

Perception of car Drivers toward Safety Cyclist Using ADAS

Nurfitri Izzaty Zamrud¹, Kamarudin Ambak^{2*}

¹Faculty of Civil Engineering and Build Environment,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA

²Smart Driving Research Center, Faculty of Civil Engineering and Built Environment,
Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, MALAYSIA

*Corresponding Author Designation

DOI: <https://doi.org/10.30880/rtcebe.2022.03.01.202>

Received 4 July 2021; Accepted 13 December 2021; Available online 15 July 2022

Abstract: The lack of safety towards cyclist has been highlighted due to road crash statistic in Malaysia. By using the technology of Advanced Driver Assistance System (ADAS), this study can help to improve the safety of cyclist in future. This study was conducted to determine the level of consumer acceptance on the idea of technology Advanced Driver Assistant System (ADAS) installation based on the Technology Acceptance Model (TAM). The objective of this study is to identify the factors that influence the perception of car drivers toward cyclist and determine the acceptance of car drivers using ADAS based on TAM. The study area was in around Putrajaya and the questionnaire was conducted and distributed among 200 respondents via google form in the study area. The questionnaire was design based on Technology Acceptance Model (TAM) by doing a survey online due covid-19 pandemic. The Regression and Correlation analysis were used for this study and the analysis were significant ($p = 0.000$) for acceptance of ADAS. The result of this study shows that the perceived easy of use (PEoU) is a dominant factor of TAM were contributing to the installation of Advanced Driver Assistance System (ADAS). Among the opinions to install the system of ADAS is that the system helps to increasy the safety in driving and reduce the amount of accident.

Keywords: Advanced Driver Assistance System, Technology Acceptance Model

1. Introduction

Cycling has lately been seeing a revival in popularity on Malaysian routes. Usually, cycling is more apparent to sports and enjoyment than working transportation, whereas cycling is essentially good for health and environment. In terms of road traffic accidents, cycling fatalities are ranked fourth after motorcycle, automobile and pedestrian historical records[1]. Research was conducted by the researcher to establish the safety system for drivers and to increasy cyclists' safety. The development and use of intelligent transport systems has been advocated in order to improve road safety. Advanced driver

*Corresponding author: kamardin@uthm.edu.my

assistance systems (ADAS) were developed with the clear intention of improving driving behavior and promoting comfort and safety for road users, anticipating accidents to prevent or reduce their incidence [2]

There is a type of ADAS in the system with the highest impact on safety that can detect a blind spot and cyclist detection with emergency break. In this research, it will concentrate on a system that identify the cyclists ahead of the vehicle, alert drivers to an impending accident, and self-break the car if the driver can't respond in time [3]. Therefore, to make these systems more successful, it is necessary to understand how acceptability was considered in research, and who is its determinant.

Thus, this study described the acceptance of this safety system among drivers as users of this system who will definitely feel and go through it. The objective of this study was to identify factors that influence the perception of car drivers towards safety cyclist and determine the acceptance of car drivers using Advanced Driver Assistance System (ADAS) based on Technology Acceptance Model (TAM). Through this model, the factor of user acceptance of this safety system can be known that is whether car's driver acceptance is more dominant to Perceived Acceptance or Perceived Easy of Acceptance.

1.1 Advanced Driver Assistance System

Advanced Driver Assistance System also known as ADAS, are systems for supporting the driver and has provided a risk of life-saving and severe crash injury prevention [4]. These systems provide the driver with the required details, simplify intimidating and routine activities, and improve safety in the overall vehicle. The Advanced Driver Assistance System should also be able to understand, interpret, forecast and respond to road conditions that are essential factors for understanding of the context. The context-sensitive ADAS driver support system is designed to help drivers respond to changes in the environment and to the context [5]. Thus, there are various type of ADAS that can implementation for purpose of safety.

1.2 Technology Acceptance Model

The technology acceptance model (TAM) model was first created in 1989 by Davis to clarify acceptance of the information system [6]. The TAM also comes into comparison with rational theory and expected theory of action. These theories offer a strong basis to explain how values, behaviours and compartmental intent impact information system acceptability and based on psychosocial theory of high-technology product.

