



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND FABRICATION OF MOTORCYCLE  
CORNERING WARNING SYSTEM**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

**DANIEL ARIFF BIN MAHUSIN**

**B071511105**

**960823295005**

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING  
TECHNOLOGY

2018

**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

Tajuk: DESIGN AND FABRICATION OF MOTORCYCLE CORNERING  
WARNING SYSTEM

Sesi Pengajian: 2019

Saya **DANIEL ARIFF BIN MAHUSIN** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **\*\*Sila tandakan (X)**

**SULIT\***

Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam

AKTA RAHSIA RASMI 1972.

TERHAD\*

Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

TIDAK

TERHAD

Yang benar,

Disahkan oleh penyelia:

.....

.....

DANIEL ARIFF BIN MAHUSIN

AHMAD ZUL HUSNI BIN CHE

MAMAT

Alamat Tetap: PT3391, Taman Desa

Warna Zaharah, Kg Kolam Abu, 18500

Machang, Kelantan

Cop Rasmi Penyelia

Tarikh:

Tarikh:

\*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

## DECLARATION

I hereby, declared this report entitled DESIGN AND FABRICATION OF MOTORCYCLE CORNERING WARNING SYSTEM is the results of my own research except as cited in references.

Signature: .....

Author : DANIEL ARIFF BIN MAHUSIN

Date:

## **APPROVAL**

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

Signature: .....

Supervisor : AHMAD ZUL HUSNI BIN CHE MAMAT

## ABSTRAK

*Sebuah motosikal mempunyai risiko tertinggi untuk terlibat dalam kemalangan di jalan raya berbanding dengan jenis kenderaan lain. Selain itu, motosikal adalah kenderaan yang paling sukar untuk mengekalkan kestabilannya walaupun sedikit kecemasan berlaku berbanding kenderaan roda empat lain seperti kereta yang lebih stabil untuk dipandu. Selain itu, kemalangan bermotor yang boleh membawa kecederaan atau maut yang berlaku di negara kita Malaysia adalah dinominasi oleh penunggang motosikal dan beberapa kemalangan berlaku apabila seorang penunggang motosikal mengambil selekoh di jalan raya. Oleh itu, peranti yang boleh memberi amaran kepada pelumba perlu dicipta. Peranti ini akan menggunakan sensor gyro sebagai komponen utama. Sensor gyro ini akan mengesan sudut bersandar motosikal di arah paksi-y dan data akan dihantar ke Arduino untuk ditafsirkan sama ada sudut condong yang dilakukan oleh penunggang motosikal semasa mengambil selekoh melebihi tahap sudut condong yang sesuai atau tidak. Peranti ini diharapkan dapat meningkatkan ciri keselamatan motosikal dan membantu penunggang menunggang motosikal mereka dengan cara yang lebih selamat.*

## **ABSTRACT**

A motorcycle has the highest risk to involve in an accident on the road compared to other types of vehicles. Moreover, a motorcycle is the hardest vehicle to retain its stability when even a slight malfunction happens compared to other four-wheeled vehicles like a car that is more stable to drive. Furthermore, motorized accidents that can bring injury or fatal that happen in our country Malaysia is dominant by the motorcyclist and some of the accidents happen when a motorcyclist is cornering on the road. Therefore, a device that can give warning to riders needs to be invented. The device will consist of a gyro sensor as main components. This gyro sensor will detect leaning angle of a motorcycle in the y-axis direction and will the data will be sent to an Arduino to interpret whether the leaning angle that being done by a motorcyclist during cornering exceed maximum appropriate leaning degree or not. This device hopefully can improve the safety feature of a motorcycle and helps riders to ride their motorcycle in a safer way.

## **DEDICATION**

This project report is lovingly dedicated to my respective parents who have been my constant source of inspiration. They have given me the drive and discipline to tackle any task with enthusiasm and determination. Without their love and support, this project report would not have been made possible. I also dedicated this project to my project supervisor who never failed to teach and guide me, to my family who supports me in everything, to my friends who helped me finish this project report, and most of all to the Almighty God who gives me strength and good health while doing this.



## ACKNOWLEDGEMENTS

I have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them. I am highly indebted to Universiti Teknikal Malaysia Melaka (UTeM) communities for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project. I would like to express my gratitude towards my parents for their kind co-operation and encouragement which help me in the completion of this project. I would like to express my special gratitude and thanks to all the lecturers especially my project supervisor Encik Ahmad Zul Husni Bin Che Mamat for giving me such attention and time. My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

## **TABLE OF CONTENTS**

	<b>PAGE</b>
<b>TABLE OF CONTENTS</b>	x
<b>LIST OF TABLES</b>	xv
<b>LIST OF FIGURES</b>	xvi
<b>LIST OF APPENDICES</b>	xx
<b>LIST OF SYMBOLS</b>	xxi
<b>LIST OF ABBREVIATIONS</b>	xxii
<b>LIST OF PUBLICATIONS</b>	xxiii
<b>CHAPTER 1      INTRODUCTION</b>	<b>1</b>
1.1    Introduction	1
1.2    Problem Statement	2
1.3    Objective	2
1.4    Scope	3
1.5    Rational of Study	3
1.6    Expected Result	3
1.7    Summary of Chapter 1	4
<b>CHAPTER 2      LITERATURE REVIEW</b>	<b>5</b>

