

**FACTORS CONTRIBUTING TO THE  
CHARACTERISTICS OF DRIVER'S ATTENTION  
ON CONSPICUITY LEVEL DURING VISUAL  
CLUTTERED ENVIRONMENT**

**NURSYUHADAH BINTI ZULFAKUR**

**MASTER OF SCIENCE  
(COMPUTER SCIENCE)**

**UNIVERSITI PERTAHANAN NASIONAL  
MALAYSIA**

**2024**

**FACTORS CONTRIBUTING TO THE CHARACTERISTICS OF DRIVER'S  
ATTENTION ON CONSPICUITY LEVEL DURING VISUAL CLUTTERED  
ENVIRONMENT**

**NURSYUHADAH BINTI ZULFAKUR**

Thesis submitted to the Centre for Graduate Studies, Universiti Pertahanan Nasional  
Malaysia, in fulfilment of the requirements for the Degree of Master of Science  
(Computer Science)

**2024**

## ABSTRACT

Safety on the road has been one of the major concerns as the number of road users increase. Vehicle task demand and the surrounding environment are important aspects in maintaining the attention and manoeuvring decisions of the drivers. Visual distraction while driving, whether intended or not, can interfere with recognition, perception and other cognitive behaviours. Visual driving distractions refer to any activity that takes your visual field away from the direction you are driving including looking at a map while driving or looking the road advertisements while driving. This research was conducted to identify and measure the level of attention towards guiding and include six phases of this research which are comprehensive literature review, a preliminary study, data collection, data classification, data analysis, and a conclusion. Research also gathered 61 students from the first year at National Defence University Malaysia and used EEG devices running inside a virtual reality laboratory. Prior to the study, a preliminary study with five drivers was conducted to determine the main factors that can effect the level of respondents' attention. Following that, survey method was given to the respondents in order to analyse the activities that affect the respondents' attention level. This study underwent the preliminary study that involved 5 respondents in real time condition of driving on the road. In this study, the ANOVA method, F-test two samples for variances, and correlation coefficient were chosen because they meet the requirement of analysing the results with 95% accuracy. According to the findings of the study, the analysis showed that road advertisement has the highest effect on the attention level of respondent while driving but still less than  $\alpha$  which is 0.05, thus H null is rejected.

## ABSTRAK

Keselamatan jalan raya telah menjadi salah satu faktor utama kerana bilangan penggunaannya semakin hari semakin meningkat. Akta cara pemanduan dan persekitaran sekeliling merupakan aspek penting dalam mengekalkan konsentrasi dan kebolehan membuat keputusan bagi seorang pemandu. Gangguan visual semasa aktiviti pemanduan, sama ada sengaja atau tidak, boleh mengganggu tahap konsentrasi, persepsi dan tingkah laku kognitif pemanduan. Gangguan visual boleh terdiri daripada apa-apa sahaja yang boleh mengganggu pemandu dari arah pemanduan. Kajian ini dijalankan untuk mengenalpasti dan mengukur tahap konsentrasi terhadap pemanduan dan melibatkan enam fasa iaitu, tinjauan literatur yang komprehensif, kajian awal, pengumpulan data, klasifikasi data, analisis data dan kesimpulan. Kajian mengumpulkan seramai 61 orang pelajar tahun satu dari Universiti Pertahanan Nasional Malaysia dengan menggunakan peranti *Electroencephalogram* yang dijalankan di dalam makmal dalam realiti maya. Sebelum kajian dijalankan, satu kajian rintis telah dijalankan terlebih dahulu yang melibatkan lima orang untuk mengenal pasti faktor utama yang mempengaruhi perhatian subjek. Selepas itu, kaedah kaji selidik pula diedarkan kepada orang awam untuk menganalisis aktiviti yang mempengaruhi tahap perhatian subjek. Kajian ini dimulai dengan menjalani kajian dalam keadaan sebenar semasa aktiviti pemanduan yang telah melibatkan 5 orang subjek. Kaedah ANOVA, *F-test two sample for variances* dan *correlation coefficient* telah dipilih dalam kajian ini kerana kaedah ini memenuhi keperluan menganalisis keputusan dengan ketepatan 95%. Hasil analisis mendapati bahawa papan iklan jalan

raya mempunyai kesan yang paling tinggi terhadap tahap perhatian responden semasa memandu tetapi masih kurang daripada  $\alpha$  iaitu 0.05, justeru H null ditolak.