TAM suggests that people who are motivated and considered to be more beneficial would more often use a technology and potentially applying it to their task. TAM provides two aspects of the attitude:

- i. Perceived usefulness
The extent to which a person believes it that system help in their performance
- ii. Perceived easy of use
The extent to which a person believes it to be effortless to use a particular system

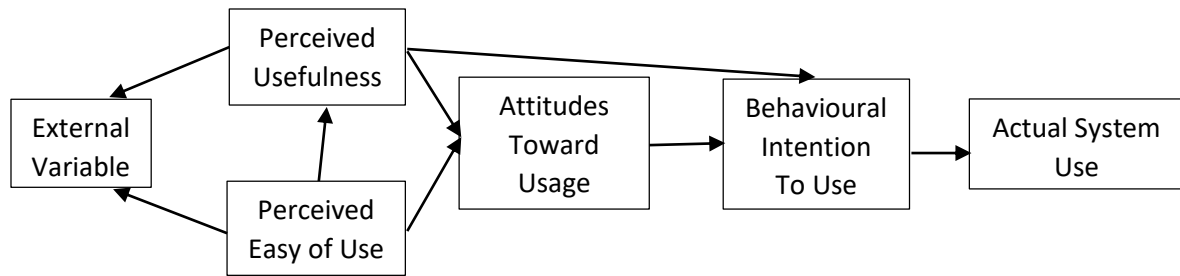


Figure 1: Technology Acceptance Model (TAM) [7]

2. Materials and Methods

The study focuses on the views and opinions of car drivers toward safety cyclist and the ADAS system. The most frequent instrument employed in many studies for collecting important information is questionnaire survey as a tool for data collection. The questionnaire was designed on the basis of the Technology Acceptance Model (TAM). Therefore, the questionnaire has divided into three sections, the first section is the respondent's information, the second section is the survey questionnaire on car driver behaviour toward safety cyclist and the last section is the survey questionnaire on the acceptance of Advanced Driver Assistance System (ADAS). The questionnaire for the instrument design, measurement and likert scale is used to allow respondents to answer this questionnaire from scale 1 to scale 5. Distribution of survey forms has been done using google form around Putrajaya areas and the respondents selected were random in terms of race, gender, race, level of education and status of the respondents.

The study areas were conducted at Putrajaya since the place is known as favorite cyclist route. The respondents must also be Malaysian citizens and they have car license because the technology system will implement to their vehicle. Based on [8] a random sample must be sufficient size to generalize a random sample and prevent sample errors or biases. According to Krejcie and Morgan, (1970) rapid growth for study has made it important to provide an effective sample size approach that is representative of a given population. Based on the location of study the overall population in Putrajaya area is 91,900 people, according to the Department of Statistics Malaysia in year 2018. However, this study only selected 200 respondents who are sufficient for this study.

Therefore, before the actual study is done, the researcher should thus do a pilot study to check that the questionnaire carried out fits the objective of the analysis before the main study is completed. [8] A questionnaire was also applied as an analysis tool and a pilot study carried out by 20 initially participants. Hence, 20 respondents have been chosen from the google form after the survey is distributed. As a reference to the dependability of questionnaire items, the Cronbach's Alpha Score was utilized. Alpha Cronbach is a linked reliability multiplier for items [9]. For the pilot study conducted on 20 respondents, the result of Cronbach's Alpha value obtained was 0.743. This data was analyzed using SPSS software version 26.0. Lastly, 200 questionnaires was distributed to do the actual study in the study area.

3. Results and Discussion

3.1 Descriptive Analysis

Based on the study data obtained through 200 respondents, 52% of which 104 respondents are female and the remaining 48% (96 respondents) are male. Next, the races which is the most numerous in this study is Malays with 90% (181 respondents). Next, the majority in age range between 21 to 30 years with 42.5% (85 respondent) and mostly are from zone 3 which is in presint 11 to 15 with 44% (88 respondents). As for the level of education, it is 72.5%, which is 145 respondents with degree holders and followed by master holders of 30 respondents (15%). The results of the study also show 97% (196 respondents) has full (B, D) license type and the highest experience in driving is 16 to 20 years with 34.5% (55 respondents). More than half of the respondents have their own vehicle, that is, 175 respondents (87%) and had the experience in accident with the frequency 34% (68 respondents) of 2-5

years. Other than that, most respondent knows about the ADAS with 70.5% (141 respondents) and agree with the system that can help to improve safety with 65.5% (131 respondent). Besides, the respondent also agree that the car's driver and cyclist are lack of interaction between each other with 63.65% (138 respondent) and most places that occurs accident frequently at road intersection with 69.5% (139 respondents). However due to this pandemic covid-19, the strict movement happen so there is no regularly accident happen involve the cyclist. The preference of respondents based on other categories, however, is also significant and balanced. This is because the ADAS system is a modern system. The data also shows that the number of females is higher than male respondents because females are more intense on safety in driving behaviour [9].

