ACCIDENT REDUCTION (NIGHT RIDING) IN ROAD SAFETY STUDY ON SMALL MOTORCYCLES BY 3 PROACTIVE MEASURES

JANE DANIELA ANAK MUGAN

A project report submitted in partial fulfilment of the requirement for the award of the Degree of Master of Mechanical

Faculty of Mechanical and Manufacturing Engineering Universiti Tun Hussein Onn Malaysia

JANUARY 2014

ABSTRACT

Bikers are often involved in accidents like other road users. Many are injured and killed each year and their proportion of all traffic injuries has increased, mainly due to the doubling of the number of motorcycles in use in the last decade. The overall aim of this study is to increase the awareness of other road users of motorcyclists' visibility and their attitudes to road safety and road safety measures, especially during night riding. There were three proactive measurements conducted to compare and enhance the visibility of the motorcyclist during night riding. The three measurements used were application of the reflective sticker on the sides of the motorcycle; a new design of using LED lights on motorcycles safety vest and Circuit modification on signal lamps, where the signal stays on both sides during the riding while the blinkers are still affective when needed. The data collection was by doing field testing on the three proactive measures and questionnaires were distributed to collect surveys among road users, especially small motorcycles and car users. The result shows that by doing some modifications on the safety apparel and on the motorcycle itself will improved motorcyclist's safety during night riding. The findings also found out that the modification done will enhance and increase the visibility of the small motorcycle riders during night riding. Thus, the research is expected can reduce accident among small motorcycle riders.

ABSTRAK

Penunggang motorsikal sering terlibat dalam kemalangan seperti juga pengguna jalan raya yang lain. Ramai yang cedera dan terbunuh setiap tahun dan nisbah kemalangan terus meningkat, berkadaran dengan bilangan motosikal yang meningkat dua kali ganda. Matlamat keseluruhan kajian ini adalah untuk meningkatkan tahap kesedaran pengguna jalan raya yang lain akan kebolehlihatan penunggang motorsikal serta menambah pengetahuan penunggang motosikal kepada langkah-langkah keselamatan di jalan raya, terutamanya semasa menunggang waktu malam. Terdapat tiga kaedah pengukuran proaktif dilakukan untuk membandingkan dan meningkatkan kebolehlihatan terhadap penunggang motosikal semasa menunggang di waktu malam. Ketiga-tiga ukuran tersebut adalah penggunaan pelekat reflektif di sisi motosikal; reka bentuk baru menggunakan lampu LED pada jaket keselamatan dan pengubahsuaian litar pada lampu pandu arah. Pengumpulan data adalah dengan melakukan ujian lapangan kepada ketiga-tiga langkah proaktif tersebut, serta soal selidik telah digunakan untuk mengumpul kaji selidik di kalangan pengguna jalan raya, terutama penunggang motosikal kecil dan pengguna kereta. Hasil dapatan, menunjukkan bahawa dengan melakukan beberapa pengubahsuaian pada pakaian keselamatan dan motosikal itu sendiri akan meningkatkan tahap kebolehlihatan para penunggang motosikal semasa menunggang di waktu malam.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Research background

This research purpose is to conduct a testing procedure to compare the visibility of safety apparel for a motorcyclist during night riding; and common safety is to be determined in this study. There are three methods of measurement will be used to study its effectiveness in reducing the accident rate of motorists at night time.

The three proactive measures involve modifications are to be done on the motorcycle itself and on the safety equipment wore by the motorcyclists. The three counter measures are; Reflective paint or stickers designed for the usage on the sides, front and back of the motorcycles, a new design of using LED lights on motorcycles safety vest and circuit modification on signal lamps, where the signal stays on both sides during the riding while the blinkers are still affective when needed.

This Master project is divided into five main chapters. Chapter 1 describes the background of motorcyclist's safety during night riding, research objectives and their benefits to the motorcyclist especially night time. Then, it is followed by the literature review of previous researches conducted in Chapter 2. Chapter 3 is mainly discusses the research methodology. Chapter 4 is basically a discussion on the results obtained and gathered from the field testing and experiment.

