akibat kemalangan jalan raya. Objektif kajian ini adalah untuk mengumpul pengetahuan mengenai keselamatan motosikal serta sistem nasihat, dan maklumat yang dikumpul kemudiannya dikodkan untuk membangunkan sistem nasihat aplikasi berasaskan komputer yang kemudiannya diverifikasi, disahkan dan dinilai untuk mencerminkan penerimaan pengguna akhir. Kaedah yang digunakan dalam kajian ini dibahagikan kepada beberapa fasa seperti pengumpulan data, pembangunan sistem nasihat berasaskan komputer dan verifikasi, pengesahan dan penilaian sistem nasihat. Dua kaedah pengumpulan data iaitu melalui kajian literatur dan melalui pakar domain. Sistem ini dibina dengan menggunakan Microsoft Visual Studio dengan bahasa Visual Basic. Fasa verifikasi ialah proses dalam menentukan sama ada sistem mengesahkan spesifikasi, manakala fasa pengesahan memeriksa sistem untuk melihat sama ada ia memenuhi spesifikasi dan jangkaan pengguna. Bagi fasa penilaian pula, sistem dinilai oleh pengguna manusia bukan pakar. Sistem nasihat yang dibangunkan dipanggil Sistem Nasihat Keselamatan Motosikal (MSAS) dan ia berguna untuk pelbagai kategori pengguna akhir terutamanya pelajar. Pembangunan MSAS merangkumi 4 tetingkap utama iaitu Laman Utama, Perpustakaan, Sistem Penasihat dan Perihal. Setiap tetingkap menyediakan pelbagai butang yang dikodkan kepada fungsi masing-masing. Sistem ini dianggap lengkap apabila jurutera pengetahuan berpuas hati dengan kerja pengaturcaraan dan reka bentuk sistem. MSAS dianggap sah apabila cadangan dalam MSAS hadir dalam jawapan yang diberikan oleh penilai pakar dan keputusan menunjukkan bahawa cadangan untuk faktor 1 dan faktor 3 daripada kedua-dua MSAS dan penilai pakar adalah serupa sebanyak 67% dan 50% persamaan untuk faktor kedua, iaitu keadaan kenderaan. Fasa pengesahan dilakukan melalui Borang Google dan keputusan menunjukkan kebanyakan rating adalah empat dan lima. Daripada keenam-enam aspek, tiada satu pun aspek yang dinilai di bawah 4. Secara keseluruhannya, lebih daripada 60% responden sangat bersetuju bahawa sistem ini memuaskan untuk digunakan.

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LIST OF ABBREVIATIONS

PTW	Powered Two-Wheelers
RTI	Road Traffic Injury
ITS	Intelligent Transportation System
ABS	Antilock Brake System
RSC	Road Safety Class
GT	Green Transportation
WHO	World Health Organization
RTAs	Road Traffic Accidents
MIROS	Malaysian Institute of Road Safety Research
VTA	Vehicle Type Approval
PPE	Personal Protective Equipment
CSSP	Community Support Safety Programme
DRL	Day-Running-Light
HVWB	High Visibility Windbraker
HICs	High-Income Countries
LMICs	Low- and Middle-Income Countries
CBR	Case-based Reasoning
DAS	Driver Advisory System
MMJ	Multi-Material Joining
C-ITS	Cooperative Intelligent Transportation System
DDA	Drowsy Driving Advisory
GLOSA	Green Light Optimal Speed Advisory
GHG	Green House Gas
MSAS	Motorcycle Safety Advisory System

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CHAPTER 1

INTRODUCTION

1.1 Overview

Transportation gives a huge impact on various aspects especially towards human and the economic growth of a particular country. Wider accessibility will be provided with an appropriate transportation system and therefore giving a higher chance for individuals and businesses to have social and economic interactions extensively. Vehicles are the devices of transportation that are highly demanded by humans as it benefits them in many ways. Vehicles help humans to move from one place to their desired destination conveniently. Vehicles can be classified into two major categories which are non-motorized vehicles such as cycling or walking, and motorized vehicles such as cars and motorcycles.

Public transportation or also known as public transit is one of the government initiatives in order to make the world a healthier place. It is a form of transportation that allows the public to travel in a group. The size of the group depends on the type of public transport used by them. Public transportation is generally a transportation system that uses another system, namely a group travel system. A group travel system on the other hand can be defined as a system when there are ten or more persons going on the same itinerary. The idea of moving together in a group using public transportation gives a vast amount of benefits to many aspects. For instance, road congestion will be reduced as the use of private vehicles is decreasing which will eventually lead to less air pollution and thus, improving the quality of human life.

Public transportation can help to alleviate issues such as traffic congestion and accidents caused by different transportation externalities (Azizul Ladin et al., 2015).

