DEVELOPMENT OF LOW-COST MOTORCYCLE OVER LEANING WARNING SYSTEM USING ARDUINO

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A thesis submitted
in fulfilment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours

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2022

DECLARATION

I declare that this project entitled "**DEVELOPMENT OF LOW-COST MOTORCYCLE OVER LEANING WARNING SYSTEM USING ARDUINO**" is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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Date : 18/1/2022

APPROVAL

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

Signature : 

Supervisor Name : Ts. Khairul Amri Bin Tofrowaih

Date : 28th January 2022

DEDICATION

This project report is dedicated with gratitude to my parents for their unending support and for always being by my side to motivate me during my difficult moments. Furthermore, I'd like to involve my siblings in the accomplishment of this project. Their unending love and support teach me that I should never surrender and should strive harder in all I do. Furthermore, I'd like to utilise this chance to thank my classmates for their hard work and willingness to share knowledge about this project. Also, my supervisor, Ts. Khairul Amri Bin Tofrowaih, who was helpful in the completion of this project. My gratitude for being able to share this triumph with him since he has always kept a close eye on me during my report writing and project fabrication from the start. I am always grateful for his generosity in guiding me.

ABSTRACT

Road accidents are one of the top causes of mortality in Malaysia, accounting for around one-third of all fatalities. Numerous motorcycle riders were involved in a fatal traffic accident because of a sharp corner. Likely, an inexperienced motorcyclist will find it difficult to lean the motorcycle when riding through the corner. The motorcyclist also may mistake their speed based on their lean angle. This research intends to build up a Low-Cost Motorcycle Danger Over Leaning Warning System to ensure that motorcyclist can estimate their lean angle when riding through the corner. The microcontroller that the system used is the Arduino Nano with the integration of a Gyro sensor and a GPS sensor to monitor the lean angle and speed. This device will alert the motorcyclist by blinking the LED light when the motorcycle's lean angle has exceeded the standard limit. The advantage of using this system is its low cost and small component size. From the field test, the lean angle was found around 8° and did not exceed 20° with variable speed and corner radius. Although the 50m radius corner (roundabout) is smaller than the corner 72.62m, the lean angle was found 24% higher. Furthermore, the Average (Experiment Angle) was found to increase as the radius corner increased. The more radius corner tends to have the more lean angle. Additionally, the percentage difference decreases as the corner radius increases. The findings of this project allow us to identify the proper lean angle and speeds on variable corner radius for the future development of advanced motorbike safety features.

ABSTRAK

Kemalangan jalan raya adalah salah satu punca utama kematian di Malaysia, menyumbang kira-kira satu pertiga daripada semua kematian. Ramai penunggang motosikal terlibat dalam kemalangan jalan raya yang maut kerana selekoh tajam. Kemungkinan, penunggang motosikal yang tidak berpengalaman akan merasa sukar untuk mengawal motosikal apabila menunggang di selekoh. Penunggang motosikal juga mungkin tersilap kelajuan mereka berdasarkan sudut condong motosikal mereka. Penyelidikan ini berhasrat untuk membina Sistem Amaran Condong Bahaya Motosikal Kos Rendah untuk memastikan penunggang motosikal dapat menganggarkan sudut condong motosikal mereka apabila menunggang melalui selekoh. Pengawal mikro yang digunakan sistem ialah Arduino Nano dengan penyepaduan sensor Gyro dan sensor GPS untuk memantau sudut dan kelajuan. Peranti ini akan memberi amaran kepada penunggang motosikal dengan mengelipkan lampu LED apabila sudut condong motosikal telah melebihi had standard. Kelebihan menggunakan sistem ini ialah kosnya yang rendah dan saiz komponen yang kecil. Daripada ujian lapangan, sudut condong didapati sekitar 8° dan tidak melebihi 20° dengan menggunakan kelajuan dan jejari selekoh yang berubah-ubah. Walaupun jejari selekoh 50m (jalan bulatan) lebih kecil daripada selekoh 72.62m, namun sudut condong didapati 24% lebih tinggi. Tambahan pula, Purata (Sudut Eksperimen) didapati meningkat apabila jejari selekoh meningkat. Semakin banyak jejari selekoh menghasilkan sudut yang lebih condong. Penemuan projek ini membolehkan kami mengenal pasti sudut condong dan kelajuan motosikal pada pelbagai jenis jejari selekoh yang sesuai untuk pembangunan ciri keselamatan motosikal di masa hadapan.