Motorcycles are a relatively cheap and a reliable mode of transportation. According to Road Transport Malaysia statistics, the registration of motorcycles in Malaysia states a rapid increament year by year. The statistics is shown in Figure 1.0 below.

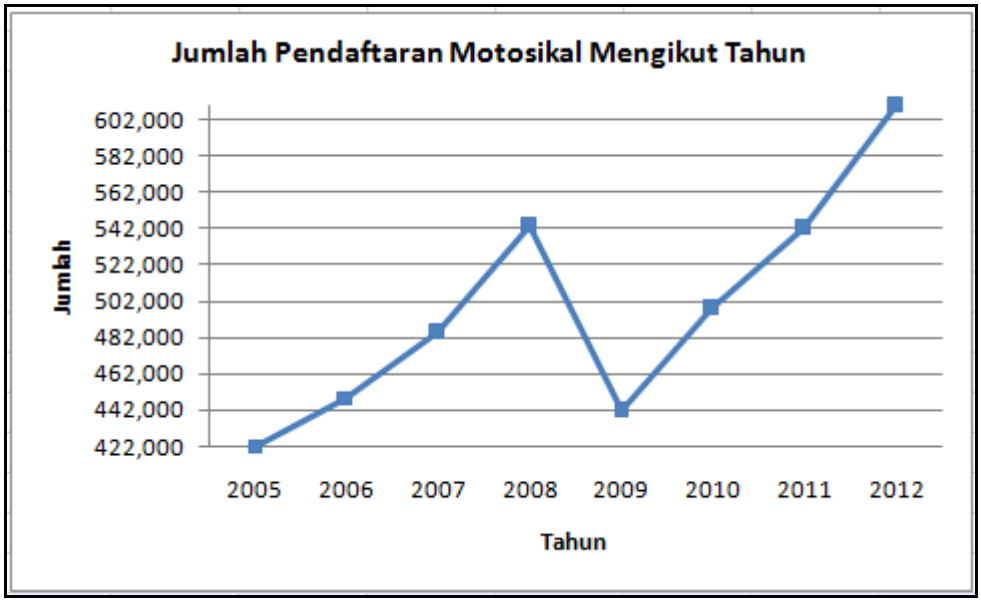

Figure 1.0: Statistics for motorcycles registration. (Road Transport Malaysia, 2013)

In Malaysia, they represent about half (50.6%) of the total registered vehicle. Off all road casualties in 1997, 67.7% involved motorcyclists. Motorcyclists fatalities accountered for 59.7% of all road fatalities (PDRM 1997). As such, an in-depth

study on the causes of the fatalities among motorcyclists is needed to identify appropriate measures that can be taken to reduce them. The visibility of motorcyclist during nighttime riding is crucial to ensure safety.

1.2 Problem Statement

Road accidents have caused huge losses to the country. It involves injuries, suffering and death but the histories of road accidents seem endless in the world, and specifically in Malaysia.

Thus, the desires to travel safe and smoothly remains as intention of the government and the individual road users. In Malaysia, 96% of injuries and deaths from accidents are caused by driver carelessness and low visibility of the motorcyclist to other road users. Figure 2.0 shows the example of motorcycle accident in Malaysia.

Figure 1.1: Examples of motorcycles accidents in Malaysia

Obviously, the major factor to road accidents is the result of failure of the road user himself when on the road. Table 1.0 shows the Statistics of Road Accidents in Malaysia referred to the Driving Education Curriculum from Road Transport Department of Malaysia (JPJ). Apparently can be seen that the number of road accidents involving motorcyclist has a high number and it increases every year.

