BLUETOOTH ACTIVATED DC MOTOR

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BORANG PENGESAHAN STATUS TESIS♦

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This thesis is submitted as partial fulfillment of the requirements for the award of the Bachelor of Electrical Engineering (Hons.) (Electronics)

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Specially Dedicated

To my beloved Parents

My siblings and also my friends

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ABSTRACT

Nowadays, Bluetooth is a common way to connect and transfer information between things such as cell phones, laptops and PCs, printers, and digital cameras. The idea of using Bluetooth technology also a big motivation as it is interested in obtaining a much more comprehensive understanding of how it works. The goal of this project is to design a controller that will be able to run a DC motor wirelessly using Bluetooth technology. This controller will be able to function through a software application on a laptop or desktop computer from within a distance of the motor. This project involved three main parts to be developed, which are hardware, circuit and software. The hardware parts consists the materials that are used to build. The circuit part consists of the microcontroller circuit, because the microcontroller is known as a brain of the circuit. All the movement will be assigned by using microcontroller. The software part is to design the programming that will be used to assign an angle of movement for each DC motor.

ABSTRAK

Pada masa kini, Bluetooth adalah satu cara yang biasa digunakan untuk menghantar maklumat seperti telefon bimbit, komputer riba, pencetak dan kamera digital. Penggunaan idea menggunakan teknologi Bluetooth merupakan satu motivasi besar di mana penggunaannya adalah sangat menarik. Matlamat projek ini adalah mereka rekaan pengawal motor dengan menggunakan teknologi Bluetooth. Pembinaan projek ini terbahagi kepada tiga bahagian utama iaitu perkakasan, litar, dan perisian. Pembinaaan perkakasan adalah proses untuk membina iaitu proses pemilihan bahan dan reka bentuk yang sesuai. Pembinaan litar adalah proses pembinaan litar pengawalmikro yang berfungsi sebagai otak. Ini kerana semua pergerakan motor dikawal oleh pengawalmikro. Pembinaan perisian adalah pembinaan aturcara untuk digunakan dalam mengawal pergerakan motor.

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LIST OF ABBREVIATIONS

AC	Alternating Current
DC	Direct Current
I/O	Input / Output
IC	Integrated Circuit
PIC	Programmable Intelligent Computer
PC	Personal Computer
Rx	Receive
Tx	Transmit
SPP	Serial Port Profile
USB	Universal Serial Bus
UART	Universal Asynchronous Receiver Transmitter

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Bluetooth is an industrial specification for wireless personal area networks (PANs). It provides a way to connect and exchange information between devices such as mobile phones, laptops, PCs, printers, and digital cameras globally unlicensed short-range radio frequency. This latest technology was never designed to provide for anything other than short-range connectivity and communications.
This short-range limitation is in fact a benefit that was purposely designed into the specifications. [3]

1.2 What are the Benefits of Bluetooth

As more and more devices start to use Bluetooth technology, more manufacturers will be eager to make their products compatible. A chain reaction will occur, making Bluetooth the standard for cutting edge wireless. One of the benefits of the short-range design of its networking is the possibility of interference from devices belonging to others who are in close proximity. This keeps others from connecting with user devices and is a form of basic security intended to protect the devices and data.

Another benefit of limiting the range of networking devices is that less power is required for the transmission over shorter distances. This in turn means that user can enjoy longer battery life, and since the majority of its enabled products are powered by battery, this is an important feature for most users. This 'Bluetooth Activated DC Motor' is operating which is manually. Here a Bluetooth module KC21 was used. In response to receive signal from the device, a laptop may send instructions to the device via Bluetooth to activate it. The laptop is directed to a system for electronically activate the dc motor which is the microcontroller is the brain of the system.

1.3 Objectives

There are several objective of this project that try to achieve:

(i) To use Bluetooth communication link in transmitting and receiving process

(ii) To activate and control DC motor from a distance

1.4 Scopes

This project focuses on establishing Bluetooth connection. The operation of the devices attached to the slave module must be able being controlled by the master module. To complete the project objective, the following criteria are set into consideration: The scopes of this project are:

(i) In order to use Bluetooth, a device must be compatible with certain Bluetooth profiles. These define the possible applications and uses of the technology.

(ii) Develop the program to control the microcontroller for DC motor.

(iii) The motor is able being activated through a wireless connection on a laptop via Bluetooth

(iv) Develop the circuit for the DC motor control.

1.5 Thesis Outline

Chapter 1 explains the idea of this project. The objective and the scope of the project are also described in this section.

Chapter 2 provides a brief explanation on the existing technology and system that has a similar function with this project. The literature reviews were used as the main reference for this project.

