# DANCING ROBOT
# (SOFTWARE)

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I dedicate this book to my parents, family members
and last but not least, to all my KUTKM lecturers and friends.

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## ABSTRACT

This Dancing Robot project is divided into two main sessions. The first session is hardware while the second session is software. This dancing robot will dance according to the programmed music within a specific time frame about 2 to 3 minutes. This robot will be design in hardware and going to operate by interfacing the software to control all the robot's movements due to the dancing steps that had programmed. The software chosen to apply on the robot is PIC C language. This programming then will be applied to the motors that are assembled in this circuit for the robot's movements. In this project, the circuit is powered by Lithium battery. Integrated circuits (IC) and memory integrated circuit PICA6F877A are used and have a different function to operate the circuit.

# ABSTRAK

Projek *Dancing Robot* ini dibahagikan kepada dua bahagian utama. Bahagian pertama ialah perkakasan manakala bahagian kedua ialah perisian. *Dancing robot* ini akan menari mengikut muzik yang telah diprogramkan dalam sela masa yang telah ditetapkan antara 2 ke 3 minit. Robot ini akan direkacipta dalam bentuk perkakasan dan kemudiannya dikolaborasikan dengan perisian untuk mengawal pergerakan robot mengikut langkah tarian yang telah diprogramkan. Perisian yang akan digunakan adalah *Programmable Integrated Circuit* (PIC) dan bahasa yang dipilih adalah bahasa C. Aturcara ang telah ditulis ini akan disalurkan ke bahagian perkakasan untuk pergerakan motor- motor yang terdapat dalam litar. Dalam projek ini, bateri jenis litium akan membekalkan kuasa pada litar. Beberapa litar sepadu (IC) dan litar sepadu bermemori, 16F877A akan digunakan di dalam litar mengikut funsi masing-masing.

# LIST OF CONTENTS

# LIST OF TABLE

## LIST OF FIGURE

# LIST OF SHORT FORM

| | | |
|---|---|---|
| UTM | - | Universiti Teknologi Malaysia |
| PWM | - | Pulse Width Modulation |
| IC | - | Integrated Circuit |
| PIC | - | Programmable Integrated Circuit |
| DC | - | Direct Current |
| RIS | - | Robotic Invention System |
| A/D | - | Analog to Digital |
| VDC | - | Voltage Direct Current |
| CCP | - | Capture/Compare Pin |
| FR | - | Face Recognition |
| OBJR | - | Object Recognition |
| LTM | - | Long Term Memory |
| STM | - | Short Term Memory |
| SBL | - | Situated Behavior Layer |
| MC | - | Motion Control |
| SPI | - | Serial Peripheral Interface |
| I2C | - | Inter-Integrated Circuit |
| USART | - | Universal Asynchronous Receiver Transmitter |
| CMOS | - | Chip Complementary Metal-Oxide Semiconductor |

# BAB 1

# INTRODUCTION

## 1.1 INTRODUCTION

For decades, popular culture has been enthralled with the possibility of robots that act and look like humans. Like many new technologies, these early generations of commercially available humanoids are costly curiosities, useful for entertainment, but little else.Robots can be split into several categories, including factory robots and utility robots such as can-collectors. Humanoids may prove to be the ideal robot design to interact with people.

In the beginning, robots only used on a singular function or purpose that is as an aid to human. Nowadays, the robot is not also assigned to do work but also entertain. As part of it, dancing robots were created. Dancing robots grab people's attention with heir ability to dance on the floor especially on their own feet. Sony QRIO surely one of the lead example of world's robotic technologies. Its smooth movement when dancing captures everyone's heart. These inventions increase people's interest on robotic world. Another type of entertainment robot is Sony's *AIBO* robot, which in its first version priced at over **$1800** sold out in a matter of minutes. Robots of this kind interact with humans, sensing their environment and reacting in real time. Their behavior can be unpredictable, and most un-robot like. These are the types of robot that imitate life most accurately.

