UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT ROBOT DRIVE SYSTEM USING MECANUM WHEEL

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

by

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I hereby, declared this report entitled “Design and development a robot drive system using mecanum wheel” is the results of my own research except as cited in references.

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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:

……..

Supervisor

ABSTRAK

Pemilihan penggerak untuk robot saat ini masih tertumpu kepada penggunaan roda biasa. Hal ini mungkin kerana kosnya yang jauh lebih murah berbanding dengan roda mecanum. Projek ini akan menunjukkan manfaat dan kemampuan robot apabila menggunakan roda mecanum sebagai penggerak dari segi jenis gerakannya. Roda Mecanum juga dikenali sebagai Roda Sweden yang telah wujud di dunia sejak tahun 1973. Roda mecanum adalah istimewa dan unik jika dibandingkan dengan roda lain tetapi roda ini mahal berbanding dengan roda standard yang lain dan kerana rekabentuknya, proses pengaturcaraan lebih sukar dan rumit. Tujuan projek ini adalah untuk merancang dan mengembangkan sebuah robot yang mampu bergerak di segala arah dengan menggunakan roda mecanum khusus. Projek ini melibatkan proses untuk mereka bentuk dan membina sistem pandu robot dengan roda mecanum dan dikendalikan secara manual menggunakan alat kawalan jauh. Pada peringkat awal projek ini di PSM1, ia melibatkan proses untuk merancang dan membina robot dari segi struktur mekanikal, litar elektronik dan pengaturcaraan PIC. Dua rekabentuk konsep telah dicadangkan. Yang terbaik dipilih untuk fabrikasi. Projek ini melibatkan proses untuk menghasilkan alat kawalan jauh khas untuk robot dan ‘voltage regulator’ dalam proses fabrikasi komponen elektronik. Komponen SK40C dan MD30B, juga gunakan dalam projek ini sebagai mikropemproses dan pemacu motor. Setelah semua proses selesai termasuk pemasangan semua komponen, kod pengaturcaraan dimuat turub dan juga di uji. Kaedah ujian dirancang dan dilaksanakan dalam menentukan samada projek ini mencapai matlamat projek ataupun tidak. Sebagai kesimpulan, projek ini berjaya mencapai matlamat projek tapi masih memerlukan penambahbaikan lebih lanjut di masa akan dating untuk memastikan robot ini lebih sempurna.

ABSTRACT

Locomotion for most mobile robots today is still focused on the standard wheel. This may be due to its cost which is much cheaper compared to mecanum wheel. This project will show the benefit of using mecanum wheel as locomotion from its movement specialty. Mecanum wheels also known as Swedish wheel were born to the world in 1973. The mecanum wheels are special and unique compared to other wheels. These wheels are expensive compared with other standard wheel and due to its design, the programming process more difficult and complex. The aim of this project is to design and develop a mobile robot that able to move at any direction using the specialty of mecanum wheel. This project involves to design and build a robot drive system with mecanum wheel and controlled manually using a teach pendant. In the early stages of this project at PSM1, it involves a process to design and develop the robot mechanical structure, electronic circuit and programming PIC. Two conceptual designs have been proposed. The best one will be chosen for fabrication. This project involves to fabricate a custom made of teach pendant and voltage regulator for electronic component. The SK40C and MD30B, also being use in this project as the microcontroller and motor driver respectively. After all designing and development process is fully done, it involves to assemble and component, loading programming and test the robot. The testing methods are planned and perform in order to define weather this project is achieve the objective or not. As the conclusion, this project is successfully achieved the project aim but it still require further improvement to make this robot perfect.

DEDICATION

This final year project report or PSM1 report is wrote in order to fulfill the requirement before continue work for PSM2 project. First of all, this report will dedicates to beloved supervisor, Madam Syamimi binti Shamsuddin who always giving advice and best guides to write a best report. Without her guidance, I would be not able to write this report with good contents and with proper format. This report also will dedicate to my family who are always supports me to do best in study especially my mom and dad. Finally, I would like to thanks to all of my friends especially Mohd Iskandaredzuan, Mohd Firdaus, Mazalinda and Kannan; student under Madam Syamimi supervision for PSM project for your support and kindness in helping me to finished this report. Thank you very much.

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I would like express my gratitude especially to Allah S.W.T for His fate on me through this project and chances give to me to keep breathing and healthy until today. And also to everyone who has offered me valuable advice in order to finish this project.

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ZUL AZRI BIN ZAINAL
APRIL 2011

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CHAPTER 1

INTRODUCTION

This chapter discusses the basic idea of this PSM project; design and development of a robot drive system with Mecanum Wheel. The topic that will be covered in this chapter is project background, problem statement, project aim & objective, scope, project planning and expected outcome.