## ACKNOWLEDGEMENTS

First and foremost, I would like to express my deepest and sincere gratitude to my research supervisor Prof Madya Dr Nur Hafizah Moziyana binti Mohd Yusop that always guided me, contributed her precious ideas and have the patience and always believed that I can do this although I took many more years to finish this thesis. I also want to thank my co-supervisors Dr Dian Indah binti Daruis and Dr Yuhanim Hani binti Yahaya that have been so helpful, kind and generous to me.

I cannot express enough gratitude to my husband Muhammad Anwar Syaamil that have been through this tough journey with me. I would like to dedicate this Master to my Princesses because without these two, I will not get the strength to finish it. Nur Ayra Syuhadah and Nur Aafiyah Syuhadah that always strong from the womb until you girls were born. Thank you for always having a smile for Mommy, having patience with Mommy and supporting me in my emotional state.

Last but not least, I would like to dedicate my research to my family especially my parents Zulfakur and Zalila that have given their continuous support, took care of my little cute princesses, had patience, gave guidance and sacrificed throughout this journey. I would also like to thank my best friend Norashikin who dragged me to do this master. Without her ideas, this thesis will probably remain in my dreams. Thank you for believing in me and making my dreams come true. Thank you again to all of you from the bottom of my heart!

## **APPROVAL**

The Examination Committee has met on **11 September 2023** to conduct the final examination of **Nursyuhadah Binti Zulfakur** on his degree thesis entitled **Factors Contributing to the Characteristics of Driver's Attention on Conspicuity Level during Visual Cluttered Environment**.

The committee recommends that the student be awarded the of Master of Science (Computer Science).

Members of the Examination Committee were as follows.

**PROF. MADYA DR. ZURAINI BINTI ZAINOL**

Fakulti Sains dan Teknologi Pertahanan  
Universiti Pertahanan Nasional Malaysia  
(Chairman)

**PROF. MADYA TS. DR. NORSHAHRIAH BINTI ABDUL WAHAB**

Fakulti Sains dan Teknologi Pertahanan  
Universiti Pertahanan Nasional Malaysia  
(Internal Examiner)

**TS. DR. RATNA ZUARNI BINTI RAMLI**

Fakulti Sains Komputer  
Universiti Teknologi Mara (UiTM)  
(External Examiner)

## **APPROVAL**

This thesis was submitted to the Senate of Universiti Pertahanan Nasional Malaysia and has been accepted as fulfilment of the requirements for the degree of **Master of Science (Computer Science)**. The members of the Supervisory Committee were as follows.

**PROF. MADYA DR. NURHAFIZAH MOZIYANA BINTI MOHD YUSOP**

Fakulti Sains dan Teknologi Pertahanan  
Universiti Pertahanan Nasional Malaysia  
(Main Supervisor)

**PROF. MADYA DR. DIAN DARINA INDAH BINTI DARUIS**

Fakulti Kejuruteraan Pertahanan  
Universiti Pertahanan Nasional Malaysia  
(Co-Supervisor)

**DR. YUHANIM HANI BINTI YAHAYA**

Fakulti Sains dan Teknologi Pertahanan  
Universiti Pertahanan Nasional Malaysia  
(Co-Supervisor)

**UNIVERSITI PERTAHANAN NASIONAL MALAYSIA**

**DECLARATION OF THESIS**

Student's full name : **NURSYUHADAH BINTI ZULFAKUR**  
Date of birth : **1<sup>st</sup> DECEMBER 1995**  
Title : **FACTORS CONTRIBUTING TO THE CHARACTERISTICS OF DRIVER'S ATTENTION ON CONSPICUITY LEVEL DURING VISUAL CLUTTERED ENVIRONMENT**  
Academic session : **2023/2024**

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged.

