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DESIGN OF RIDDEN HEXAPOD ROBOT FOR AMUSEMENT PARK

MOHD ROSZAIMIE BIN MOHD RAMLI

This report is presented in

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"I declare this report is on my own work except for summary and quotes that I have mentioned its sources"

Signature : ……..

Name of Author : ……..

Date : ……..

Dedicated to my beloved mom and dad

ACKNOWLEDGEMENTS

First of all, my utmost thanks to Allah for everything. For the air that I breathe and for the five senses given, I am still alive with which I can see His greatness through His creation. Utmost thanks also given to Him for the honors of being born as a Muslim and for the honor of having faith in Him.

I would like to express my gratitude to En. Herdy Rusnandi whose give me the opportunity to done this project, without his supervised I can't understand about this project needed. I want to thank to my fellow friends whose help and support me from the problem arise during this project.

ABSTRAK

Pengajian yang dijalankan di dalam Projek Sarjana Muda (PSM) ini adalah berkenaan dengan mereka-bentuk Robot Tungangan Heksapod untuk kegunaan ditaman-taman tema sebagai mesin hiburan. Objektif utama dalam pengajian ini adalah untuk memastikan bahawa robot tunggangan heksapod ini boleh ditunggang oleh pengunjung-pengunjung taman tema. Selain itu, ianya ditentukan oleh konsep reka-bentuk Robot Tunggangan heksapod itu sendiri dan analisis tentang kekuatan yang dapat ditampungnya. Selain itu, pengajian ini berkehendakkan untuk mereka-bentuk sistem pergerakkan asas robot.

ABSTRACT

This outcome of Projek Sarjana Muda (PSM) study is to design a ridden hexapod robot operate as entertainment machine at amusement park. Main objective in this study would be to ensure that visitors of amusement park can be riding this hexapod robot. Apart from that, it was set by conceptual of design and any able analysis strength for critical component. Then, this study also desired to design basic maneuver of robot.

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NOMENCLATURE

FAE	Finite element analysis
CW	Clockwise
CCW	Counter Clockwise
DOF	Degree of Freedom
MAX	Maximum
NO.	Number

CHAPTER 1

INTRODUCTION

1.1 Background

This project is conducted to define a suitable design of ridden hexapod robot for amusement parks. This design is consider to the problem arise with entertainment facilities at the amusement park. Ridden hexapod robot is a robot that has six-legs to walk with a mechanical movement. It also having stabilities to stand statically better than two or three or fourth legs robots.

Ridden hexapod robot legs needs to design with a vary arrangement with typically symmetric. Furthermore, the basic movements of this hexapod robot need to design systematically with gaits control that allowed the robot to move forward, backward and turn or may be side step.

Ridden hexapod robot also designs to move on the rough terrain or off road terrain and obstacle areas efficiently. In order to design this ridden hexapod robot, the most important is to analyze the strength of the critical component due to load acting.

1.2 Problem Statement

Amusement park was visit by a lot of people year by years. The facilities of amusement park completely fulfill with the machine for entertainment. Most of this entertainment machine will design with wheel vehicle and the fix rail vehicle. It is consider to the terrain and the size of the park.

Wheel vehicle need a smooth track to run and the fix rail vehicle was ran through the rail design with the limited motion. Ridden hexapod robot is design to move on the rough terrain and as a ridden machine for entertainment at amusement park.

1.3 Objective

i. The objective require to design hexapod robot can be ride by visitors of amusement park as an entertainment machine.

1.4 Scope

There are three scopes following by:

i. Conceptual design for ridden hexapod robot.
ii. Analyze the strength of the critical components.
iii. Design the basic maneuver for ridden hexapod robot.

CHAPTER 2

LITERATURE REVIEW

Literature review of project is important to get more information through comparison from element related. For this ridden hexapod robot, the data can collected from the comparison of the hexapod robot structure, gait mechanism, actuator used, mechanical joints and torque measurement. Furthermore, data will be analyses to get accuracy in element or study before design process conducted.