Chapter 3 describes the entire system design to accomplish this project. This chapter has the detail explanation on the hardware as well as the hardware configuration that has been developed in the project.

Chapter 4 provides the result and analysis obtained from the project. It is based on the result and the overall performances of the system design.

Chapter 5 gives the conclusion and recommendation which may improvise this project in the future. This chapter also cites the cost of the project and the potential of this project to be commercialized.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In order to make this project successful, some studies and information has been done. The information is fetching from many sources such as books, articles, journals, and internet. All of this information is very useful as a guide in doing this project. This studies of information based on some major component and topic that related to the project that will be used in the project such as hardware and software.

2.2 Communication

Bluetooth is the name of a wireless technology standard for connecting devices, set to replace cables. It uses radio frequencies in the 2.45 GHz range to transmit information over short distances of generally 33 feet (10 meters) or less. Bluetooth provides a way to connect and exchange information between devices like personal digital assistants (PDAs), mobile phones, laptops, PCs, printers and digital cameras via a secure, low-cost, globally available short range radio frequency. Bluetooth lets these devices talk to each other when they come in range, even if they are not in the same

room, as long as they are within up to 100 meters (328 feet) of each other, dependent on the power class of the product. Products are available in one of three power classes:

i. Class 3 (1 mW) is the rarest and allows transmission of 10 centimeters (3.9 inches), with a maximum of 1 meter (3.2 feet)

ii. Class 2 (2.5 mW) is most common and allows a quoted transmission distance of 10 meters (32 ft)

iii. Class 1 (100 mW) has the longest range at up to 100 meters. This class of product is readily available.

The specification was first developed by Ericsson, and was later formalized by the Bluetooth Special Interest Group (SIG). The SIG was formally announced on May 20, 1999. It was established by Sony Ericsson, IBM, Intel, Toshiba and Nokia, and later joined by many other companies as Associate or Adopter members. [4]

2.2 Bluetooth Technology

Automatic communication between various devices within a small area in a house or an office makes it possible to provide unique and innovative services to a professional worker or a small group of workers using portable devices. Bluetooth technology has this potential and is coming along fast and quick. It will replace clumsy wires, make information transfer automatic without synchronization cradles and introduce many new applications. Technology visionaries hope that it will do what infra red could not do over the past six years. Figure 2.1 below shows how the Bluetooth connected.

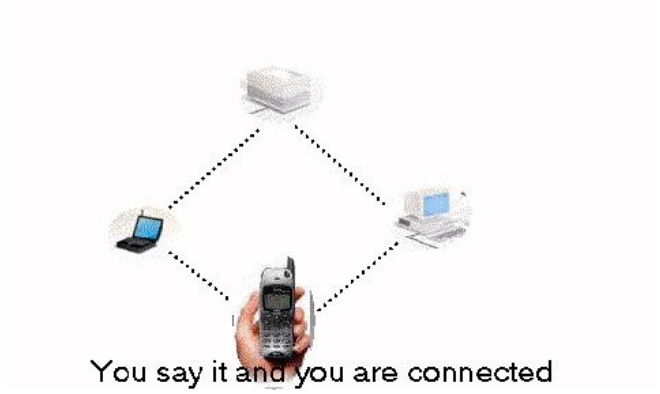

Figure 2.1: Bluetooth Connection

2.3.1 How Bluetooth Technology Works

This technology achieves its goal by embedding tiny, inexpensive, short-range transceivers into the electronic devices that are available today. The radio operates on the globally-available unlicensed radio band, 2.45 GHz (meaning there will be no hindrance for international travelers using Bluetooth-enabled equipment.), and supports data speeds of up to 721 Kbps, as well as three voice channels. The Bluetooth modules can be either built into electronic devices or used as an adaptor. For instance in a PC they can be built in as a PC card or externally attached via the USB port. [3] Figure 2.2 below show the Different Functional Blocks in the Bluetooth System.