I further declare that this thesis is classified as:

- CONFIDENTIAL** (Contains confidential information under the official Secret Act 1972)\*
- RESTRICTED** (Contains restricted information as specified by the organisation where research was done)\*
- OPEN ACCESS** I agree that my thesis to be published as online open access (full text)

I acknowledge that Universiti Pertahanan Nasional Malaysia reserves the right as follows.

1. The thesis is the property of Universiti Pertahanan Nasional Malaysia.
2. The library of Universiti Pertahanan Nasional Malaysia has the right to make copies for the purpose of research only.
3. The library has the right to make copies of the thesis for academic exchange.

\_\_\_\_\_  
Signature

\_\_\_\_\_  
\*\*Signature of Supervisor/Dean of CGS/  
Chief Librarian

Click here to enter text.

\_\_\_\_\_  
IC/Passport No.

Click here to enter text.

\_\_\_\_\_  
\*\*Name of Supervisor/Dean of CGS/  
Chief Librarian

Date:

Date:

\*If the thesis is CONFIDENTIAL OR RESTRICTED, please attach the letter from the organisation with period and reasons for confidentiality and restriction.

\*\* Witness

## TABLE OF CONTENTS

	<b>TITLE</b>	<b>PAGE</b>
	<b>ABSTRACT</b>	<b>ii</b>
	<b>ABSTRAK</b>	<b>iii</b>
	<b>ACKNOWLEDGEMENTS</b>	<b>v</b>
	<b>APPROVAL</b>	<b>vi</b>
	<b>APPROVAL</b>	<b>vii</b>
	<b>DECLARATION OF THESIS</b>	<b>viii</b>
	<b>TABLE OF CONTENTS</b>	<b>ix</b>
	<b>LIST OF TABLE</b>	<b>xii</b>
	<b>LIST OF FIGURE</b>	<b>xiv</b>
	<b>LIST OF ABBREVIATION</b>	<b>xiv</b>
	<b>LIST OF SYMBOL</b>	<b>xvii</b>
	<b>LIST OF APPENDICE</b>	<b>xviii</b>
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Background	1
	1.2 Problem Statement	3
	1.3 Objective	6
	1.4 Research Questions	6
	1.5 Research Scope	7
	1.6 Hypothesis of Research	8
	1.7 Significance of Research	9
	1.8 Thesis Structure.	9
	1.9 Conclusion	11
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	<b>12</b>
	2.1 Introduction	12
	2.2 Case Study	13
	2.2.1 Accident during Driving	13
	2.2.2 Conspicuity	16
	2.2.3 Electroencephalogram in Application	18
	2.2.4 Electroencephalogram in Driving	21
	2.2.5 Driver Attention Level	24
	2.2.6 Road Advertisements	26
	2.2.7 Digital Advertisement along Roadside	30
	2.2.8 Statistical Method	31
	2.3 Software Device	36
	2.3.1 EEG ID	36
	2.3.2 SteamVR	37
	2.4 Hardware Device	37
	2.4.1 Neurosky Mindwave Mobile	37
	2.4.2 Myndplay EEG	39
	2.4.3 HTC Vive Virtual Reality	40