1.1 Background

Robot basically can be describe as a machine that programmable and can perform any task without human control. Human tend to build a robot because the robot able to work in flexible and unlimited time, able to handle heavy task and also able to repair if having any damages or problems. According to that, robot nowadays is popular in use especially in manufacturing and production industries. It can be prove by seeing to Malaysian car brand companies such as Perodua and Proton that are using a robot in their production line for a certain process such as for painting and welding process. This

topic then will explained more about the robot including with robot history, its definition and many more.

1.1.1 History Of Robot

Starting from 250BC, human already started to create some mechanism that can be function autonomously without human assistant. This can be prove by Ctesibius of Alexandria invention who build organs and water clocks with movable figures (Jaeger 2005). Starting from that moment, human aggressively build a robot and improve the robot functions and ability. After for a long time human keep build the unnamed system, the word “Robot” then had been introduced by Czech writer, Karel Capek in his play entitled R.U.R or in full name is Rossuum's Universal Robots in early 1920s. "Robot" in Czech comes from the word "robota", meaning "compulsory labor" (Isom 2005). The robot technology today’s is advance until the robot were able to walk and act as a human and also able to serve a human. It can seen in year 1996 when Honda build the self regulating, bipedal humanoid robot called ASIMO.

1.1.2 Robot Definition

There is lots of different definitions of robots can be seen in different dictionaries and encyclopedias. But the basic knowledge about robot is it is manufactured by a human to perform any human task that may harm human if performed. A robot is a re-programmable multifunctional manipulator designed to move material, parts, or specialized devices through variable programmed motions for performance of a variety

of tasks (Zhihong 2006). Robot basically are built either to be control manually by a teach pendant or autonomously controlled. Manual robot is a robot that controlled by an operator in order to move or perform any task in certain range. The device used to control the robot called as teach pendant. Autonomous robot is different with manual robot as it is without human control. Autonomous robot basically will perform a task by a programming inserted in robot memory. So that, in order to change the autonomous robot task, human need to add or reprogram the robot.

Robotics can be described as a study of robots. In addition for this sub-title, there are three Isaac Asimov's laws of Robotics. The laws are:-

a) A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
b) A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
c) A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

These three Isaac Asimov's laws is basically is used as a guide or reference for any human who want to built a robot. It is because Asimov believes in fictions that machine or system able to harm and destroyed its creators and he believe that knowledge has it dangers (Clarke 1993). Because of he's believes, he create these 3 laws for creator guidance.

1.1.3 Classification of Robots

There are lots of robot types in this world. The main classification of robot includes; Cartesian Robot, Parallel Robot, Spherical Robot, Scara Robot, Cylindrical Robot, Articulated Robot and Mobile robot. Below are the definitions of every category (Types Of Robots, ROVer Ranch)[4]:-

a) Cartesian robot /Gantry robot: Used for pick and place work, application of sealant, assembly operations, handling machine tools and arc welding. It's a robot whose arm has three prismatic joints, whose axes are coincident with a Cartesian coordinator.

b) Cylindrical robot: Used for assembly operations, handling at machine tools, spot welding, and handling at diecasting machines. It's a robot whose axes form a cylindrical coordinate system.

c) Spherical/Polar robot: Used for handling at machine tools, spot welding, diecasting, fettling machines, gas welding and arc welding. It's a robot whose axes form a polar coordinate system.

d) SCARA robot: Used for pick and place work, application of sealant, assembly operations and handling machine tools. It's a robot which has two parallel rotary joints to provide compliance in a plane.

e) Articulated robot: Used for assembly operations, diecasting, fettling machines, gas welding, arc welding and spray painting. It's a robot whose arm has at least three rotary joints.

f) Parallel robot: One use is a mobile platform handling cockpit flight simulators. It's a robot whose arms have concurrent prismatic or rotary joints.

g) Mobile robot: have the capability to move around in their environment and are not fixed to one physical location. Mobile robot function is flexible and it is basically according to its creator research and focus in performing task.

Figure 1.1 below shows the figure of five robot classification listed and discussed from seven which is; Cartesian robot, cylindrical robot, spherical robot, scara and articulated robot. The figure is consist with it kinematic structure and working space.

