

**ANALYSIS ON DISTRACTION WHILE DRIVING: A CASE STUDY
ON STAFFS AND STUDENTS OF ENGINEERING CAMPUS,
UNIVERSITI SAINS MALAYSIA**

By

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ABSTRAK

Kecederaan dan kemalangan jalan raya semakin meningkat setiap tahun. Kebanyakan kemalangan berpunca daripada gangguan ketika memandu. Gangguan ketika memandu ialah sebarang aktiviti selain daripada aktiviti asal iaitu memandu. Semua jenis gangguan termasuk, terganggu menghantar dan menggunakan telefon pintar, makan dan minum, bercakap kepada penumpang, berdandan, membaca (termasuk peta), menggunakan sistem navigasi, menonton video, membetulkan radio, pemain CD, atau pemain MP3. Sehingga kini, tiada kajian mendalam yang memfokuskan gangguan ketika memandu di Malaysia. Oleh itu, objektif kajian ini dijalankan adalah untuk mengenalpasti persepsi pemandu terhadap gangguan ketika memandu dengan menggunakan borang soal selidik berdasarkan "*Susceptibility to Driver Distraction Questionnaire (SDDQ)*", untuk menganalisa gangguan yang dialami oleh pemandu berdasarkan tugas tambahan yang diberi di dalam kajian eksperimen ini juga bertujuan mengkaji hubungan di antara faktor-faktor sosio-demografi pemandu dengan gangguan pemandu berdasarkan SDDQ dan kajian eksperimen. Keputusan daripada kajian ini menunjukkan kebanyakan pemandu yang terlibat dengan gangguan ketika memandu dipengaruhi oleh faktor psikologi seperti tahu kawal kelakuan terutama untuk gangguan secara sukarela. Membetulkan radio dan menghantar pesanan telefon telah dikenalpasti sebagai gangguan yang paling tinggi dikalangan responden. Hal ini berdasarkan jumlah gangguan pandangan mata responden dari fokus kearah jalan raya ketika melakukan tugas ini. Tambahan pula, menghantar pesanan telefon juga diakui sebagai tugas paling mengganggu fokus pemanduan bagi 19 daripada 21 jumlah responden. Hubungan di antara sosio-demografi dan gangguan pemanduan berdasarkan SDDQ dan tugas eksperimen menunjukkan umur dan jantina sebagai parameter yang mempengaruhi semua soalan di dalam SDDQ dan tugas eksperimen.

ABSTRACT

The road traffic accidents and injuries were increased by each year. Mostly the accidents that occurred will involving the distracted drivers while driving. Distraction while driving is any activity that could divert a person's attention away from the primary task of driving. These types of distractions including texting, using a smartphone, eating and drinking, talking to passengers, using a navigation system, adjusting radio, CD player, or MP3 player. Until now, there is no in depth study that focusing on the distraction while driving in Malaysia. Therefore, the objective of this study is to identify the drivers' perception toward distraction while driving by using questionnaire survey based on Susceptibility to Driver Distraction Questionnaire (SDDQ), to analyze the driving distraction based on the secondary task given in the experimental survey and to determine the relationship between socio-demographic factors with drivers' distraction based on SDDQ and experimental tasks. The results from this study showed that the most drivers have involved in driving distraction influenced by perceived social norms toward voluntary distraction. Radio-operating and phone texting were identified as the most distraction tasks among the respondents involved in this study. It is based on the total eye glance of the respondent from their focus in this tasks. Furthermore, phone texting also be ranked as the most distracting tasks by 19 respondents out of 21 number of respondents. The relationship between socio-demographic with drivers' distraction based on SDDQ and experimental tasks show that age and gender as the influenced parameter that correlated with all the question in SDDQ and experimental tasks.

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LIST OF ABBREVIATIONS

WHO	World Health Organization
NHTSA	National Highway Traffic Safety Administration
SPSS	Statistical Product Service Solution
MIROS	Malaysia Institute Road of Safety
USM	Universiti Sains Malaysia
US	United State
GPS	Global Positioning System
BMI	Body Mass Index
UK	United Kingdom
K-MADS	Kent Multidimensional Assessment Driving Simulation
SDDQ	Susceptibility to Driver Distraction Questionnaire
STPM	Sijil Tinggi Pelajaran Malaysia
DDB	Distracted Driving Behaviour
CNC	Crash or Near Crash

CHAPTER 1

INTRODUCTION

1.1 Background

The World Health Organization (WHO, 2016) reported that, there were 1.25 million road traffic deaths globally in 2013 and numbers is estimated to be increased each year. Road traffic injuries also mentioned as a first rank that caused death among the people aged 15–29 years, in 2012. Meanwhile, Malaysia was ranked as the top 25 countries that involved in car accidents.

