UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF FOUR WHEELED AUTONOMOUS ROBOT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic & Automation) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours. The member of the supervisory committee is as follow:

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Supervisor

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ABSTRACT

The purpose of this project is to design and develop a four-wheel autonomous robot for the ROBOCON 2010 competition. This robot will utilize Light Dependant Resistor (LDR) sensor, two-wheel drive and Peripheral Interface Controller (PIC) microcontroller in order to perform its specified task. This robot will be programmed to track down a white line on a green colored game field. The main aim for this project is to produce an efficient, precise and high speed robot platform to carry out the competition task within an optimum time frame. The project involves data gathering about major robot components including hardware, software and studies on similar past project. The methodology discusses the flow chart of the whole project and Pugh Method of design selection. The design phase includes design process and design selection. By using SolidWork 2008 software, two designs are proposed. The best design will be chosen to be fabricated. The objectives that requires designing and developing the four wheels autonomous robot is achieved and give good result to fulfill the requirement of the ROBOCON 2010 competition.

ABSTRAK

Projek ini bertujuan untuk merekabentuk dan membangunkan sebuah robot berautonomi beroda empat untuk pertandingan ROBOCON 2010. Robot ini akan menggunakan penderia jenis Perintang Peka Cahaya, pacuan dua roda dan mikropengawal PIC dalam menyempurnakan tugasnya. Robot ini akan diaturcarakan untuk menjejak garisan putih pada latarbelakang kawasan gelanggang berwarna hijau. Tujuan utama projek ini adalah untuk menghasilkan robot yang cekap, tepat dan berkelajuan tinggi dalam menjalankan tugas dengan penggunaan waktu yang optimum. Projek ini merangkumi pengumpulan data tentang komponen utama robot termasuklah dari perkakasan, perisian dan juga kajian tentang projek lepas yang hampir sama. Bahagian methodologi membincangkan carta aliran berkaitan dengan keseluruhan projek dan pemilihan rekabentuk menggunakan kaedah Pugh. Fasa rekabentuk termasuklah proses rekabentuk dan pemilihan rekabentuk. Dengan menggunakan perisian SolidWorks 2008, dua rekabentuk dikemukakan. Rekabentuk terbaik akan dipilih untuk difabrikasi. Objektif yang memerlukan rekabentuk dan pembangunan robot berautonomi beroda empat telah tercapai dan memberikan hasil yang serta memenuhi keperluan bagi pertandingan ROBOCON 2010.

DEDICATION

Specially dedicated to my beloved father, Haji Shaari bin Kassim and my mother, Hajjah Jamaliah binti Hassan who are very concern, understanding, patient, and supporting. Special thanks to my supervisor, Mrs. Syamimi binti Shamsuddin for her constructive guidance, encouragement and patient in fulfilling our aspiration in completing this project. To my brothers, sisters, and my entire friend, the work and success will never be achieved without all of you.

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LIST ABBREVIATIONS

ABU	-	Asia-Pacific Broadcasting Union
AC	-	Alternate Current
ADC	-	Analog-to-Digital Converter
AGV	-	Automated Guided Vehicles
API	-	Application programming interfaces
BLDCs	-	Brushless direct-current motors
CAD	-	Computer Aided Design
CATIA	-	Computer Aided Three-dimensional Interactive Application
CCP	-	Capture/ Compare/Pulse width modulation
Co	-	Company
CPU	-	Central Processing Unit
DC	-	Direct Current
DOF	-	Degree of freedom
EEPROM	-	Electrically erasable programmable read-only memory.
HDPE	-	High density Polyethylene
IDE	-	Integrated Development Environment
I/O	-	Input and Output
IR	-	Infra red
LDR	-	Light dependent resistor
LED	-	Light Emmiting Diod
NASA	-	National Aeronautics and Space Administration.
PC	-	Personal Computer
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interface Controller
PLC	-	Programmable Logic Control
PMDC	-	Permanent-magnet direct-current
PSM	-	Projek Sarjana Muda

QFD	-	Quality Function Deployment
RAM	-	Random Access Memory
R/C	-	Radio controlled
ROBOCON	-	Robot Contest
ROI	-	Return on investment
ROM	-	Read only memory
TV	-	Television
USART	-	Universal Synchronous Asynchronous Receiver Transmitter
VCRs	-	Video cassette recorder
LDR		Light Dependent Resistor
LED		Light Emmiter Diod
V		Volt

CHAPTER 1
INTRODUCTION

This chapter reviews the overall content of the project. Introduction of the project includes the project background, problem statements of the project, project aims and objectives, project scopes, robotic technologies and project planning.