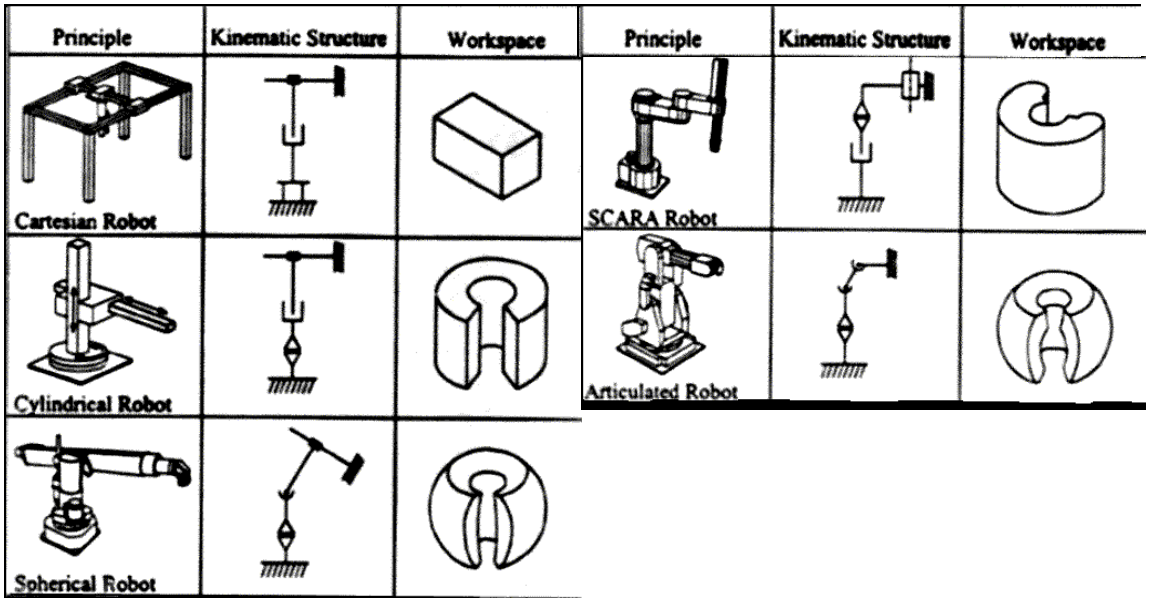

Figure 1.1 Robot classification; Cartesian, cylindrical, spherical, scara and articulated robot (Braz 1999)

Figure 1.2 then show the image or parallel robot while 1.3 is a mobile robot.

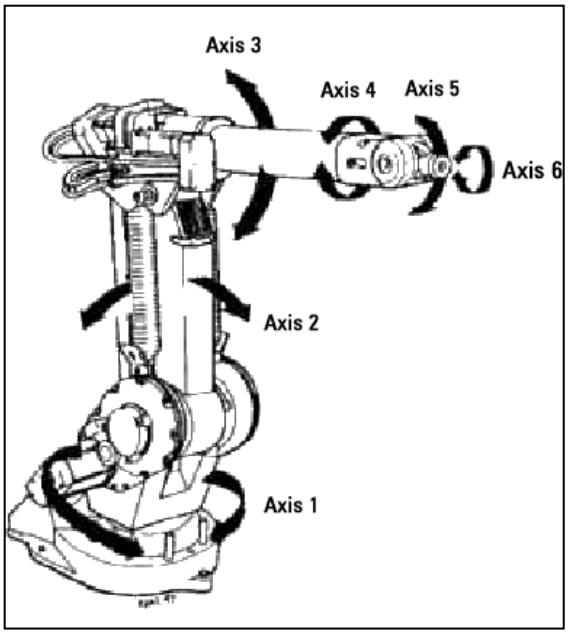

Figure 1.2 Articulated robot (Hyland 2001).

Figure 1.3 A mobile robot for hazardous task (Braz 1999).

1.1.4 Application of Mobile Robot

Mobile robot can be described as a small robot that operated autonomously or manually controlled that can move at any environment profile given. Every mobile robot can be operated to do any task depending to its function and reason of its development. Mobile robot nowadays is widely used in order to perform any task that simple and repeated job or dangerous to human being such as a mobile robot for military used, for an example; the mine detection robot. Mobile robot is widely in use today in many sectors. In manufacturing industries as an example, mobile robot can be used as a part supplier from section to section. It will reduce manpower from supply parts and also will increase accuracy to supplying time. Because of mobile robot size is not over than human sizes and have capability to move around, human tend to use it as a service robot in certain area such as shopping complex for shopping guidance and hospital for nurses and doctor support service. Basically, mobile robot can be used in any sectors and its applications are wide as it can be design and built according to desire task.

1.1.5 Mobile Robot with Mecanum Wheels

Mecanum wheel is a special wheel that consists with the free-rolling sub-wheels positioned at an angel offset from the wheel rotation around its circumference. It is sometimes called the Ilon wheel after its Swedish inventor, Bengt Ilon, who came up with the idea in 1973 when he was an engineer with the Swedish company Mecanum AB (Easton 2009). By using mecanum wheels, mobile robots are able to change its motion direction without needs to turn its drive wheel because the robot that used mecanum wheels is not with the directional drive wheels. This is because of the mecanum wheels specialty. Another specialty of using mecanum wheel is all wheels are consists with independently motor driver and all wheels are giving its role to perfrom any desire direction movement.