



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

INTRODUCTION OF DOUBLE GYROSCOPE CONCEPT FOR MOTORCYCLE

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

by

HARIZ BIN ABU HANIFAH

B071410430

950502145613

FACULTY OF ENGINEERING TECHNOLOGY

2017

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: INTRODUCTION OF DOUBLE GYROSCOPE CONCEPT FOR MOTORCYCLE

SESI PENGAJIAN: 2017/18 Semester 1

Saya **HARIZ BIN ABU HANIFAH**

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 ()

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

Disahkan oleh:

Alamat Tetap:

No 1, Jalan Kayak 13/25, Seksyen
13, 40100 Shah Alam, Selangor.

Cop Rasmi:

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 perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled “Introduction of Double Gyroscope Concept for Motorcycle” is the results of my own research except as cited in references.

Signature :

Author’s Name : HARIZ BIN ABU HANIFAH

Date :

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

EN MUHAMMED NOOR BIN HASHIM

.....

(Project Supervisor)

ABSTRAK

Pada masa kini, kesesakan jalanraya selalu berlaku di banda-bandar besar setiap hari. Ramai penduduk menggunakan motosikal sebagai kenderaan utama untuk pergi ke tempat kerja mereka. Tetapi, motosikal mereka tiada alat penimbang giroskop untuk memberi keseimbangan sepanjang masa kepada penunggang apabila mereka dalam kesesakan atau jalan yang sempit. Oleh itu, projek ini membincangkan tentang mereka bentuk dan menghasilkan sebuah konsep penimbang giroskop untuk menstabilkan motosikal. Ia boleh menstabilkan motosikal dengan menggunakan kesan yang dikenali sebagai precession. Precession berfungsi sebagai contoh, jika arah daya yang dikenakan kepada giroskop yang sedang berputar adalah sama dengan arah pusingan giroskop, giroskop itu akan bertindak balas dengan berpusing arah berserenjang (iaitu 90°) daripada paksi daya tersebut. Oleh disebabkan demikian, ia dapat berterusan menstabilkan motosikal. Tujuan menghasilkan konsep dua giroskop ini adalah untuk memudahkan penunggang motosikal untuk menstabilkan motor mereka.

ABSTRACT

Nowadays, traffic congestion often happens in big cities every day. People tend to ride a motorcycle to go to their workplace to avoid the traffic jammed. But, their motorcycles do not have a gyroscope stabilizer to keep their motorcycle balance during in the traffic jammed. The gyroscope stabilizer helps to ensure that the motorcycle keep balance when the riders are having a difficulty to ride in a narrow road. Thus, this project discusses on designing and developing a concept of double gyroscope for motorcycle for balancing. It can balance the motorcycle by using the effect called precession. The precession function as example, if the force applied to the rotating gyroscope is following the spin axis of the gyroscope, the gyroscope will counter the applied force by rotating along perpendicular axis (which is 90°) to the applied force. From that, it can continuously balance the motorcycle. The purpose of developing the double gyroscope concept is to ease the motorcycle rider to keep their motorcycle balance.

DEDICATION

Special dedication to my beloved family members, especially to my father Abu Hanifah Bin Ishak and my mother Roslinah Binti Mohd Yusup who always supported and encouraged me with motivation and love through my whole journey.

To my respected and professional supervisor, Sir Muhammed Noor Bin Hashim for endless guidance and support from bottom to the top.

To my helpful friends, Muhammad Azmir Bin Zainal and Ahmad Faiz Bin Che Hasan, my fellow colleague and all faculty members. For all your care, support and believe in me.

ACKNOWLEDGEMENT

First and foremost, I would like to recite Alhamdulillah and thanks to Allah for providing me strengths and courage to successfully finishing up my thesis. This thesis would not have been possible to complete without the support from many people surround me. I wish to express my sincere appreciation to my beloved supervisor, En. Muhammed Noor Bin Hashim for valuable experience, encouragement, guidance, critics and friendship. For the time being in preparing this thesis, I would also like to thank you to all people I was contact, the researchers, the academicians and practitioners which has been contributed in my understanding and thoughts.