Table 1.0: Statistics of Road Accidents in Malaysia

Vehicle Involved	Year				
	2005	*2006*	*2007*	*2008*	*2009*
Motorcycle	376,061	411,976	428,475	441109	472307
Car	97,072	104,302	111,958	113381	113962
Van	19,031	20,465	21,187	20501	19220
School Bus	1,106	1,235	1,274	1134	1160
Factory Bus	1,126	1,176	1185	1120	864
Express Bus	1,836	2,156	2,091	2056	2348
Small Lorry	12,372	13,915	17,464	18290	16459
Lorry	20,284	20, 406	19,138	18262	19188
Trailers and Tanker Trucks	9,406	10, 494	11,193	11101	11077
Four-wheel Drive	19,106	20,928	22,018	22656	23581
Taxi	7,043	7,754	8,816	8816	8669
Bicycle	2,751	2,857	2,693	2443	2486
Total of Vehicle Involved	581,082	635,082	668,173	676114	705623

Therefore, currently many different efforts have been developed to avoid vehicle crash on the road especially that involve with motorcyclists. The invention basically is well suited for motorcycle rider, where reflective paint or stickers designed for the usage on the sides, front and back of the motorcycles, a new design of the safety vest equipped with the LED light and circuit modification on signal lamps, where the signal stays on both sides during the riding while the blinkers are still affective that is more transparent to road users. The reason why these methods

are used because most of the road accident happens due to visibility where the road user could not see the presence of the motorcyclist in front or next to them.

1.3 Objectives of Study

The goals of this study are;

a) To enhance visibility of the motorcyclist using small motorcycle especially during night riding.
b) To create awareness of the motorcyclist' presence to other road users during night riding.
c) To reduce accidents among motorcyclist during night time.

From the research, it is hoped that it will reduce accident among the motorcyclists especially during night riding.

1.4 Research Scope

This project was confined to reduce accident, especially during night riding in road study on small motorcycles, regardless of its models. It incorporated the safety study using three proactive measures of motorcyclist safety at night riding. The three counter measures are

a) Applications of reflective paint or stickers designed for the usage on the sides, front, back and sides of the motorcycles.
b) A new design of using LED lights on motorcycles safety vest.

c) Additional signal lamp and circuit modification on signal lamps, where the signal stays on both sides during the riding while the blinkers are still affective when needed.

1.5 Research Significance

Nowadays, an accident involving small motorcycle has been increasing rapidly. Most of the accidents occurred during night time. The main factor that causes the accident occurs is the low visibility level of the motorcyclist during night riding. During night riding, other road users, especially car drivers are not alert of the presence of the motorcyclist.

Therefore, a research must be made to increase and enhance the awareness of other road users of the motorcyclist's visibility. The result of this research is expected that it will decrease the occurrence of motorcyclist accidents especially at night riding. The research will help create the awareness of the road users as well.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A motorcycle (also called a motorbike, bike, motor or cycle) can be defined as a two or three wheeled motor vehicle. Motorcycles vary considerably depending on the task they are designed for, such as long distance travel, navigating congested urban traffic, cruising, sport and racing, or off-road conditions.

Motorcycles are one of the most affordable forms of motorised transport in many parts of the world and, for most of the world's population; they are also the most common type of motor vehicle. In Malaysia, the number of registered motorized two-wheelers had increased more than five-folds from 1.19 million in year 1979 to 6.2 million in the year 2003 [19]. The proportion of motorcycles on the Malaysian roads varies from 35% - 75% depending on states. About 68% of all roads accident injuries in Malaysia involved motorcyclists and their overall relative risk are about 20 times higher than passenger cars [15].

While people choose to ride motorcycles for various reasons, those reasons are increasingly practical, with riders opting for a powered two-wheeler as a cost-efficient alternative to infrequent and expensive public transport systems, or as a means of avoiding or reducing the effects of urban congestion.

At the same time, motorcycles have a higher rate of fatal accidents than automobiles or trucks and buses. The two major causes of motorcycle accidents are:

Motorists pulling out or turning in front of motorcyclists and violating their rights-of-way, and motorcyclists running wide through turns.

Therefore, many studies are conducted to reduce road accidents which involve motorcyclist. Three proactive measures have been identified to enhance the visibility of the motorcyclist especially during night riding.

2.2 Reflective paint or stickers

2.2.1 Introduction

Reflective paint is a type of paint that contains thousands of little glass spheres, designed to reflect lots of light, even at night. It is most frequently used for signs on highways, but is also used on license plates, fishing lures, on mobile objects to be tracked (like a golf ball), or as an indicator on certain machinery.

