GYROSCOPE IMPLEMENTATION ON MOBILE ROBOT

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(MECHATRONICS)

APRIL 2010

"I hereby declared that I have read through this report entitle "Gyroscope Implementation On Mobile Robot" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronic)"

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This Report is submitted in Partial Fulfillment of Requirements for the Degree of Bachelor in Electrical Engineering (Mechatronic)

Faculty of Electrical Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APRIL 2010

"I hereby declared that this report entitle "Gyroscope Implementation On Mobile Robot" is the result of my own work except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree."

Signature : ……

Name : Ismail Bin Mohd Khairuddin

Date : ……

To my dearly loved father and mother

To all my lectures and friends

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Alhamdulillah, finally the Final Year Project (FYP) report is complete. I'm taking this opportunity to thank to whoever generously advice and assists me while I was doing my Final Year Project (FYP) directly or indirectly.

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ABSTRACT

This project basically describes about *"Gyroscope Implementation on Mobile Robot"* for the needs of Robocon 2010, where gyroscope is involved for manual robots and autonomous robot. This project basically divide into 3 main section/parts which is design the mechanical structure (finding the centre of gravity), electrical circuit, and the controller. The main reason this project is created is because of the needs of the robot which is able to turn in precise, perfect and quick motion when it is given its order. The concept of this project is using the gyroscope as device that detects the changes of degree by using the angular velocity. The gyroscope detects the changes of degree by using the changes of angular velocity. The signal from gyroscope is analog signal. To write the program for gyroscope, C language programming is to be used. To convert the signal output from gyroscope, Analogue Digital Converter (ADC) is to be used in microcontroller program and the microcontroller PIC16F2877A and PIC18F2685 is used.

ABSTRAK

Projek ini secara langsungnya menjelaskan tentang *"Gyroscope Implementation on Mobile Robot"* untuk pertandingan Robocon 2010, di mana gyroscope akan terlibat dalam robot manual serta robot automatik. Secara kasarnya, projek ini terbahagi kepada 3 bahagian penting iaitu rekabentuk struktur mekanikal (titik tengah graviti robot), bahagian elektrikal dan juga kawalan. Tujuan utama projek ini dihasilkan adalah untuk menghasilkan satu robot yang dapat berpusing dengan sempurna, cepat dan apabila ia di arahkan utuk melakukan tugasan. Konsep yang diguna pakai dalam penghasilan robot ini ialah, menggunakan sensor gyroscope untuk mengesan perubahan sudut melalui putaran halaju. Gyroscope akan mengesan perubahan sudut melalui perubahan putaran halaju. Isyarat yang dihasilkan oleh gyroscope adalah signal analog. Untuk mengaturcara program, aturcara bahasa C telah digunakan. Oleh kerana keluaran dari gyroscope adalah keluaran Analog, Penukar Analog Kepada Digital telah digunakan dalam mikropengawal dan mikropengawal yang telah digunakan adalah mikropengawal PIC16F877A dan juga PIC18F2685.

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LIST OF ABBREVIATION

ADC	:	Analog Digital Converter
PIC	:	Programmable Intelligent Computer
UPP	:	Universal Pulse Processor
RAM	:	Random Access Memory
ROM	:	Read Only Memory
EEPROM	:	Electrically Erasable Programmable Read Only Memory
I/O	:	Input/Output
MEMS	:	Micro Electro Mechanical Systems
DC	:	Direct Current
IFC	:	Interface Free Controller
LCD	:	Liquid Crystal Display
CCP	:	Capture Compare Pulse Width Modulation
CCPR	:	Capture Compare Pulse Width Modulation Register
PWM	:	Pulse Width Modulation
PCB	:	Printed Circuit Board
GND	:	Ground
OUT	:	Output
EMF	:	Electromagnetic Field
TTL	:	Transistor-Transistor Logic
EN	:	Enable
FYP	:	Final Year Project

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

In this section, an introduction towards project will be briefed. This chapter consists of objective, problem statement and scope of the project.

1.1 Introduction of Project

This project is titled as “Gyroscope Implementation on Mobile Robot”. The purpose of this project is to product a mobile robot that can be turned precisely and perfectly. To accomplish this project divided on three parts: mechanical part, electrical part and software part.

In the mechanical part base for mobile robot will be constructed. It includes the finding of centre of gravity of the mobile robot. In the electrical part, the implementation of the sensor will be done, where as the connection of driven motor to the controller board is also included in this part.

