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Signature	:	
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Date	:	7 May 2008

BI-PEDAL WALKING ROBOT

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"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation)

Signature	:	
Supervisor's Name	:	En. Fariz Bin Ali @ Ibrahim
Date	:	7 May 2008

Special dedication to my loving parent, all my siblings, my supervisor Mr. Fariz Ali and to my dearest friends.

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ABSTRAK

Tujuan projek ini adalah untuk membina satu robot yang berjalan dengan dua kaki menggunakan kawalan PIC. Robot ini mampu bergerak dengan gerakan asas seperti berjalan ke hadapan, berjalan ke belakang, serta boleh pusing ke kiri dan juga ke kanan menggunakan kedua-dua kakinya. Pengawal motor yang akan digunakan ialah pengawalmikro PIC 16F877A. MikroC akan digunakan untuk menulis program yang akan digunakan untuk pengawalmikro PIC16F877A. PIC 16F877A merupakan satu mikropengawal yang sangat baik dengan berbekalkan 33 pin yang boleh dijadikan pin masukan ataupun pin keluaran serta beberapa komponen dalaman seperti ‘clock’ dan pengubah analog kepada digital. Motor DC akan digunakan dalam membina robot ini. Kelebihan motor DC ia adalah dari segi kos dimana ia adalah murah dan senang diperolehi. Selain itu, Litar kawalan motor dibina dengan menggunakan konponen L293b, “H-Bridge” dalaman yang boleh digunakan untuk tujuan putaran dua hala motor DC.

ABSTRACT

This project intends to build a bi-pedal walking robot using PIC control. This robot is able to perform basic movement such as walking forward, backward, turn left and turn right using its two legs. The motor controller circuit will be used in this project is 16F877A PIC microcontroller. MikroC software will be used to writes the C programming for PIC microcontroller. PIC 16F877A is a very good controller with 33 input output pin and also several build in hardware such as clock and analogue digital converter. The advantage of using DC motor is from the view of cost, DC motor can be get in a cheap price and easily can be find. The motor driver circuit had been build for the purpose of motor rotation. The build-in H-Bridge in the L293b is use for the forward reverse rotation for the DC motor.

TABLE OF CONTENTS

TABLE LIST

FIGURE LIST

CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter robot will be the main discussion topic. What is robot? What is autonomous robot? Beside that, the objective of the project, scope of the project and also the problem statement of the project will also be presented in this chapter. All these will be discuss in more detail in the sub-topic 1.2, 1.3, 1.4 and 1.5 below.

1.2 What is a robot?

According to Robot Institute of America (1979):

"A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks"[1].

According to Webster dictionary:

"A robot is an automatic device that performs functions normally ascribed to humans or a machine in the form of human (Webster, 1993)" [1].

Generally, robots have three main parts known as processor, sensor, and motor control system. There are quite similar when compare human with robot, just the mechanism is different. Sensor of the robot can represent eyes of human, while actuators represent the legs of human and controller as the brain of human.

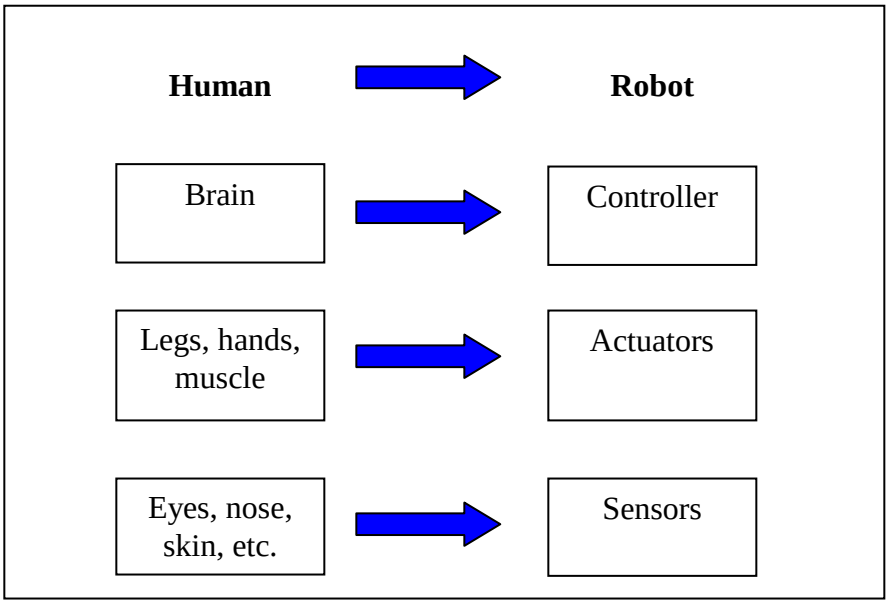

Figure 1.1: Comparison between human and robot

1.2.1 Application of Robot

Robot can replace human's job in industry because robot can do many things faster than humans. Robots do not need to be paid, eat, drink, or go to the bathroom like human. They can do repetitive work that is absolutely boring to human and they will not stop, slow down, or fall asleep like human.

