UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BLUETOOTH CONTROLLED STAIRS CLIMBING ROBOT

This report submitted in accordance with requirement of University Teknikal Malaysia Melaka (UTeM) for the Bachelor of Manufacturing Engineering (Robotic and Automation) with Honours.

By

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FACULTY OF MANUFACTURING ENGINEERING

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Bluetooth Controlled Stairs Climbing Robot**

SESI PENGAJIAN: 2008/09 Semester 2

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I hereby, declared this report entitled "Bluetooth Controlled Stairs Climbing Robot" is the result of my own research except as cited in reference.

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Date : 22 MEI 2009

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

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(Official Stamp of Supervisor)

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ABSTRACT

This project is about designing and developing a stairs climbing robot which is manually controlled using Bluetooth wireless technology. This project is actually an improvement of a previous PSM project of stairs climbing robot. The improvement focuses on the design structure, robot capability and technology implementation. For the design structure, the improved stairs climbing robot have a more stable structure compared to previous design. The base of the improved robot is wider and has larger surface contact to the ground, therefore it is more stable. For robot capability, the improved stairs climbing robot uses tracked wheels, this type of wheel increases the traction between wheels and stairs during climbing thus preventing it from slipping. This also increased the capability of the robot to climb stairs compared to the previous one that was only able to climb two steps of stairs. In the technology implementation, the improved stairs climbing robot utilizes Bluetooth technology. That adopted frequency hopping technique minimizes the chance of signal interference compared to the previous robot that uses radio frequency (RF) signal that was highly exposed to interferences during communication. The result from testing shows that this robot is able to climb up stairs better from the previous stairs climbing robot.

ABSTRAK

Projek ini adalah berkenaan dengan mereka dan membangunkan sebuah robot yang boleh menaiki tangga yang dikawal secara manual dengan menggunakan teknologi wayarles Bluetooth. Projek ini adalah suatu penambahbaikan dari projek PSM sebelum ini. Penambahbaikan ini adalah bertumpu pada struktur reka bentuk, keupayaan robot dan penggunanan teknologi pada robot berkenaan. Untuk struktur reka bentuk, robot ini mempunyai struktur yang lebih stabil berbanding dengan reka bentuk robot sebelum ini. Tapak asas robot ini mempunyai keluasan permukaan bersentuh dengan lantai yang lebih besar, oleh itu ia lebih stabil. Dari segi keupayaan, ia menggunakan roda bertrek, roda jenis ini meningkatkan daya geseran antara roda-roda dengan tangga semasa mendaki dan menghalang ia daripada tergelincir. Ini juga dapat menembahkan keupayaanya untuk memanjat tangga dengan lebih baik berbanding dengan robot sebelum ini yang hanya dapat menaiki dua anak tangga sahaja. Dalam penggunaan teknologi pula, robot ini menggunakan teknologi Bluetooth. Teknologi ini menggunakan teknik frekuensi loncatan bagi mengurangkan gangguan isyarat berbanding dengan robot sebelum ini yang menggunakan isyarat frekuensi radio (RF) yang sangat terdedah kepada gangguan semasa berkomunikasi. Hasil daripada ujian yang telah dijalankan ke atas robot ini, ia mampu untuk menaiki tangga dengan lebih baik berbanding robot sebelum ini.

DEDICATION

To my parents, Sumaidi Sukarso and Rohaidah Hassan;
Supervisor, Pn. Syamimi Bt Shamsuddin;
Co-supervisor, En. Muhamad Arfauz bin Abdul Rahman;
Girlfriend, Nor Hayati Nadzli;
Housemate, Addam, Adam, Abie, Ajis and Apis;
Whose love of reading has been an inspiration.

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AC	Alternating current
ADC	Analog-to-Digital converter
Al	Aluminum
AM	Amplitude modulation
CAD	Computer aided design
CAE	Computer aided engineering
CAM	Computer aided manufacturing
CATIA	Computer Aided Three Dimensional Interactive Application
Cd	Cadmium
CPU	Central processing unit
C++	A language used in programming
DC	Direct current
DWG	A file format used for 2 and 3 dimensional design data
ECO	Engineering change orders
EDR	Enhanced Data Rate
FFD	Full Function Devices
FM	Frequency modulation
HAZ	Heat-affecting zone
HCI	Host Controller Interface
GHz	Giga hertz
GPS	Global positioning system
Hz	Hertz
IBM	A company major that manufacturer of computer hardware
ISM	Industrial Scientific and Medical
I/O	Input/output
KOH	Potassium hydroxide
Mbps	Mega bits per second
Ni-Cad	Nickel cadmium
Ni-MH	Nickel metal hydride
$Ni(OH)_2$	Nickel hydroxide
PAN	Personal-Area Networks