A retroreflective material also can be defined as materials that is a retroreflector and is either (1) not intended to comply with the requirements of the standard for background material, or (2) is a combined-performance, retroreflective material [13].

2.2.2 Application of reflective paint or sticker

Apparently, the application of reflective paint or sticker on the body of a motorcycle is hardly can be found. Often found that the reflective sticker is added to the helmet or the safety apparel such as the safety vest wear by the motorcyclist.

According to Liebowitz and Owens [8], at night, the visibility distance of pedestrians clad in dark clothing is less than one-third the distance required to stop for a vehicle traveling 88 km/h, and approximately one-half the distance required to stop for a vehicle traveling 56 km/h. Consequently, many pedestrian accidents that occur in night time are not accidents by normal definition [20].

Many studies have shown that retroreflective markings increase the visibility distance of pedestrians or motorcyclists at night. Sufficient reflectivity, contrast, area, and durability of retroreflective markings have been considered the key variables affecting pedestrian and motorcyclist visibility. While providing a substantial improvement in the distance at which a pedestrian is detected, good retro reflectors, as such, may not ensure that a driver recognizes the bright target as a person. However, the recognition might be important, because drivers may be more cautious when seeing a pedestrian on or alongside the road than when seeing some other objects.

In a study by Schumann et al. [9] demonstrated that for photometrically matched stimuli, chromatic stimuli (red, orange, yellow, green, and blue) were perceived to be brighter than achromatic stimuli (white).

Looking specifically at retro-reflective striping, high-visibility paint, built-in lighting and other reflectors on emergency vehicles, researchers found that:

- Retro-reflective materials can help heighten emergency vehicle visibility, especially during nighttime conditions.
- Using contrasting colors can help civilian drivers find a hazard amid the visual clutter of the roadway.
- Fluorescent colors (especially fluorescent yellow-green and orange) offer higher visibility during daylight hours [12].
- It seems clear that properly applied/maintained retroreflective sheeting materials can effectively increase the night-time visibility and conspicuity of

treated objects, as frequently used across the United States in a wide range of traffic control applications [4].

2.3 LED lights on motorcycles safety vest

2.3.1 Introduction

High visibility safety vest plays an important role in enhancing the visibility of the wearer in daytime especially during night time to other road users. Made with high-visibility colours and retro reflective materials, vests can be worn over jackets to increase the chance of being seen and allow drivers to better judge the speed and position of riders, especially in adverse conditions of dark and wet.

Three safety vests were identified as the most commonly used safety vest in night-time for motorcyclist. The America national standard for high visibility safety apparel No. 107-1999 issued by the American National Standards Institute (ANSI) and International Safety Equipment Association (ISEA) clearly specifies minimum amounts of retro reflective materials, colours, and the placement of material, for apparel used to enhance the visibility and safety of consumer [18].

2.3.2 Common safety vest

Three classes of high-visibility safety apparel help the user choose the proper garments for a work situation. The classes state the minimal amount of background and retroreflective material, and placement of retroreflective material needed as well as technical requirements for garment design. Garments that cover the torso, such as

T-shirts and safety vests, are intended to meet Class 1 or Class 2 requirements [1]. The garments are as shown in Figure 2.0.

Figure 2.0: Classes of safety garments

2.3.3 LED lights safety vest

Many inventors have come out with many inventions of jacket, vest and traffic signalling system. A research [18] shows a motorcyclist garment with illuminated traffic signals comprising: a garment having a back side, a neck opening, and arm openings; and a light-emitting assembly.

The light emitting diode (LEDs) are powered and triggered by the signal tapped directly from the signal at the motorcycle tail, break and left and right signal fixture. Although the garment conveniently getting the power source from the motorcycle tail, the motorcyclist has inconveniently reconnect and disconnect when they embark and disembark from the motorcycle especially when having to do some work which require small time frame.

V.M. Pacheco *et al.* [21] investigated about a traffic signalling device system for motorcyclists comprising a safety brake and running light assembly mounted to a motorcycle jacket [6]. The safety brake light has an L.E.D. housing supported by an outboard support member and a leather piece. The disadvantage of this system is it requires the rider to mount the LEDs on the jacket, connect some wiring to the motorcycle tail and mount the control box to the gas tank or near the motorcycle controls. This is very time consuming and inconvenient to the users.