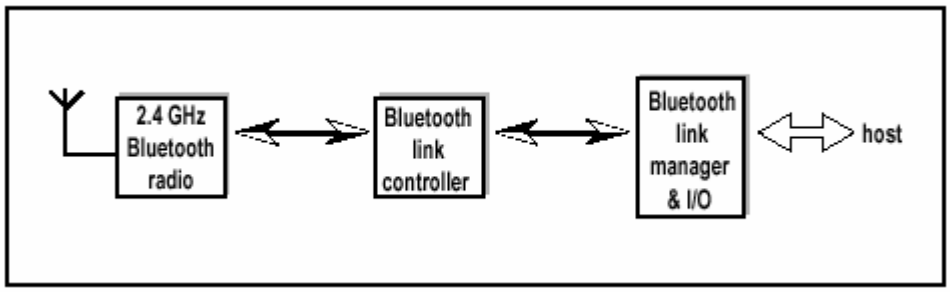

Figure 2.2: Different Functional Blocks in the Bluetooth System

2.3.2 Bluetooth Technology and Transceiver

Bluetooth Technology is standard for short-range radio communication. It is a low cost bi-directional (2 ways) wireless interface between mobile devices that provides low power consumption. Bluetooth Transceiver referring to Bluetooth Transmitter and Receiver and every Bluetooth node have Bluetooth Transceiver. The aim is to eliminate the usage of cables. Bluetooth system operates in worldwide unlicensed 2.4GHz Industrial-Scientific-Medical (ISM) frequency band. Bluetooth devices can form a network. The basic network is Piconet where there are masters node and other act as slave node/s. At least 2 nodes are required to form Bluetooth network, either one of the nodes can be master. The role of master is just to search and initiate the connection, once the link is established; the role of each node is equal.

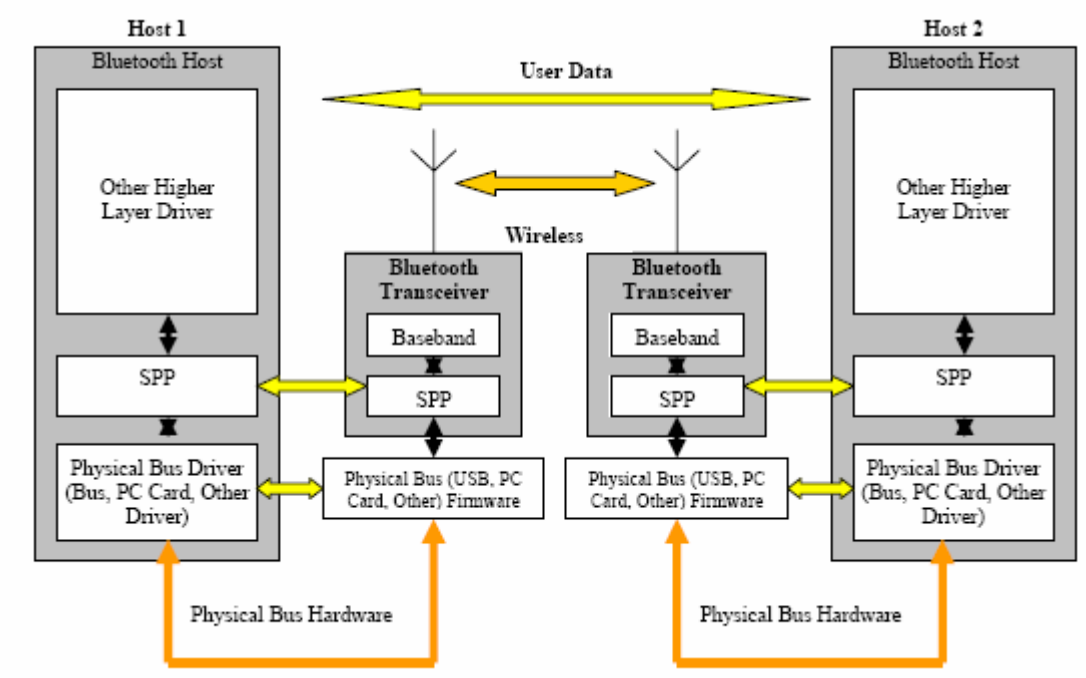

Figure 2.3: Host to host communication through Bluetooth Transceivers

Bluetooth transceiver is a wireless transceiver that transmits and receives. Signal wirelessly through Bluetooth protocol, thus a host, or in other words a controller is necessary if data processing is required in the application. As shown from the above figure, there are two hosts (Host 1 and 2, it can be microcontroller, computer, PDA,

etc) and two Bluetooth transceivers. Both host need to communicate (exchange data), while Bluetooth transceiver is the tools to transfer the data between host. Thus, to process data and operate Bluetooth transceiver, a controller is necessary. There are few methods to connect Bluetooth transceiver to host, where most common used are UART and USB. KC Bluetooth transceiver use UART to communicate. SPP (Serial Port Profile) is a Bluetooth standard profile which provides the platform for a host to communicate with Bluetooth transceiver serially. [11]

2.3.3 UART

UARTs (**U**niversal **A**synchronous **R**eceiver **T**ransmitter) are serial chips on your PC motherboard (or on an internal modem card). The UART function may also be done on a chip that does other things as well. On older computers like many 486's, the chips were on the disk IO controller card. Still older computer have dedicated serial boards.