Individual stationary sensors have limited ranges and applications. Watchdogs or human can lose their level of alertness during a shift or can easily be injured by an intruder. Autonomous robot systems are tools which combine the precision of sensors

with the mobility and intelligence of humans. Robotic site security sentries are able to work long hours at a consistently high level of precision and vigilance.

Nowaday, doctors have to use a robot instead when operating. A human would not be able to make a hole exactly one 100^{th} of a inch wide and long. When making medicines, robots can do the job much faster and more accurately and delicate than a human. Some doctors and engineers are developing prosthetic (bionic) limbs by using robotic mechanisms.

People are interested in places that are sometimes full of danger, like outer space, or the deep ocean. Thus, when they cannot go there themselves, they make robots which are able to go there for exploration. The robots are able to carry cameras and others instruments so that they can collect information and send it back to their human operators. The continuing development of autonomous robot technologies furthers our abilities to explore the universe.

Beside that, robot can be applied in military operations to reduce the number of casualties which occur during military actions. The military also uses robots for locating and destroying mines on land and in water, entering enemy bases to gather information and spying on enemy troops.

1.3 Project Objective:

The objectives of this project are:

1. To build a robot which can move in forward, backward, turn left and turn right direction.
2. Build a robot that can be in stable condition when it was walking or turning either to left or right side.
3. Build a robot which using PIC microcontroller to control the movement of the robot.

1.4 Project Scope

The scope of this project is to build a bi-pedal walking robot that is able to perform tasks such as walking in forward position, backward position, turn left and also turn right. The signal of the movement will be sent by microcontroller 16F877A to the DC motor. This signal will control the speed of the motor and also will decide which motor will rotate first. MicroC will be used to write the program and also be the compiler to change the C language into hex file language. Besides that Proteus 6.0 is used as simulation software for the program that has been written to make sure the program or coding that had been write are up to expectation.

For the mechanical part of the robot, aluminium is used as the main material for the whole robot, because aluminium is light weighted and easy to be drill if any drilling needed compare to other material such as metal or standard steel. Other materials that been use are various size of screws and also the stripboard of the microcontroller board and motor driver board act as the support for the body.

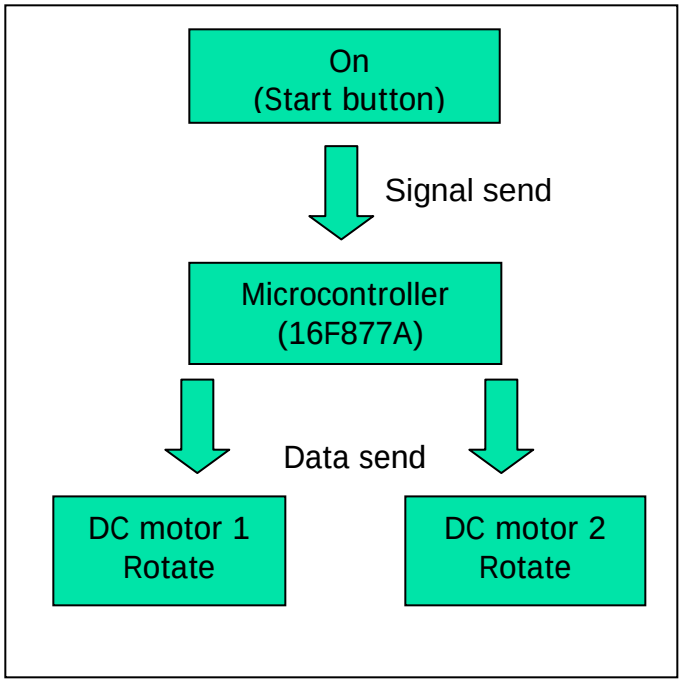

Figure 1.2: Flow chat for motor control

From the flow chart above, the whole robot system can be view easily. First when the robot start button is on there will be voltage to activate the microcontroller when the microcontroller is activated signal will be send to the motor 1 and motor 2. Which motor will be rotated first are depend on how the program is written.

