

DEVELOPMENT OF ALL-TERRAIN ROBOT USING
LEGGED MOTION FOR MILITARY PURPOSE

MOHAMMAD FIRDAUS BIN AHMAD
B050810063

UNIVERSITI TEKNIKAL MALAYSIA MELAKA
2011



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**DEVELOPMENT OF ALL-TERRAIN ROBOT USING LEGGED
MOTION FOR MILITARY PURPOSE**

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

by

MOHAMMAD FIRDAUS BIN AHMAD

B050810063

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DECLARATION

I hereby, declared this report entitled “Development of All Terrain Robot Using Legged Motion for Military Purpose” is the results of my own research except as cited in references.

Signature :
Author's Name : Mohammad Firdaus Bin Ahmad
Date : 19 Mei 2011

APPROVAL

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

.....

Supervisor

ABSTRAK

Pembangunan robot berkaki telah menjadi sangat popular dalam dunia robotik. Roda berfungsi baik di permukaan yang tersedia seperti rel dan jalan, tetapi berprestasi buruk ketika berada pada permukaan yang lembut atau tidak rata. Dengan demikian, robot berkaki adalah lebih sesuai terutama dalam bidang ketenteraan. Tujuan projek ini adalah mereka dan membangunkan sebuah robot untuk semua permukaan untuk tujuan ketenteraan menggunakan gerakan kaki. Tiga rekaan konseptual telah dicadangkan. Rekaan yang terbaik yang menggunakan empat kaki dipilih dengan menggunakan kaedah Pugh. Perisian MPLAB digunakan untuk memprogramkan pengawal mikro PIC 16F877A. Setelah menyambung bahagian mekanikal, elektrik dan program, mekanisma yang siap sepenuhnya akan diuji. Keputusan kajian menunjukkan bahawa sasaran projek tercapai dengan robot mampu bergerak di atas permukaan lantai. Tetapi robot sangat susah untuk bergerak di atas permukaan pasir dan rumput. Cadangan untuk mengatasi masalah ini adalah untuk merekabentuk semula badan dan kaki dan penstrukturan semula program untuk gerakan robot.

ABSTRACT

Developments of legged robots are becoming more popular in the robotics world. Wheel excel on prepared surfaces such as rails and roads, but perform poorly when the terrain is soft and uneven. Thus, a legged mobile robot is most suitable especially for military application. The aim of this project is to design and develop an all-terrain robot for military purpose using legged motion. Studies from the previous similar projects had been carried out to gather information for the design and development of this project. Three conceptual designs were proposed. The best design with four legs is selected using the Pugh Method. MPLAB software is used to program the PIC 16F877A microcontroller. After interfacing the mechanical, electrical and programming elements, the full working mechanism is tested. Results show that the project target is achieved as the robot is able to move on the floor surface. But it can hardly move on grass and sand surface. Recommendations to overcome the problem are to redesign the robot based and it legs and restructures the programming for the robot movement.

DEDICATION

Special thank to my beloved father, Ahmad Bin Bab and my mother, Siti Noraini Binti Hashim who very concern, understanding and supporting me. Also special thanks to my supervisor, Madam Syamimi Binti Shamsudin for her constructive guidance, encouragement and patient in fulfilling my aspiration in completing this project. Without all of you, the work and all the success never been achieved.

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CHAPTER 1

INTRODUCTION

The first chapter consists of background study, problem statement of the project, project aim and objective, research, scope, project planning, expected outcomes and chapter conclusion.

1.1 Background

Manufacturing is a wealth-producing sector where it helps the economic on some of the major country in the world. It produces a finish-good product or service that can be use by human kind. Discussion about the manufacturing will have people relate it with use of machines and tools. In earliest century, the finish-good of service and product are produce manually handle by artisan. But nowadays, manufacturing world is conquering by machine that function semi-auto and fully automatics. Application of robots also involve in manufacturing especially using mobile robot.