Many robot kits were design to let the public having them as a part of hobby. As for this project, the robot will have two legs instead of moving platform, previously done by Universiti Teknologi Malaysia's student, to let the robot have more humanoid looking. But still we cannot afford to have it dance according any music played. But it still fun to have it moving while the music played. Other robot that could perform as dancing robot is RoboSapien. RoboSapien is a toy robot like biomorphic robot designed by Mark Tilden and produced by Wow Wee toys. The RoboSapien is preprogrammed with moves, and also can be controlled by an infrared remote control included with the toy, or by either a personal computer equipped with an infrared transmitter, and an infrared transmitter-equipped PDA.

The other dancing robot that available in that market now is using PDA's with the LEGO Mindstorms kits. The LEGO MINDSTORMS Robotics Invention System (RIS) is a kit for building robots. It consists of a programmable brick (with a Hitachi H8/3292 microprocessor) named the RCX, and a lot of other traditional LEGO building parts named TECHNICS.

For our project, we have decided to focus on entertainment robots that design and construct our own. The purpose is to seek out people and entertain them by dancing to them.

## 1.2 OBJECTIVES

The main objective of this project is to design a new ROBODANCE. This dancing robot be characterized by mobile robot which is wheels will be used for its leg's movements. For the robot's movements, five servomotors and one DC motor will be used. This robot will be design in hardware and going to operate by interfacing the software to control all the robot's movements due to the dancing steps that had programmed. Source Boost Software with C language is used to program the IC16F877A with the dancing robot steps that will be performed. In this project, the circuit is powered by Lithium battery.

## 1.3 PROBLEM STATEMENT

There are several issues that need to face on and fully attention while doing this project especially in software session:

1.3.1 First, it is necessary to learn and understand the software before it can be applied according to the specification. In this project, In this Programmable Integrated Circuit (PIC) with C Language, Source Boost is chosen as the software device to fulfill the programming terms of the project.

1.3.2 The motor specifications and its operation especially for servomotor need to study and understand first before starting and writing the programming for robot's movements.

1.3.3 The main problem for the whole project is hardware and software interface. If there is any error occurs in preparing either hardware or software, interfacing both of them may lead to the failure. The crucial part is to troubleshoot the project and debug the error. In this case, part by part testing will be required in order to locate the error and fixed or reduce it.

1.3.4 Troubleshooting process is need to be done between software and hardware in addition make sure that the programming that has be compiled and built is capable to operate the motor properly due to motor's torque and load.

## 1.4 SCOPE OF WORK

The scope of work in this project firstly involves researching on the past dancing robot movements and its construction. Then, Programmable Integrated Circuit (PIC) software needs to be studied and understood in order to create the new dancing steps for this ROBODANCE. In this case, a detailed understanding on Source Boost software with C language is needed in order to create a new programming for this robot's movements. In spite of that, studying and understanding the characteristics and specifications on how to control this integrated circuit (16F877A), servomotor and DC must be done before writing the programming.

### 1.4.1 SOFTWARE SESSION

Generally, in software session, firstly, it is important to know on how to use the related software and its operations. For this dancing robot project, Source Boost software is used in order to write and build the programming for robot's movements. In this software, there are three languages that could be applied for coding the programming. There are C, Basic and assembly languages. Each of these languages has their own source code in coding the program. For assembly and Basic languages, the programs will be simpler and shorter than C language. This assembly language which is also known as machine language needs programmer to take more time in understanding its source code. In C language, it is easier to understand because this program is user friendly. Programmer does not need more time in understanding the programming.

### 1.4.2 HARDWARE SESSION

While writing and building programming, there are some hardware parts that need to be considered on their specification and operations. The parts are microcontroller integrated circuit (16F877A) and servomotor.

For the chosen IC 16F877A, it has 40 pins that built with 8k byte flash memory and five input and output ports(A, B, C, D, and E) including CCP pin for PWM in port C. Figure 1.4.2.1 and 1.4.2.2 below show the IC 16F877A and the pin diagrams for IC 16F877A.