When PCs all had parallel bus architecture, the UART's purpose was to convert bytes from the PC's parallel bus to a serial bit-stream. The cable going out of the serial port is serial and has only one wire for each direction of flow. The serial port sends out a stream of bits, one bit at a time. Conversely, the bit stream that enters the serial port via the external cable was converted to parallel bytes that the computer can understand. UARTs deal with data in byte sized pieces, which is conveniently also the size of ASCII characters.

Say you have a terminal hooked up to a serial port on your PC. When you type a character, the terminal gives that character to its transmitter (also a UART). The transmitter sends that byte out onto the serial line, one bit at a time, at a specific rate. On the PC end, the receiving UART takes all the bits and reconstruct the byte (parallel on older PCs) and puts it in a buffer. For newer PCs that might have a PCI-e serial port, the UART doesn't need to convert parallel-to-serial since the PCI-e "bus" is already a serial

line. But the PCI-e line carries an encoded signal which must be decoded and then greatly slowed down to the speed of the RS-232 serial line.

Along with converting between serial and parallel, the UART does some other things as a byproduct (side effect) of its primary task. The voltage used to represent bits is also converted (changed). Extra bits (called start and stop bits) are added to each byte before it is transmitted. Also, while the flow rate (in bytes/sec) on the parallel bus inside the computer is very high, the flow rate out the UART on the serial port side of it is much lower. The UART has a fixed set of rates (speeds) which it can use at its serial port interface. [9]

2.4 DC Motor

DC motors are usually available in two general types. Alike, AC motors also come in two different types. They can be two phase or three phase AC motors. Although on technical front, the differences in DC and AC motors are sometimes marginal, but some of these differences make one types better than the other for a certain use. In general, the DC electric motors work for conditions controlling the speed is essential. It is due to the factor that DC motors have a steady and constant current. DC motors are also the first and earliest motors used. But these good factors are also accompanied with some limitations; for instance, the DC electric motors are incapable of producing power over long period of time. [6]

2.4.1 Advantages of DC Motor

A DC motor is an electric motor that runs on direct current (DC) electricity. DC motors provide excellent speed control for acceleration and deceleration with effective and simple torque control. The fact that the power supply of a DC motor connects

directly to the field of the motor allows for precise voltage control, which is necessary with speed and torque control applications.

DC motors perform better than AC motors on most traction equipment. They are also used for mobile equipment like golf carts, quarry and mining equipment. DC motors are conveniently portable and well suited to special applications, such as industrial tools and machinery that is not easily run from remote power sources. [6] Figure 2.3 below show the picture of various kind of DC motor.

Figure 2.4: DC Motor

2.4.2 How Does DC motor work

A DC motor works by converting electric power into mechanical work. This is accomplished by forcing current through a coil and producing a magnetic field that spins the motor. The simplest DC motor is a single coil apparatus, used here to discuss the DC motor theory.

The voltage source forces voltage through the coil via sliding contacts or brushes that are connected to the DC source. These brushes are found on the end of the coil wires and make a temporary electrical connection with the voltage source. In this motor,

the brushes will make a connection every 180 degrees and current will then flow through the coil wires. At 0 degrees, the brushes are in contact with the voltage source and current is flowing. The current that flows through wire segment C-D interacts with the magnetic field that is present and the result is an upward force on the segment. The current that flows through segment A-B has the same interaction, but the force is in the downward direction. Both forces are of equal magnitude, but in opposing directions since the direction of current flow in the segments is reversed with respect to the magnetic field. At 180 degrees, the same phenomenon occurs, but segment A-B is forced up and C-D is forced down. At 90 and 270-degrees, the brushes are not in contact with the voltage source and no force is produced. In these two positions, the rotational kinetic energy of the motor keeps it spinning until the brushes regain contact. [6]

2.5 Microcontroller

A microcontroller is a single-chip device that contains memory for the program information and data. It has logic for programmed control reading inputs, manipulating data, and sending outputs as well as the central processing unit (CPU) that has built-in interface for input/output (I/O). Microcontroller Unit (MCU) has built-in interface capability is used for sensors, actuators, and communications [8]

2.5.1 PIC Microcontroller

The PIC was developed as a peripheral controller. PIC (Peripheral Interface Controller) is the IC which was developed to control peripheral devices, alleviating the load from the main CPU. Compared to a human being, the brain is the main CPU and the PIC is equivalent to the autonomic nervous system. [7]

2.5.2 PIC16F877A

This powerful (200 nanosecond instruction execution) yet easy-to-program (only) 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications [5]. Figure 2.4 below show the 40 pin of PIC16F877A. [7]