I am very thankful to Universiti Teknikal Malaysia Melaka (UTeM) for providing a great facilities in the campus and also to all my the lecturers, tutors and teaching engineers of Faculty of Engineering Technology (FTK) for their support and motivation during this project development, a deep thankfulness for everything and may God bless all of us.

Last but not least, biggest appreciation to my entire family especially my beloved father and mother, En. Abu Hanifah Bin Ishak and Pn. Roslinah Binti Mohd Yusup and family members for their continuous supports from the initial of this project till the end of it. My sincere appreciation also extends to all my fellow friends which is Ahmad Faiz Bin Che Hasan, Muhammad Azmir Bin Zainal, Mohd Faiz Bin Nazari, Muhammad Tarmizi Bin Bahari and others who have provided assistance at various events and conditions. Their views and tips are useful indeed. Thank you for the time sacrificed to accompany me.

TABLE OF CONTENT

Abstrak	i
Abstract	ii
Dedication	iii
Acknowledgement	iv
Table of Content	v
List of Tables	viii
List of Figures	ix
CHAPTER 1: INTRODUCTION	1
1.0 Introduction	1
1.1 Project Background	1
1.2 Problem Statement	4
1.3 Objectives	4
1.4 Scope of Project	4
CHAPTER 2: LITERATURE REVIEW	6
2.0 Introduction	6
2.1 Gyroscope	6
2.1.1 Type of Gyroscope	7
2.1.2 The Stability Theory	11
2.1.3 Gyroscopic Stability	11
2.2 Applications of Gyroscope	12
2.2.1 Gyroscope Function	13
2.2.2 Gyrocompass	14
2.3 Calculation and Formula of Gyro Create Stabilizing Torque	17
2.4 Example Design of Gyroscope	18

CHAPTER 3: METHODOLOGY	23
3.0 Introduction	23
3.1 Flowchart	24
3.2 Problem Definition	25
3.3 Sample Design	25
3.3.1 Sample Design 1 for Double Gyroscope Stabilizer	26
3.3.2 Sample Design 2 for Double Gyroscope Stabilizer	27
3.3.3 Sample Design 3 for Double Gyroscope Stabilizer	28
3.4 Concept Selection Method	29
3.4.1 Concept Screening	29
3.4.2 Concept Scoring	30
3.5 Design Prototype	31
3.5.1 3D Scanning	31
3.5.2 CATIA V5 Software	32
3.6 Prototype Assembly	33
3.6.1 Fabrication Process	33
3.6.2 Material	35
3.7 Prototype Testing and Evaluation	36
CHAPTER 4: RESULT & DISCUSSION	38
4.0 Introduction	38
4.1 Design Concept	38
4.1.1 Design Concept A	39
4.1.2 Design Concept B	40
4.1.3 Design Concept C	41
4.2 Concept Selection Method of Double Gyroscope Concept for Motorcycle	42
4.3 Design Sketches of Double Gyroscope Concept for Motorcycle	44
4.4 Fabrication Process	46
4.4.1 The measuring process	47
4.4.2 Cutting Process	47

4.4.3 Bending Process	49
4.4.4 Drilling Process	50
4.4.5 Tighten the bolts and nuts to assemble the parts process	51
4.4.6 Electrical Work Process	53
4.4.7 Touch up	54
4.5 Specifications of the Gyroscope	55
4.6 Complete Double Gyroscope Concept for Motorcycle	57
4.7 Result	59
4.8 Discussion on the Problems	59
CHAPTER 5: CONCLUSION & RECOMMENDATION	60
5.0 Introduction	64
5.1 Conclusion	64
5.2 Recommendation	66
REFERENCES	68

LIST OF TABLES

Table 3. 1: Materials and components for prototype fabrication	35
Table 4. 1: Double Gyroscope Concept for Motorcycle's Concept Screening Matrix ...	42
Table 4. 2: Double Gyroscope Concept for Motorcycle's Concept Scoring Matrix	42
Table 4. 3: Rating score	43
Table 4. 4: The discussion on the problems for double gyroscope concept	59