PDA	Personal digital assistant
PLC	Programmable logic controller
PLM	Product lifecycle management
PC	Personal computer
PVC	Polyvinyl chloride
QoS	Quality of Service
RF	Radio frequency
RFD	Reduced Function Device
SIG	Special Interest Group
UART	Universal Asynchronous Receiver/Transmitter
2D	Two dimensional
3D	Three dimensional

CHAPTER 1
INTRODUCTION

This chapter is a brief of what actually this whole project is all about and this allows a glimpse of the entire report and provides understanding of the author's work. This introduction section contains project background, problem statement, project aim and objectives, project scope, project benefits and project planning (using the Gantt chart).

1.1 Project Background

Climbing robot has been a field of increasing activity in the previous years. This can be seen through the research and development of many types of mobile robots such as climbing and walking robot. The example of the previous research and development done by professors, engineers and even scholars are:

a) Hybrid locomotion of a wheel-legged machine by Halme, A. *et al* that introduce the combination of leg and wheel locomotion to gain effective natural terrain mobility.
b) A Biomimetic Climbing Robot Based on the Gecko by Menon and Sitti (2002) propose a study on climbing locomotion that involved adhesive adopted from gecko lizard.
c) A motorless micro walking robot by Doroftei (2000) which develop a six legged robot that require no motor for its movement instead using small memory alloy wire (muscle wire) by heating to archive movement.

In this project, the designed climbing robot is for climbing a structured terrain which is a flight of stairs that has six inches of height for each step. It is a manual stairs climbing robot which is control wirelessly by using a Bluetooth module.

1.2 Problem Statement

This stairs climbing robot is actually an improvement version from the previous project of stairs climbing robot in term of design structure, capability and technology. For the design structure, this robot will tackle the critical flaws of previous robot which is the stability. The previous robot is quite small compared to the stairs itself and its shape is not suitable for the steps of stairs therefore maintaining stability would be a major problem for it.

In term of capability, this improved robot should be more reliable compared to previous one. It must be able to climb up more then two steps of stairs and this capability depends on the design structure of the robot. This improved robot utilizes Bluetooth technology in controlling its movement. The Bluetooth technology is low-cost, requires low power, and utilizes a radio-based link which does not require a line-of-sight connection in order to communicate.

1.3 Project Aim and Objectives

The aim of this project is to design and develop a stairs climbing robot. This robot is an improvement compare to the previous project done by a senior student. In order to achieve it, the aim and objectives are:

a) To design, develop and improve the mechanical structure of previous stairs climbing robot.
b) To program the Bluetooth stairs climbing robot microcontroller
c) To pair the Bluetooth enable microcontroller with the Bluetooth adapter from the computer so that it can be able to sent and receive signal.

1.4 Project Scopes

In this project of stairs climbing robot there are three main scopes that need to be focused on and there are:

a) To used Bluetooth as a medium of transferring and receiving signal for stairs climbing robot in manual mode.
b) To design and develop a stable structure of a climbing robot
c) To produce a working robot that can climb stairs.

1.5 Project Benefits

In future, the application of stairs climbing robot can be used as devices that ease human daily life in many ways for example as a medium of transportation to carry heavy load fast and efficiently through stairs which would be a hectic job of an ordinary human. Beside that, this application would give its biggest contribution to the disable people/paralyze, by incorporated this technology into a wheel chair which enable them to climb stairs like any other ordinary person. If there are continuously increasing performance to this robot for higher speed and better motion, soon it can just climb stairs but also go through any terrain that it encounters and this is perfect for military used in combat vehicle.

The method of connecting and controlling this robot is via Bluetooth that give cable-free connections, which means real freedom to working environment regardless of location and wire availability. This technology allows robot and other handy gadgets to make use of "short range, low power" radio technology to connect to each other. With the growth demand toward Bluetooth devices, it will replace the inconsistency of radio frequency (RF). With Bluetooth it is possible to be in another room and still be able to access another device with no use of wires. Bluetooth radio uses a fast acknowledgement and frequency-hopping scheme to make the link robust, even in noisy radio environments.

1.6 Project Planning

This project of stairs climbing robot will be carried out according to these time planning. Table 1 shows the activity planning for semester one while table 2 shows the activity planning for semester two.