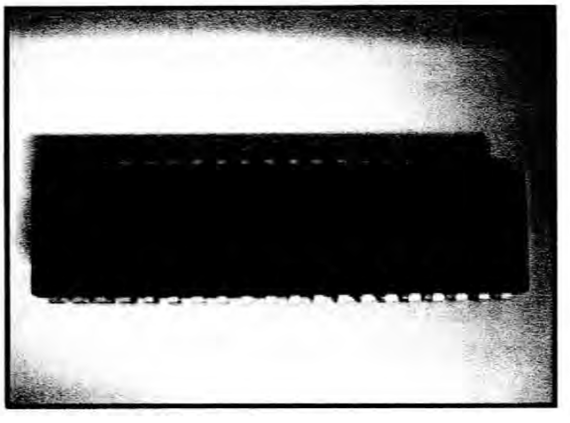

Figure 1.4.2.1: IC 16F877A

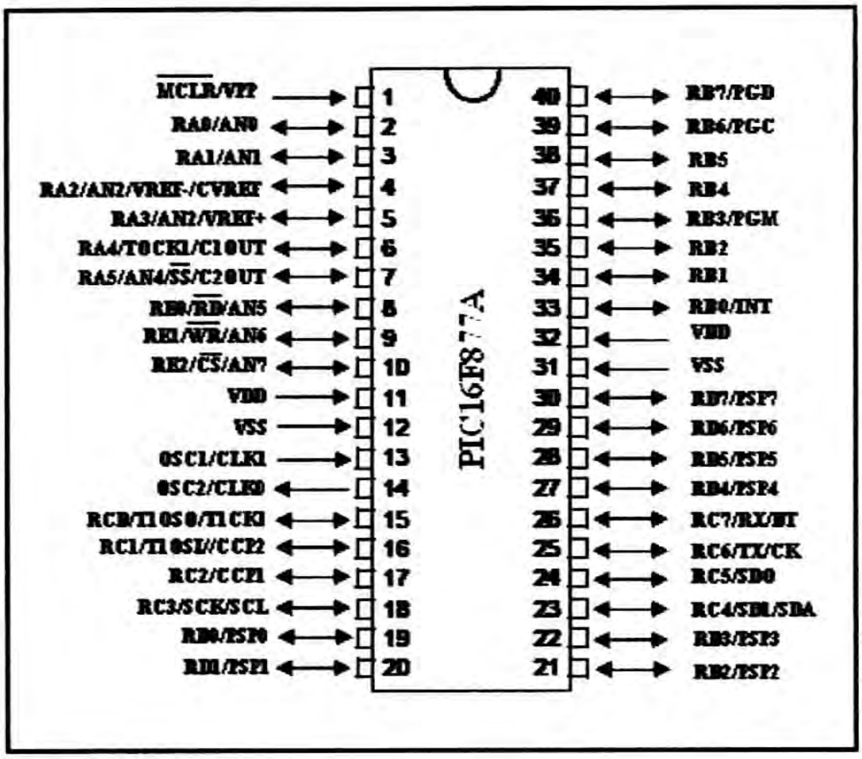


Figure 1.4.2.2: IC 16F877A pin diagrams

Another advantages of this IC compared to the other ICs is it has its own analog to digital comparator which is readily built in this IC. This analog module has two analog comparators and up to 8-channel Analog-to-Digital (A/D) converters. These microcontrollers also have 10000 times of erase or write cycle Enhanced Flash Program memory typical.

Second hardware part that needs to consider and understand while writing programming is servomotor. These servomotors will be placed to move the robot's arms and waist. The type of servomotor that used in this project is RC servomotor (C40S). Figure 1.4.3 below shows the servomotor and its parts.

