UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF 6 LEGGED HEXAPOD ROBOT (CH3 – R) BODY KIT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering Technology (Product Design) (Hons.)

by

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I hereby, declared this report entitled “Development of 6 Legged Hexapod Robot (CH3 – R) Body Kit” is the results of my own research except as cited in references.

Signature	:	…….
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Date	:	15 December 2014

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Product Design) (Hons.). The member of the supervisory is as follow:

……

(Engr. Hassan Bin Attan)

ABSTRAK

Robot berkaki telah berkembang dengan cepat dari tahun ke tahun sejak tahun 1990 lagi. Robot berkaki ini telah berkembang daripada mempunyai satu kaki sehingga ke 6 kaki, malah kini robot telah berkembang kepada “hybrid” malah robot juga telah boleh terbang. Robot mengandungi banyak komponen sensitif seperti komponen elektronik, wayar, bateri dan banyak lagi untuk memastikan robot sentiasa berfungsi dengan baik. Hal ini telah menjadi masalah kerana komponen dalaman dalam robot memerlukan perlindungan. Tujuan utama projek ini adalah untuk mereka bentuk satu penutup yang sesuai dan menarik untuk “6 Legged Hexapod Robot (CH 3 - R)”. Penutup badan ini akan melindungi komponen dalaman di dalam robot itu untuk memastikan robot boleh berfungsi dgan baik tanpa ada sebarang halangan. Reka bentuk penutup badan ini juga akan mengambil kira tahap kebebasan atau jenis pergerakan robot itu sendiri. Ini perlu kerana reka bentuk penutup badan perlu mengelakkan daripada mengganggu mana-mana komponen dalaman atau bahagian luar robot apabila robot itu bergerak. Dalam kajian selanjutnya projek ini boleh diperbaiki dimana reka bentuk penutup badan ini boleh dimuatkan ke dalam mana-mana robot yang mungkin mempunyai casis luar yang sama.

ABSTRACT

Legged robot has growing up fast from year to year since the year 1990. The legged robot has evolved from having one leg up to 6 legs, even now the robot have evolved into hybrid or even into flying robot. A robot may contain a lot of sensitive component such as electronic component, wire harness, battery and many more in order to make sure the robot stay functioning. This issue has become a problem because the interior component of the robot needs a proper protection. The aim of the project is about to design a suitable and attractive body kit for 6 Legged Hexapod Robot (CH 3 – R). This body kit will protect the interior component inside the robot itself to make sure the robot can stay functioning. The design of the body kit also will take into account the degree of freedom or even the type of movement of the robot itself. This is because the design of the body kit needs to avoid from disturbing any component interior or even the exterior of the robot when the robot are moving. In further studied this project can be improved into the design of the body kit can be fit into any robot that may have same exterior chassis.

DEDICATION

I dedicate this thesis to the most important person in my life which is my parent, to the supervisor and to my friend. To the Faculty of Engineering Technology of University of Teknikal Malaysia Melaka (UTeM) also I dedicated this thesis.

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In the Name of Allah, the Most Merciful, the Most Compassionate all praise is to Allah S.W.T, the Lord of the worlds; and prayers and peace be upon to Muhammad S.A.W, His servant and messenger.

First and foremost, I must acknowledge my limitless thanks to Allah, the Ever Magnificent; the Ever Thankful, for His helps and bless. I am totally sure that this thesis would have never become truth, without His guidance.

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I also would like to express my wholehearted thanks to my familyfor their generous supportthey provided me throughout my entire life and particularly through the process of pursuing the master degree. Because of their unconditional love and prayers, I have the chance to complete this thesis.

Last but not least, 1 would like to take this opportunity to say warm thanks to all my beloved friendswho have been so supportive along the way of doing my thesis.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

DOF	-	Degree Of Freedom
STL	-	Standard Tessellation Language
IGS	-	Initial Graphics Exchange Specification
CAD	-	Computer-aided design
2D	-	Two Dimension
3D	-	Three Dimension
CATIA	-	Computer Aided Three-dimensional Interactive Application
WRP	-	Geomagic three dimension Wrap File

CHAPTER 1
INTRODUCTION

1.1 Background

Since the first robot been built in 1968, “Phony Pony”, the robotic technologies have booming to the achievement that can ever be dreamed off. Nowadays there are lot type of robot such as walking, mobile, hybrid and even flying robot. Many of this robots used in different type of area such as military which is used to spy on enemy, research, manufacturing and many more

Walking robot are one of the most used robot in many area, this is because this type of robot can walk on many type of surface. The technologies of walking robot start in applying the concept of walking animals such as 4 legged animal, horse, cow and etc. After that the technologies have evolve to another step which are designing 6 legged robot, then, finally the technologies have boomed to 2 legged robot which copying the concept of human.