LIST OF FIGURES

Figure 1. 1: Concept in Fiction “Two Boys In A Gyrocar: The Story of a New York to Paris Motor Race”	2
Figure 1. 2: Example of Gyroscope	3
Figure 2. 1: Example of Gyroscopic Vehicle, Draft NEWT	7
Figure 2. 2: Example of Ring Laser Gyroscope (RLG)	8
Figure 2. 3: Example of Fiber Optics Gyroscope (FOG)	9
Figure 2. 4: Example of MEMS gyroscope	10
Figure 2. 5: Example of Dynamically Tuned Gyroscope (DTG)	10
Figure 2. 6: Back view of the gimbal and flywheel	12
Figure 2. 7: Typical gyrocompass	15
Figure 2. 8: Sperry gyrocompass	15
Figure 2. 9: Anschütz gyrocompass	16
Figure 2. 10: Illustration on how gyro create stabilizing torque calculated.....	18
Figure 2. 11: An elevation of a simple form of Louis Brennan’s invention.....	19
Figure 2. 12: Side elevation of the invention.....	19
Figure 2. 13: End elevation of the invention, of a modification in which the gyrostats are automatically controlled.....	19
Figure 2. 14: End elevation of the invention.....	20
Figure 2. 15: A part side elevation of the invention, of another modification in which the gyrostats are automatically controlled	20
Figure 2. 16: Being a plan view of the same of the invention	21
Figure 2. 17: A detail view of the guides for the spindle of the gyrostat.....	21
Figure 2. 18: A side elevation of the invention.....	22
Figure 2. 19: A part end elevation of the invention of another modification	22
Figure 3. 1: Flowchart	24

Figure 3. 2: A Cross section of gyroscope stabilizer with air bearing support mounted in precession frame	26
Figure 3. 3: A Cross section of US patent gyroscope stabilizer for boat.....	27
Figure 3. 4: Leonardo da Vinci’s drawing of perpetual motion machine.....	28
Figure 3. 5: Example of concept screening matrix	30
Figure 3. 6: Example of concept scoring matrix.....	31
Figure 3. 7: Example of 3D Scanning Process	32
Figure 4. 1: Design Concept A.....	39
Figure 4. 2: Design Concept B.....	40
Figure 4. 3: Design Concept C.....	41
Figure 4. 4: The top view of design sketch Double Gyroscope Concept	45
Figure 4. 5: The side view of design sketch Double Gyroscope Concept	45
Figure 4. 6: The front view of design sketch Double Gyroscope Concept.....	46
Figure 4. 7: Measuring Process.....	47
Figure 4. 8: Cutting Process.....	48
Figure 4. 9: The sheet metal is bent by using press brake machine	49
Figure 4. 10: Example of press brake machine.....	50
Figure 4. 11: Drilling process	51
Figure 4. 12: One side of concept shows bolts and nuts are tighten to combine the wheels and the wood body with the sheet metal	52
Figure 4. 13: The gyroscope is attached to the gyroscope holder by tighten the bolts and nuts	53
Figure 4. 14: Actual complete electrical wiring circuit	54
Figure 4. 15: The gyroscope is painted by using spray paint.....	55
Figure 4. 16: The specifications for gyroscope A.....	56
Figure 4. 17: The specifications for gyroscope B.....	56
Figure 4. 18: Top view of complete Double Gyroscope Concept for Motorcycle	57

Figure 4. 19: Side view of complete Double Gyroscope Concept for Motorcycle.....57
Figure 4. 20: Front view of complete Double Gyroscope Concept for Motorcycle58
Figure 4. 21: Overview of complete Double Gyroscope Concept for Motorcycle.....58

CHAPTER 1

INTRODUCTION

1.0 Introduction

The introduction, background, problem statement, objectives and scope of the project will be discussed in this chapter. This project will be focused on designing and developing a concept of double gyroscope for motorcycle for balancing. It can balance the motorcycle by using the effect called precession. The precession function as example, if the force applied to the rotating gyroscope is following the spin axis of the gyroscope, the gyroscope will counter the applied force by rotating along perpendicular axis (which is 90°) to the applied force. From that, it can continuously balance the motorcycle. The purpose of developing the double gyroscope concept is to ease the motorcycle rider to keep their motorcycle balance.