Most of the robot is designed to be helping hand task. It help human in work that would be difficult, unsafe, assembly product, inspect part, welding and many more.

Mobile robots now are use in many departments. As an example, mobile robot call Automated Guide Vehicle is use in factory. It can carry and supply an equipment and tool to operator based on programming that install and applied in it system. In hospital, mobile robots are use in serving medicine to patient.

At this moment we can conclude that application of mobile robot are used worldwide in many sector.

1.2 Problem Statement

There is a need for a type of vehicle or platform that can travel in difficult terrain where an existing vehicle cannot go. Legged robots are very useful in tasks such where conventional wheels have difficulty to perform. Wheels excel on prepared surfaces such as rails and roads, but perform poorly when the terrain is soft and uneven. This problem is crucial when application of robot is applied in military purpose where uneven terrain exists (Raibert 1986).

The developments of new systems or products are usually born out of occurring problems. It also happens in development of mobile robot especially for military purpose. The use of mobile robot in military is to replace human for dangerous and hazardous environments such as bomb disposal tasks. In military, there is a lot of environment and uneven terrain where soldiers have to work with or without machines. Most of the military machines or transportation available use wheels as locomotion (ROBOTS 1986).

For the case of military robots, locomotion is the most important aspect. A lot of environment and uneven terrain must be traversed by the robot. The problem that occurred is the need for a machine that can perform on all-terrain. It is because most military tasks are on all-terrain that consists of hard ground and soft ground. Sometimes at this type of ground it consists of grass, sand/soil and mud. This can occur slip problems. So suitable

locomotion is an important aspect to consider. When the need for that kind of vehicle appears in military, the mobile aspect must be analyzed (Raibert 1986).

Through research and development for this project, this problem will be overcome and can give a significant contribution to the user especially to the military development in Malaysia.

1.3 Project Aim and Objective

This project aims to produce an efficient and suitable locomotion of an all-terrain robot platform to carry out military operation using the legged motion.

To fulfill the project aim, there are three objectives have been line up and must be achieved:

- a) To design and develop the mechanical structure of legged motion platform of a mobile robot suitable for terrain grass, sand and floor for military purpose.
- b) To develop the electrical and electronic circuit embedded with PIC16F877A as the microcontroller.
- c) To interface between the hardware and programming software in order for robot to successfully perform its specified tasks.

1.4 Scope

This project will focus on the design and development of a legged robot. It also includes the programming of the PIC microcontroller. Design and development of the structure and circuit for this robot will covered in this project. The application of the robot at all-terrain that consists of grass, sand and soil will carry out in this project specifically for an autonomous robot. Robot design for terrain that consists of water is not covered in this project.

1.5 Expected Outcomes

Through the research and development carried out research, the expected outcome is:

- a) Achieved the project aim and objective.
- b) Develop robot using legged locomotion.
- c) The robot can function in it's defined of environment scope.

1.6 Project Planning

The chart shown in figure 1.0 and figure 1.1 illustrate the planning work for this project.