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LIST OF SYMBOLS AND ABBREVIATIONS

ASV	-	Advanced Safety Vehicle
cc	-	Cubic Centimetres
CDI	-	Capacitor Discharge Ignition
fpm		Frame per minute
g	-	Gram
GB	-	Gigabyte
GPS	-	Global Positioning System
GSM	-	Global System for Mobile Communications
IIC	-	Inter-Integrated Circuit
ITS	-	Intelligent Transportation System
JKR	-	Jabatan Kerja Raya
kb	-	Kilobyte
Kg	-	Kilogram
Km	-	Kilometre
Km/h	-	Kilometre per hour
LCD	-	Liquid-Crystal Display
LED	-	Light-Emitting Diode
mA	-	Milliampere
MB	-	Megabyte
MHZ	-	Megahertz
MIROS	-	Malaysian Institute of Road Safety Research
mm	-	Millimetre
MVC	-	Multiple Vehicle Crash
NHTSA	-	National highway traffic safety administration
OLED	-	Organic Light-Emitting Diode
PDRM	-	Polis Diraja Malaysia
ROR	-	Run off Road
rpm	-	Revolution per minute
SVC	-	Single Vehicle Crash

TOPSIS	-	The Technique for Order of Preference by Similarity to Ideal Solution
V	-	Voltage
VDC	-	Volts Of Direct Current
WHO	-	World Health Organization

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CHAPTER 1

INTRODUCTION

1.1 Background

Motorcycle has been one of the common choices of transportation because it is easier to ride and faster to get to destination during bad traffic condition. Because of so many people using motorcycle, 12,933,042 motorcycles registered as their primary transportation in 2017 (Lee, 2017), the rate of accident involving motorcycle has been increasing yearly.

When compared to other modes of transportation, motorcycles are involved in the most traffic accidents in Malaysia. According to the traffic branch Bukit Aman, the overall number of motorcycle accidents has increased from 0.05% in 2007-2008 to 9.5% in 2015-2016. From 2007 to 2016, the total number of full motorcycle accidents increased by 1% per year.

Table 1.1 Total Vehicle Involved in Road Accident

Years	Motorcycle	Car	Van	Bus	Lorry	4wd	Taxi	Bicycle	Others	Total
2007	111765	426941	21109	10285	47696	21823	8809	2690	14909	666027
2008	111819	435665	20392	9356	48250	22793	8769	2463	11571	671078
2009	113962	472307	19220	9380	46724	23581	8669	2486	9294	705623
2010	120156	511861	18788	9580	50438	25777	9899	2178	11756	760433
2011	129017	546702	17916	9986	53078	30828	11197	2033	16394	817151
2012	130080	655813	15143	10617	42158	32891	11680	1310	21540	921232
2013	121700	632602	17148	10123	39276	52512	11651	1370	15441	901823
2014	125712	617578	15041	9193	37481	41464	10856	1275	27743	886343
2015	123408	625758	14565	8804	34942	46163	9591	1119	29924	894274
2016	135181	670935	14470	9462	35064	48907	8399	1318	36833	960569

The Malaysia Institute of Road Safety Research (MIROS) analysed data from 2011 traffic accidents and noticed that human behaviour/negligence, road infrastructure and surrounding environment, and vehicle condition are the leading causes of accidents. The most significant factor contributing to road accidents is human behaviour/negligence, which accounted for 80.6 percent of all incidents, compared to 13.2 percent for road infrastructure and surroundings and 6.2 percent for vehicle component (Buku Statistik Kemalangan Jalan Raya Malaysia, Ministry of Transport Malaysia, 2017).