A research has developed a Smart Motorcycle Safety Vest (SMS-V) that has several advantages which are very important in order to increase the visibility of other road user to the motorcyclist especially at night. The employment of simple RF circuit in this project has made the safety vest more dynamic and futuristic.

In the experimental results, a motorcyclist would be safer if wearing a proposed safety vest because the motorcyclists can be observed more clearly almost two times better than normal vision. This research has a very high impact where it can be as an alternative way in reducing the number of motorcycle [10].

2.4 Additional signal lamp and circuit modification on signal lamps

2.4.1 Introduction

Turn signals formally called “directional indicators” or “directional signals”, and informally known as “directional”, “blinkers” of “flashers” are signal light mounted near the left and right front and rear corners of a vehicle, and sometimes on the sides,

used to indicate to other drivers that the operator intends a lateral change of position (turn or lane change).

Electric turn signal light were devised as early as 1907. The modern turn signal was patented in 1938 and was later offered by most major automobile manufacturers. Today, turn signal lamps are required on all vehicles that are driven on public roadways in most countries.

2.4.2 Signal lamp modification

Alternative systems of hand signals were used earlier, and they are still common for bicycles. Hand signal are also sometimes used when regular vehicle light are malfunctioning. The effectiveness of a flashing lamp shall be considered directly related to its attention-getting value in this review, for example, the more conspicuous the lamp the greater its effectiveness.

The intent will be to summarize research which deals primary with the contributions of factors such as shape, colour, line-of-sight, flash frequency and duration, intensity, background, and adaptation to the effectiveness of flashing lights on vehicles. Flash shape, the temporal distribution of light in the flash cycle, for directional an indicator is usually square, but for rotating beacons it is more nearly sinusoidal. More complex distributions of intensity within the flash cycle are generally considered not practical as a coding dimension [16]. However, the relative attention-getting value of different flash shapes has not been examined thoroughly.

Colour coding has been examined and rejected by Projector et al. [14] because of variation in observer colour vision, desaturation of colour in haze or fog,

and variation in filter efficiencies. However, researchers at California University [3] and Mortimer [11] conclude that through although the basic lighting system should employ full functional separation and be colour independent, colour should be used as a redundant coding parameter as this has been shown to increase effectiveness.

In a study of flashing versus steady lights in automobile turning signals Brown and Gibbs [2] found that when little visual search is required a steady light is more effective. However, when the signal is not seen by foveally, a flashing light has more attention-getting power. Signal positional effects on reaction time to flashing lamps were further examined by Rain [17].

The shortest times were when the stimulus was presented foveally. In general nasal side of the retina was found to be superior to the temporal side with respect to the speed of reaction. In addition, Rains believes that the difference in reaction time between the fovea and periphery would be smaller if larger areas and/or longer flash durations were employed as the periphery is capable of greater area and temporal summation.

A series of experiments by Joseph Lucas Ltd. [7] were conducted to determine minimum and maximum preferred and acceptable rear signal lamp intensities for both steady and flashing lamps for day and night use. During the daytime higher intensities were preferred. Higher intensities were also preferred at night at greater distances while at shorter distances glare effects lead to lower preferred intensities. The result also suggested that signal background, glare, and thus observer adaptation could have an important influence on the effectiveness of flash lamps.

In a study similar to that that reported by Gerathewohl [5] examined the interactions of flash frequency, duration, and signal contrast. Observers were required to detect the presence of a white flashing light with 90 % of the light being distraction lights. Three brightness contrasts: 0.16, 0.95, and 11.26; three flash frequencies: 1 flashes every 3 sec, 1 flash per sec, and 3 flashes per sec; and two flash durations: 0.1 sec and 0.2 sec were used. Test signal were presented 5 degrees to the left or right of the observer's central line-of-sight. Brown and Gibbs [2] also examined the effects of flash frequency and duration of flash on response time. In this experiment, however, observers were required to identify that a signal was flashing.

