ACCEPTANCE ON AUTONOMOUS VEHICLE AMONG MALAYSIANS

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DECLARATION

I declare that this Choose an item. entitled “Acceptance On Autonomous Vehicle Among Malaysian” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

I hereby declare that I have checked this thesis and, in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Technology Automotive) with Honours.

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DEDICATION

Dedicated to

My honorable father, Marhalim bin Samori

My precious mother, Rosmah Binti Telong

My adored sibling, Nurul Syahira Atiqah, Muhammad Firdaus Aiman

My supporting teammates,

Siti Nur Amirah Binti Azizi

and

My supervisor for her guidance,

Dr. Nur Hazwani Bin Mokhtar

Thank you so much

ABSTRACT

The autonomous vehicle is expected to reduce road accident that caused by human error. In addition to minimizing human interference and improving traffic control mechanisms, the autonomous vehicle safety system will contribute to a modern mobility world with less traffic and better driving. This study aims to determine Malaysian acceptance of the autonomous vehicle safety system. All the factor in this research are adaption from Car Technology Acceptance model (CTAM) and Unified Theory of Acceptance and Use of Technology (UTAT) for autonomous vehicle safety system. In this model consist Effort expectancy, social influence, relative advantage, perceived risk, self-efficacy, anxiety, attitude and public acceptance. Public acceptance could be predicted through the factor that had been develop. A survey of 283 participant was conducted in Malaysia and the data were analyzed using Statistical Package for the Social Sciences (SPSS) and Structural Equation Modelling (SEM) to find the relationship of the hypothesis, correlation, and regression. The results of this study suggest that attitude, self-efficacy, social influence and perceived risk influence public acceptance. The finding of this study provides useful information to government, researchers and practitioners interested in increasing user acceptance of AV in the future.

ABSTRAK

Kenderaan autonomi itu dijangka dapat mengurangkan kemalangan jalan raya yang disebabkan oleh kesilapan manusia. Selain meminimumkan gangguan manusia dan menambah baik mekanisme kawalan lalu lintas, sistem keselamatan kenderaan autonomi akan menyumbang kepada dunia mobiliti moden dengan kurang trafik dan pemanduan yang lebih baik. Kajian ini bertujuan untuk menentukan penerimaan Malaysia terhadap sistem keselamatan kenderaan autonomi. Kesemua faktor dalam penyelidikan ini adalah penyesuaian daripada model Penerimaan Teknologi Kereta (CTAM) dan Teori Penerimaan dan Penggunaan Teknologi Bersepadu (UTAT) untuk sistem keselamatan kenderaan autonomi. Dalam model ini terdiri daripada jangkaan usaha, pengaruh sosial, kelebihan relatif, risiko yang dirasakan, efikasi kendiri, kebimbangan, sikap dan penerimaan awam. Penerimaan orang ramai boleh diramalkan melalui faktor yang telah dibangunkan. Tinjauan terhadap 283 peserta telah dijalankan di Malaysia dan data dianalisis menggunakan Statistical Package for the Social Sciences (SPSS) dan Structural Equation Modelling (SEM). Hasil kajian ini mencadangkan bahawa sikap, efikasi kendiri, pengaruh sosial dan persepsi risiko mempengaruhi penerimaan orang ramai. Dapatan kajian ini memberi maklumat berguna kepada kerajaan, penyelidik dan pengamal yang berminat untuk meningkatkan penerimaan pengguna AV pada masa hadapan.

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CHAPTER 1

INTRODUCTION

1.1 Background

In Malaysia, road accidents are one of the leading causes of death and injury. According to the World Health Organization (WHO), Malaysia has one of the highest rates of road fatalities per capita worldwide (Toroyan, Peden and Iaych, 2013). Human error and attitude (80.6%) lead the most to a road crash in Malaysia, according to a MIROS report based on accident data from 2011 to 2018, followed by road condition (13.2%) and vehicle condition (6.2%) (Malaysia, 2018). Autonomous vehicles are expected to reduce road accidents caused by human error (Banks, Plant and Stanton, 2018).In addition to minimizing human interference and improving traffic control mechanisms, the autonomous vehicle safety system will contribute to a modern mobility world with less traffic and better driving. The autonomous vehicle is being developed by companies such as Nissan, Ford, Volvo, Toyota, Daimler, Hyundai, BMW, and Honda. These manufacturers are set to release fully automated. For example, the vehicle that can drive themselves without human interference (Faggella, 2020).