1.1 Background

Nowadays, development of technologies especially in robotic are growing in a very fast pace. A variety design of robots has been develop in recent years in order to improve the design and their performance. The most popular robot today is the autonomous robot.

Autonomous robots can be defined as the robot which is programmed for perform task continuously without human guide in unstructured environment. Every robot has different ability to perform task and different robots can be autonomous in different ways.

Autonomous distributed robots have potential to accomplish various missions which conventional robots have not ever done such as cooperative transportation, collection and construction (Inou *et al* 2003). Autonomous robot can perform the task that human cannot perform like space and underwater exploration and tasks that may dangerous for human like handling chemical and explosive materials. Industrial and technical applications of autonomous robots are continuously gaining in importance. They are already widely used for surveillance, inspection and transportation tasks.

One of the main characteristic of an autonomous mobile robot is its ability to move through the operational space, avoiding obstacles and finding its way to the next location, in order to perform its task, capabilities known as localization and navigation. In order to know where to go, the robot must have accurate knowledge of its current location. That means it should use a great variety of sensors, external references and algorithms. In order to move in tight areas and to avoid obstacles mobile robots should have good mobility and ability. These capabilities mainly depend on the wheels design. Research is continuously going on in this field, to improve the autonomous navigation capability of mobile robotic systems (Doroftei *et al* 2007).

Basically, autonomous robot can be developed in two way locomotion. It depends on the requirement whether to develop a legged robot or wheeled robot. Locomotion is most important part in design and develops a robot. In each case, the locomotion system is driven by a motor, which turns a shaft, cam, or lever. This motive force affects forward or backward movement. Wheels are the most popular method for providing robots with mobility. Robot wheels can be just about any size, limited only by the dimensions of the robot and builder outlandish imagination (Mccomb 2006).

Refering the Miles (2002), wheels are pretty much proven in all types of robot applications, from the smallest desktop Sumo machine to the largest mobile industrial robots. Even designers for NASA's Mars-exploration robots gave up on legs and other means of locomotion in favor of wheels.

Robots can have just about any number of wheels, although two is the most common, creating a differentially driven robot.

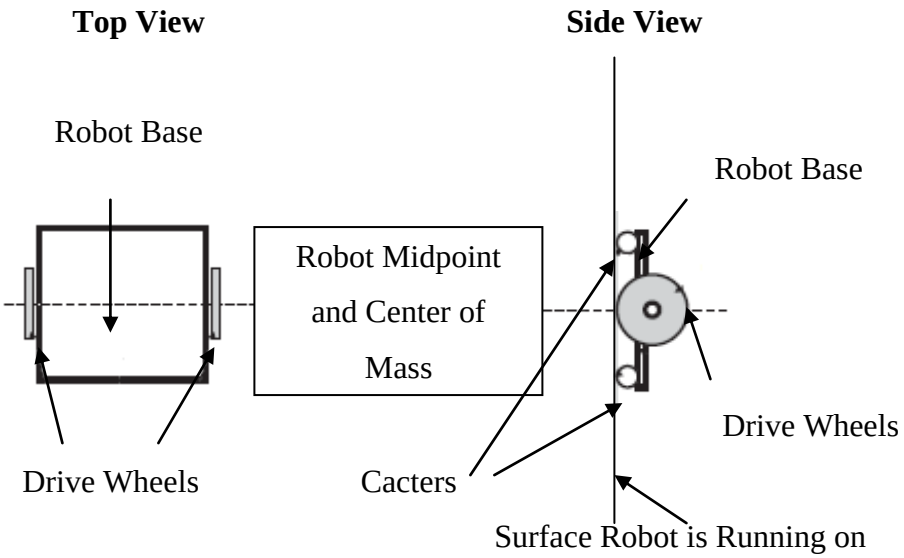

Figure 1.0: Design of an ideal differentially driven robot (Mccomb 2006).

Figure 1 shows the design of an ideal differentially driven robot. In this case, the robot is balanced on the two wheels by one or two free-rolling casters, or perhaps even a third swivel wheel. Besides that, autonomous robot also can be a four wheel locomotion.

Figure 1.1: Four wheel Mobile Robot (www.robots.mobilerobots.com)