6 legged robot applying the concept of insect in the walking system such as spider. The 6 legged robots contain a body which is basically round and have 6 legs around the body. This type of robot normally used for research because of the walking concept itself. The 6 legged robots can walk on different type of surface such as rocky, puddle desert and many more. These advantages make this robot a perfect robot to research in mountain, jungle and etc.

This 6 legged robot walk by using the concept of ripple gait which is 2 legs will move at the same time and another's 4 legs will stand. This concept of walking make the 6 legged robot move faster than using other concept. This kind of movement is exactly same with movement of the spider.

There are 6 motor that controlling each legs of the robot. The motor is located inside on the top of the legs and controlled by DC motor located on the body of the robot.

1.2 Problem Statement

Nowadays, robots have become one of the families of the society. Robots have been used in house, industries, military and many other places. People tend to use the robot than do it by him/her self although in small or simple activities such as cleaning.

Walking robot contains a lot of electronic device and wires that need a proper protection in order to make sure the robot stay function properly. The 6 Legged Hexapod Robot (CH3 – R) is a robot does not have a casing or body kit to protect the wiring and electronic component inside the robot. This robot only has a skeleton chassis to protect their component.

This wire harness for the 6 Legged Hexapod Robot (CH 3 – R) also need a proper arrangement since the chassis of the robot does not prepare a route or compartment for the wire harness. This will cause the wire to scatter all over the chassis.

The 6 Legged Hexapod Robot (CH 3 – R) also does not have a compartment for battery. The user can assemble the battery anywhere on the robot. This will make the battery may be misplaced when the robot are moving. The design of the 6 Legged Hexapod Robot (CH 3 – R) also is simple and not so attractive.

The idea for solution is designing a body kit that covers all the component of the robot without affecting the degree of freedom or the component of the robot itself. With this body kit, the electronic component can be protected from any danger that may damage the robot.

1.3 Objectives

To ensure this invention properly runs towards the goals and requirement, the objectives of this invention are as below:

- To design a suitable body kit concept for 6 legged hexapod robot (CH 3 – R)
- To apply the reverse engineering approach for a 6 legged hexapod robot(CH 3 – R) to generate 3d modeling
- To design a compartment or battery holder for 6 legged hexapod robot (CH3 – R)
- To design and compartment for wire harness for the 6 Legged Hexapod Robot (CH 3- R) robot to make sure the wire harness not clutter

1.4 Scope of Project

In this project, in order to make sure the electronic component and wiring for the CH3 – R robot stay protected without damaging other component and movement, the design of the body kit will focusing on the degree of freedom of the robot.

The robot contains 6 degree of freedom that need to be considered when designing the body kit. This degree of freedom is very important to the robot because it affecting the main function of the robot which is walking. This robot can move in any direction, straight, backward, right and even to the left. The design of the body kit of the robot needs to consider that movement and not blocking any degree of freedom of the robot.

This type of robot walks by using concept of movement of the spider. This type of walking is been called as Tripod gait which is 3 legs move at the same time 2 on the left and 1 on the right or the opposite ways. This design will focus this type of movement so that the design will not block the walking procedure of the robot itself.

CHAPTER2
LITERATURE REVIEW

These chapters contain important information that is relevant to the 6 Legged Hexapod Robot (CH 3 – R) such as the degree of freedom, Type of movement, Patent and many more. All the previous study and research will help and support when designing and assembling the for the 6 Legged Hexapod Robot (CH 3 – R).

2.1 Degree of Freedom

2.1.1 Introduction of Degree of Freedom (DOF)

Based on Yu (1997) in his book "Illustrating degrees of freedom in terms of sample size and dimensional" state that the degree of freedom is an intimate stranger to statistics students. In other word, based on Jack Good's, (1973) in his article "What are Degrees Of Freedom" clams that the degrees of freedom is a difference in dimensionalities of parameter spaces.

2.1.2 Degree of Freedom in Robotic Area

According to the Larry Ross in his book "Robotics: Theory and Industrial Application, 2nd Edition" Degrees of freedom (DOF) is a term used to describe a robot's freedom of motion in three dimensional space specifically, the ability to move forward and backward, up and down, and to the left and to the right. The movement of robot is consider a degree of freedom. The robot will contain a lot of degree of freedom if the robot can move on many axis even rotate on the axis.

As a rule, you need one motor for each degree of freedom that you want to achieve, according to the Introduction to Robotics. The motor will control the each type of movement for the robot. There are 3 type of movement which is yaw, pitch and roll. Larry Ross and his friend also claims that, the pitch, or bend, is the up-and-down movement of the wrist. The yaw is the side-to-side movement, and the roll, or swivel, involves rotation.