It is undeniable that humans today are acutely aware of the advantages for using non-motorized vehicles in order to sustain our world, but yet motorized vehicles have always been the chosen primary medium of transportation. The ownership of cars and motorcycles increases as the need towards transportation escalates. More vehicles on the road leads to adverse circumstances such as traffic congestion, air and noise pollution and lower quality of life. The increasing growth of private vehicle use not only exacerbates environmental difficulties, but also creates social challenges such as traffic congestion and health concerns (Azizul Ladin et al., 2015). On the other hand, sustainable transportation depends on the rate of road accidents; higher rate of road accidents, results to lower transportation sustainability. Therefore, the aim of this study is to develop an advisory system that provides information and advice on safety specifically for motorcycle riders in avoiding severe injury. Concurrently, this study will strongly encourage sustainable transportation by lowering the chance of accidents.

1.2 Research Background

Heavy road traffic due to abundance of vehicles on the road will result in higher chances of road accidents. Motorcyclists in particular will suffer more serious injuries than car users. 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., 2015). Road accidents are considerably the most common cause of mortality. According to the World Health Organization (WHO) (2018), 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 (Barzegar et al., 2020). Death rate due to road accidents will continue to increase if there are no initiatives to reduce it. If urgent action is not done, road traffic deaths are expected to rise to the seventh leading cause of death

by 2030, accounting for around 90% of worldwide road traffic fatalities (Barzegar et al., 2020).

There are various factors that can cause traffic accidents involving motorcyclists. It is worth acknowledging beforehand that different countries show different factors of motorcycle accidents as the usage of them might be different for each country. The wide variety in motorcycle fatal collisions around the globe might be due to differences in motorcycle usage, purpose, and exposure (Abdul Manan et al., 2018). Following from the previous study by (Abdul Manan et al., 2018), motorcycle crashes can be classified into three classes which are motorcycle crash by itself, motorcycle crash with another vehicle and motorcycle crash with other vehicles.

Therefore, in order to improve motorcycle safety, this study will discuss on developing a computer-based application advisory system for motorcycle safety at campus towards sustainable transportation. This study focuses on how to reduce fatal injuries involving motorcycle accidents by developing an advisory system that provides end user wide information regarding important matters that are related to their safety. Advisory systems and expert systems provide solutions to the end users regarding their concerns and problems. However, both systems have some differences despite the same function they portray. The differences are summarized in the Table 1.1 below.

Table 1. 1 Differences between expert system and advisory system

Expert System	Vs	Advisory System
According to (Mohammed et al., 2019)		According to (Bourne et al., 2017)
When considering an issue, expert systems frameworks employ representative thinking, for example, symbols are utilized to replicate many		Rather than being partners in the process, end-users must be encouraged to adopt research outputs.

types of learnings, such as realities, concepts, and guidelines.		
Heuristics are used by expert frameworks to manage arguments, reducing the review zone solution.		Advisory systems have a wider choice of options
An expert system's ability to explain itself is a distinguishing quality in which it allows experts to examine their own reasoning and justify their decisions.		For innovation creation, adoption, and adaptation, the proper combination of information from both local experience and specialist knowledge is frequently required.

Several gaps are introduced in this study which include, lack of exposure on the safety of motorcycle users among student, no motorcycle advisory system developed specifically for the use of student and increasing number of motorcycle accidents in campus. This advisory system is not only an important initiative to lessen the fatal injuries among motorcyclists, but it also benefits the engineer in helping them make decisions on how to improve related traffic or transportation issues. In addition, it is also useful for young engineers that have less experience in industry to expand their knowledge especially for the transport engineers. Transport experts are also given the opportunity to channel their knowledge in this advisory system for better understanding of end users.

1.3 Problem Statement

The main focus of this study is to develop a computer-based application advisory system for motorcycle safety at campus towards sustainable 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. It is important to develop this system as it is one of the actions that can be taken in order to reduce fatal injuries involving motorcycle accidents on

campus. There are many past researchers who contributed or studied on the development of such advisory systems. However, even though there are many studies related to this advisory system, there are still several unanswered questions. In this study, three research gaps are identified and are further discussed as follows.

Firstly, lack of exposure on the safety of motorcycle users among student. There is wide knowledge and information regarding motorcycle safety studied by past researchers. However, the exposure of that knowledge is very limited especially among the student and thus leads them to violating the road laws. Young motorcyclists between the ages of 18 and 35 are more likely than other age groups to break traffic laws (Sultan et al., 2016) and most of the Malaysian student studied at higher education (universities) are among the age of 18 to 23 years old. (Chang et al., 2018) mentioned that In 2016, there were 532,049 students in Malaysia's twenty public universities. Therefore, the likelihood of a motorbike user increases with the number of students enrolled.

More exposure of motorcycle safety among campus communities is necessary as it helps in reducing the accidents involving motorcycles. According to (Idris et al., 2019), research and knowledge in the field of road accidents are critical for understanding what causes road accidents and what actions can be made to address the problem in order to reduce the number of accidents.

Secondly, no motorcycle advisory system developed specifically for the use of the student in campus. Various advisory systems or expert systems developed by past researchers that are useful for their targeted end-user, but instead, in this study, the targeted end-user are the campus' students. For instance, (Yousif et al., 2020) found several advisory systems built by other researchers such as the software named MECHROM, developed by (Abdul Manan et al., 2017) in which this system is used for data analysis and collecting. Therefore, it is necessary to develop a simple but yet suitable for the student to use. This advisory system will help in better understanding for the end-user (student) regarding motorcycle safety and therefore helps in reducing motorcycle accidents.

