“We acknowledge have read this work. In our view, this work were adequate in terms of scope and quality for the award of a Bachelor of Mechanical Engineering (Automotive)”

Signature :…………………………………………………………….
Supervisor Name I :…………………………………………………………….
Date :…………………………………………………………….

Signature :…………………………………………………………….
Supervisor Name II :…………………………………………………………….
Date :…………………………………………………………….

APPLICATION OF GYROSCOPE TECHNOLOGY IN HUMAN MOBILE TRANSPORTER

MOHD AIZUDDIN BIN YUSOF

This report is submitted in partial fulfillment of the conditions for the award
Bachelor of Mechanical Engineering (Automotive)

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

APRIL 2010

"I admit that this report is the result of my own work except for a summary and each quote has been explained in the source"

Signature	:………………………………………………………….
Writer Name	:………………………………………………………….
Date	:………………………………………………………….

For beloved father and mother

For beloved family

For loved one

ACKNOWLEDGMENT

Greatest thanks to ALLAH Almighty for His blessings and giving me the ability to finish this project, which hopefully can contribute in further research.

I would like to express my gratitude and appreciation to my respectful lecturer supervisor, Mr. Mohd Nazim Bin Abdul Rahman for his supervision, invaluable advice and inspiring encouragement in guiding me in completing this research.

Further acknowledgements also to all lecturers and technicians at Faculty of Mechanical Engineering at UTeM for their support and help during the completion of this work. Especially Dr. Rozaidi Bin Ramlan and Mr. Faizul Akmar Bin Abdul Kadir for shared their knowledge about the Gyroscopes and MEMS technology.

Last but not least, I would like to express my gratitude and affection to my beloved parent, Yusof Bin Ismail and Zainah Binti Samod, family and friends for their unconditional support and smile during developing the original version of this style document.

Thanks…….

ABSTRACT

The criminal cases among the pedestrian increase rapidly in last two years especially in the crowd place. The criminal cases include the snatch thief, kidnapping and intimidation. Further more, the crime become more aggressive until causing the victims had seriously injured and there is certain case cause the victim death. Police department find the solution to decrease this criminal cases by make the patrolling around the pedestrian area using the Human Mobile Transporter (HMT). Due to that problem, the Police Department (PDRM) planned to make collaboration with UTeM to produce the first Human Mobile Transporter in Malaysia. HMT is a vehicle that equip with two wheels which powered by electric motor and controlled by Gyroscope to get it stability. The main objective of this project is to study the application of Gyroscope in Human Mobile Transporter. Under this project, there are two methods used to get the idea about Gyroscope application in Human Mobile Transporter which are literature study and experiment. Literature study is conducted by studied the main behavior of Gyroscope, MEMS technology and the general idea of HMT. There are several experiments conducted under this project which are moment inertia, angular momentum, and rigidity and precession gyroscope. The result from the literature review and experiments are used to design the basic concept of the Human Mobile Transporter. As a conclusion, the functions of the Gyroscope in Human Mobile Transporter not only to stabilize the vehicle but also act as a maneuver mechanism.

ABSTRAK

Kes jenayah dikalangan pejalan kaki meningkat dengan mendadak dalam tempoh dua tahun kebelakangan ini terutamanya di tempat tumpuan orang ramai. Antara kes-kes jenayah yang berlaku adalah seperti jenayah ragut, penculikan dan peras ugut. Sejak akhir-akhir ini, kegiatan jenayah dikalangan pejalan kaki semakin menjadi-jadi sehingga menyebabkan mangsa mengalami kecederaan yang serius termasuklah kematian. Polis Diraja Malaysia (PDRM) mendapati penyelesaian terbaik untuk mengurangkan kes-kes jenayah ini adalah dengan melakukan rondaan yang kerap di sekitar kawasan pejalan kaki dengan menggunakan kenderaan yang dikenali sebagai *Human Mobile Transporter* (HMT). Oleh yang demikian pihak Polis telah merangka kerjasama dengan UTeM untuk menghasilkan *Human Mobile Transporter* yang pertama di Malaysia. *Human Mobile Transporter* adalah kenderaan dua tayar yang dikuasakan oleh motor elektrik untuk bergerak dan menggunakan Gyroscope untuk mendapatkan kestabilan. Tujuan utama projek ini adalah untuk mempelajari aplikasi *Gyroscope* didalam *Human Mobile Transporter*. Dalam pelaksaan projek ini, ada dua kaedah yang digunakan untuk mendapatkan idea tentang aplikasi *Gyroscope* di dalam *Human Mobile Transporter* iaitu kajian ilmiah dan eksperimen. Kajian ilmiah dilakukan untuk mendapatkan beberapa konsep mengenai perilaku *Gyroscope*, teknologi MEMS dan gambaran umum mengenai *Human Mobile Transporter*. Beberapa eksperimen yang dijalankan dibawah tajuk ini adalah untuk mengkaji *Moment Inertia*, Momentum sudut, *Rigidity* and *Precession Gyroscope*. Hasil daripada kajian ilmiah dan eksperimen akan digunakan dalam merekabentuk konsep asas *Human Mobile Transporter*. Sebagai kesimpulan, fungsi *Gyroscope* didalam *Human Mobile Transporter* tidak hanya untuk menstabilkan kenderaan tetapi berfungsi sebagai mekanisme pergerakan.

LIST OF CONTENT

CHAPTER	TITLE	PAGES

CHAPTER **TITLE** **PAGES**

LIST OF TABLE

LIST OF FIGURE

FIGURE	TITLE	PAGE

FIGURE	TITLE	PAGE

LIST OF SYMBOLS

C	= Capacitance of a Fixed Parallel Plate Capacitor
ε	= Permittivity of Material between the Parallel Plates
A	= Plate Area
g	= Gap between the Plates
w	= Width of Plate
L	= Length of Plate
z	= Coordinate of the Movable Plate
W	= Energy of a Capacitor
V	= Voltage across the Plates
Kz	= Force Balance between the Spring and the Electrostatic Forces
ZPI	= Deflection at Pull-in
VPI	= Voltage at Pull-in
Kes	= Negative Electrostatic Stiffness
x	= Displacement
F	= Electrostatic Force
ωc	= Frequency
Fc	= Coriolis Force
M	= Mass of the Moving Fluid
V	= Velocity
Ω	= Rotation
τ	= Rate of the Change of Angular Momentum of the Torque
I	= Moment of Inertia of the Disc

ω	= Angular Velocity of the Disc
ωp	= Precession Velocity
m	= Mass of Rotor
t	= Time for 50 oscillation
T	= Periodic Time
l	= Length of Wires
d	= Distance between Wires
HMT	= Human Mobile Transporter

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

1.1 Background study

Final year project (PSM) is a subject that must be taken and pass with the excellent by the final year student under Mechanical Faculties to complete their studies in UTeM. The benefits of the Final Year Project are students will learn about the developing project from the beginning until the end period with applying the technical terms into the projects. From these experiences, student will be able to conduct a proper engineering research in their working life.

For this PSM, a topic related to development of Gyroscope technology in Human Mobile Transporter (HMT) has been selected. HMT is a vehicle similar to mini scooter that are using electric motor as it power train to move it. The HMT is inspired by the Dean Kamen using the effect of the gyroscope to stable it because the Human Mobile Transporter has two wheels.