2.1	Introduction	5
2.1.1	Types of Motorcycle	6
2.1.2	Standards	6
2.1.3	Cruiser	7
2.1.4	Sport bike	8
2.1.5	Underbones	9
2.2	Motorized Accident	10
2.3	Curve Accidents	12
2.4	Motorcycle Rider's Behaviour	14
2.4.1	Demographic Criteria (Gender)	14
2.4.2	Rider Experience	15
2.4.3	Physcometrics Aspect (Familiarity)	15
2.5	Appropriate Leaning Degree	16
2.5.1	Fake Force	16
2.5.2	Torque	16
2.6	Sensor	17
2.7	Types of Sensor	19
2.7.1	Temperature Sensor	19
2.7.2	Proximity Sensor	19

2.7.3	Infrared Sensor	20
2.7.4	Ultrasonic Sensor	21
2.7.5	Light Sensor	22
2.7.6	Gyro Sensor (MPU-6050)	23
2.8	Motorcycle Safety Feature	24
2.8.1	Anti-lock Braking Systems(ABS)	24
2.8.2	Disc Brake	25
2.8.3	Airbag	26
2.8.4	Light	27
2.8.5	Rider Airbag Jacket	28
2.8.6	Helmet	29
2.8.7	Stability Control	30
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	<b>31</b>
3.0	Introduction	31
3.1	Flowchart	32
3.2	Gyro Sensor	33
3.3	Arduino Uno	34
3.4	Circuit Connection Schematic Diagram	35
3.5	Method Of Installation	36

3.6	Analyzing Parameter	37
3.6.1	Curve Road	37
3.6.2	Roundabout	37
3.6.3	U-Turn	37
3.6.4	Speed	38
3.7	Results	38
3.8	Rider Safety Feature	39
3.8.1	Helmet	40
3.8.2	Rider Jacket	40
3.8.3	Gloves	41
3.8.4	Jean Pants	42
3.8.5	Shoes	42
<b>CHAPTER 4</b>	<b>RESULTS AND DISCUSSION</b>	<b>43</b>
4.1	Introduction	43
4.2	Schematic Diagram and Actual Product	43
4.3	Project Coding	45
4.4	Analysis Results and Discussion	46
4.4.1	Results for Curve Road	48
4.4.1.1	Speed: 20km/h	49

4.4.1.2	Speed: 40km/h	52
4.4.1.3	Speed: 60km/h	55
4.4.2	Results for Roundabout Road	58
4.4.2.1	Speed: 20km/h	59
4.4.2.2	Speed: 40km/h	62
4.4.2.3	Speed: 60km/h	65
4.4.3	Results for U-Turn Road	68
4.4.3.1	Speed: 20km/h	69
4.4.3.2	Speed: 40km/h	72
<b>CHAPTER 5</b>	<b>CONCLUSION AND FUTURE WORK</b>	<b>75</b>
5.1	Conclusion	75
5.2	Future Work	77
<b>REFERENCES</b>		<b>79</b>
<b>APPENDIX</b>		<b>84</b>

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
Table 2.1:	Road accident severity in Sweden and Malaysia in 2008	11
Table 3.1:	Table Results	39
Table 4.1:	Test result of Motorcycle Cornering Warning System	47

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.1:	Standard Motorcycle (source: Standard)	6
Figure 2.2:	Cruiser Motorcycle (source: Cruiser)	7
Figure 2.3:	Sport bike Motorcycle (source: Sport bike)	8
Figure 2.4:	Underbones Motorcycle (source: Underbones)	9
Figure 2.5:	Fatality distribution by mode of transport	10
Figure 2.6:	Temperature Sensor (source: Temperature Sensor)	19
Figure 2.7:	Proximity Sensor (source: Proximity Sensor)	19
Figure 2.8:	Infrared Sensor (source: Infrared Sensor)	20
Figure 2.9:	Ultrasonic Sensor (source: Ultrasonic Sensor)	21
Figure 2.10:	Light Sensor (source: Light Sensor)	22
Figure 2.11:	Gyro Sensor (source: Gyro Sensor)	23
Figure 2.12:	Anti-lock Braking System for motorcycle (source: ABS)	24
Figure 2.13:	Disc brake for motorcycle (source: Disc Brake)	25
Figure 2.14:	Airbag for motorcycle (source: Airbag)	26
Figure 2.15:	Headlight for motorcycle (source: Light)	27