For software part, the algorithm of the robot will be programmed in MicroC and MPLab software. The C language will be use and will be compiled to hex file, and PIC16F877A PIC18F2685 has been chosen for this programming.

1.2 Problem Statement

In previous Robocon competitions, the suitability of the robot(s), the efficiency of the pilot in handling the manual robot and technology used was the key of success in solving the problems and winning the competition.

The suitability of the robot depends to the paths that are used, the efficiency to do turning and also what that has been programmed with. However, there will be problems faced, when a perfect and precise turn is needed. If to be concluded from previous competition almost every robot were not able to turn precisely and perfectly. This problem will take time in the competition.

Other than that, most of robot that competes chooses to follow the line to finish the task. The problem will occur when the line is not on a flat surface (e.g. a ramp) and an obstacle is in the way. Because of the problem, it will take time. Hence, in order to solve the problem, a gyro sensor will be used.

1.3 Objective

The objectives of this project are:

1. Design and construct a mobile robot base for gyroscope implementation.
   Design a base to implement the gyroscope.
2. To implement gyroscope for mobile robot turning operation.
   Construct a programming for gyroscope that focused on turning.
3. To integrate gyro for motion on other surface.
   Construct the programming for gyroscope based on the surface.
4. To implement additional usage of gyro based on Robocon 2010 theme.
   The programming for gyroscope is based on Robocon 2010 rule and it's requisite.

1.4 Scope of Project

1. Construct a mobile robot.
2. Developing and testing the sensors (gyroscope and encoder) for mobile robot turning.
3. Programming the controller using MikroC and MPLab C Compiler software.
4. Mobile robot is tested based on the specification of Robocon field.

1.5 Layout Project

Chapter 1: Introduction

This chapter will simply introduce about the project. This chapter contains introduction, objectives, scope of project and problem statement.

Chapter 2: Literature Reviews

This chapter shows about the studies and research that relevant to the project.

Chapter 3: Theory and Background

The theory of the device that has been used will be state out in this chapter

Chapter 4: Research Methodology

This part will show the canvass about the research methodology used in this project.

Chapter 5: Result, Discussion and Analysis

This part will state out the result that be obtained, discussion and analysis of the result.

Chapter 6: Conclusion and Recommendation

This chapter will talk about conclusion and recommendation of the project.

CHAPTER 2

LITERATURE REVIEW

To have a briefing understanding of the researches related to the project, a few literature reviews had been done. This chapter will describe the related literature reviews.

2.1 Introduction to the Gyroscope

Gyroscope or also called gyro is a sensor that measures the rotation velocity or rotation rate of an object. Theoretically, a gyroscope is any device that can measure angular velocity and primary used for navigation and also measuring the orientation based on the principle of conversation of angular momentum of [2,13].

The early gyroscope that has been found is 1700's, spinning devices were being used for sea navigation in foggy conditions. The more traditional spinning gyroscope was invented in the early 1800's, and the French scientist Jean Bernard Leon Foucault coined the term gyroscope in 1852 [13]. A freely rotating disk, called a rotor, was mounted on a spinning axis in the center of a larger, stable wheel. As the earth spun on its axis, the stable wheel rotated with it, but the rotor did not move. The movement of the mounted wheel followed the rotation of the earth, rotating around the center disk and demonstrating the earth's spin. The gyroscope was invented by Leon Foucault, a French physicist, in the attempt to demonstrate the earth's rotation. [13]

Gyro are currently use for gaming and virtual reality input device, motion with MMI (man- machine interface), image stabilization for digital video and digital still cameras, GPS navigation system also for robotics.

2.2 Basic Operation and Types of Gyro

Gyro operation is differently depending on their type. Basically, gyro is has three (3) types which is rotary (classic) gyroscope, vibrating structure gyroscope and optical gyroscope [1, 2]. Traditional spinning gyroscopes work on the basis that a spinning object (disk) that is tilted perpendicularly to the direction of the spin will have a precession. The precession keeps the device oriented in a vertical direction so the angle relative to the reference surface can be measured. The spinning object is directly mounted to the series of gimbals and the gimbals offer the spinning disk to additional degree of freedom [1, 2, 13].

Vibrating structure gyroscope it is MEMS (Micro-machined Electro-Mechanical Systems) which is device/sensor that is available commercially, affordable, and very small in size [1, 2, 13]. The MEMS will convert the angular rate from gyro in different capacitive change based on the *Coriolis force. Coriolis force* is when an object is moving in a periodic fashion (either oscillating or rotating), rotating the object in an orthogonal plane to its periodic motion causes a translational force in the other orthogonal direction [13].