According to NHTSA (2014), 3,179 people were killed, and 431,000 were injured in motor vehicle crashes involving distracted drivers. According to this report, the distraction while driving is any activity that could divert a person's attention away from the primary task of driving. All distractions endanger driver, passenger, and bystander safety. These types of distractions including texting, using a cell phone or smartphone, eating and drinking, talking to passengers, grooming, reading (including maps), using a navigation system, watching a video and adjusting a radio, CD player, or MP3 player.

Up to the recent time, there is no in depth study that focusing on the distraction while driving in Malaysia. Therefore, the objective of this study is to identify the drivers' perception toward distraction while driving by using the questionnaire survey based on Susceptibility to Driver Distraction Questionnaire (SDDQ) developed by Feng et al. (2014).

This study also aimed to analyze the driving distraction based on the secondary tasks that given in the experimental survey. Both objectives are important to achieve the third aim of this study which is to determine the relationship between the types of distraction and the factors that influenced the distraction while driving.

According to Jain and Busso (2011), self evaluation towards distraction can be performed by using a questionnaire survey as a first approach to identify the driver's perception toward distraction. Therefore, the drivers in this study are given the opportunity to rank the given secondary tasks according to the most distracted to the least distracted. For the experimental survey, subjective evaluation of distraction through the observation and video recording were done while the secondary tasks given. The drivers were asked to drive a car and performed the secondary tasks where all of the activities and movements were recorded. The data from the observation and video recording will be analyzed by using the Statistical Product Service Solution (SPSS).

1.2 Problem Statement

In Malaysia, road accident is a serious problem. In year 2004, there were 326,815 road accident cases and the number increased to 476,195 cases in 2014. The number of accident cases significantly increase by every year with 65.5% for a decade as shown in Table 1.1. (MIROS,2014).

Table 1.1: General Road Accident Data in Malaysia (1997 – 2014)
(Malaysian Institute Road of Safety,2014).

Year	Registered Vehicles	Population	Road Crashes	Road Deaths	Serious Injury	Slight Injury	Index per 10,000 Vehicles	Index per 100,000 Population	Index per billion VKT
1997	8,550,469	21,665,600	215,632	6,302	14,105	36,167	7.37	29.1	33.57
1998	9,141,357	22,179,500	211,037	5,740	12,068	37,896	6.28	25.8	28.75
1999	9,929,951	22,711,900	223,166	5,794	10,366	36,777	5.83	25.5	26.79
2000	10,598,804	23,263,600	250,429	6,035	9,790	34,375	5.69	26.0	26.25
2001	11,302,545	23,795,300	265,175	5,849	8,680	35,944	5.17	25.1	23.93
2002	12,068,144	24,526,500	279,711	5,891	8,425	35,236	4.90	25.3	22.71
2003	12,819,248	25,048,300	298,653	6,286	9,040	37,415	4.90	25.1	22.77
2004	13,828,889	25,580,000	326,815	6,228	9,218	38,645	4.52	24.3	21.10
2005	15,026,660	26,130,000	328,264	6,200	9,395	31,417	4.18	23.7	19.58
2006	15,790,732	26,640,000	341,252	6,287	9,253	19,885	3.98	23.6	18.69
2007	16,813,943	27,170,000	363,319	6,282	9,273	18,444	3.74	23.1	17.60
2008	17,971,901	27,730,000	373,071	6,527	8,868	16,879	3.63	23.5	17.65
2009	19,016,782	28,310,000	397,330	6,745	8,849	15,823	3.55	23.8	17.27
2010	20,188,565	28,910,000	414,421	6,872	7,781	13,616	3.40	23.8	16.21
2011	21,401,269	29,000,000	449,040	6,877	6,328	12,365	3.21	23.7	14.68
2012	22,702,221	29,300,000	462,423	6,917	5,868	11,654	3.05	23.6	13.35
2013	23,819,256	29,947,600	477,204	6,915	4,597	8,388	2.90	23.1	12.19
2014	25,101,192	30,300,000	476,196	6,674	4,432	8,598	2.66	22.0	10.64

However, there is no statistic regarding the road accident caused by distraction in Malaysia. Meanwhile, in the other country, there are many types of case studies has been conducted and will be explained in the literature review (Chapter 2) in this dissertation.

As the road accidents are keeps on increasing, the actions and countermeasures were taken only after the road accident occurred. Furthermore, the factor of accident occur caused by driver's distraction did not mentioned in the previous study. To solve this problem, a study about the driver's distraction while driving to the determine the type of distraction and the factor influenced a driver has been conducted to identify the other caused by human behavior.

1.3 Objectives

The objectives of this research are as follows:

- I. To identify the drivers' perception toward distraction while driving.
- II. To analyze the driving distraction based on secondary tasks.
- III. To determine the relationship between type of distraction and factors influenced driver involved in distraction while driving.