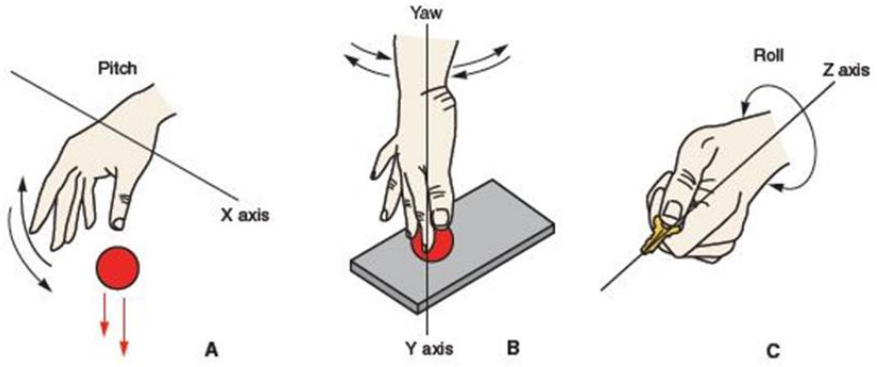

Figure 1: Type of rotational movement of hand (Degree of Freedom)

There are also different types of movement or degree of freedom, which is traverse movement. Based on Larry Ross, in his book, there are 3 kind of traverse movement, which is rotational traverse is movement on a vertical axis. This is the side-to-side swivel of the robot's arm on its base. The radial traverse is the extension and retraction of the arm, creating in-and-out motion relative to the base. The vertical traverse provides up-and-down motion.