	2.5 Conclusion	40
<b>CHAPTER 3</b>	<b>RESEARCH METHODOLOGY</b>	<b>42</b>
	3.1 Introduction	42
	3.2 Research Methodology	43
	3.2.1 Phase 1: Comprehensive Literature Review	44
	3.2.2 Phase 2: Preliminary Study	45
	3.2.3 Phase 3: Data Collection	49
	3.2.4 Phase 4: Data Classification	52
	3.2.5 Phase 5: Analysis of Data	54
	3.2.6 Phase 6: Hypothesis Testing	55
	3.3 Conclusion	56
<b>CHAPTER 4</b>	<b>EXPERIMENTAL STUDY</b>	<b>57</b>
	4.1 Introduction	57
	4.2 Data Collection Method	57
	4.2.1 Data Collection Method: Questionnaire	57
	4.2.2 Data Collection Method: Interview with Expert	60
	4.2.3 Data Collection Method: Preliminary Study	62
	4.2.4 Data Collection Method: Actual Study using Virtual Reality Simulation	68
	4.3 Method of Data Analysis	73
	4.3.1 Hypothesis Testing of ANOVA	74
	4.3.2 Hypothesis Testing of F- test two sample for Variances	75
	4.3.3 Correlation Coefficient	75
	4.4 Conclusion	76
<b>CHAPTER 5</b>	<b>ANALYSIS OF DATA</b>	<b>77</b>
	5.1 Introduction	77
	5.2 Result of Questionnaire	78
	5.2.1 Demographic study	79
	5.2.2 General factor that affected the attention level of respondents	82
	5.2.3 Visual factors that affect the attention level of driver while driving	86
	5.3 Result of Preliminary Study	90
	5.4 Result of Actual Study using Virtual Reality	92
	5.5 Conclusion	101
<b>CHAPTER 6</b>	<b>CONCLUSION</b>	<b>102</b>
	6.1 Introduction	102
	6.2 Contribution	102
	6.3 Advantages	108
	6.4 Limitation of Research	109
	6.5 Future Works	110
<b>REFERENCES</b>		<b>111</b>

<b>APPENDICES</b>	<b>117</b>
<b>BIODATA OF STUDENT</b>	<b>121</b>
<b>LIST OF PUBLICATIONS</b>	<b>121</b>

## LIST OF TABLE

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
<b>Table 2.1</b>	Studies Reviewed about Accident During Driving	13
<b>Table 2.2</b>	Studies Reviewed about Conspicuity In Driving	17
<b>Table 2.3</b>	Studies Reviewed about EEG	19
<b>Table 2.4</b>	Studies Reviewed about EEG in Driving	21
<b>Table 2.5</b>	Studies Reviewed about the Effect of Road Advertising and Talking	27
<b>Table 2.6</b>	Method Used to Analyse Data	32
<b>Table 2.7</b>	Studies Using Neurosky Mindwave Mobile	38
<b>Table 3.1</b>	Comprehensive Literature Review	45
<b>Table 3.2</b>	Preliminary Study	48
<b>Table 3.3</b>	Data Collection	51
<b>Table 3.4</b>	Data Stored in Microsoft Excel	52
<b>Table 3.5</b>	Data Classification	53
<b>Table 3.6</b>	Analysis of Data	55
<b>Table 3.7</b>	Hypothesis Testing	56
<b>Table 4.1</b>	Factor that Involved in Preliminary Study	64
<b>Table 4.2</b>	Measurement Category of Attention Level	64
<b>Table 4.3</b>	Strength of Correlation Coefficients	76
<b>Table 5.1</b>	Result of General Factors That Affects Attention Level of Respondents While Driving	85
<b>Table 5.2</b>	Result of Visual Factor that Affect The Attention Level of Driver While Driving	89
<b>Table 5.3</b>	Result of Attention Level Drivers on Visualization Factor	90
<b>Table 5.4</b>	One Way ANOVA Digital Advertisement	92
<b>Table 5.5</b>	One Way ANOVA Road Advertisement	93
<b>Table 5.6</b>	One Way ANOVA Road Sign	94
<b>Table 5.7</b>	F-Test Two Sample for Variances Between Digital Advertisement and Road Advertisement	95
<b>Table 5.8</b>	F-Test Two Sample for Variances Between Road Sign and Road Advertisement	96
<b>Table 5.9</b>	F-Test Two Sample for Variances Between Digital Advertisement and Road Sign	97
<b>Table 5.10</b>	Result of Correlation Coefficient	98
<b>Table 6.1</b>	Result of Hypothesis Testing Between Factor of Distraction and Attention Level of Driver While Driving in a Virtual Reality Environment	104
<b>Table 6.2</b>	Result of Hypothesis Testing Between Digital Advertisement and Attention Level of Driver While Driving in a Virtual Reality Environment	104