Table 1: Respondent Demographic

Item	Frequency (n)	Percentage (%)
Gander		
Male	96	48
Female	104	52
Race		
Malay	181	90
Chinese	8	4
Indian	8	4
Other	3	2
Age		
20 years old and below	3	1.5
20 to 30 years old	85	42.5
31 to 40 years old	67	33.5
41 years old and above	45	22.5
Living Places		
Zone 1 (Presint 1-5)	21	10
Zone 2 (Presint 6-10)	22	11
Zone 3 (Presint 11-15)	88	44
Zone 4 (Presint 16-20)	69	35
Education Level		
Spm	4	2
STPM/Diploma	20	10
Degree	145	72.5
Master	30	15
PHD	1	1
License Type		
Full (B, D)	196	97
Learning (L)	1	1
Probation (P)	3	2
No license	0	0
Driving Experience		
5 years and below	40	20
6 – 10 years	55	27.5
11 – 15 years	34	34
16 – 20 years	69	34.5
21 years and above	2	1
Own Vehicle		
Yes	175	87
No	25	13
Involve in Accident		
Yes	106	47

No	94	53
Having an Accident		
Once	34	72.34
2 Times	6	12.77
3 Times	7	14.89
4 Times	0	0
More than 5 Times	0	0

Table 2 shows the respondent experience on driving around the study area. Based on data collection total 70.5% (141 respondents) have latest technology system and other 29.5% (59 respondents) don't have it. Next, a total of 65.5% (131 respondent) have a knowledge about ADAS and other 34.5% (69 respondents) don't know. As show 63.65% respondent think that ADAS helps to increase the safety in driving. It is because most respondent agree with 91% that they lack of interaction toward each other. The result for the last questions in part B shows us the majority respondents choose at road intersection is the most accident occur with 69.5%. Through the past studies, ADAS helps increase safety in driving where the context-sensitive ADAS driver safety system is designed to help drivers respond to changes in the environment and to the context [10]. In addition, lack of interaction can be helps when there are priority rule plans towards safety cycling environment which is cyclist yield toward vehicle, always give in toward each other and alternatives based on specific features[11].

Table 2: Respondent Experience

Item	Frequency (n)	Percentage (%)
Latest Technology System		
Yes	141	70
No	59	29.5
Knowledge about ADAS		
Yes	69	34.5
No	131	65.5
ADAS Helps Increase Safety in Driving		
Yes	4	63.65
No	138	1.85
Lack of Interaction		
Yes	182	91
No	18	9
Places Accident Occur Frequently		
Road Intersection	139	69.5
Stop at Traffic Light	90	45
Highway	64	32
Car Parking	61	30.5
Housing Area	88	44
Other	1	0.5

3.2 Correlation Analysis

Table 3 below shows the correlation between the variables in the Technology Acceptance Model (TAM). The value of R variables have a weak connection is between 0.2 and 0.4 . The significant values show the correlation between the two variables. The results of the value correlation between the variable receiving and ($p < 0.01$) receiving the variable may be discovered among the perceived utility and the perceived easy-to-use variable for testing the first variable. Whereas the last variable's correlation analysis is between the perceived utility dependent variable and the easy to use perceived correlation with the independent variable intended to receive ($r = 0.635$, $p < 0.01$), this shows a positive linear

relationship between the two variables to the independent variable. The data analysis findings indicate that all independent factors have a linear and substantial positive connection with the dependent variables where the R value is evaluated to be between 0.5 and 0.69 between the internal and exterior[12].

Table 3: Pearson Correlation Analysis

		Perceived Usefulness	Perceived Easy of Use	Intention To Receive
Perceived Usefulness	Pearson Correlation	1		
Perceived Easy of Use	Pearson Correlation	.629**	1	
Intention To Use	Pearson Correlation	.560**	.635**	1

** . Correlation is significant at the 0.01 level (2-tailed).

In addition, research between the perceived usefulness variables and the perceived easy of use variables was carried out to determine whether or not the variable has an impact on perceived usefulness. Thus, the beta value obtained shows that the perceived easy of use has a powerful impact on the perceived usefulness of this study, means that perceived easy of use leads to the perceived usefulness of the Advanced Driver Assistance System (ADAS). Ambak et.al., [13] also discussed the perceived easy of use effected the perceived usefulness and confirms the relationship between these two variables.