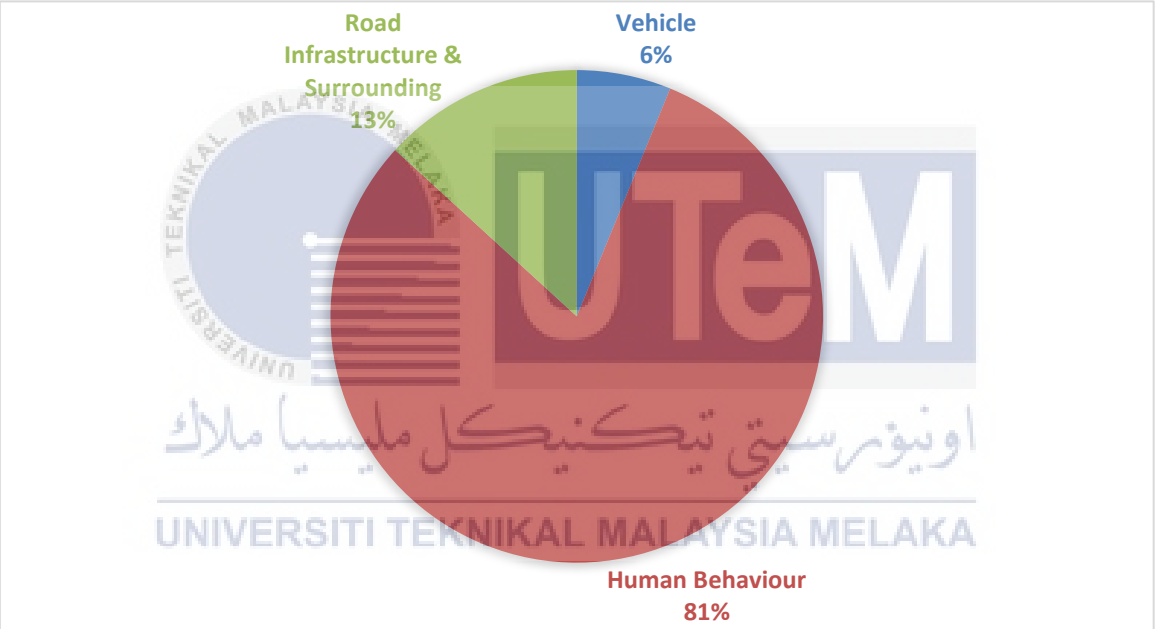

Figure 1.1 Accidental Factors

Figure 1.2 shows that fatal collisions on curved segments accounted for 16 percent of all traffic crashes in Malaysia in 2015. While several accidents occurred on straight roads, those that occurred on curved roads often resulted in death. Glennon C et al., found that the incidence of curve-related crashes is higher than that of straight-road crashes (Glennon C et al., 1985). According to PDRM statistics, the proportion of fatal accidents in the curved region is 46%, while the proportion in the straight road is 43% (PDRM, 2015).

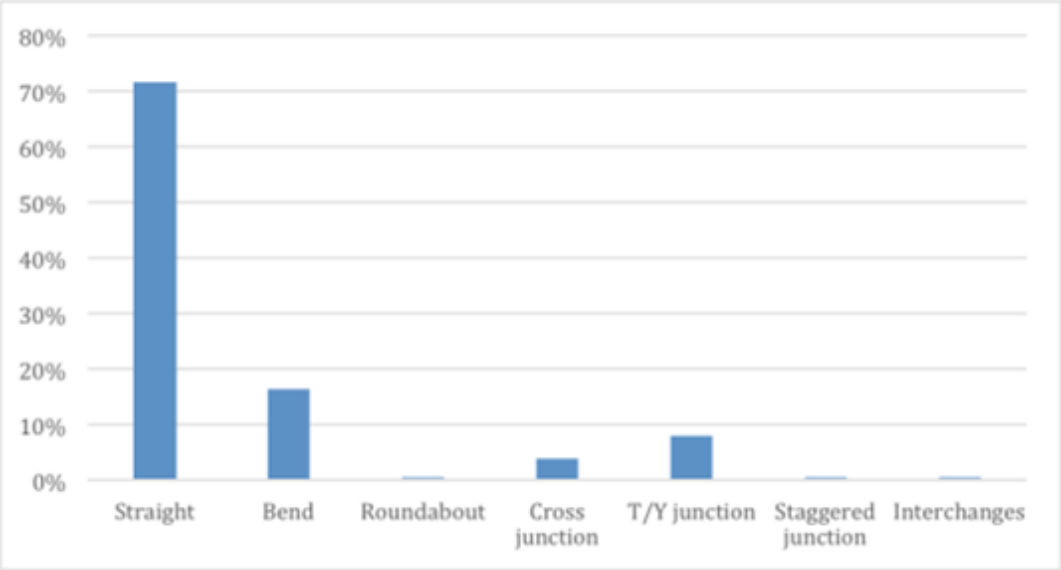

Figure 1.2 Fatal Crashes by Road Type for 2015 (Source: PDRM)

1.2 Problem statement

Motorcycle riders were exposed to a severe danger of injuries and, under the worst scenario, mortality if they were engaged in a traffic accident. Comparing fatalities between motorcyclists and passengers, the Road Transport Department of Malaysia reports that the number of fatalities involving motorcyclists and passengers was the highest (61.2 percent) for the period 2008 to September 2017.

Although the fatal crash was dominated by straight road type, Figure 1.2, the other factor to road accident also include corner road as mention by Cheng et al., sharp corners are also a major contributor to the likelihood of roadside accidents, with around 30% of run-off-road(ROR) occurrences occurring on curves (Cheng et al., 2020). According to Huth et al., mention that crash at corner is excessive braking causes a slide-out and a tumble while excessive speed causes a curve to go wide (Huth et al., 2012). The reason of crash during curve is because of rider's misjudgement for appropriate speed while riding in the corner (Clarke, D. D., Ward, P., Bartle, C. & Truman, 2004).

1.3 Objective

To reduce the number of accidents during cornering cases, a countermeasure must be made to make the motorcyclist alert to its speed and leaning angle while cornering. A system where the rider can be alerted that he is in suitable leaning angle and speed during corner is the purpose of this study. The efficiency of the system, however, will depend significantly on the adoption and use of the system by riders.

a) To design and fabricate a Low-Cost Motorcycle Danger Over Leaning Warning System using Arduino.

b) To perform field test Low-Cost Motorcycle Danger Over Leaning Warning System using Arduino in actual under bone motorcycle.

1.4 Scopes

a) This system is used only for under bone type motorcycle.

b) Curved road layout type only because the designed system is to function during cornering.

c) The system life span is limited to battery capacity.

d) This system will only assist the rider not taking control over the motorcycle.

e) Arduino nano as the system microcontroller.

f) Using low-cost gyro meter sensor.

g) Using low-cost GPS sensor.

h) Does not consider friction between road and motorcycle tire.

i) Assumption of motorcycle and rider has the same lean angle during corner.