Optical gyroscopes are most commonly ring laser gyroscopes. These devices send two lasers around a circular path in opposite directions. If the path spins, a phase shift can be detected since the speed of light always remain constant. Optical gyroscopes operate on the principle of the Sagnac effect. Usually the rings are triangles or rectangles with mirrors at each corner. Often optical gyroscope units consist of 3 mutually orthogonal gyroscopes for rotation sensing about all three orthogonal rotation axes. They are also typically implemented with 3-axis accelerometers thus providing full motion sensing in 6 DOF [13].

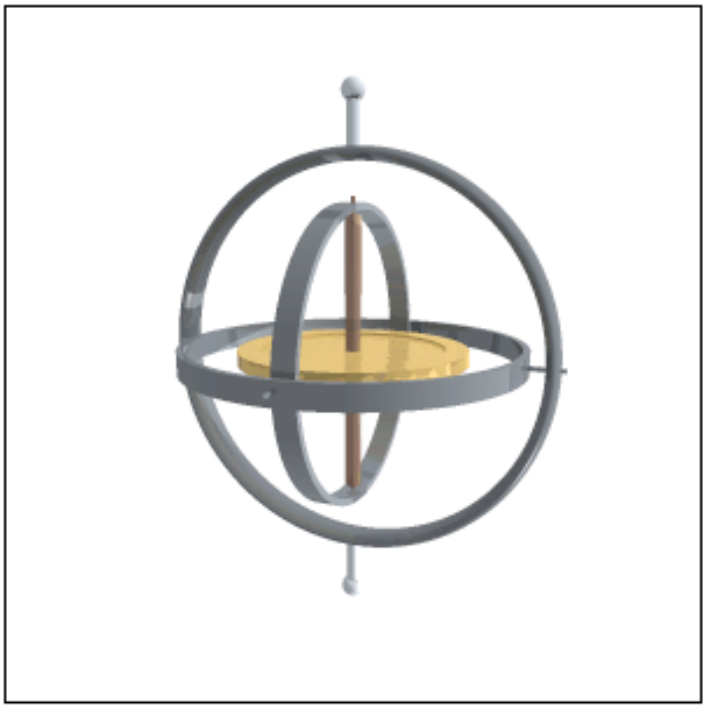

Figure 2.1: Rotary (classic) Gyroscope Operation

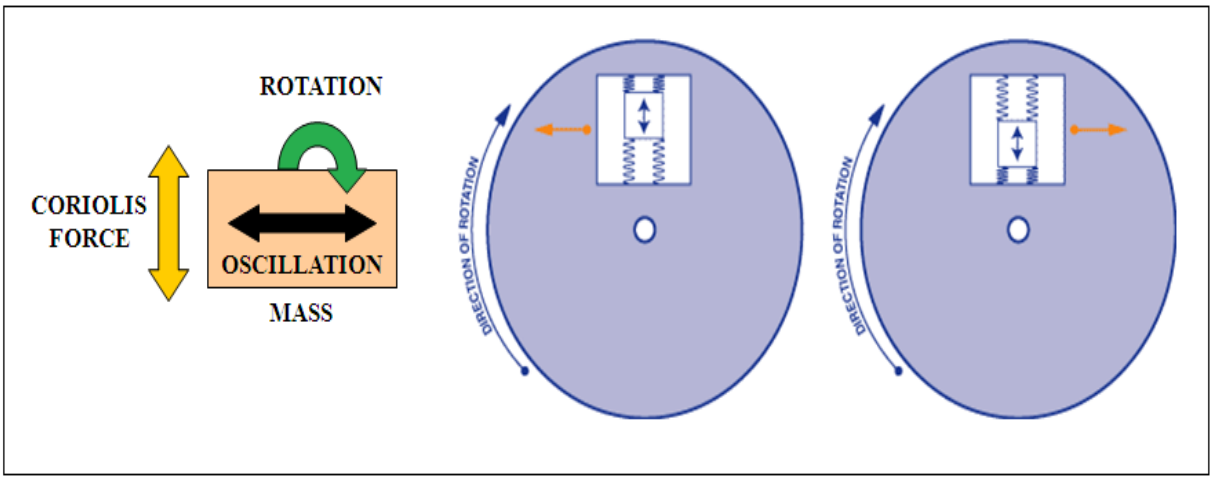

Figure 2.2: Coriolis force Principle Operation