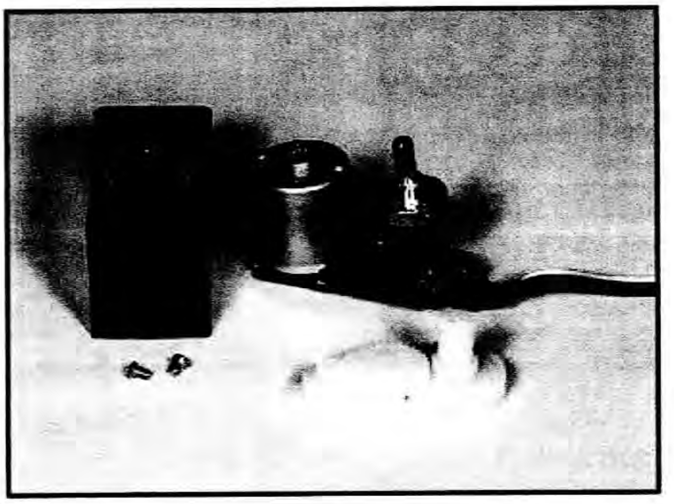

Figure 1.4.2.3: Servomotor

Servomotor is a special motor that commonly used in robot projects. Servomotors are basically geared down dc motors with positional feedback control, allowing for accurate positioning of the rotor, with a range of 90 degrees. They can also be modified to allow for continuous rotation. Servomotors have three wires, usually red, black and white as shown in the figure above. The red wire is for +VDC, the black for ground and the white is for position control. This control signal is a variable-width pulse, which can be varied from 1 to 2 ms. The pulse width controls the rotor position.

A 1.0 ms pulse rotates the shaft all the way counter-clockwise. A 1.5 ms pulse puts the rotor at neutral (0 degrees), and a 2.0 ms pulse will position the shaft all the way clockwise. The pulse is sent to the servo at a frequency of approximately 50 Hz. The relationship between the pulse width and the rotor position can be seen in figure 1.4.4 below.