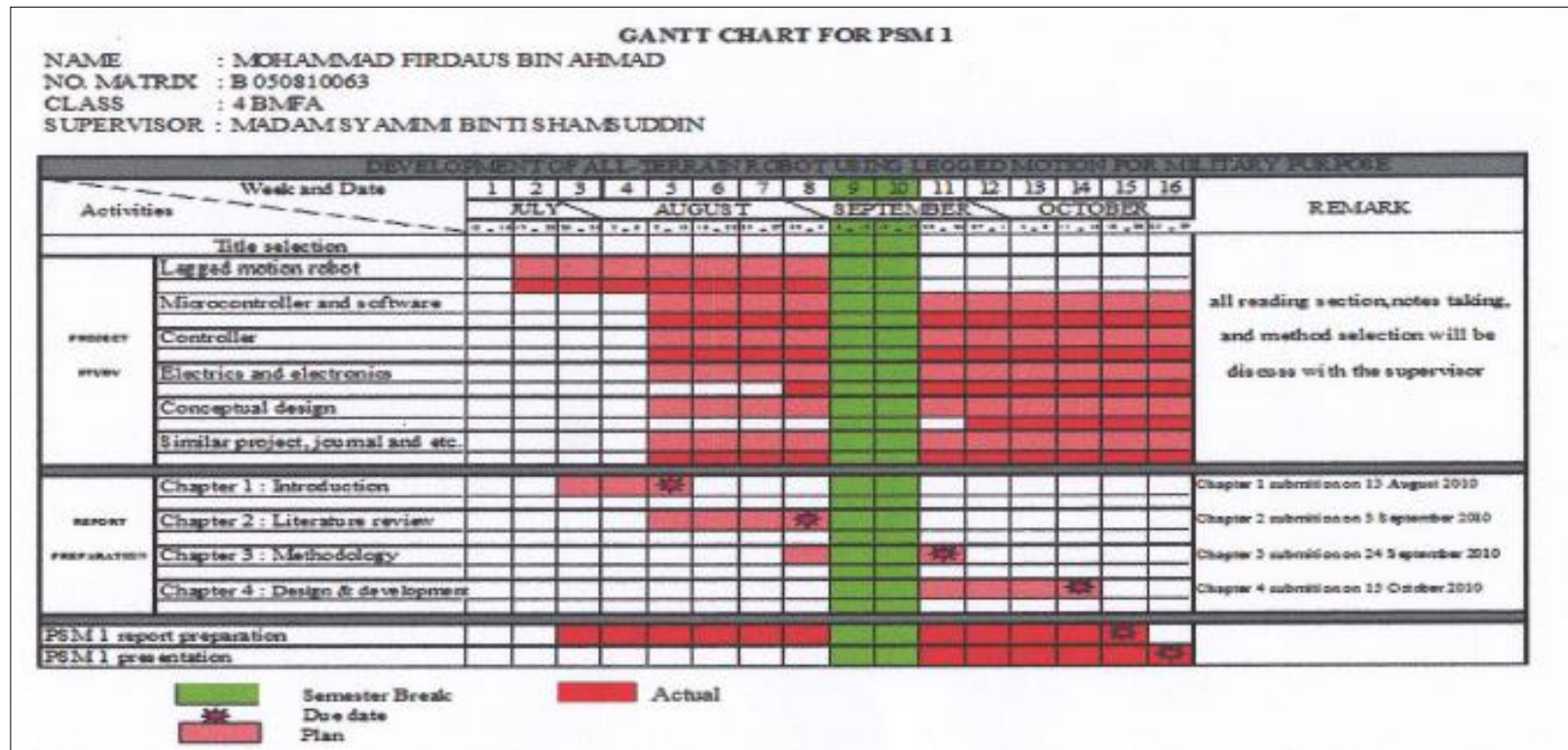


Figure 1.0: Gantt Chart for PSM 1

GANTT CHART FOR PSM 2

NAME : MOHAMMAD FIRDAUS BIN AHMAD
 NO. MATRIX : B 050810063
 CLASS : 4 BMFA
 SUPERVISOR : MADAM SYAMM BINTI SHAMSUDDIN

Week and Date		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	REMARK
Activities	Week and Date	JAN				FEB				MAC				APRIL				
		Planning Work																
PROJECT DEVELOPMENT	Design/development circuit																	
	Design/development mechanical																	
	Programming construction																	
	Assembly all mechanism																	
	Troubleshooting																	
	Testing and gather result																	
REPORT PREPARATION	Chapter 4 : Design and Development																	
	Chapter 5: Result and Discussion																	
	Chapter 6 : Conclusion Recommendation																	
	Checking section for all chapter																	
PSM 2 report preparation																		
PSM 2 presentation																		

 Actual
 Due date
 Plan

Figure 1.1: Gantt Chart for PSM 2