3.3 Regression Analysis

3.3.1 Regression analysis of perceived usefulness with perceived easy of use and intention to use

To examine the relationship between Intention to receive, Perceived usefulness and Perceived easy of use will be analyses by using multiple regression. Table 4 shows a summary of R squares of 0.446 which shows 40% change in the independent variable (Perceived usefulness and Perceived easy of use) on the dependent variable (Intention to use). In table 5, shows the ANOVA table for the regression. ANOVA stands for Analysis of Variance on the independent variables (perceived usefulness and perceived easy of use) and the dependent variables (intention to use). The variance of residuals (or errors) is the value of the mean square error (MSE) that valued 0.235. The F-statistic is a Mean Square (Regression) divided by the Mean Square (Residual) $18.649/0.235 = 79.212$ The results of the regression analysis showed a significant relationship ($p = 0.000^b$) between the dependent variables (intention to use) to the independent variables (perceived usefulness and perceived easy of use). Regression analysis is a very general method used to explain and analyze the relationships between variables [14].

Table 4: Model summary (R²) perceived usefulness and perceived easy of use

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.668 ^a	.446	.440	.485

Table 5: ANOVA table for intention to use with perceived usefulness and perceived easy of use

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	37.299	2	18.649	79.212	.000 ^b
	Residual	46.381	197	.235		
	Total	83.680	199			

- a. Dependent Variable: Perceived usefulness
- b. Predictors: (Constant), perceived easy of use, Intention to use

Table 6 illustrates the intention to use with perceived usefulness and perceived easy of use of multiple regression analyses. The independent perceived variable of usefulness is strongly related to the intended variable ($\beta = 0.267$), however the perceived easy of use variable is more dominant than the perceived usefulness variable of β , which is 0.467. A number of statistical techniques to correlation are used to analyze the link between the variable criterion and the numerous predictor variables.[14].

Table 6: Multiple regression coefficient of intention to use with perceived usefulness and perceived easy of use.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.180	.267		4.411	.000
	Perceived usefulness	.277	.071	.267	3.907	.000
	Perceived easy of use	.455	.067	.467	6.848	.000

- a. Dependent Variable: Intention to Use

3.3.2 Regression analysis of intention to use and behaviour

To examine the relationship between intention to use and behaviour will be analyses by using multiple regression. Table 7 shows a summary of R squares of 0.404 which shows 40% change in the independent variable (behaviour) on the dependent variable (Intention to use). Table 8 shows a multiple regression analysis of the intention to use with the behaviour. The independent intention to use variable ($\beta = 0.267$) is strongly linked to the intention to use variable, however the perceived usefulness variable is dominating more than the perceived utility variable, with a value of β are 0.467. The intention to use thus has a big impact on behavior [14].

Table 7: Model summary (R²) intention to use.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.635 ^a	.404	.400	.502

- a. Predictors: (Constant), intention to use

Table 8: Multiple regression coefficient of intention to use with behaviour

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	1.451	.263		5.525	.000
Intention to use	.666	.058	.635	11.56	.000

