UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Design and Development of Manual Robot using Mecanum Wheels

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

by

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APPROVAL

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ABSTRACT

The aim of this project is to design and develop of a manual robot using mecanum wheels for Robocon 2010 competition. This report covers all components of a manual robot, focusing on aspects of design and motion. This report includes the related literature study and methodology for this project. Mecanum wheels are used to obtain continues movement from any direction and configuration during the competition compared with others types wheels. Four DC motors will drive four mecanum wheels on the robot. The combination of mechanical robot designed with mecanum wheel and robot motion control will result with a more precise movement of manual robot control. As the result, manual robot has successful been develop. And it also archives the objective of this project, but there the mecanum wheel is unable to attach to the manual robot. It is because mecanum wheel is late to deliver and can't make it until the due date. The manual robot can perform for the ROBOCON 2010 task. The robot can complete the task which is complete the puzzle for pyramid Khufu.

ABSTRAK

Matlamat projek ini adalah untuk merekabentuk dan membangunkan sebuah robot manual dengan menggunakan roda mecenum untuk pertandingan Robocon 2010. Kajian in adalah berkenaan merekacipta robot manual dan pergerakan robot. Robot manual ini akan mengunakan roda mecanum, dimana ianya akan memberikan pergerakan yang berterusan daripada sebarang arah dan kedudukan semasa pertandingan berbanding mengunakan jenis tayar yang lain. Keempat-empat roda mecanum pada robot manual akan digerakkan oleh empat buah motor elektrik. Kombinasi rekabentuk bahagian mekanikal robot dengan roda mecanum serta kawalan pergerakan member satu pendedahan yang luas dalam kajian pergerakan robot manual. Hasil projek ini, robot manual berjaya dihasilkan dengan jayanya, semua objektif tentang projek ini berjaya. Akan tetapi, roda mecanum tidak dapat di pasang pada robot manual kerana kelambatan tiba sebelum tarikh yang diperlukan. Robot manual ini berjaya untuk melakukan tugasan yang diperlukan bagi pertandigan ROBOCON 2010 dimana harus menyiapkan pyramid Khufu.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

mm	-	millimetre
Co	-	Company
DC	-	Direct Current
CPU	-	Central Processing Unit
PLC	-	Programmable Logic Control
CAD	-	Computer Aided Design
PIC	-	Peripheral Interface Controller
RAM	-	Random Access Memory
ROM	-	Read only memory
I/O	-	Input and Output
PCB	-	Printed Circuit Board
PS	-	Play Station

CHAPTER 1
INTRODUCTION

1.1 Background

In general, robots are designed and controlled by a computer or similar device. The motion and movement of the robot are controlled through a controller that is under the supervision of the computer, in other words, itself is running some type of program. If the program is change, the action and motion of robot will also automatically change. Therefore, the robot is designed to be able to perform any task that can be programmed within limit, of course simply by changing the program. There are various ways to defining a robot. Robot is a device that effective for us to do work for us or move anything that we want, via its functions. Wheel is used to for help the robot navigation to do a movement from a place to another place. Mecanum wheel was designed and invented in Sweden in 1973 by Bengt Ilon, an engineer with Swedish company Mecanum AB (Diegel et al 2002). Mecanum wheel is based on the principle of a central wheel. With a number of rollers placed at an angle around the periphery of the wheel. The angled peripheral roller translates a portion of the force in the rotational direction of the wheel to force normal to the wheel directional. Depending on each individual wheel direction and speed, the resulting combination of all these forces produces a total force vector in any desired direction thus allowing the platform to move freely in direction of resulting force vector, without changing the direction of the wheel.

1.2 Problem Statement

The idea of this project is from tournament Robocon 2010, which is to develop and design a manual robot using mecanum wheels. Usually, robots that enter the tournament will using a conventional wheel, where it hard and difficult to control while changing the move or changing position while the robot is moving. The direction of conventional wheel can go front, back, left and right only. With the limitations of the conventional, it will not efficiently to do various tasks that need speed changing position and movement. It will take a lot of time by using the conventional wheel.