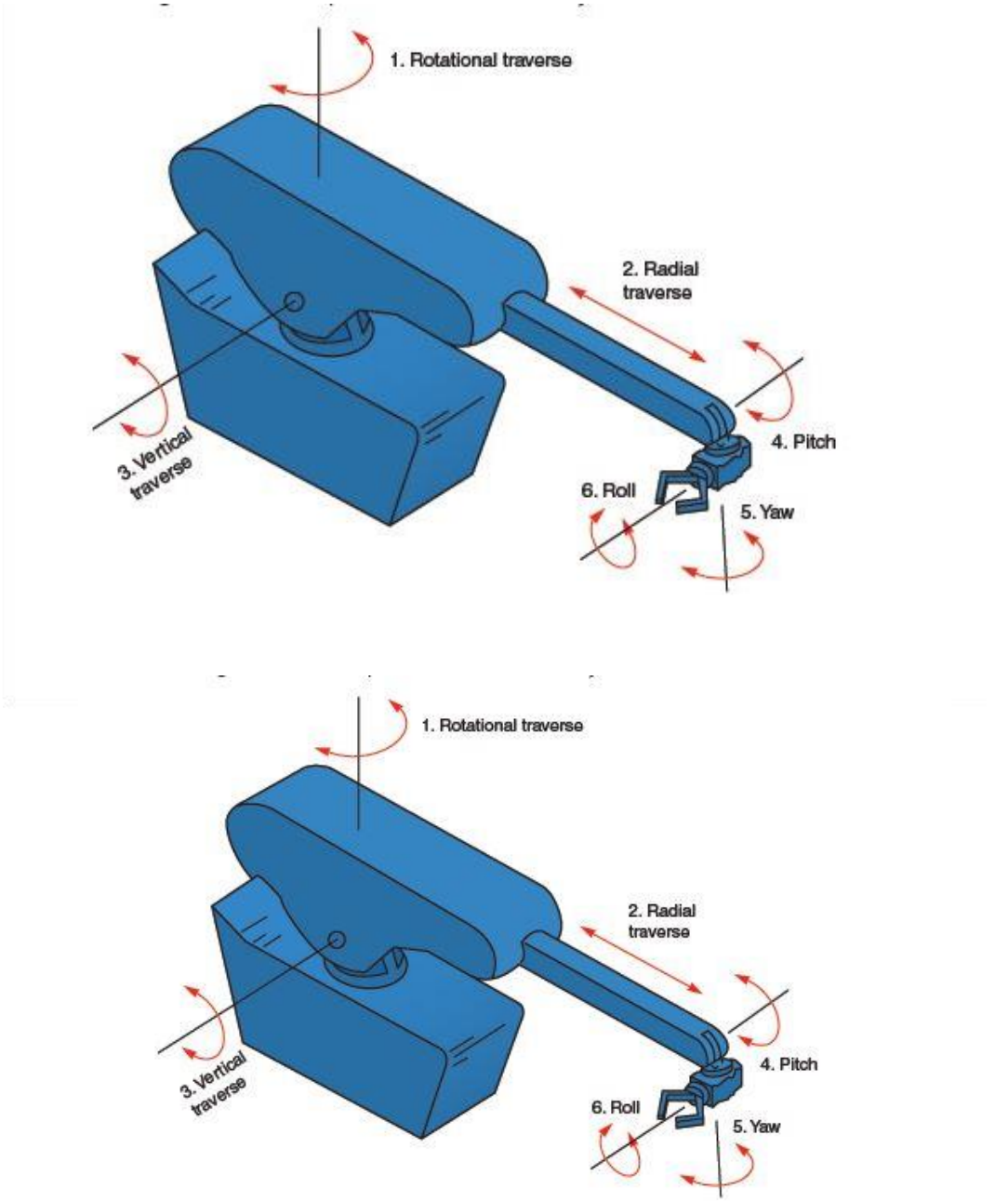

Figure 2: Example of degree of freedom in a hand robot.

2.2 Motion of Robot

2.2.1 Introduction of Robot Motion

According to G. Clark Haynes, in his article, “Gaits and Gait Transitions for Legged Robots” claims that a gait is a cyclic motion pattern that produces locomotion through a sequence of foot contacts with the ground. G. Clark Haynes also says that the legs provide support for the body of the robot while the forces resulting from ground contact propel the robot. Gaits can differ in a variety of ways, and different gaits produce different styles of locomotion.

In other word, Josep M. Porta in his thesis “Gait Analysis for Six-Legged Robots” says that a gait is a state of the robot defined as a function of few last executed steps. In simple word, what Josep trying to say that a gait is, the concept of movement for the legs will become a function and can be analyze to further study.

There are also a writer how says that a gait is a sequence of leg motions coordinated with a sequence of body motions for the purpose of transporting the body of the legged system from one place to another. The writer named as EmreKaralarli in her thesis entitled as “Intelligent Gait Control of a Multi legged Robot Used in Rescue Operations”

As a conclusion, a gait is a sequence or type of concept movement for the legs of the robot to move from one place to the other place.

2.2.2 Type of Hexapod

Firstly, based on the Xilun Ding, in her article, "Locomotion analysis of hexapod robot" claim that there are 2 type of hexapod robot. She said typical hexapod robots could been classified into rectangular and hexagonal ones .Rectangular hexapods inspired from insects have six legs distributed symmetrically along two sides, each side having three legs. Hexagonal hexapods have six legs distributed axis symmetrically around the body (that can be hexagonal or circular). In simple word, Xilun Ding says that there are 2 type of hexapod robot which is Circular base and Hexagonal base. This concept will be explain detail in this figure.

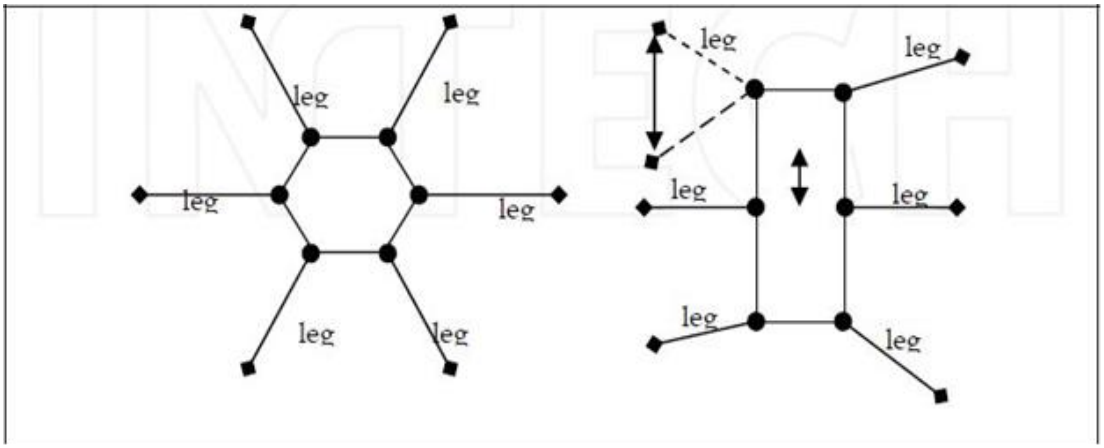

Figure 3 : Type of Hexapod Robot

In this project, we will focus on the circular hexapod robot. However, for the case of this gait study will be focusing on both concept of hexapod robot. This is because the type of gait is just the same for both circular and hexagonal hexapod robot.