<b>Table 6.3</b>	Result of Hypothesis Testing Between Road Advertisement and Attention Level of Driver While Driving in a Virtual Reality Environment	105
<b>Table 6.4</b>	Result of Hypothesis Testing Between Road Sign And Attention Level of Driver While Driving in a Virtual Reality Environment	106
<b>Table 6.5</b>	Result of F-Test Two Samples For Variances Between Digital Advertisement and Road Advertisement	106
<b>Table 6.6</b>	Result of F-Test Two Samples For Variances Between Road Sign and Road Advertisement	107
<b>Table 6.7</b>	Result of F-Test Two Samples For Variances Between Digital Advertisement and Road Sign	108

## LIST OF FIGURE

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
<b>Figure 1.1</b>	Thesis Structure	10
<b>Figure 3.1</b>	Six phases in research method	43
<b>Figure 3.2</b>	Route taken for preliminary analysis study	48
<b>Figure 3.3</b>	Flowchart of data collection	49
<b>Figure 4.1</b>	Demographic study	58
<b>Figure 4.2</b>	General factor that affect the attention level respondents while driving	59
<b>Figure 4.3</b>	Visual factor that affect the attention level respondents while driving	60
<b>Figure 4.4</b>	Driver wearing the headset while driving	63
<b>Figure 4.5</b>	Mobile Headset	65
<b>Figure 4.6</b>	Data collected by EEG Analyzer	66
<b>Figure 4.7a</b>	Road advertisements have more than road signages	66
<b>Figure 4.7b</b>	Colour of roadside advertisement	67
<b>Figure 4.7c</b>	Size of roadside advertisement	67
<b>Figure 4.7d</b>	Position of roadside advertisement	67
<b>Figure 4.7e</b>	Colourful and brightness digital billboard	68
<b>Figure 4.8</b>	Road that have been used in preliminary study	68
<b>Figure 4.9</b>	Respondent wearing the HTC Vive and Myndplay EEG	70
<b>Figure 4.10</b>	Myndplay EEG Device	70
<b>Figure 4.11</b>	HTC Vive	71
<b>Figure 4.12</b>	Data Collected by eegID	71
<b>Figure 4.13a</b>	Storyboard the collection of data	72
<b>Figure 4.13b</b>	Storyboard the collection of data	73
<b>Figure 4.14</b>	General procedure	74
<b>Figure 4.15</b>	General procedure of F-test two sample of variances	75
<b>Figure 5.1</b>	Ages	79
<b>Figure 5.2</b>	Gender	80
<b>Figure 5.3</b>	Frequency of driving in one week	81
<b>Figure 5.4</b>	General factors that affected the attention level of respondents while driving	82
<b>Figure 5.5</b>	Line graph result of attention level of drivers on visualization factor	91
<b>Figure 5.6</b>	Scatter diagram between road advertisement and digital advertisement	98
<b>Figure 5.7</b>	Scatter diagram between road advertisement and road sign	99
<b>Figure 5.8</b>	Scatter diagram between digital advertisement and road sign	100

## LIST OF ABBREVIATION

ANOVA	-	Analysis of Variances
EEG	-	Electroencephalogram
MIROS	-	Malaysian Institute of Road Safety Research
MCO	-	Malaysia Movement Control Order
IQR	-	Interquartile range
UPNM	-	Universiti Pertahanan Nasional Malaysia

## LIST OF SYMBOL

$r$	-	Correlation coefficient
$\alpha$	-	Alpha
$\leq$	-	Less than or Equal to
$>$	-	More than
%	-	Percentage
=	-	Equal sign
-	-	Negative value
$H_0$	-	Null hypothesis
$H_1$	-	Alternative hypothesis

## LIST OF APPENDICE

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGE</b>
	Appendix A : Questionnaire	117
	Appendix B : Labsheet Experiment	119

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Safety on the road has been one of the major concerns as the number of road users increase. Vehicle task demand and the surrounding environment are important aspects in maintaining the attention and manoeuvring decisions of the drivers. Based on study Al-Tit et al., (2020) according to the 2018 report from the World Health Organization WHO (2018) on road safety, traffic accidents caused 1.35 million deaths in 2016.