Safety systems for autonomous vehicles are supposed to reduce the number of collision because these vehicles can be driven automatically without human control. The autonomous emergency braking (AEB) system is one example of an autonomous vehicle safety system available on a vehicle manufactured by Honda (Accord, Civic, CRV), Toyota (Camry, Corolla, Alphard, Vellfire), Perodua (MyVi) and others. When a collision is unavoidable, the AEB mechanism immediately applies the brake. AEB is a system to alert the driver and independently brake if there is no human response and the situation is critical. In the future, the autonomous steering system (AES) is expected to be available on production care. To prevent a collision, the AES, such as the one designed by Nissan, will automatically apply steering.

The rapid industrial revolution in autonomous vehicle safety influenced to investigate the major factor in driver behavior in adapting to the autonomous vehicle safety system. The safety mechanism of autonomous vehicles reliability may be a deciding factor in their Acceptance (Merat *et al.*, 2012). According to a study conducted by Verberne, Ham and Midden(2012), confidence is a critical physiological element in determining the acceptability of autonomous safety systems in vehicles. Choi and Ji, (2015) found, driver confidence level largely determined user's ability to accept autonomous vehicles. Lastly, a study by B *et al.*, (2017) found that the intention to use the autonomous vehicle was linked to trust and perceptions of risk benefits knowledge (Seppelt and Lee, 2019).

Even though these analyses have identified a possible factor that affects the future potential adoption of autonomous vehicle safety systems, these factors must have several further studied from two points of view. The first factor related to the technology acceptance model needs to be studied by looking more closely at the context of autonomous vehicles. Previously, several studies looked at factors influencing technology acceptance models, but the results were often inconsistent due to differing views on the underlying structure. Reviewing previous autonomous vehicle research and reorganizing the relationship between the variables will provide valuable insight into the implementation of autonomous vehicles.

1.2 Problem Statement

Malaysian is a rapidly developing country with potential for future technological growth. The automotive vehicle (AV) is an emerging innovation that inspires excitement and apprehension among the general public. Due to a lack of exposure to an autonomous vehicle, most Malaysian are skeptical of its prospect. Based on study that conducted in France, public participation in AV test tends to garner trust in the technology and system (Kassim, Mohd Jawi and Nasruddin, 2019).

A study by WHO, (2020) around 1.35 million people fatal road accident occurs every year worldwide. The study by (Zhang *et al.*, 2020)stated that accident-related variables can be divided into five categories: vehicle condition, offending driver, environment factors, tunnel characteristic, and tiredness or sleep. The development of autonomous safety vehicle can provide excellent benefit to a human driver and reduce road accident.

1.3 Research Objective

This research aims to know about Malaysian acceptance of autonomous vehicle safety systems, the objectives are as follows:

a) To design and develop research instrument (questionaire).

b) To analyze a behaviour model of acceptance on autonomous vehicle safety system in Malaysia using Structural Equation Modelling.

c) To determine the relation between Malaysian acceptance on autonomous vehicle safety systems.

1.4 Scope of Research

The scope of this research are as follows:

d) Determine the relation between Malaysian acceptance of autonomous vehicle safety system.

e) Determine either Malaysian ready to adopt autonomous vehicle with autonomous vehicle safety.

f) There are two types of target participants: participant with at least 2 years of driving experience and participant who work in the automotive industry for Proton and Perodua.

g) This study will focus on Car Technology Acceptance model (CTAM) and Unified Theory of Acceptance and Use of Technology (UTAT) for Autonomous vehicle safety system.

CHAPTER 2

LITERATURE REVIEW

This chapter is an overview of previous researcher related to autonomous vehicle study such as level of autonomous, automotive standards that covers safety in autonomous driving and accidents related to autonomous vehicles.