1.3 The Aim and Objective

The aim of this project is to design and develop manual robot platform for robocon 2010. To achieve this aim, these objective need to be fulfilled:-

a) To design and develop a mechanical structure of a manual robot with mecanum wheels for Robocon 2010 competition.
b) To develop electronic and electrical system, circuitry and programming using PIC for the robot.
c) To interface between the mechanical system and the PIC controller to develop an efficient manual robot for ROBOCON 2010.

1.4 Project Scope

The scope of project is very important in order to support in the build and development process of this project. Listed below are the descriptions of scope for this project:

a) Mechanical and fabrication:

Fabrication process is one of important process in mechanical job in order to build the gripper, lifting mechanism and chassis of the robot.

b) Electrical and electronics:

In order to build and a robot it will have a circuit for controller and electrical system. Therefore, it will have a wiring of electrical system between controller and actuator (motor) and circuit for controller and motor driver.

c) Programming:

In order to control the robot, will use a PIC microcontroller and programming software of Microchip. Which is use to do a programming process and burn the program into microcontroller.

d) Testing and development:

This process where a testing do and training to make sure robot can perform smoothly, efficient and precise to do the task of Robocon 2010.

1.5 Introduction to Robotics

Robotics is the science and technology of robots, their design, manufacture, and application (Isaac 2003). Robotics systems consist of not just robots, but also other devices and system that are use together with robots to perform the necessary task. Robot may be used in manufacturing environments, in underwater and space exploration or even for fun. In any capacity, robot can be so useful but its steel need to be programmed and controlled.

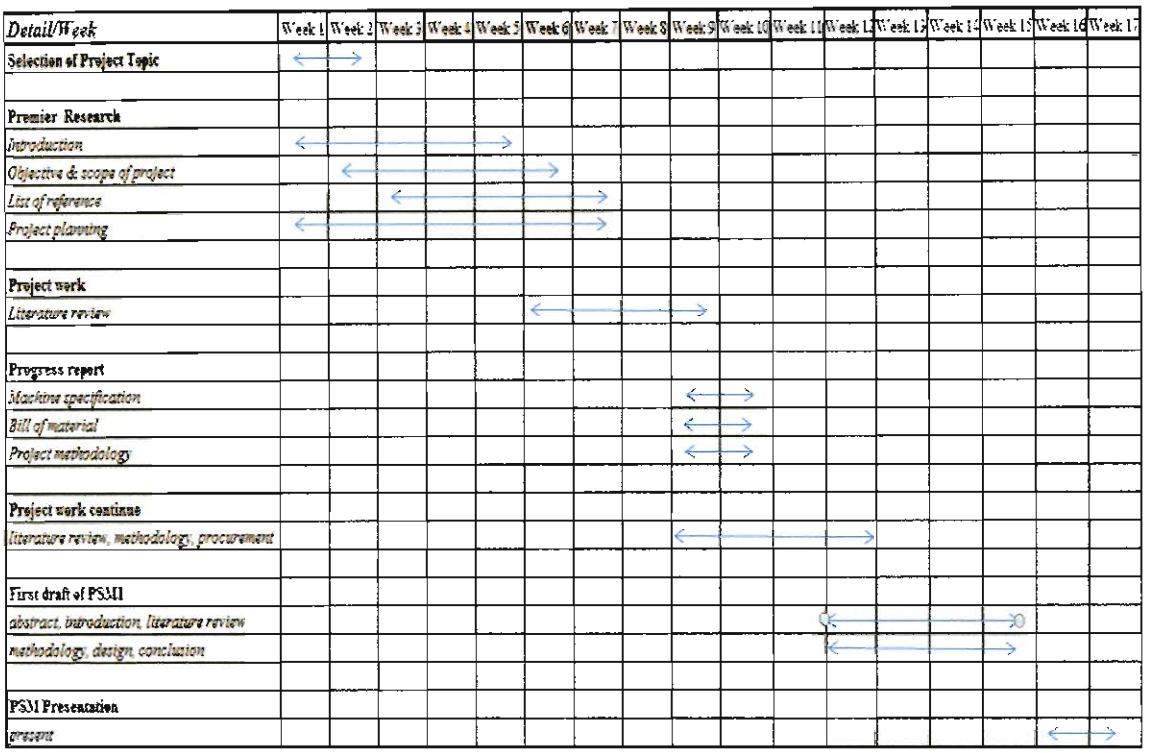
Robotics can be defined to mean the intelligent and interactive connection of perception to action and planning. There are following technologies that include in general definition robotics:

