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

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

by

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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.

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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 gerakkan 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 bahagia mekanikal, elektrikal 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 utnutk bergerak di atas permukaan pasir dan rumput. Cadangan untuk mengatasi masalah ini adalah untuk merekabentuk semula badan dan kaki dan penstrukturan semula program untuk gerakkan 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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TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURES

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 of 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. Wheel excel on prepare surface such as rails and roads, but perform poorly when the terrain is soft and uneven. This problem be crucial when application of robot is applied in military purpose where uneven terrain exists (Raibert 1986).

The developments of new system 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 environment such as bomb disposal task. In military, there a lot of environment and uneven terrain where soldier have to work with or without machine. Most of the military machine or transportation available use wheel as locomotion (ROBOTS 1986).

For the case of military robots, locomotion is the most important aspects. A lot of environment and uneven terrain must robot through. The problem that occurred is the need of machine that can perform at all-terrain. It is because; most military task is at all-terrain that consists of hard ground and soft ground. Sometimes at this type of ground it consists of grass, sand/soil and muddy. This can occurred slip problem. So suitable

locomotion is important aspect to considerate. When the need of 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 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.

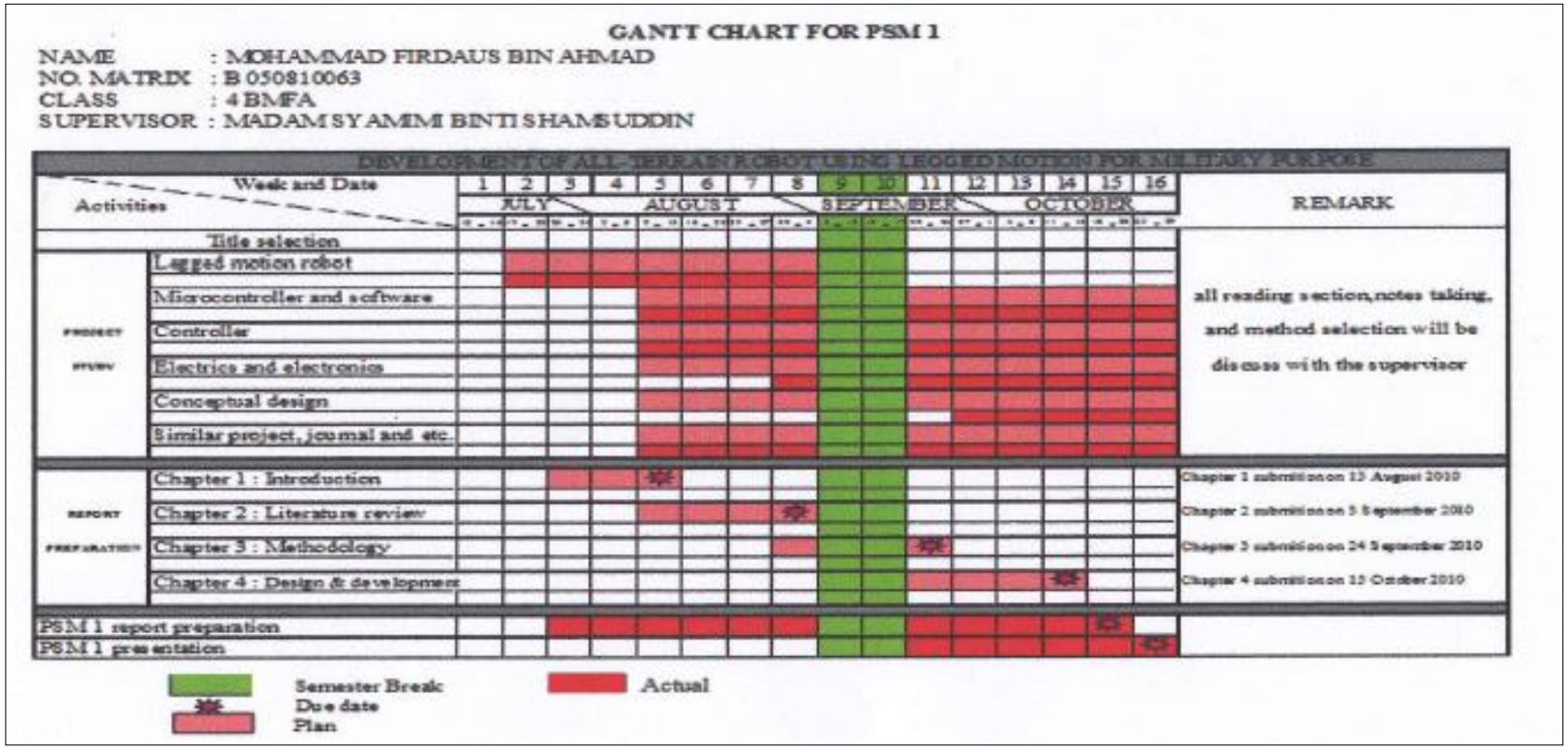

Figure 1.0: Gantt Chart for PSM 1

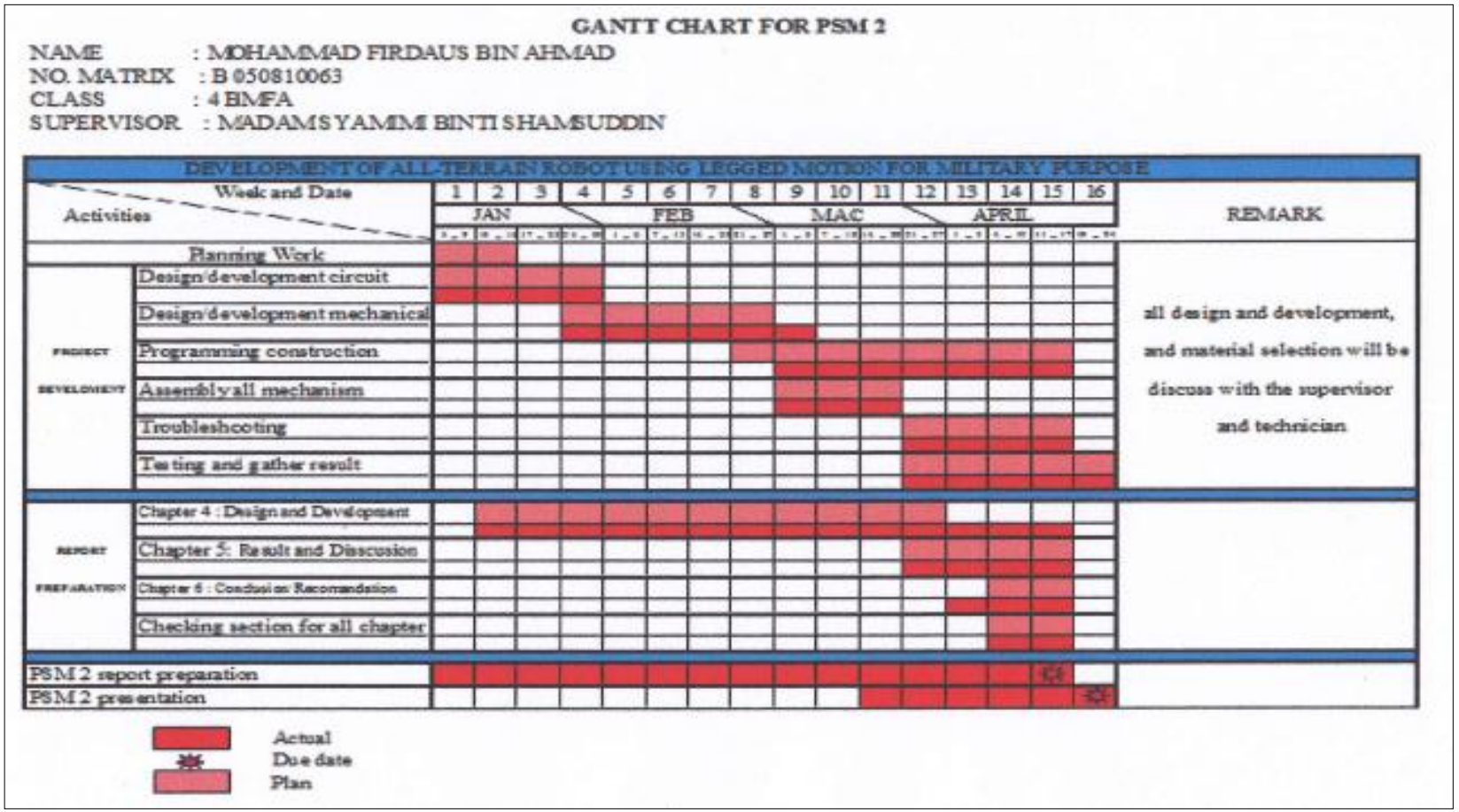

Figure 1.1: Gantt Chart for PSM 2