2.1 Introduction to Autonomous Vehicle

The technology of autonomous driving is poised to become the next major digital revolution in the automotive industry. According to Izquierdo-Reyes *et al.*, (2018), the author defined that term autonomous refers to the ability to self-govern. Furthermore, it stated that driving an autonomous vehicle that involves the autonomous operation and targets the vehicle is capable to be driven by computer, actuator, and sensor. It also targets that the autonomous vehicle can be operated in actual traffic situation without human presence Fully autonomous driving will involve a technical device taking up control of the vehicle and eliminating the human drive (Garidis *et al.*, 2020). Based on research by¸ Hashimoto *et al.*, (2016), The authors studied that autonomous driving and connected vehicles should improve road safety and driver comfort by reducing driver's responsibilities. The author also stated that they used the Advanced Driver Assistance System (ADAS) to support driver while driving, thus fully automated and connected vehicle will become intelligent transportation system in the future and potentially replacing human drivers.

Autonomous vehicle is a component of the automobile and transportation industries are part of the most significant historical transformation. Besides that, autonomous vehicle is an important research component for government and universities (Cavazza *et al.*, 2019). Autonomous vehicles would most likely take decades to conquer new vehicle purchases and fleets (Lee, 2020). In addition, Endsley (2019) stated that the prospect of highly autonomous vehicles is far from clear, and the progress is depending on human-autonomy integration would be crucial. In the study by Todorovic, Simic and Kumar, (2017) the author described the fusion of connectivity, electrification, and changes depending on consumers' transformation from conventional vehicle to the autonomous and electric vehicle.

In recent years, the level of automation of autonomous vehicles has significantly increased, prompting a desire for future advancements. Autonomy was described as an intelligent system capacity to complete certain tasks despite the system's ambiguity (Wang *et al.*, 2021). Most autonomous vehicles use LiDAR (Light Detection and Ranging) as the "eyes" for the autonomous vehicle to detect obstacles and avoid them. Besides that, LiDAR is the key to enable the evolution to Advanced Driver Assistance Services (ADAS) as seen in Figure 2.1 Roadmap to Automation- Driver Driven to Driverless Vehicles below (Anonymous, 2016).

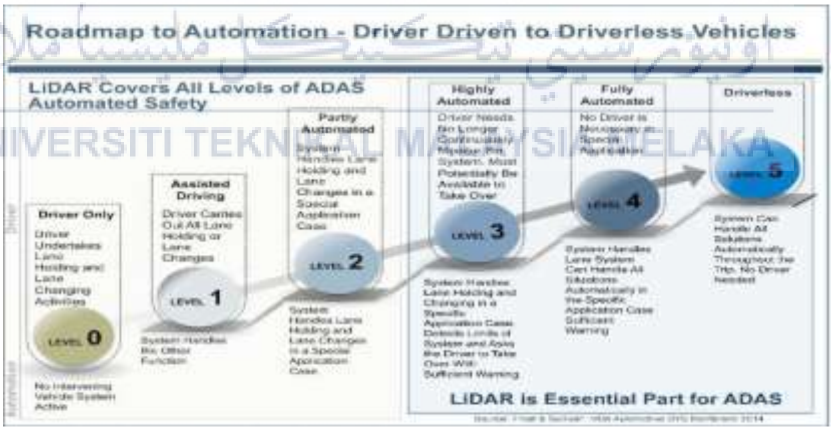

Figure 2.1 Roadmap To Automation- Driver Driven To Driverless Vehicles (Andrew Hussey, 2016)

To Minimizing the risk, standard and policy making will be required to maximizing the social benefits of autonomous vehicle technology (Anderson *et al.*, 2016). Wang *et al.*, (2017) stated that there are several standards of vehicle automation recommended by the Society of Automotive Engineering (SAE), United State National Highway Traffic Safety

Administration (NHTSA), and Germany Federal Highway Research Institute (BASt). The NHTSA implemented SAE International six level of automation defined in SAE J3016 for its" Federal Automated Vehicles Policy" in September 2016. Table 2.1 above shown the corresponding between SAE International, BASt (Germany) and NHTSA (United States) level (Jahromi, 2018).