1.4 Scope of Work

This study was focused on the distraction while driving. This study used an experimental and questionnaire survey, where the respondents targeted were comprised of staffs and students in Engineering Campus, Universiti Sains Malaysia.

In this study, the data collected were based on the questionnaire survey were related with drivers' perception toward distraction including distraction engagement, voluntary distraction and susceptibility to involuntary distraction. While, the data collected based on the experimental survey to identify types of distractions for driver

while driving and also to analyze the driver's distraction while do a several secondary tasks given. All respondents need to fulfill both part of the survey given.

The time and route for the data collected were determined. The suitable time for this experimental task was during a dry day with less congestion traffic. While, the route location has been chosen at Pekan Parit Buntar, Perak which located near with Engineering Campus, USM. The route distance is about 8km which will be started and ended at the Engineering Campus, USM.

1.5 Dissertation Outline

This dissertation contains 5 chapters to discuss the topic which is Analysis on Distraction While Driving: A Case Study on Staffs and Students in Engineering Campus, USM. In chapter 1, all the introduction discusses the background of study, problem statement, objectives and the scope of research study.

Next, chapter 2 provides the literature review on this topic which discuss in several subtopics. The subtopics are definition of driver's distraction and the types of distraction while driving. Also, factors influencing distraction while driving are also explained. Lastly, the evaluation used for driving distraction while driving were discussed based on the previous studies.

Chapter 3 is consisted of detailed information for the methodology including the data collection procedure and data analysis. All of the results and the discussion of data analysis will be shown in chapter 4. Lastly, chapter 5 is the summary of the whole thesis. The conclusion and suggestion for the future studies were also described in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Driver's distraction is an important issue for road safety. It is because there are many accident cases caused by this issue. Distraction occurs when a driver's attention is, voluntarily or involuntarily, diverted away from a driving task which is a primary task by an event or object or called as secondary task that make they not be able to perform a primary task (Young & Regan, 2007). Driver's distraction is defined as a "specific type of inattention where the distraction occurs when drivers divert their attention from the driving task to focus on some other activity" (National Highway Traffic Safety Administration, 2014).

Common secondary tasks for a driver including phone operating, texting by using mobile phone, operating radio, GPS-operating and following, conversation with passengers, and others. Many people did not realize that all of the secondary tasks are an important major can caused a crashes during driving. While, for past many years, road safety professionals and stakeholder have been concern towards distraction or more generally inattention during driving, but now they more focusing on cell phone using while driving. It is happened because nearly 80% of crashes and 65% near crashes has been found by naturalistic driving study. It also mentioned about inattention on road, fatigue and secondary task demand to define distraction towards drivers while driving. To prevent this problem that can caused accident, distraction of drivers need to be studied (Regan et al. 2009)

In USA, a case study done by Braitman et al. (2008) identified the factors leading to crashes among novice drivers. This study shows three-fourths of the crashed were involved by teenagers. The factors contributed with their crashes were failing to detect another vehicle or traffic control, speeding and losing control of the vehicle or sliding. The most failures to detect another vehicle were not looking thoroughly, distraction while driving or inattention.

In addition, Jain & Busso (2011) also already studied about the assessment of driver's distraction and driver distraction has been determined. These assessments are compare the three method by using perceptual evaluations, self assessments and multimodal future analysis to characterize driver distractions. For the first approach which is based on perceptual evaluations where subjectively evaluate by external raters. The second approach was self assessments, where identified the type of distraction based on the drivers themselves. Lastly, by third approach was to identify salient features across different modalities such as CAN-Bus signals, eye glance behavior and acoustic signal.

2.2 Types of Distraction

Secondary tasks are usually distract the drivers' attention from the primary driving task. According to Beanland et al. (2013) in-vehicle distraction were the mostly reported involved passengers such as talking with passengers, arguing with passengers, passengers arguing with each other and attending to small children in the back seat. Other than that, looking at or adjusting vehicle systems such as using the mobile phone, changing CDs or radio station, operating or following GPS system were also included in the distractions while driving.

NHTSA (2011) has reported that The World Health Organization (2010) has categorized three types of driver's distraction which are visual (eyes off the road), manual (hands off the wheel) and cognitive (mind off of driving) in their policy statement.

2.2.1 Operating Mobile Phone (conversation and texting)

The common distraction while driving is operating a mobile phone. Operating mobile phone either by talking or texting can caused a driver to be distracted from driving. According to Kanakaraj et al. (2016), having a conversation on mobile phone while driving can lead to road accident because it influenced the cognitive function of persons, including his or her concentration and also the time of processing a message to their brain. This also can be a distraction to the driver even if they were using the hands free or hand-held phones.

