PNEUMATIC CONTROL OF SIX LEGGED ROBOT

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PNEUMATIC CONTROL OF SIX LEGGED ROBOT

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

by

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation) with honors. The member of the supervisory committee is as follow:

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EN. KHAIROL ANUAR BIN RAKIMAN

ABSTRACT

In this project, the primary objective is to design and develop a pneumatic control system for six leg insect walking robot. Usually, insect walking robot such as hexapod use stepper motor to move their legged and show the sequence that it's made. The locomotion of walking robot is more important to any robot no matter for insect robot, wheel robot or bipedal walking such as in term of the number of possible gaits and degree of freedom (DOF). The is a lot of work executed to develop six legged robot that pneumatically control which are fabrication of body part, programming of PLC and testing were carried out after assembly have been made. At the end, it was produce a result which this six legged robot is able to operate by using pneumatic system and controlled by using programmable logic circuit (PLC) control system. Furthermore, this six legged robot is able to follow the gaiting system that have been stated which is tripod gait by using the method of fabrication, programming, assembly and testing. There are several limitation in this project during execution of project which are time, project budgets and improper standard operating procedure. To make improvement and future work for this six legged robot, an improvement need to give more attention on improvement this project servo motor so that this six legged robot is able to move forward and backward. For the extra improvement, the placement of sensors can be considered where this robot able to detect obstacle where it can protect the six leg robot from damaged. Pneumatic system is applied and show the ere mechanism sequence how it work or move. In order to keep insect walking robot in smooth motion there is necessary to develop structured pneumatic control system circuit in term of sequential and logic criteria. The robot controller uses tripod gait for their movement. Numerous works focused on six leg insect walking robot fabrication of mechanical part and complete design of pneumatic control circuit by using PLC system.

ABSTRAK

Dalam rancangan ini, objektif utama adalah untuk mempelajari dan merancang suatu sistem kawalan pneumatik untuk robot serangga enam kaki yang berjalan. Kebiasanya, robot serangga berjalan seperti hexapod menggunakan motor stepper untuk menggerakkan kaki dan menunjukkan pergerakan yang dibuat. Pergerakan robot berjalan lebih penting bagi setiap robot tidak kira sama ada robot serangga, robot berkaki dua roda atau berjalan seperti dari segi jumlah gaits dan darjah kebebasan (DOF). Terdapat banyak kerja yang perlu dilakukan untuk robot enam kaki ini dimana ia dikawal oleh sistem pneumatik dimana fabrikasi bahagian badan, aturcara PLC dan ujian telah dilakukan selepas selesai pemasangan. Diakhir projek ini, ia telah menghasilkan keputusan dimana robot enam kaki ini mampu beroperasi dengan menggunakan sistem pneumatik dan dikawal oleh sistem PLC. Selain itu, robot enam kaki ini boleh mengikut sistem berjalan yang telah dinyatakan iaitu gaya berjalan 'tripod', dengan mengikuti proses fabrikasi, aturcara, pemasangan dan ujian terhadap robot enam kaki. Terdapat beberapa had dalam projek ini, antaranya adalah masa, bajet projek dan prosedur operasi standard yang tidak betul. Untuk penambahbaikan dan kerja masa akan datang untuk robot enam kaki ini, perlu lebih fokus kepada penambahbaikan servo motor projek ini jadi robot ini dapat bergerak ke hadapan dan kebelakang. Untuk penambahbaikan tambahan, pemasangan sensor digalakkan dimana robot ini dapat mengesan halangan dihadapan sejurus dapat mengelakkan dan melindungi robot dari kerosakan. Untuk membuat pembaikan untuk robot ini, sistem pneumatik akan digunakan dan menunjukkan pergerakan mekanisma bagaimana ia bekerja atau bergerak. Dalam mereka rangka robot serangga berjalan dalam keadaan lancar, litar kawalan pneumatik diperlukan dari segi pergerakan dan kriteria logik. Sistem kawalan robot menggunakan cara berjalan jenis tripod gait. Kebanyakan kerja yang dilakukan terutama kepada fabrikasi bahagian mekanikal dan menyelesaikan rekabentuk litar kawalan pneumatic dengan menggunakan system PLC.

DEDICATION

Specially dedicated to my beloved father, NORIDAN BIN TURIMAN and my beloved mother, SERI MARZALINDA BTE KERYA who had been so consistently and patiently supporting me in this research. Besides that, I also dedicated all of this to all of my beloved siblings, lecturers and colleagues who interested in this research.