a. Dependent Variable: Behaviour

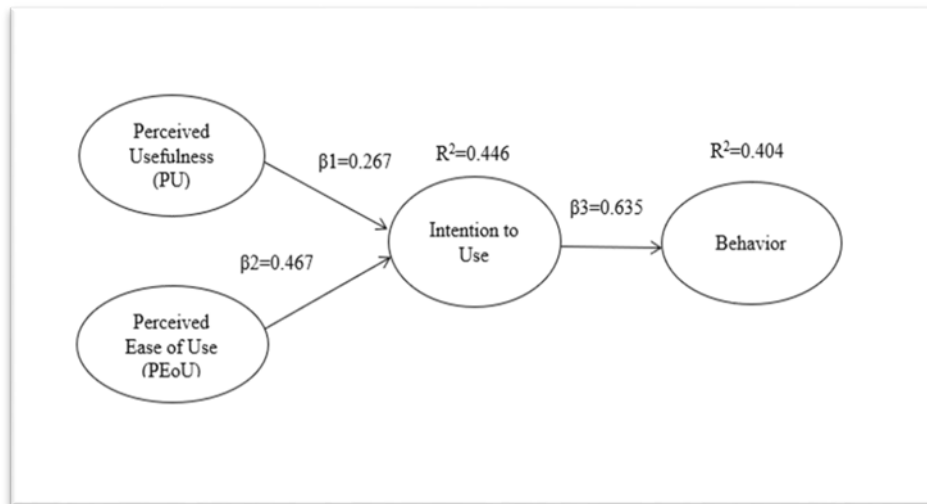


Figure 2: Structure Model of TAM for safety cyclist using ADAS

4. Conclusion

The safety of cyclist can be determined when this study states that the car’s driver shows their contribution in order to increase the safety of cyclist. The data analysis also shows the most positive perception from the car’s driver toward cyclist. Besides, the acceptance of car drivers using Advanced Driver Assistance System (ADAS) based on Technology Acceptance Model (TAM) have shown the opinion and factor that influence users to accept the advanced driver assistance system (ADAS). This is also shown in the Perceived Easy Of Use (PEoU) factor is a more dominant than other factor of TAM. However, there are various opinions and factors need to be emphasized for the installation of the system requirements. Among the opinion that can be considered based on the study conducted is in order to keep the safety of cyclist, this system should be installed in all automobile company, and everyone should apply it to their mobile car. Next, the system can help the beginner to start their driving and well prepared of the safety system itself. In order to further improve the safety cyclist and other road users, the system need to be more monitored so that there are no technical problems occur while the system is in use. In a nutshell, need to keep spread the knowledge about this safety system to people by using the media social, advertisement, radio, and others.

Acknowledgement

The authors would like to thank Universiti Tun Hussein Onn Malaysia (UTHM) for funding this study under the Smart Driving Research Center (SDRC), Faculty of Civil Engineering and Build Environment for support and providing facilities to accomplish the study.

References

- [1] A. Hamzah, A. H. Ariffin, M. S. Solah, N. F. Paiman, and M. R. Osman, "Exploring cycle crash characteristics in Malaysia," 2017.
- [2] M. De Angelis, V. M. Puchades, F. Fraboni, L. Pietrantoni, and G. Prati, "Negative attitudes towards cyclists influence the acceptance of an in-vehicle cyclist detection system," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 49, no. 2017, pp. 244–256, 2017,
- [3] ERTRAC, "ADAS European Road Safety 2016," *Eur. Comm.*, vol. 125, no. 3, pp. 344–351, 2016, [Online].
- [4] L. Viktorová and M. Šucha, "Drivers' Acceptance of Advanced Driver Assistance Systems – What To Consider?," *Int. J. Traffic Transp. Eng.*, vol. 8, no. 3, pp. 320–333, 2018,
- [5] A. Paul, R. Chauhan, R. Srivastava, and M. Baruah, "Advanced Driver Assistance Systems," *SAE Tech. Pap.*, vol. 2016-Febru, no. February, pp. 1–5, 2016,
- [6] Y. Lee, K. A. Kozar, and K. R. T. Larsen, "The Technology Acceptance Model: Past, Present, and Future," *Commun. Assoc. Inf. Syst.*, vol. 12, no. December, p. 50, 2003,
- [7] S. I. L. N. Neville, *Advances in Intelligent Systems and Computing 1207 Advances in Human Factors and Systems Interaction*. 2019.
- [8] H. Taherdoost, "Determining sample size; How to calculate survey sample size," *Int. J. Econ. Manag. Syst.*, vol. 2, no. 2, pp. 237–239, 2017, [Online]. Available: <http://www.iaras.org/iaras/journals/ijems>.
- [9] J. H. Song, "Master Dissertation in Engineering Analyzing consumers' purchasing intention of self-driving vehicle and vehicle equipped with ADAS," *Anal. Consum. Purch. Intent. self-driving Veh. Veh. equipped with ADAS - Using Technol. Accept. Model*, vol. 2, no. 02, pp. 12–19, 2018, [Online]
- [10] A. Paul, R. Chauhan, R. Srivastava, and M. Baruah, "Advanced Driver Assistance Systems," *SAE Tech. Pap.*, vol. 2016-Febru, no. February, pp. 151–158, 2016,
- [11] A. P. Silvano and A. Linder, "Traffic safety for cyclists in roundabouts: geometry, traffic, and priority rules: a literature review," *Vti Notat*, vol. 21, no. 31A-2017, p. 35, 2017, [Online]. Available: <http://vti.diva-portal.org/smash/get/diva2:1158974/FULLTEXT01.pdf%0A>
- [12] Ambak, Ismail, R., Abdullah, R. A., Borhan, M. N. (2011). Using Structural Equation Modelling and The Behavioral Interection to Use Safety Helmat Remainder System. *Reseach Journal of Applied Science, Engineering and Technology*. 5(3). 881-888.
- [13] R. Saadé and B. Bahli, "The impact of cognitive absorption on perceived usefulness and perceived easy of use in on-line learning: An extension of the technology acceptance model," *Inf. Manag.*, vol. 42, no. 2, pp. 317–327, 2005
- [14] S. K. Grange, A. C. Lewis, and D. C. Carslaw, "Source apportionment advances using polar plots of bivariate correlation and regression statistics," *Atmos. Environ.*, vol. 145, pp. 128–134, 2016