There are many types of distractions that can lead to impaired driving, but recently there has been a marked increase around the world in the use of mobile phones by drivers that is becoming a growing concern for road safety. The distraction caused by mobile phones can impair driving performance. Drivers using mobile phones may have: slower reaction times (notably braking reaction time, but also reaction to traffic signals), impaired ability to keep in the correct lane, and shorter following distances (Haque & Simon, 2015).

It is supported by National Safety Council (2012) data show drivers talking on cell phones are involved in more crashes than texting. All of the study show hands free phones offer no safety benefit when driving. According to Saifuzzaman et al. (2015), drivers have perceived the risk associated with distraction caused by phone conversation

while driving. To compensate the risk, they showed risk compensatory behavior by increasing spacing and decreasing speed from baseline condition.

Text messaging also results in considerably reduced driving performance, with young drivers at particular risk of the effects of distraction resulting from this use. Drivers using a mobile phone are approximately 4 times more likely to be involved in a crash than when a driver does not use a phone. Hands-free phones are not much safer than hand-held phone sets (World Health Organization, 2016).

In addition, World Health Organization (2011) suggested that texting while driving would translate into an increased crash risk. Since text messaging involves both lengthy periods of visual distraction as well as cognitive distraction, it has the potential to be a particularly dangerous behaviour to engage in while driving.

2.2.2 Interacting with in-vehicle devices (Operating radio & CD)

Other than that, interacting with in-vehicle devices also can be a distraction for the drivers. According to Young & Regan (2007), a driver's ability to maintain speed, throttle control and lateral position on the road can be distracted by interacting with in-vehicle devices such as operating radio for radio channel or song selections. It also can increase the risk of being involved in a collision by impair drivers' visual search patterns, reaction times, and decision-making processes.

2.2.3 Sleepy

Sleepiness also has been identified as one of the most important factors contributing to road crashes (Hallvig et al., 2013). This study compared sleepy driving

on the real road and in the simulator driving. The results showed the indicators of sleepy driving showed a similar response pattern to night driving both in the simulator and for real driving. It was proved that the relative validity of simulators is acceptable for many variables for this kind of study.

According to de Mello et al. (2013), fatal may occur when drivers having a decrease in driver alertness resulted by inadequate or disordered sleep. Sleep disorders will reduce the efficiency while operating a vehicle thus it is linked to a number of generalized health and behavioral disorders. It was found that, excessive workload and lack of physical and mental as a major contributing factor to a road accident as shown on Figure 2.1.

Causes of Accidents		Rates of Accidents related Sleep Disorders, Excessive Sleepiness and Fatigue	Strategies to Prevention Crashes
Internal factors 1. Hours of work driving 2. Sleep disorders 3. Higher levels of sleepiness 4. Alcohol and drugs abuse 5. Fatigue 6. Higher levels of stress 7. High body mass index (BMI) 8. OSAS associated with alcohol 9. Sleep medications	External factors 1. Monotony of roads 2. Structural roads 3. Time of work 4. Time-of-day influences	-15 a 30% in European Union (in general). United States and Australia. -6% in England and 15% in France. -20 a 30% of highway accidents in UK. -20 a 40% of the accidents in Brazil.	1. Naps 2. Caffeine intake 3. Break to rest 4. Physical exercise 5. Restorative sleep 6. Healthy nutritional habits 7. Phototherapy 8. Sleep disorders treatment 9. Reducing working hours at the wheel

Figure 2.1: A summary of the causes and preventing strategies of sleepiness during driving. (Mello et al., 2013)

Lucidi et al. (2013) reported that the drivers that involved with night shift jobs would likely to be tired. He claimed that driving in the middle of the night could cause

insomnia and chronic sleepiness that could lead to road accidents. Sleepiness increase the risk of accidents especially involved a young drivers and non-urban roads. His study also claimed that 12.3% of the participating drivers in his study reported sleepiness was the major factor of road accidents occurred.

2.2.4 Operating and following GPS

According to Jensen et al. (2010), the uses of GPS navigation while driving leads to a considerable decrease in driving performance. They conducted an experiment to compare three output configurations of a GPS guide on drivers and driving performance. The uses of GPS navigation that indicated visual output were found to influenced the substantial amount of eye glances. While, for the experiment that introduced an audio output in combination with visual output reduced the frequency of glances. Therefore, the effects of distraction on driving performance were minimal.

2.2.5 Eating while driving

Eating while driving also could cause distraction. According to Alosco et al. (2012), both texting and eating/drinking associated with poor performance on a simulated driving task. The study aims to examine the adverse impact of eating/drinking behavior relative to texting and undistracted behaviors on a simulated driving task. The study involved 186 participants were recruited from undergraduate psychology courses with a valid driver's license who drive on a regular basis. The study was utilized the Kent Multidimensional Assessment Driving Simulation (K-MADS) to compare simulated driving performance among participants randomly assigned to texting (N = 45), eating (N = 45), and control (N = 96) conditions. Found that eating was associated with reduced

simulated driving performance because simultaneous task completion introduces multiple distractions that may limit driving performance.