Figure 2.16: Motorcycle Rider Airbag Jacket (source: Rider Airbag Jacket)	28
Figure 2.17: Motorcycle Helmet (source: Helmet)	29
Figure 2.18: Stability Control for motorcycle (source: Stability Control)	30
Figure 3.1: Gyro Sensor	33
Figure 3.2: Arduino Uno	34
Figure 3.3: Circuit Schematic Diagram	35
Figure 3.4: MS 88 Helmet	40
Figure 3.5: Rider Jacket	41
Figure 3.6: Hand Gloves	41
Figure 3.7: Jean Pants	42
Figure 3.8: Shoes	42
Figure 4.1: Schematic Diagram of Motorcycle Cornering Warning System	44
Figure 4.2: Actual Product of Motorcycle Cornering Warning System	44
Figure 4.3: Curve Road Location 1	48
Figure 4.4: Curve Road Location 2	48
Figure 4.5: Result for 20km/h Curve Road Location 1	49
Figure 4.6: Result for 20km/h Curve Road Location 2	50
Figure 4.7: Leaning Angle graph for 20km/h Curve Road	51
Figure 4.8: Result for 40km/h Curve Road Location 1	52
Figure 4.9: Result for 40km/h Curve Road Location 2	53

Figure 4.10: Leaning Angle graph for 40km/h Curve Road	54
Figure 4.11: Result for 60km/h Curve Road Location 1	55
Figure 4.12: Result for 60km/h Curve Road Location 2	56
Figure 4.13: Leaning Angle graph for 60km/h Curve Road	57
Figure 4.14: Roundabout Road Location 1	58
Figure 4.15: Roundabout Road Location 2	58
Figure 4.16: Result for 20km/h Roundabout Road Location 1	59
Figure 4.17: Result for 20km/h Roundabout Road Location 2	60
Figure 4.18: Leaning Angle graph for Roundabout Road (20km/h)	61
Figure 4.19: Result for 40km/h Roundabout Road Location 1	62
Figure 4.20: Result for 40km/h Roundabout Road Location 2	63
Figure 4.21: Leaning Angle Graph for Roundabout Road (40km/h)	64
Figure 4.22: Result for 60km/h Roundabout Road Location 1	65
Figure 4.23: Result for 60km/h Roundabout Road Location 2	66
Figure 4.24: Leaning Angle graph for Roundabout Road (60km/h)	67
Figure 4.25: U-Turn Road Location 1	68
Figure 4.26: U-Turn Road Location 2	68
Figure 4.27: Result for 20km/h U-Turn Road Location 1	69
Figure 4.28: Result for 20km/h U-Turn Road Location 2	70
Figure 4.29: Leaning Angle graph for U-Turn Road (20km/h)	71

Figure 4.30: Result for 40km/h U-Turn Road Location 1	72
Figure 4.31: Result for 40km/h U-Turn Road Location 2	73
Figure 4.32: Leaning Angle graph for U-Turn Road (40km/h)	74

## LIST OF APPENDICES

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGE</b>
Appendix 1	Coding Page 1	84
Appendix 2	Coding Page 2	85
Appendix 3	Coding Page 3	86
Appendix 4	Coding Page 4	87
Appendix 5	Coding Page 5	88

## LIST OF SYMBOLS

<b>D, d</b>	-	Diameter
<b>F</b>	-	Force
<b>g</b>	-	Gravity = 9.81 m/s
<b>I</b>	-	Moment of inertia
<b>l</b>	-	Length
<b>m</b>	-	Mass
<b>N</b>	-	Rotational velocity
<b>P</b>	-	Pressure
<b>Q</b>	-	Volumetric flow-rate
<b>r</b>	-	Radius
<b>T</b>	-	Torque
<b>Re</b>	-	Reynold number
<b>V</b>	-	Velocity
<b>w</b>	-	Angular velocity
<b>x</b>	-	Displacement
<b>z</b>	-	Height
<b>q</b>	-	Angle
<b>°</b>	-	Degree

## LIST OF ABBREVIATIONS

<b>PCA</b>	Principal Component Analysis
<b>ABS</b>	Anti-lock Braking System
<b>PC</b>	Personal Computer
<b>IC</b>	Integrated Circuit
<b>LCD</b>	Liquid-crystal Display
<b>LED</b>	Light-emitting Diode
<b>deg</b>	Degree
<b>km/h</b>	Kilometre per Hour
<b>USB</b>	Universal Serial Bus
<b>ICSP</b>	In-circuit Serial Programming
<b>MARG</b>	Magnetic, Angular Rate and Gravity
<b>AC</b>	Alternating Current
<b>DC</b>	Direct Current

## **LIST OF PUBLICATIONS**

## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

In this modern age, a motorcycle is the most popular motor vehicle use by people, especially in Malaysia. This trend happens because this type of vehicle is the most affordable and most practical vehicle on the road for users. Despite this, motorcycle also has the highest risk to involve in an accident on the road compared to other types of vehicles. This is because two-wheeled motorcycle vehicle is the hardest vehicle to retain its stability when even a slight malfunction happens compared to other four-wheeled vehicles like a car that is more stable to drive. This is why motorized accidents that can bring injury or fatal that happen in our country Malaysia is dominant by the motorcyclist.

The most critical situation for riders when riding their motorcycle is when doing leaning at the curve. This is because when leaning at curve are not being done correctly and stable, the riders can lose control of their motorcycle and can be involved in an accident. Although there's lots of safety feature available on nowadays motorcycle, not even single safety feature for leaning purpose of motorcycle invented. This is why the design and fabrication of motorcycle cornering warning system are needed to assist and warn the riders to take leaning at curve roads more safely.