1.1 Project Background

A gyrocar is a two-wheeled vehicle. Gyrocar has a dynamic balance is provided by the rider, and in some cases by the geometry and mass distribution of the bike itself, and the gyroscopic effects from the wheels. Balance was provided by one or more gyroscopes in a gyrocar.

In 1911, the concept was designated in fiction "Two Boys in a Gyrocar: The story of a New York to Paris Motor Race" by Kenneth Brown. First concept of Gyrocar is The

Shilovski Gyrocar which custom-made in 1912 by the Russian Count Pyotr Shilovsky (Spry & Girard 2008). The gyrocar was motorized by a modified Wolseley C5 engine of 16 - 20 hp, with a bore of 90 mm and a stroke of 121 mm. The weight of the gyrocar was 2.75 tons and it had a very large turning circle (Zhang 2014).



Figure 1. 1: Concept in Fiction “Two Boys In A Gyrocar: The Story of a New York to Paris Motor Race”

(Source: <http://cs.pikabu.ru/post_img/2013/11/14/6/1384413785_201760158.jpg>
17/05/17)

In 1927 Louis Brennan, funded to the tune of £12,000 by John Cortauld built a more successful gyrocar. The two contra-rotating gyros were stored under the front seats, spun in a horizontal plane at 3500 rpm by 24 V electric motors driven from standard car batteries.

In the automotive industry, safety means that users, operators or manufacturers do not face any risk or danger coming from the motor vehicle or its spare parts. Safety play an important role to ensure that users of the vehicle are not exposed to danger. Hence, gyroscope in motorcycle provide a feature that can help the motorcycle to keep it balance and prevent from falling that can hurt the user of the vehicle.

The gyroscope is a spinning wheel or disc that axis of rotation is free to assume any orientation by itself. There are many types of gyroscope such as the electronic, microchip-packaged MEMS gyroscopes found in consumer electronics devices, solid-state ring lasers, fiber optic gyroscopes, and the extremely sensitive quantum gyroscope (Spry & Girard 2008).

The function of the gyroscope is to maintain direction in tunnel mining in gyrotheodolites, and inertial navigation systems. Gyroscopes also can be used to build gyrocompasses, which balance or replace magnetic compasses in ships, aircraft, spacecraft, and vehicles which is to assist in stability or be used as part of an inertial guidance system.



Figure 1. 2: Example of Gyroscope

(Source: <<http://www.sciencekids.co.nz/images/pictures/physics/gyroscope.jpg>>
17/05/17)

1.2 Problem Statement

The main problem that is faced by the people is traffic congestion frequently occurs in big cities every day. People tend to ride a motorcycle to go to their workplace to avoid the traffic jammed. But, their motorcycles do not have a gyroscope stabilizer to keep their motorcycle balance during in the traffic jammed. The gyroscope helps to ensure that the motorcycle keep balance when the riders are having a difficulty to ride in a narrow road.

1.3 Objectives

The purpose of this project is to design a prototype of double gyroscope for motorcycle for balancing. The gyroscope is expected will be able to stabilize the motorcycle. In short, the objectives are:

- i. To design a prototype of double gyroscope for motorcycle for balancing
- ii. To develop a prototype of double gyroscope for motorcycle

1.4 Scope of Project

The scope of this project will be focusing on two main sections. The first main section will focus on designing the prototype of the double gyroscope concept while the second main section will be focusing on fabricating the prototype of the double gyroscope concept for motorcycle.

In the designing of the prototypes, some sample of designs of the gyroscope stabilizer will be taken from the website or article journal from past researcher and then showed in methodology chapter. Then, the designs will be compared to find the most effective and suitable concept by using the concept selection method. Concept screening and concept scoring matrix will be used to calculate the total marks and rank all the designs. The design that obtain the highest marks will be chosen to be sketched in blank paper. The sketch will contain all the dimensions and measurement for all the parts used in the concept design.