2.2.6 Passenger in vehicle

The distraction that caused by children as a passenger in the vehicle also one of the common distraction for drivers while driving. According to Macy et al. (2014), the survey found that having children in the vehicle as passenger can caused an accident. The task given such as giving food to a children and picking up a toy for a child in a rear seat of a moving vehicle could require a driver to be distracted for keep their eyes of the road. Furthermore, the hands off from wheel also can increases the risk of accident occur.

Koppel et al. (2011) reported that around 10% driver’s crash risk occurred when drivers having a distraction with children in their car while driving. This study used a naturalistic, observational approach to examine if children in vehicles are a significant source of driving distraction. Table 2.1 below shows the proportion of child occupant-related potentially distracting activities engaged in by driver while eyes off the road for more than 2s and while vehicle in motion.

Table 2.1: The proportion of child occupant-related potentially distracting activities engaged in by driver while eyes off the road for more than 2s and while vehicle in motion. (Koppel et al. (2011))

Potentially distracting activities engaged in by driver	% of activities while eyes off road >2s and vehicle in motion
Checking on children	9
Talking/playing with children	14
Assisting children	17
Overall proportion	10%

On the other hand, the study by Simons-Morton et al. (2011) stated crash or near crash rates among young drivers were 75% lower in presence of and adult passengers and 96% higher among those young drivers with risky friends. It is showed that the young drivers were more distracted while driving with peer passengers rather than adult passengers. This study claimed that the adult passengers would be expected to co-drive and encourage teenage drivers to attend carefully to the driving task. Presumably, adult passengers would also influence the in-vehicle environment, reducing distraction and maintaining a relatively serious mood.

Furthermore, Pradhan et al. (2014) stated that the peer passenger's presence can caused the drivers having a problem to keep their eyes on the road. In this study, male drivers were drove a driving simulator with a male passenger who posed either as a risk-accepting passenger or as a risk-averse passenger. The results showed the presence of a male passenger could reduce the visual scan. The reduction indicated the driver's focus on his/her driving performance.

2.3 Factors Influencing Distraction While Driving

Many studies in Malaysia conducted about road accidents are commonly focused on the factor related with vehicle or roadway. Many accident cases are reported with non-driver factors including slippery road, brakes or tires failures and improper corner roads. According to Braitman et al. (2008), 60% of the accident cases that happened were related with driver's behavior rather than the factor that related with vehicle or roadway. It is also found that three main driver behaviors contributed to crashes which were failing to detect other vehicles, speeding and lost control of the vehicle. Other common factors

that influencing the distraction while driving were including age, driving experience and gender.

2.3.1 Age and driving experience

Basically, age and driving experience are influencing each other. A young age and inexperience drivers have higher risk on road accident rather than the older and experience drivers. It is supported by Braitman et al. (2008) that factors such as difficulty in navigating on slippery roads, not looking thoroughly at other vehicle or traffic controls were contributed to a large proportion of novice teenage drivers' crashes.

Meanwhile, according to Young & Regan (2007), the distracting effects of engaging in secondary tasks while driving is more capable for older drivers and young novice drivers rather than experienced or middle-aged drivers. The age-related difference gives an impact to both aspects which is temporal and structural aspects of task performance. As predicted, young drivers adopted less headways and it is shown that young drivers having a higher response times – particularly with regard to the processing of more demanding material (Andrews & Westerman, 2012).

A young driver with a less experience of driving tended to have a high risk of accident while driving. It is claimed by Hassan et al. (2013) that a young driver with a common distraction such as using a cell phone while driving was greatly contributed in crash risk. A young driver is tended to overestimate their diving skills. The percentage of the young drivers involved in text-messaging or visibly manipulating handheld devices increased from 1.7 percent in 2013 to 2.2 percent in 2014. Since 2007, the young drivers (age 16 to 24) have been observed to be involved in operating the electronic devices compare with older drivers (NHTSA, 2012a).

2.3.2 Gender

Gender is another influencing factor for road accidents. Young and Regan (2007) reported that males were more likely to be involved in road accident rather than female drivers. It was happened because male drivers tend to speeding and lost control of the vehicle. In addition, male drivers especially young males were more intended to drive in high speed and thus it will cause a lost control of vehicle.

Oppenheim et al. (2016) also agreed that the male drivers experienced a lot of road accidents rather than female drivers. this is caused by their aggressive behavior while driving including exceeding the speed limits, crossing the red lights and also cutting across one or more lanes in front of other vehicles.

Meanwhile, the study also reported that female drivers tend to commit more errors while driving. Female drivers were also claimed to be more inclined to commit in-vehicle distractions as a major causes of an accident compared the male drivers who exceed the speed limits as the main reason of road accident (Hassan et al., 2013).