Table 2.1 The corresponding between SAE International, BASt (Germany) and NHTSA (United State) level (Jahromi, 2018).

Level	**0**	**1**	**2**	**3**	**4**	**5**
SAE	No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
NHTSA	No Automation	Function specific Automation	Combined Function Automation	Limited self-driving Automation	Full self-driving Automation	
BASt	Driver only	Driver Assistance	Partial Automation	High Automation	Full Automation	

2.1.1 SAE International

The SAE is a group of engineers who work in the automotive industry that establishes a framework for classifying the degree of autonomy that a vehicle may have (Izquierdo-Reyes *et al.*, 2018). According to (SAE on-road Automated Vehicle Standards Committee, 2018) Narayanan (2020), there are six levels of autonomous driving, level 0 (no driving automation) to level 5 (fully automation). Level 0 to level 2 still using human drive to assess the driving circumstances while driving. Generally, at the SAE level 0, they are fully controlled by the human driver are responsible for all aspects, and this future is limited to provide warning, and momentary assistance (Reid *et al.*, 2019; Teoh, 2020) stated that most of the vehicle currently operate at level 0. The study by Seppelt and Lee, (2019) and Reagan, (2019) stated that most vehicles are currently at stage level 1 and level 2 with the system are limited to road condition, clear weather condition, and selected speed.

Driver assistance intelligent elements in the first level of SAE provide a layer of comfort and safety, either steering or acceleration using information about the driving circumstances, hope that the driver will be able to steer the vehicle and manage the remaining aspects. Most of the vehicles at level 1 usually have a system that can assist the driver either longitudinal (i.e., speed and following distance) or lateral (i.e., lane-keeping) of driving task (Teoh, 2020; Wang *et al.*, 2021). Another feature might have at this level likes cruise control and Anti-Lock Braking System (ABS) (Reid *et al.*, 2019). Level 2 provide multidimensional assistance that combines adaptive cruise control and lane centering, specific driving mode of both steering or acceleration/deceleration using information that allows the driver to respond to hazard and stay engaged in driving activity in order for automation to take over as it approaches its operational limits (Reagan, 2019).

Human drivers were primarily responsible for monitoring the road and surrounding vehicle at level 0 until level 2. Nevertheless, from level 3 until level 5, the automated driving system executes monitoring the scene and driving task, including longitudinal and lateral. However, the driver must be prepared to take over when the system determines the vehicle can handle it (Reid *et al.*, 2019). Besides that, Wang *et al.*, (2021) stated that at level 3, the vehicle could execute without the driver's control and perform automatic acceleration and deceleration steering in a specific environment. While at level 4 is high automation, the vehicle can perform dynamic driving tasks under certain conditions with supporting infrastructure (i.e., maps and connectivity). The driver is not required to keep the driver hands on the steering wheel all the times. Lastly, the highest SAE level of automation is at level 5, fully automated or known as self-driving. The vehicle can perform all the dynamic driving tasks under all condition and scenarios (Reid *et al.*, 2019).

Table 2.2 Summary table describing levels (SAE on-road Automated Vehicle Standards Committee, 2018)

SAE Level	Name	Narrative Definition	Execution of Steering And Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
Level 0	No Automation	The human driver's full-time execution in all aspects of the dynamic driving activity.	Human driver	Human driver	Human driver	n/a
Level 1	Driver Assistance	A driver assistance system executes a specific driving mode either steering or acceleration/deceleration using information about the driving situation and with expectation that the human driver can handle the remaining aspects of the complex driving activities.	Human driver and system	Human driver	Human driver	Some driving modes
Level 2	Partial Automation	A driver assistance system executes a specific driving mode of both steering or acceleration/deceleration using information about the driving situation and with expectation that the human driver can handle the remaining aspects of the complex driving activities.	System	Human driver	Human driver	Some driving modes
Automated driving system ("system") monitor the driving environment						
Level 3	Conditional Automation	Specific driving mode by automated driving systems perform all facets of the dynamic	System	System	Human driver	Some driving modes