2.1 Hexapod Robot Structure

The important part in designing of hexapod robot require in determination of leg structure and main body structure. Commonly the structure design of hexapod robot was refer to the biological inspiration. The concept of biological was capable to automate the hexapod robot with locomotion control of the leg to explore the ground and the flexibility in static or dynamic of hexapod robot body.

2.1.1 Body Structure

The body structure was design depending on the degree of freedom of leg characteristic. There are two basic body structure of hexapod robot, rectangular and hexagonal. Generally the hexagonal is axi-symmetric which have much gaits mechanism and easily to change the direction. According to the rectangular design, a special gait is required for turning action. Generally, it requires four steps for a rectangular robot to realize a turning action.

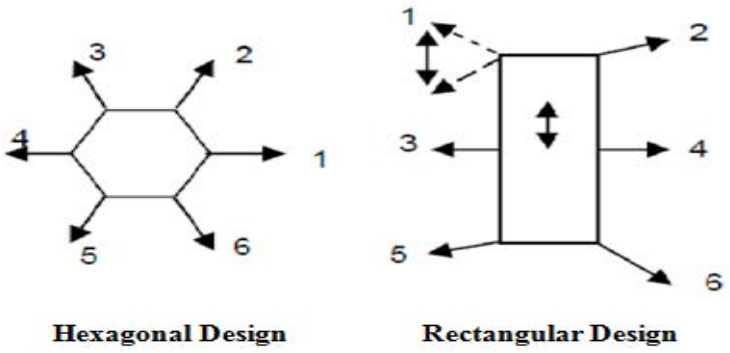

Figure 1 : General body structure of hexapod robot

2.1.2 Leg Structure.

Wheeled vehicles were excellent on a plane surfaces. However, much of the earth's surface is unsuitable for such systems. Besides that, the leg structure design needed for this hexapod robot mechanism system to clearly moving on the rough terrain.

The ground contact in hexapod robot legged system is not continuous and the leg support is obtained at discrete footholds.

In order to design a leg structure of hexapod robot, cockroach used as a model for biological inspirations. Three segments, coxa, femur and tibia, divided the cockroach leg. The coxa-femur and femur-tibia were joints together and connected by soft tissue. This implies that each joint works much like a ball and socket joint, and it can contribute to the leg compliance for the purpose of shock absorbing.

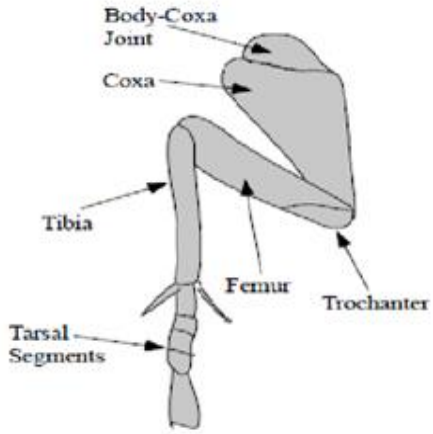

Figure 2 : Cockroach leg structure

There have three-degree-of-freedom (3DOF) for front and middle leg and two-degree-of-freedom (2DOF) for rear leg. The leg structure translated, yawing, pitching and rolling motion in response to the input. Furthermore, the insect speed range was determined on a branch of periodic gaits.

The hexapod model highlights the importance of stability in evaluating effective locomotors performance. Then, the sprawled-posture runners with large lateral and

opposing leg forces can be stable in the horizontal plane over a range of speeds. Each cockroach leg performs different function:

i. Front legs – used to push the body over the obstacles. It was important as a driver when turning and deceleration performed.

ii. Middle legs – acting as a support of the cockroach body and it also used to push the body over obstacles.

iii. Rear legs – act as a supporter of mass center and the contact point to prevent body from slipping down. It was generated the major part of the forward motion.

2.2 Biological Gait for Hexapod Robot

Cockroach legs have a symmetry arrangement which three legs arranged by row. The arrangement of cockroach leg was determined the stability in static position. By degree of freedoms, legs become a supporter device that maintains the stability when it starts moving.