2.4 Evaluation for Driving Distraction Assessment

There are many evaluations or assessments that can be used to determine driver's distraction. These assessments included the perceptual evaluations, self assessments and multimodal feature analysis used to detect the attention level while drivers were driving.

Questionnaire is the most common method used to evaluate the driver's perception towards distraction while driving. Feng et al. (2014) develop the questionnaire to investigate either a driver is voluntary or involuntary by doing a secondary task while driving. Voluntary distraction occurs as a result of willingness to engage in distractions

while, involuntary distraction is related to a driver's attentional capability, more specifically, the ability to suppress distracting information (Feng et al., 2014).

Sanbonmatsu et al. (2013) also did a study to evaluate the driver's distraction by using a questionnaire. Participants completed a series of questionnaires in the context of a study of driving and driving attitudes. The first set of measures assessed their level of cell phone usage while driving. Participants were asked on *"how often do you use your cell phone while driving?"*. The answers were provided in 5 points scale *"never/rarely/sometimes/often/very often when I drive to every time I drive"*. They were also asked to report the percentage of the time they were on the phone while driving. This study examined the relationship between the participant's personality and individual differences in multi-tasking ability.

The video recording methods were found as the most commonly used to identify the movement that affect a distraction while driving. Li & Busso (2015) in their investigation towards the distraction while driving using the video recording. The study relies on real world driving data by using the UTDrive platform which is a vehicle equipped with multiple sensors including a microphone array, a frontal camera, and a road camera as shown in Figure 2.2 below. The car also records various controller area network bus (CAN-bus) signals that described the vehicle activity.

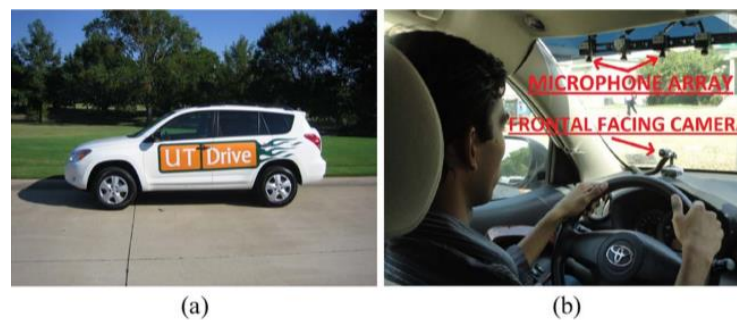


Table 2.2 : (a) UTDrive car and (b) sensors placement

Besides, eye glance technology was one of the common methods that were being used to evaluate driver behavior while driving. Frontal camera video can be used to capture and provides valuable information about eye glance behavior of the drivers. It can be analyzed by using the AFECT software which is automatically extracted for eye closure rate and head pose. It also can be categorized as a kind of distraction when the head rotation was within $\pm 10^\circ$ range (Jain & Busso, 2011).

Other than that, the study by Hirayama et al. (2014) detected the distractions based on the measurements of a driver's gaze through the drivers' focus on certain driving contexts and analyzed gaze behavior under particular peripheral vehicular conditions. In this study, the analysis of the inter vehicular distance measured by the laser scanners and the driver's gaze direction extracted from the recorded video.

In addition, an interview method was categorized as a usual method used to collect the data of drivers' distraction. According to Beanland et al. (2013) interview will helps to provide an information such as personal (e.g., age, sex, height and weight), demographic and pre-crash conditions including road, weather and lighting conditions.

An interview method also used to determine the currency of cell phone use while driving. Besides, it is help to identify the person who talking or texting with drivers. The interview questions included about whether the driver ever used a cell phone while driving and particularly can identified who was the person that communicate with the respondents (LaVoie et al., 2016).

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes in details about the method of study, equipment, data collection details and analysis that had been used in this study. The statistical analysis that used will also described in details in this chapter.

The data collection in this study consists of two part which were experimental and questionnaire surveys. For the experimental survey, the respondents were asked to drive a provided car and several secondary tasks were given. The secondary tasks were phone conversation, phone texting, GPS operating and following, radio operating, having a conversation with passengers and eating a snack. The respondents' activities and movements while involved in the secondary tasks were recorded through observation and video recording. As a precaution, the experiments were done during non-peak hour to avoid the traffic congestion and any other safety factors. Meanwhile, the questionnaire survey containing 13 questions and the aim of the survey was to gain the socio-demographics information of drivers, driver's habit while driving and driver's perception towards distraction while driving.

After done with the data collection, it will proceed to data analysis stage. All of the data were analyzed by using SPSS software. This software was helped to analyze the common types of distraction while driving and the drivers' perception towards the distraction. Results, discussion and conclusion for this study will be explained in the following subtopics in chapter 4. The flow of study for this project can be referred in Figure 3.1.