Thirdly, an increasing number of motorcycle accidents on campus. The increasing number of motorcycle accidents on campus has become a concern. Higher accident cases result in lower transportation sustainability. Development of this motorcycle safety advisory system for the use of the student is necessary as it will reduce motorcycle accidents and as a result the campus will approach a more sustainable campus in terms of transportation. 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 most of their age range from 18-20s years old. According to (Idris et al., 2019), in Malaysia, the minimum age for obtaining a motorcycle licence is 16 years old and students aged 21 years and below have less experience in riding motorcycles and accounted to 34% of fatalities cases.

1.4 Definition

This research focuses on gathering motorcycle information from the literature reviews of past studys and information collected from the expert. This information will be coded in a computer-based advisory system and is expected to be useful in reducing motorcycle accidents towards sustainable transportation.

Advisory systems are concerned not only with the transfer of technology and knowledge, but also with the empowerment of users to make joint decisions and cooperate in their implementation, as well as the establishment of effective institutions to manage collective operations (Bourne et al., 2017). Advisory system differs from the expert system but both are problem-solving systems.

The following table shows the detailed definition of some elements that are related to the title of this research study which includes computer-based, application, advisory system and sustainable transportation.

Table 1. 2 Definition of several elements regarding research title

No.	Element	Definition	Source
1	Computer-based	Structured systems that collect, process, store, and distribute didactical resources using computer hardware and software technologies.	Mandic, 2015
2	Application	• An application, often known as an application programme or application software, is a computer software package that performs a specified task for a user or, in certain situations, for another application. • An application can be a single programme or a group of programmes. The programme is a set of instructions that allows the user to run the application.	Gillis, 2021
3	Advisory system	• A system that transfers of technology and knowledge • Gives end users to make joint decisions and cooperate in their implementation	Bourne et al., 2017
4	Sustainable transportation	Sustainable transportation methods can be defined as the ways by which transportation is carried out in accordance with sustainability principles, such as minimising CO2 emissions in urban mobility and process management in businesses.	William et al., 2019

1.5 Objectives

The purpose of this study is to develop a computer-based application advisory system for motorcycle safety specifically on campus towards sustainable transportation. The three main objectives of this study are as follows:

a. To gather knowledge regarding motorcycle safety and advisory system through literature review as well as questionnaire to domain experts.
b. To develop a computer-based application advisory system for motorcycle safety at campus towards sustainable transportation.
c. To verify, validate and evaluate the developed computer-based application advisory system for motorcycle safety in order to reflect the acceptance of the end-user.

1.6 Significance Of Study

The main implication of this study is to help in reducing severe injuries among riders due to motorcycle accidents and thus achieving transport sustainability in campus as less road accidents bring a step closer to a sustainable transportation. There are several other significances of this study such as helps engineers in making decisions, helps young engineers to expand their knowledge especially among the transport engineers and gives opportunity to the transport experts to channel their knowledge in this advisory system for better understanding of end users.

As for the first importance, which is, helps young engineers to expand their knowledge especially among the transport engineers. This advisory system for motorcycle safety will benefit them (engineers) in making decisions on how to improve related traffic or transportation issues such as traffic congestion, air pollution and road accidents. Advisory system will improve the decision-making process. As a result, transportation problems on campus, especially motorcycle accidents can be solved or reduced with the engineers effective planning.

Another importance of this advisory system is that it helps young engineers that have less experience in industry to expand their knowledge especially among the transport engineers. All information gathered and coded in this advisory system are from various resources such as transport experts and journal article reviews. The information gathered will help young engineers to improve their ability in solving problems with efficient ideas and planning. (Harlim & Belski, 2010) states that effective problem solving necessitates the ability to recognize and analyze a problem, choose and organize relevant information, represent the problem, translate relevant information into a solution, develop one or more strategies, implement, and assess strategies. Therefore, development of this advisory system is necessary.

It is undeniable that transport experts have ample knowledge of broad aspects pertinent to transportation. According to (*Transportation Experts | ForensisGroup Expert Consulting*, n.d.), transportation specialists understand the significance of travel, commutes, and deliveries for vehicle operators, passengers, and freight, whether moving by private or public transit for commercial, recreational, or governmental purposes. By developing this advisory system, experts can have the chance to channel their knowledge and benefit the end user.

1.7 Limitation Of Study

A computer based advisory system is studied in this study. This advisory system main aim is to provide wide knowledge about motorcycle safety in which the content (motorcycle safety knowledge) is gathered through literature review and also from the human expert through a series of questionnaire prepared. The focus of this study is to help the motorcyclists among the student in reducing their risks of getting into road accident by exposing them the precautions that they should consider before riding the motorcycle. Therefore, there are several limitations in order to achieve the main goal of this study which are as shown in Table 1.3. Each of these limitations are further discuss as follows.