Stelling & Hagenzieker, (2012) found that talking and listening can affect driving task performance. The impacts of communicating via phone or talking to a passenger while driving such as reduce driving speed, longer reaction times, and decreased visual focus, which results in missing objects and making errors. According to Stelling and Hagenzieker (2012), the impacts of handling equipment can also contribute to visual-physical distraction, such as sending messages, entering a location in a navigation system or operating an audio device.

Visual distraction while driving, whether intended or not, can interfere with recognition, perception and other cognitive behaviours. Visual driving distractions can

be anything that takes your visual attention away from the direction you are driving. This could be an interesting billboard, street sign, car, person on the street, map, passenger, or GPS on a cellphone according to study Sazili et al., (2023). Roadside advertisement and advertising billboards are designed to attract the attention of the driver, which may cause attention to the current traffic situation to diminish. Roadside signs however, serve a different purpose where the goal of these signs is to improve road safety.

This study will look into the factor contributing to the characteristics of the driver's attention on conspicuity level during visually cluttered environment. A visually cluttered environment is one that contains visual characteristics that have the potential to impair driving performance. It is the idea that performance is determined by the interaction of the individual, the task, and the environment. In terms of visual clutter in roadscapes, such as roadside advertising, continuing to increase, and it could have an impact on driving performance according to the study Edquist & Johnston, (2008). There are (3) types of visual clutter which are i) situational clutter, ii) designated clutter and iii) built clutter. Conspicuity is defined as the ability of an object or light source to stand out from its surroundings according to Nixon et al.,(2020). It is a measure of how well a sign can attract or hold the attention of a driver. Attention is the behavioural and cognitive process of selectively focusing on a discrete aspect of information, whether subjective or objective, while ignoring other perceptible information. Based on study Stancin et al., (2021) electroencephalogram (EEG) waves can be used to measure the attention level of a driver.

According to Islam et al., (2016) EEG is the electrical activities that recorded from the surface/scalp of the brain and typically described in terms of rhythms and transients. Rhythmic activity of EEG signals is divided into bands of frequency. The common EEG rhythms are alpha, beta, theta and delta waves. Based on study Baldwin et al., (2017) in the underlying brain physiology, mind wandering has an influence on driving performance and the associated change in the attentional state of the driver is measurable.

## **1.2 Problem Statement**

Roadside advertising describes large poster billboard sites that are situated on the side of roads or motorways in high-trafficked and busy areas. Roadside advertising is designed to help small and large corporations sell their goods, services or messages and promote them. Nevertheless, road advertising signs can be a potential danger for driving and give effect to the driver's behaviour such as promotional billboards, driver distract while looking to the billboard to interpret what the messages on billboard.

The behavioural and cognitive process of selectively focusing on a discrete aspect is referred as attention of information whether considered subjective or objective while avoiding other perceivable information based on study Alosco et al., (2012). Electroencephalogram (EEG) waves can be used to measure drivers' attention levels. As a catch-all word, attention is also used to explain how selection mechanisms function in the brain and are involved in almost every phase from sensory processing to decision-making and consciousness based on study Kircher & Ahlstrom, (2017). An attentive driver must have a sufficient understanding of the current situation, including

both the ability to anticipate the likely development of the present situation and the details of how, when, and from where to sample new information to remain up-to-date. According to the study Kircher & Ahlstrom, (2017) driver distraction and inattention occur when attention is diverted away from driving tasks, distraction is suspected, and the subsequent driver's action is harmful to safe driving or risks being dangerous.