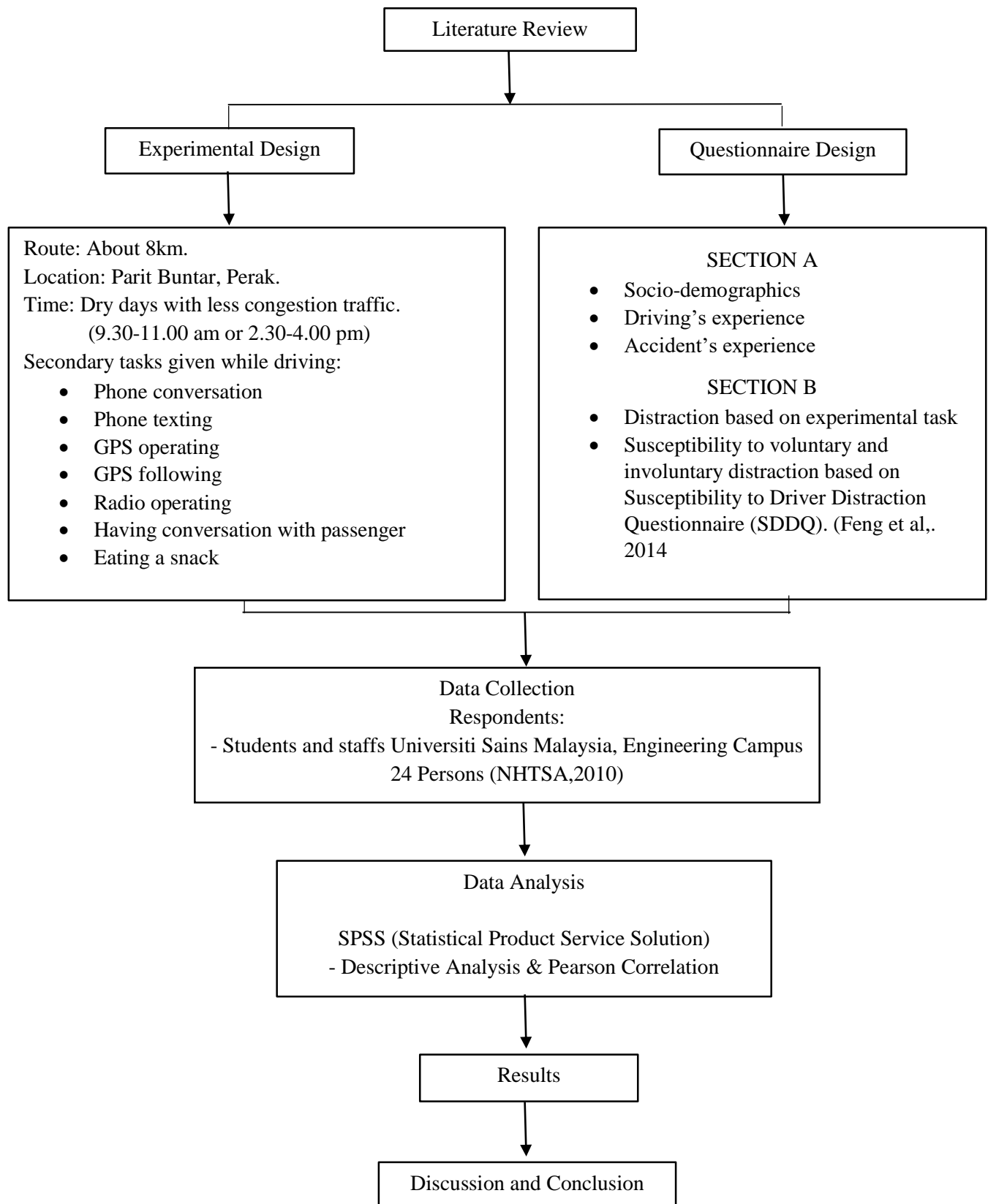


Figure 3.1: Flow chart of the study

3.2 Experimental Design

Experimental survey was used to achieve the second objective of this study which is to analyze the driving distraction based on the secondary tasks. The respondents were asked to drive a car while doing the secondary tasks that given. All respondents needed to drive a same car that provided by the researcher. The suitable time for this experimental task was designing for a dry day with less congestion traffic. The purpose was to avoid other causes of distraction and safety. Thus, the time selected was within 9.00 to 10.30 am for the morning session and 2.30 to 4.00 pm for evening session. The experiment cannot be done in wet day or rainy day to avoid the accident risk.

The experiment will take about 8km which started and ended at the Engineering Campus, USM. The designed routes were selected based on several site observation before the experiment to assure the suitability of safety factors. Each of the task was assigned to the appropriate length of routes as shown in Figure 3.2.