The gait pattern of the cockroach was fixed on tripod gait, three legs are simultaneously swung. This walking pattern is popular in real insect world, and they can walk quickly by this pattern. The other gait is referring to the metachronal gait. metachronal gait was moving a leg gradually to move forward.

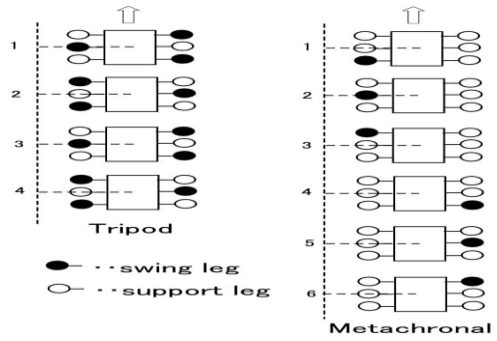

Figure 3 : Biological gaits

2.3 Hexapod Robot Actuator.

Actuator to automate mechanism of leg to walk or move should attach the hexapod robot. The actuator is a mechanical device that used for controlling and moving a mechanism system. An actuator typically a device generated by energy or power. The energy or power used to force an actuator usually created by air, electricity and liquid. The actuators usually used in mechanics mechanism are following below:

i. Pneumatic actuator
ii. Electric actuator
iii. Hydraulic cylinder

2.3.1 Pneumatic Actuator

A pneumatic actuator powered by air compressing system that convert it into motion. Pneumatic actuator generally include of a piston, a cylinder and valves. The piston was located in the cylinder that covered by a seal to keep the air in the upper part of cylinder and then allowed air pressure to force the seal downward. The pressure was moving the piston underneath and it is only have one spot for a signal input, top or bottom depending on action required.

Valve used for a signal to change the flow of compressed air in the system. Furthermore, it used to change the direction of piston whether extend or retracted. The motion of pneumatic actuator depends on type of actuator; it can be linear or rotary. Some types of pneumatic actuator were included:

i. Tie rod
ii. Rotary
iii. Grippers
iv. Rodless actuators with magnetic linkage or rotary cylinders
v. Rodless actuators with mechanical linkage

2.3.2 Hydraulic Cylinder

A hydraulic cylinder is a mechanical actuator was producing a motion by pressured of hydraulic fluid. It used to give a linear force due to a linear stroke. The hydraulic cylinder involved of a barrel, which have a piston connected to a piston rod. The barrel closed on each end by cap end and by head of cylinder. The hydraulic pressure acts on the piston to do linear work and motion.

The basic system of hydraulic included fluid reservoir, pump, control valve and hydraulic cylinder. Pump in hydraulic system used as a generator, which brings a flow of fluid to the system. The hydraulic actuator controlled by control valve to extend or retract. The force in the system use the Pascal law that similarly to F=PA whether F is equal to Force, P is pressure and A is define as area in hydraulic cylinder.

Table 1: Advantages and disadvantages of hydraulic system

Advantages	disadvantages
• Convenient power transfer • Few moving parts • Low losses over long distances • Little wear • Flexibility • Distribute force in multiple direction • Safe and reliable for many uses • Can be stored under pressure for long period • Variable speed control • Quick response (linear and rotary)	• Require positive confinement • explosive hazard if leaks • Filtration critical