Besides that, a prototype of the gyroscope will be fabricated. Processes involved to fabricate the design concept are measuring process, cutting process, bending process, drilling process, assemble the parts by using the bolt and nuts, electrical work process and touch up process. Then the prototype will be analyzed to determine whether the gyroscope concept can stabilizes the motorcycle concept.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will be discussed about certain published information from past researcher regarding to the gyroscope, permanent magnet and perpetual motion. The history for the gyroscope, permanent magnet and perpetual motion also will be explained in this chapter. Besides, the basic function of the gyroscope, permanent magnet and perpetual motion also will be discussed in this part. It also will cover with some basic theories with a principle for a better understanding about this project.

2.1 Gyroscope

Louis Brennan was first considered the single track gyroscopic vehicle problem in 1905, later then many extensions were developed and some prototypes were made (Spry & Girard 2008). The differences in the several schemes lie in the number of gyroscopes active, the direction of the spin axles comparative to the rail, and in the technique used to produce the acceleration of the spin axle. Gyroscopic vehicle is one of such a new prototype commuter vehicle that can run on the road safely and efficiently.



Figure 2. 1: Example of Gyroscopic Vehicle, Draft NEWT (Zhang 2014)

Gyro is a many faceted, spatially-stabilized torque (orbital) geometrics phenomenon and an energy device that has a load-bearing, force-seeking, spatially-anchored stability reference (Congress et al. 1998). While, gyroscope is whichever device that can measure angular velocity (Jr. 1992). Properties of gyroscopes can be found in heavenly bodies in motion, artillery projectiles in motion, turbine rotors, different mobile installations on ships and aircraft propeller rotating (Review 2010). The online Museum of Retro Technology cites many articles and samples of gyrocars such as 1961 Ford Gyrocar prototype called the Gyron and a prototype from Gyro Transport Systems of Northridge, California that was on the cover of the September are also included, 1967 issue of "Science and Mechanics" (Spry & Girard 2008).

2.1.1 Type of Gyroscope

Gyroscope is the most important thing of an inertial navigation system or any direction system. Gyroscope was invented a century ago and have been used as references to recognize inertial state of a moving body. Since Kettering bug to the Apollo spacecraft, the value of gyro has determined the performance of the general mission. Gyroscope has been a feature behind 'make or break' of the many missions.

Gyroscopes have changed over the period and hence, many technologies on which gyroscopes are founded today, though only some of them find their place in the real-world applications. It is fascinating to know more about several types of gyroscopes and understanding how they operate.

Two of the types of gyroscope are Ring Laser Gyroscope (RLG) and Fiber Optics Gyroscope (FOG). Both ring laser and fiber optic type gyroscopes function based on a basic principle which is Sagnac effect. Sagnac effect includes splitting a beam of light in two and transfer them through different opposite paths and then producing interference between the two beams. The fringe pattern is detected and the rotation of the platform can be calculated based on the fringes. In a ring laser type gyroscope, the ring is the segment of the laser while in a fiber optic gyroscope, light from an external laser is penetrated through a fiber optic cable (Source: <<http://www.aeronsystems.com/gyroscopes-and-their-types/>> 21/05/17)



Figure 2. 2: Example of Ring Laser Gyroscope (RLG)

(Source: <http://www.pref.tochigi.lg.jp/kogyo/english/img/voice/025_04.jpg> 21/05/17)



Figure 2. 3: Example of Fiber Optics Gyroscope (FOG)

(Source: <<http://emcore.com/wp-content/uploads/2016/02/EMP-1-Fiber-Optic-Gyroscope-FOG.jpg>> 21/05/17)

Besides, Micro-Electro-Mechanical Systems (MEMS) gyroscope also one of the types of gyroscope. Usually, MEMS sensing structures range from 1 micrometer to 100 micrometers. MEMS gyroscopes use a vibrating part for rate measurement. The fundamental principle is, slightly vibrating body has a tendency to continue vibrating in its plane of vibration. Consequently, if the orientation of the platform to which a vibrating body is involved is changed, the vibrating body will apply a force on the platform. This force can be measured and can be used to obtain the output (Source: <<http://www.aeronsystems.com/gyroscopes-and-their-types/>> 21/05/17)