Seven secondary tasks were designed based on several literature reviews. The details of the selected tasks were given in Table 3.1.

Table 3.1: Description of selected secondary tasks

	Secondary Task	Details (sources)
TASK 1	Radio-operating	The driver was asked to change the radio channel to a radio station selected. The radio was in the standard place for the common car. (Young & Regan, 2007)
TASK 2	Phone conversation	The driver dials a number that provided. A regular cellphone was used for this task and hands free cellphones were not allowed during this task. (Kanagaraj et al., 2016)
TASK 3	Phone Texting	The driver type a given text by using a same cellphone. For the phone texting task, a command such as reply, forward, delete and send were used in order for the messaging program to respond. (Strayer et al., 2013)
TASK 4	GPS-Operating (waze)	The driver was asked to enter the address information in the waze. The address information is provided. Waze used from the mobile phone only. (Beanland et al., 2013)
TASK 5	GPS-Following (waze)	After enter the address in the waze, the driver was asked to follow the instruction to the destination. (Beanland et al., 2013)
TASK 6	Having a conversation with passenger	Passenger will ask some random question to a driver while driving to establish a spontaneous conversation. (Jain & Busso, 2010)
TASK 7	Eating a snack	The drivers were asked to eat a wrap food such as sandwich while driving. This task required drivers to unwrap the food themselves. (NHTSA, 2010)



**Note: The length of Task 6 (having a conversation with passenger) was assigned as the whole routes of experiment.

Figure 3.2: Route location for the experimental task.

3.2.1 Equipment

GoPro camera used as the recording equipment in this study. This camera used to record all of the respondent's activities and movements while driving a car during the secondary task given. It should be installed properly to avoid other technical error and should be checked before start the tasks given. The camera was placed at the center of the front side mirror in a car so that can captured all the eye and body movements of the driver. The placing of the camera is shown in Figure 3.3 below. All the recorded videos were used for the data analysis. The phone used in this experiment was provided, but the respondents can use their own phone if they comfortable with it. The placement of phone was chosen by the respondents either want to hold with the phone holder or want to hold by using their hand. It is considered to make the respondents comfortable and act as normal with their common behavior while driving.



Figure 3.3: The experimental devices that have been installed in the car.

A car (VIVA 1.0EZ standard automatic with 850cc) with a good condition was used in this experimental. All respondents were asked to use the same car to avoid other type of distraction that might be influenced by a car such as break system, wheel surface

and etc. Besides, it is one factor as control environment for all participants. Only the respondents that possessed the driving license will be allowed to join the experiment.

3.3 Questionnaire Design

All of the questions in the questionnaire were design based on the parameters needed to achieve the objectives in this research. As suggested by previous study by Jain and Busso (2011), to consider the self assessments from the drivers by using a questionnaire survey. In this survey, the questionnaire form was distributed after the experimental survey. The questionnaires were contained 2 parts which were Part A and Part B. Part A was asked about the socio-demographics of the respondents such as age, gender, monthly income, type of vehicle used in campus and level of education. The respondents also been asked on experience of driving, possession of driving license and accident experience.

Meanwhile in part B, the questions focused on the distraction while driving. Respondents were asked to rank-order the tasks that more distracting to less distracting while involve in experimental survey. Other than that, this part also asked about the drivers' perception towards distraction while involved in the experimental tasks. The questionnaire also involved several questions such as distraction engagement, voluntary distraction and susceptibility to involuntary distraction based on Susceptibility to Driver Distraction Questionnaire (SDDQ) developed by Feng et al. (2014). SDDQ is basically investigated the distraction by doing a secondary task while driving for voluntary and involuntary distraction. For each parameter of questionnaire, three items were added and one item was removed from the extended SDDQ. The questionnaire used for this study can be referred in the Appendix A. The questionnaire also asked either the respondents usually involved with the distraction tasks while driving in their normal days.

3.4 Respondents

The data collection consists of experimental and questionnaire survey. Therefore, all respondents needed to fulfill both parts for data collection. For the experimental task, each respondent need to drive a car while doing a secondary tasks given and after the experiment was done, the respondents were asked to answer all the questionnaire given.

The respondents in this study were recruited based on NHTSA (2010). This report suggests that in order to examine the driving distraction, at least 24 drivers were needed as respondents. The report also suggested an equal balance of male and female respondents used in each age ranges as shown in Table 3.2.

Table 3.2: Age range for both gender according to NHTSA (2010)

Age Range	Male	Female
18-24	3	3
25-39	3	3
40-54	3	3
>55	3	3

In this study, there has a problem to find the female respondents with age range 55 and above because most of the female staffs in USM were retired at the age of 50 years old. Thus, the number of female respondents with age range 55 and above were modified. The number of female respondents in the age range between 40-54 years old were added with another three respondents from the respondent with age range 55 and above as shown in Table 3.3 below.