a) Control, simulation, kinematics and dynamic of robot.
b) Robot mobility and navigation.
c) Man-machine interfaces
d) Advanced command and programming language for robot.
e) Sensing and perception, vision and other contact sensing system.

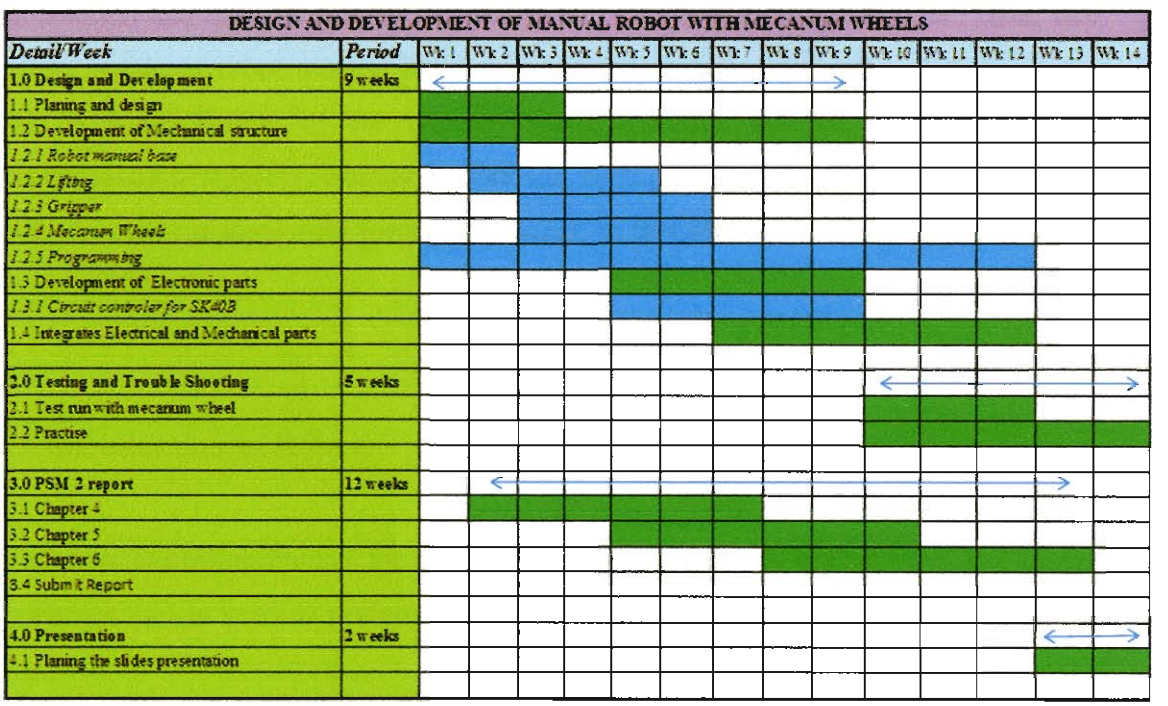
1.6 Short history of Robot

The history of morden day robot began in 1738, where Jacques de Vaucanson builds a mechanical duck made of more those 4,000 parts. The duck could quack, bathe, drink water, eat grain, digest it and void it. Whereabouts of the duck are unknown today. Then, in 1923, Karel Capek coins the term *robot* in his play *Rossum's Universal Robots (R.U.R).* *Robot* comes from the Czech word *robota*, which means "servitude, forced labor." After that, 1940, Sparko, the Westinghouse dog, uses both mechanical and electrical components. Then, a british inventor Cyrill W. Kenward has invent a device of manipulator that can move on an 3 axis, which is X, Y , Z system. This is a one of types of robot that have in this generation.

1.7.1 Gantt Chart PSM 1



1.7.2 Gantt Chart PSM 2



CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter discusses the important elements embedded inside this project. In order to build and develop a manual robot, a lot elements that should be consider and choose that suitable with the task that given for the robot in tournament ROBOCON 2010. Starting with the mechanical structure, the material features that will be discuss for build the chassis of the robot. Secondly, this chapter explains the specification and types of actuator for the manual robot. Next, the brain or robot controller will be written in this chapter. Then it will follow up with features of the wheel, for this project manual robot it will use a type of mecanum wheel. After that, the design of the gripper will be explanation and the selection of the design will be mention in this section. Then, next feature inside of robot manual is the communication between robot and the operator. This is a description of the types of communication that used such ass, serial communication wireless, Bluetooth. The last subtopic or section is the similar project with this robot manual with mecanum wheels, in this section were have a features and design of the robot.

2.1 Introduction to Robots

A robot is electromechanical system and an artificial agent. A typical robot has several properties and is used to perform several tasks such as, used in the military training,