Based on the study Baldwin et al., (2017) in the underlying brain physiology, mind wandering influences driving performance and the associated change in the attentional state of the driver is measurable. The NeuroSky Mindwave Mobile Headset was used in this study to measure the level of attention. In Perez & Bertola, (2011) as they drove on a variety of roads that differed in terms of visual clutter and the presence or absence of advertising billboards, and their eye glance behaviour was studied. The findings of this study revealed that how drivers glance at scenes influences the amount of visual clutter found on highways. According to Costa et al., (2019) the impact of six (6) different categories of advertising signs which are: i) billboards, ii) vendor signs, iii) single commercial directional signs iv) multiple commercial directional signs, v) movable display boards and vi) gas price LED displays has been investigated. According to an examination done by Becheur et al., (2019), the road safety campaigns nowadays employ negative appeals such as fear. In this research, the proper policies can be developed to promote safe behaviour among young drivers in road advertising which can lead to fewer traffic accidents.

According to Plant et al., (2017) found that to diminish speeding and observable speeding behaviour, a study is conducted to investigate the effects of anti-speeding advertisements using negative and positive emotions. Positive emotions have

a modest effect while negative emotions may not be as effective for reducing speeding young driver's behaviour. Road advertising signage contribute to the driving job and can be called environmental clutter; Oviedo-Trespalacios et al., (2019). Road advertising signs which can change frequently known as a digital billboard can increase the crash risk. Eye movements data has been explored to study about the influence of advertising billboards. According to study Marciano & Setter, (2017) within a triple task paradigm designed to stimulate certain components of driving, To identify the most distracting billboard characteristics for drivers, a collection of 161 images of actual commercial signs were used as stimuli.

Gitelman et al., (2019) found that impact of removing billboards can decrease the percentage of the injury crashes about 30% to 40% . The difference when the billboards are restored, the injury crashes increase by about 40% to 50%. This study aims to investigate the driver's perception of the effects of the visual cluttered environment on the driver, analyse the waveform of the driver's brain when the driver is affected by the visually stimulated environment and evaluate the statistical relationship of the visual simulation and driver's attention level.

### **1.3 Objective**

The objectives of the research are:

- a) To investigate the driver's perception of the effects of the visual cluttered environment on the driver.
  
- b) To analyse the waveform using headset EEG device when the driver is affected by vision while driving in a visually stimulated environment.
  
- c) To evaluate the statistical relationship of the visual simulation and driver's attention level.

### **1.4 Research Questions**

- a) How a driver perceived and affected by a visual cluttered & non-visual cluttered environment?
  
- b) How the waveform when the driver's brain is affected by vision in visually stimulated environment?
  
- c) How significant is the relationship of the visual stimulation and driver's attention level?

## 1.5 Research Scope

In this research, drivers will only use land transport as their carriage. The drivers will be driving the car while their attention level is obtained. There are currently many task demands while driving but this research only focuses on road advertising. According to the study Hinton et al., (2022) road advertising is one of the factor that contributing to accidents. Digital advertisement also involved in this study. As a solution, a method that will be used in this research is a statistical method which involves ANOVA. In this method, data that have been collected will be analysed using ANOVA and verified using F-test two samples for variance and correlation coefficient.

The pilot study method used in this research is to ensure that the outcome achieves the objective. In this method, a random driver will be interviewed based on their experience and opinion to get some snapshot for reference and guide in this research. Observation method was also used by the researcher to observe the factors that affect all the drivers attention level. This pilot study involved 30 respondents which includes all category of ages and gender which are male or female.

Virtual Reality Device which are HTC Vive will be used for collecting data, where drivers wear it to get a virtual environment. The purpose using the virtual reality environment to get the driver the similar environment as real. In this virtual environment also included the 360° degree. A virtual environment in this research will be the road advertising environment that have been recorded by innovator along the road in Kuala Lumpur. Drivers also wore an EEG headset which is a Neurosky. This device will record EEG signal focusing data on attention level from the brain and will