Since the majority of responses occurred before or during the second flash, one can conclude that the observers were looking at or near the general area where the signal was to be presented and that they responded to termination of the first flash.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains and illustrates the steps and procedures used in this research to generate the experimental and field test results and achieve the research objectives. This steps and procedures conducted are called as research methodology. This research methodology will be carried out to achieve the research objectives.

3.2 Research Structure

The main objective of this research is to do an experiment and a field test in order to increase the visibility of a motorcyclist during night time riding. Three proactive measurement or methods has been identified will be used in obtaining the data and results. The overall research structure of this research consists of five main areas as illustrated in Figure 3.0.

1. Identify the research topic and research scope;
2. Preliminary study and literature review of journal and conference papers;
3. Experimental and field test.
4. Analyze result.
5. Conclusion and suggestions for improvements.

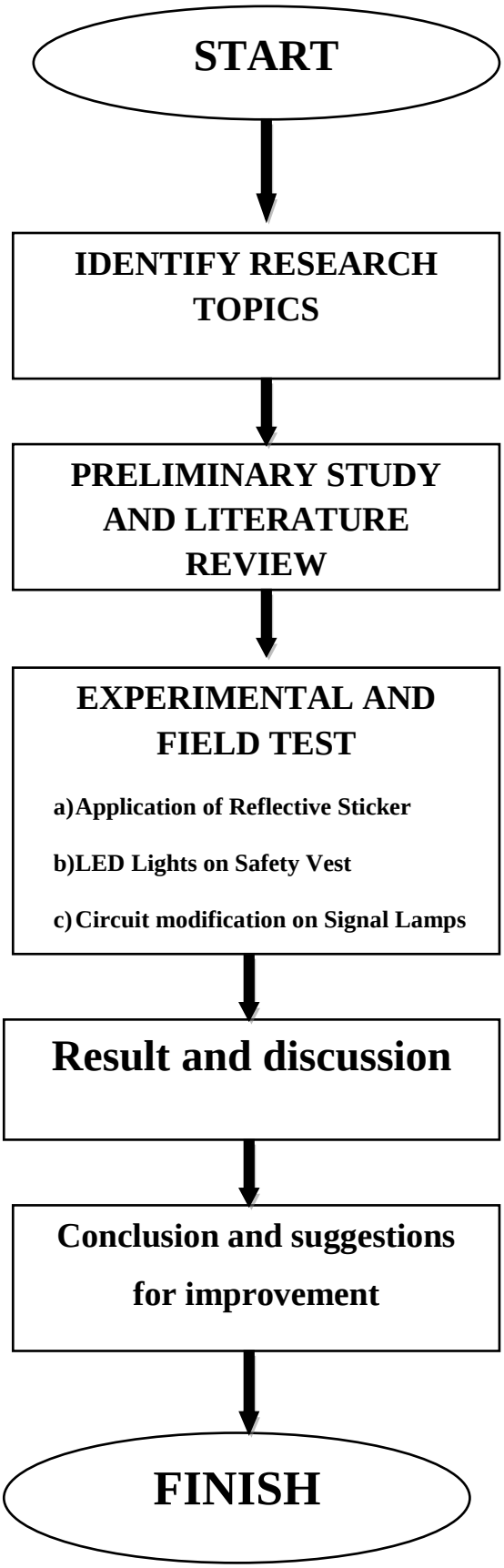

Figure 3.0: Illustration the overall detailed structure of this research

3.3 Research Methodology

3.3.1 Application of reflective stickers on motorcycle

The term intensity is used to describe the rate at which light spreads over a surface of a given area some distance from a source. In this field test, intensity of the reflector sticker is very important. This is because, if the colour is too vivid, it can disturb other driver visual but if the colour is too blur, other driver will not realize the existence of the motorcyclist. In this study, white colour is chosen for application on motorcycle as shown in Figure 3.1. The visibility distance of the motorcyclist can be seen which is to be tested are 5 meters, 10 meters, 15 meters, 20 meters and 25 meters.

The field testing will be conducted in a low light complexity; where there is no presence of other light source such as other vehicles.