keeping the house clean and many other tasks. The main components of a robot include battery, motor, programmable chip, circuit boards, sensors, LEDs, chassis, microcontrollers, wheels and the other electronic components. There are many algorithms that are used to control the movements of the robots. The programmable commands are used to picking up the objects, moving forward, backward, upward or downward. The most commonly used robot configurations are articulated robots, SCARA robots and Cartesian coordinate robots, (x-y-z robots). There are two types of robots, Autonomous and manual robots.

2.1.1 Mobile Robots

The word robot in everyday language is applied to a machine which can manipulate automatically transactional and manual work. For this purpose a robot needs to be programmed by a human, a program which is stored in his memory.A mobile robot is an automatic machine that is capable of movement in a given environment. Mobile robot can be known as autonomous of robot category because robot can perform desired tasks in any kind of environments without continuous human guide. There are many categories of mobile robot such as manual remote, line-following robot, autonomously guided robot and sliding autonomy.

2.1.2 Manual Robot

A manual robot can be recognized as robot that fully control by human guide. The features of manual robot are same with autonomous robot. But the different between these robots is the manual robot will have interface between the robot and operator. Human will control the robot hundred percent by using a controller or teach pendent. Manual robot cannot perform in automatic, which is the robot are programmed to move by command from human or operator.

2.1.3 Elements of Manual Robots

There are five major elements that have to focus in term to develop of robot. These five elements are the features of manual robot. Each element has their own propose and function in robot. In this section, it will discuss a definition and types of each element that can be used to design and develop a new robot manual.
The elements that have inside of manual robot are:

a) The brain or robot controller

The most important element for the robot is the robot controller. All the decision operation for the robot such as programming, the calculation of algorithm is located inside the robot controller. Usually for the robot controller it builds in a circuit that include of Microcontroller for the brain.

b) Power Source

To active the electronic and electric component inside the robot, must have a power source. Therefore, there a lot of several of power source can be used to active the components. For the example is a battery or solar system.

c) Actuator

Robot generally have a actuator to make the robot can move and do task. There are types of actuator that commonly can be used for the robot.

d) Body or structure of robot

The structure of robot is including with the base or chassis of robot. Beside that, it also represent of the mechanism that are used inside the robot. These mechanisms are base on the design of robot.