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LIST OF ABBREVIATIONS

PSM - Projek Sarjana Muda

UTeM - Universiti Teknikal Kebangsaan Malaysia

PLC - Programmable Logic Controller

CX-One - Programming software

AC - Alternate current

DC - Direct current

2D - 2 Dimensional

3D - 3 Dimensional

CAD - Computer Aided Design

DCV - Directional Control Valve

SOL - Solenoid

COM - Electrical grounding

CHAPTER 1

INTRODUCTION

This chapter provides a review about the project entitled “pneumatic control of six legged robot”. These including an overview of the concept of these project. Background study, problem statement, objectives and scopes of these study are discussed in this following segment.

1.1 BACKGROUND OF STUDY

Generally, robot was designed to transfer or move materials, parts and tools and also perform a complete and variety task in manufacturing and production settings. They also perform duties that are dangerous or unsuitable for human worker. Robot are also automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes and degree of freedom. There are several types of robot which they are mobile robot, industrial robot, remote-controlled robot, humanoid robot and last but not least is autonomous robot which all of them have their own function.

Pneumatic control of six legged robot, it is actually a small walking machine which have 6 legged, where 3 legged for each side. These machine basically use a system that can move it. There are many ways for a robot to move. Hydraulic and pneumatic are two common system options.

In these project, pneumatic system are used to move the robot. Actuators and pneumatic controllers are critical for automated applications on account of their huge force yield and moderately low cost. Likewise, pneumatic controllers are perfect and light-weight. These make pneumatic activation has turned into a moderate substitute for electrical actuation unique versatile computerized reasoning applications. Pneumatic actuation has an essential point of preference over electromechanical activation in light of the fact that solidness of the joints can be controlled effectively by the pressure of the compressed air connected to the cylinder. Truly autonomous, untethered robots need to deliver their own compacted air from exceptionally constrained on-board assets, in this manner expanding weight, requiring space, and expending vitality. Pneumatic systems require a sources of compressed air, various valves, and control strategies for those valves.

1.2 PROBLEM STATEMENT

Though there has been much research work done in the area of machine walking, as discussed in the literature review, there is a lot of work to be done in achieving a walking behaviors for machines. This means that there is a gap in our knowledge on how exactly humans and animals achieve walking. So, every little step towards achieving walking robot for machine is important. We can divide the machine walking into two main groups based on biologically inspired walking and they are:

a) Humanoid walking research that tries to implement the walking behavior of humans in machines
b) Animal walking which tries to mimic the behaviors of animals with different number of legs in machines

From the two above, the research in animal-like walking for machines further divides into main streams such as four legged, six legged, and eight legged walking machine research. Our research focuses on a six legged machine. Though there is an extensive amount of research in six legged walking robot.

1.3 OBJECTIVE

1. To design a six legged robot by using pneumatic system and controlled by the programmable logic circuit (PLC) system.
2. To develop a prototype of six legged robot by using method of fabrication, programming, assembly and testing that can follow the tripod gait.

1.4 SCOPE OF STUDY

1. To design an interactive insect walking robot simulation by using CATIA V5.
2. To identify the suitable gaiting system for insect walking robot.
3. To develop and design the programming and pneumatic control circuit of robot using automation studio and CX-ONE programmer.
4. To assemble and testing the component of six legged robot that using pneumatically control system.

CHAPTER 2

LITERATURE REVIEW

In this chapter will discuss and review about the design and development a prototype of pneumatic control system for pneumatic control of six legged robot by using method of design using CATIA V5, fabrication of parts, programming using PLC software which is Automation studio, assembly of component and testing.

2.1 INTRODUCTION

Mobile robots have turned out to be more valuable in this decade. Legged walking machine can work in complex regular habitats. Improvement of such machines has been constrained by actuators, power sources and control plots that can't want to rival even a portion of the "least complex" systems found in the regular world, conversely, common creatures have built up an extensive variety of means by which to locomotion through any landscape possible. Although most mobile robots are wheeled robots because of their outline and development favorable circumstances, legged robots here and there have advantages over the wheel robots particularly on normal territory. With a very much composed leg component, legged robots could navigate unlevel and unpleasant territory more viably than wheeled robots. D.J Todd (1985) expressed that they can pivot inside of a little space as well. Also, legged robots have less propensities to harm the ground than wheeled robots.