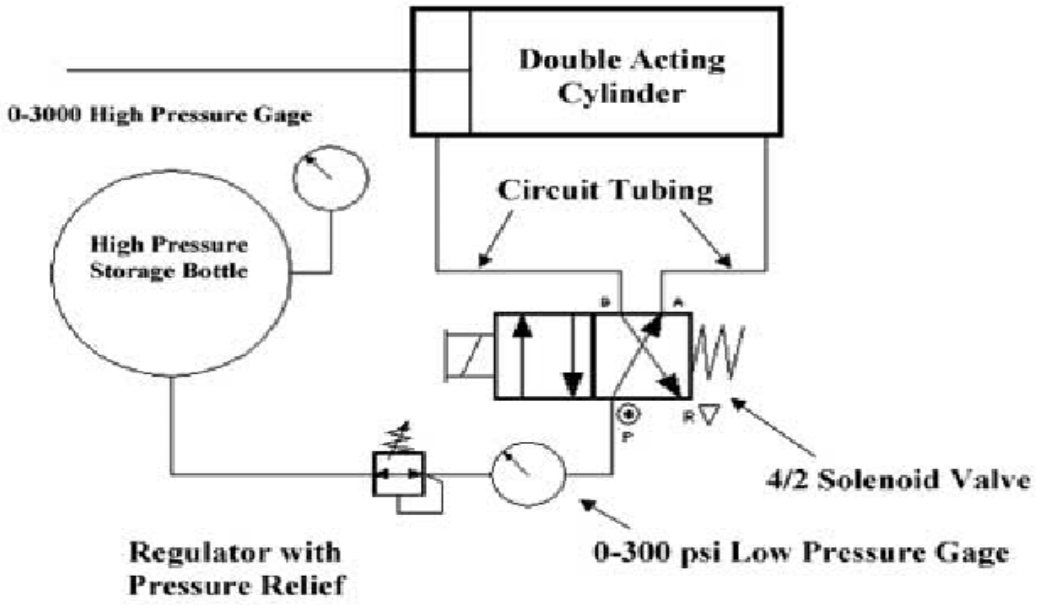

Figure 4: Pneumatic basic system

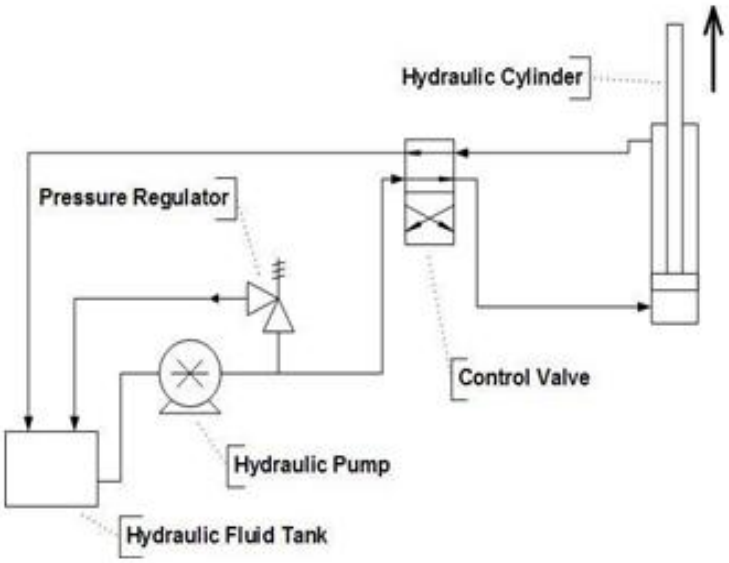

Figure 5: Hydraulic basic system

2.3.3 Electric Actuator

Electric actuators are motorizing by electricity current. Generally, electric motor is a main device to create a mechanical motion converted from electricity. An electric motor was concern to the magnets and magnetism.

Then, it used magnets to create a motion by attraction of two poles of magnet bar and repelling force to moving rotational. There are two types of electric motor commonly used which is DC motor, AC motor and.

a) DC Motor

DC motor was drove by direct current power supply by using internal commutation, stationary permanent magnets, and rotating electrical magnets. DC motor maintenance involved regularly replacing the brushes and springs, which carry the electric current, and cleaning or replacing the commutator.

These components are necessary for transferring electrical power from outside the motor to the spinning wire windings of the rotor inside the motor.

Advantages of a DC motor include:

i. Low initial cost
ii. High reliability
iii. Simple control of motor speed

Disadvantages of DC Motor include:

i. High maintenance
ii. Low life-span for high intensity uses