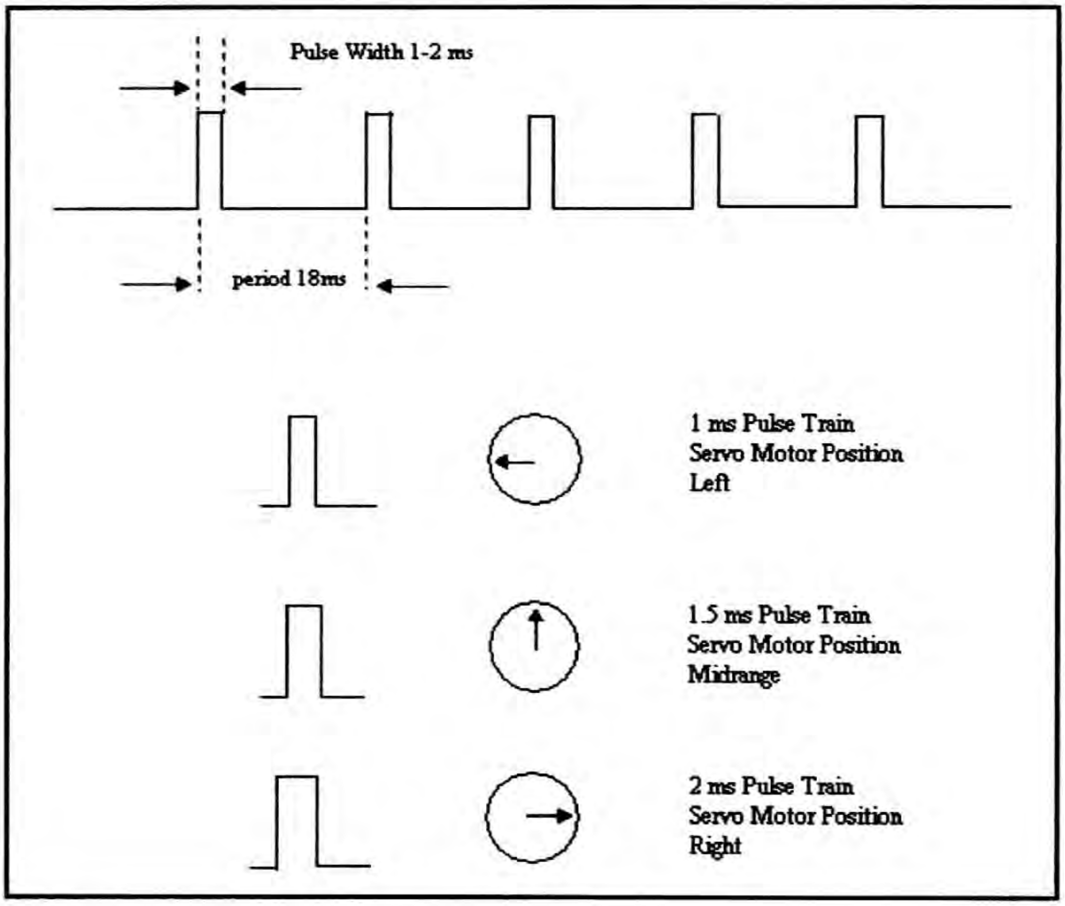


Figure 1.4.2.4: The relationship between the pulse width and the rotor position

To perform the angle of rotor position for each robot's movement in Source Boost with C language, it is ease to use delay function through the pulse calculations Compared by using CCP pin in IC, it is more simple and easy to understand. In delay calculation, angle of rotor position is found due to servomotor's pulse width as shown in figure 1.4.2.4 above.

Once the servo has received the desired position (via the PWM signal) the servo must attempt to match the desired and actual positions. It does this by turning a small, geared motor left or right. If, for example, the desired position is less than the actual position, the servo will turn to the left. On the other hand, if the desired position is greater than the actual position, the servo will turn to the right. In this manner, the servo "zeros-in" on the correct position. Should a load force the servo horn to the right or left, the servo will attempt to compensate.

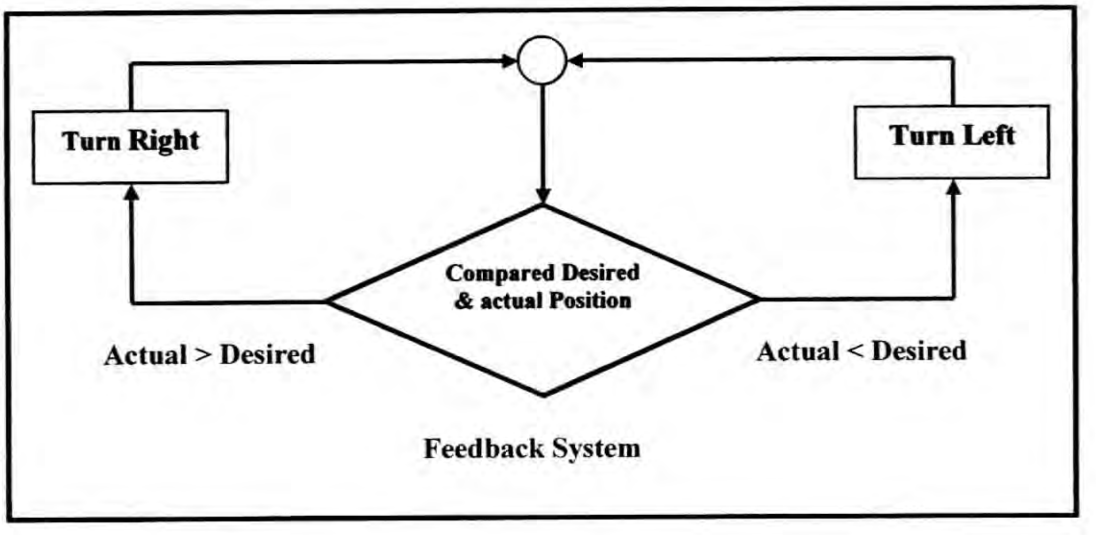


Figure 1.4.2.5: Matching the desired and actual positions

## 1.5 PROJECT METHODOLOGY

To perform the progress of the project, the methodology for this project was divided into three main parts:

i. Part 1 - Research and Study
ii. Part 2 – Designing
iii. Part 3 - Troubleshooting
iv. Part 3 – Finalizing