1.5 Problem Statement

Nowadays, study institutions in this country are lack of robotic instruments that can be use for the academic purpose especially for the lower level academic such as secondary school or first and second year student in university in Malaysia. So a bi-pedal robot that's been build can be use as the study kit for lower academic level. From the construct of the robot student can learn more a about embedded controlling and also robot control using PIC controller. May be with the exposure of this bi-pedal robot kit many more advanced robot can be make by the future students in this country with more reliable and useful microcontroller such as ATMEL, Motorola, or many other microcontroller type.

1.6 Project Planning Schedule (Gantt chart)

Table 1.1: Gantt chart

PERANCANGAN PROJEK *PROJECT PLANNING*													
Senaraikan aktiviti-aktiviti utama bagi projek yang dicadangkan. Nyatakan jangka masa yang diperlukan bagi setiap aktiviti. *List major activities involved in the proposed project. Indicate duration of each activity to the related month(s).*													
	2007							**2008**					
Aktiviti Projek: *Project's Activities*	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**
1. Proposal		X											
2. Literature review (programming and bi-pedal robot study)		X	X	X									
3. Hardware			X	X	X	X	X	X					
4. Programming					X	X	X	X	X				
5. Presentation PSM 1				X									
6. Submit report for PSM1					X								
7. Robot testing and repairing										X	X		
8. Thesis and final presentation			X	X	X	X	X	X	X	X	X		

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Study on the similar project or product that on the market is very helpful to give a brief expression on how to make a good bi-pedal walking robot project. The source can be getting from internet or any reference such as magazine or books. The mechanism of the robot can be learned easily by refer to similar robot especially for electrical student who have less knowledge regarding mechanical part.

In this chapter a few bi-pedal walking robot which can be found the sources from internet and also the journal from IEEE has becomes references of this bi-pedal walking robot project.

2.1.1 Case Study 1: KHR-2HV Humanoid Robot

Figure 2.1: KHR-2HV Humanoid Robot

KHR-2HV is a very intelligent humanoid robot. This robot is a upgrade version of previous model, KHR-1 model. Now, it has been redesigned with better gears, servos, and software, that make emulating human-like movements, such as walking, somersaulting, climbing steps, and back flips, to be as easy as assembling the robot and plugging it into computer [2]. The KHR-2HV includes some impressive performance and usability improvements including expanded programmability, real-time master/slave control, high performance KRS-788HV servos, and scalable analog inputs [3]. In addition to mechanical design changes like simpler resin plastic joints making assembly much easier than the KHR-1, Kondo has also added some nice touches like the addition of a main power switch. The interface for the KHR-2HV Humanoid is USB to serial cable. This robot is moving by using seventeen (17) KRS-788HV ICS Digital Servos (17 degrees of freedom), using RCB-3J Control Board with 24 PWM input/output and 3 analog input ports, power up by Nickel Metal Hydride (NiMH) 10.8V 300 mAh battery. This KHR-2HV humanoid robot is making up by composite and aluminum skeleton with the dimension 340mm x 180mm. This robot is manufactured by Kondo Kagagu Co. Ltd.

2.1.1.1 How did this product contribute to the project?

This KHR-2HV humanoid robot gives a very good guide on how to build a bi-pedal robot that can perform human movement. It also show how was the wiring is done by refer to its hardware manual that can be download from internet (www.kondo.com). Beside that the manual had state very clear how the robot motor is placing and the joining of the robot. So all this can benefit for the project that going to do in PSM project.

2.1.2 Case study 2: Toddler Robot

Figure 2.2: Toddler Robot

The Toddler robot is a two-servo bipedal robot controlled by an embedded BASIC Stamp® 2 microcontroller that stands 10" tall. This is a high-quality machined kit made from aluminum and brass metals [4]. This toddler robot is a very good learning kit for student to learn the basics of embedded control. This robot has the ability to walk straight and turn. This walking robot shifts its center of gravity to walk and turns by sliding its feet in opposite directions. Other than that, it can follow or avoid light, avoid or seek objects using infrared light reflection. It can be interface with digital, resistive, and frequency sensors which can be decide.

The Toddler is controlled by a surface mounted BASIC Stamp 2 module. Four infrared sensors and receivers, LEDs, servos for tilt and stride, resistors/capacitors, speaker, photoresistors complete the control system. [4]:

- Dimensions (inches) 1.38x0.67x1.26
- Weight 26.6g
- Speed (sec/60^{o}) - 0.19
- Torque (oz-in) – 47 [5]

This toddler robot is manufactured by Parallax Inc.