Figure 3.1: Reflective Sticker

3.3.2 A LED lights designed on motorcycles safety vest

In this experiment, a newly designed safety vest will be used which is an enhancement of LED lights is added to the safety vest. The LED lights will be added on both front and back of the safety vest. According to Vanessa (2010), the amount of background material is significant but less influential than the amount of retro reflective material. The example of the enhancement done to the safety vest can be seen in Figure 3.2.

Figure 3.2: LED lights safety vest

In this study, it will be conducted in a single complexity, which is in a low lights condition. The low complexity scene was characterized by little/no fixed street lighting, an absence of businesses and their associated lights, and low traffic density, but included naturally occurring distracters such as signs, driveway markers, and roadway delineators.

In conducting this field test, the motorcyclists will be instructed to wear LED added safety vest. This experiment will be performed at a straight road during night time. In the first trial these two motorcyclists located 30m away from the location of experiments. For the next trial the motorcyclist was located at 60m, 90m, 120m, and 150m respectively. Set ups of the field test is as shown in Figure 3.3. At each distance the participants would have to determine the difference between both of the safety vest by evaluating the visibility of the safety vest.

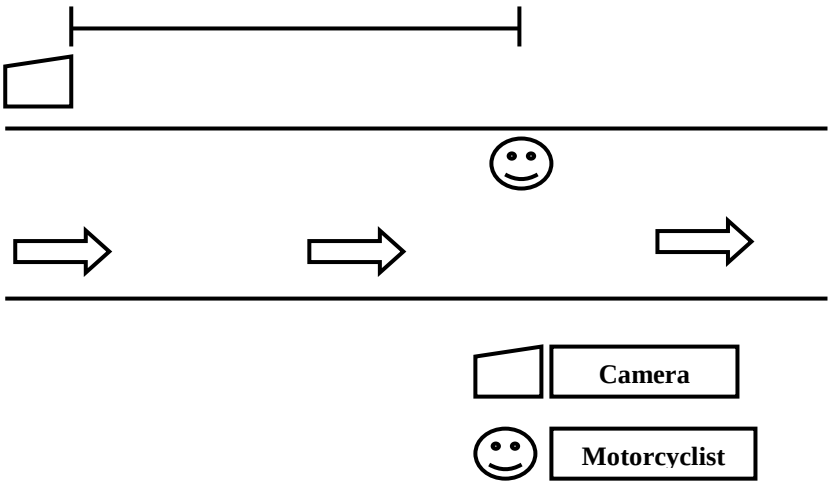

Figure 3.3: Set up for the field testing

3.3.3 Additional and modification of signal lamp

The location that has been selected is the main road from Politeknik Kuching Sarawak to the Matang junction. It is chosen due to high traffic for students or local people to get some food or other daily goods. In the implementation of the studies, an observation will be carried out to gain data in determining the following values:

i) The average distances a motorcycle being seen by using a signal lamp at night time.

a) From front side

ii) The average distances a motorcycle without using a signal lamp at night time.

a) From front side

The signal lamp setup is shown in Figure 3.4 below. Additional signal lamps are attached at both sides of the motorcycle.

Figure 3.4: Additional signal lamp setup.

Questionnaires will be prepared to complete the Survey Questionnaires to be carried out in this study which include the psycho emotional impact faced the motorcycle riders when they wait to enter a junction from the middle of a main road or from the junction to enter a main road. Besides that, these questionnaires will also try to get a motorcycle riders reaction about the effectiveness of turn signal lamp whether it can decrease the accident risk at a junction or otherwise. The total number of questionnaire distributed is fifty set. The data and the feedbacks received will be analysed using a simple analysis calculation.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Application of reflective stickers on motorcycle

4.1.1 Reflective Features

Two analyses were performed on the obtained detection distances. The first analysis was to see whether subject could detect the reflective sticker's visibility from a certain given distance. Then, the second analysis was the questionnaire analysis which was to gain opinion from public whether the applications of reflective sticker would give a big impact to the road users, especially the motorcyclist during night riding. The reflective sticker views on motorcycle were shown in Figure 4.0.