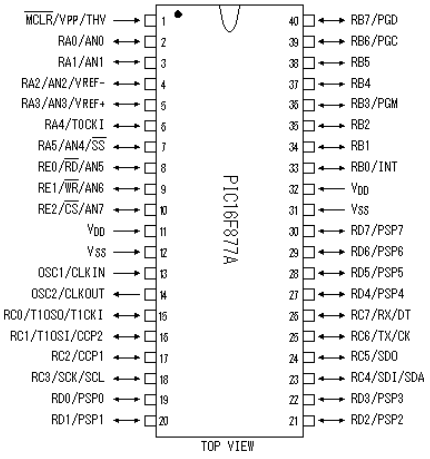

Figure 2.5: 40 Pin PIC16F877A.

2.5.3 I/O Ports

Port is refers to a group of pins on a microcontroller which can be accessed simultaneously, or on which we can set the desired combination of zeros and ones, or

read from them an existing status. Physically, port is a register inside a microcontroller which is connected by wires to the pins of a microcontroller (Nebojsa, 2003). Ports represent physical connection of Central Processing Unit with an outside world and microcontroller uses them in order to monitor or control other components or devices.

Due to functionality, some pins have twofold roles like PA4/TOCKI for instance, which is in the same time the fourth bit of port A and an external input for free-run counter. Selection of one of these two pin functions is done in one of the configuration registers. An illustration of this is the fifth bit T0CS in OPTION register. By selecting one of the functions the other one is disabled.

All port pins can be designated as input or output, according to the needs of a device that's being developed. In order to define a pin as input or output pin, the right combination of zeros and ones must be written in TRIS register. If the appropriate bit of TRIS register contains logical "1", then that pin is an input pin, and if the opposite is true, it is an output pin.

Every port has its proper TRIS register. Thus, port A has TRISA, and port B has TRISB. Pin direction can be changed during the course of work which is particularly fitting for one-line communication where data flow constantly changes direction. PORTA and PORTB state registers are located in bank 0, while TRISA and TRISB pin direction registers are located in bank 1 [7].

2.6 H-bridge

An H-bridge is an electronic circuit which enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards. H-bridges are available as integrated circuits, or can be built from discrete components.

A "double pole double throw" relay can generally achieve the same electrical functionality as an H-bridge (considering the usual function of the device). Though an H-bridge would be preferable where a smaller physical size is needed, high speed switching, low driving voltage, or where the wearing out of mechanical parts is undesirable.

The term "H-bridge" is derived from the typical graphical representation of such a circuit. An H-bridge is built with four switches (solid-state or mechanical). When the switches S1 and S4 (according to the first figure) are closed (and S2 and S3 are open) a positive voltage will be applied across the motor. By opening S1 and S4 switches and closing S2 and S3 switches, this voltage is reversed, allowing reverse operation of the motor.

Using the nomenclature above, the switches S1 and S2 should never be closed at the same time, as this would cause a short circuit on the input voltage source. The same applies to the switches S3 and S4. This condition is known as shoot-through. Figure 2.5 show structure of an H-bridge [10]

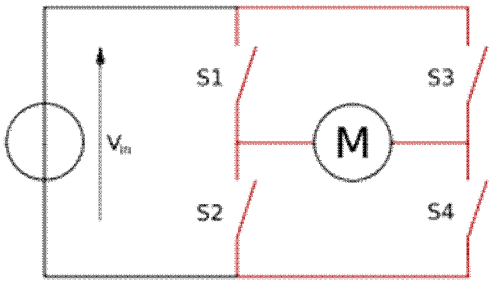

Figure 2.6 Structure of an H-bridge

2.6.1 SN754410 Motor Driver

The Texas Instruments SN754410NE is a quadruple half-H driver that can be used for bidirectional control of two DC motors or to control a single stepper motor. This driver chip is the same device that we use in our dual serial motor controller.

This item can be used as a replacement part, to stack on an existing motor controller, or other high-current device controller.

This integrated motor driver has the same pin out as the L293 that is popular in robotics applications, and the SN754410NE has the additional benefits of built-in protection diodes across the power transistors and output current capability of 1 A per driver. For even higher current applications, it is possible to physically stack two devices on top of each other to get almost 2 A of drive current, or you can consider using the L298N dual full-bridge motor driver, which can deliver 2 A per channel and has the same interface as the SN754410NE. [10]

2.6.2 Advantages using SN754410 over L293

The SN754410NE Quad Half-H Driver is an upgraded replacement for the L293D. Figure 2.6 below show the picture of SN754410. [10]

- 1-A Output-Current Capability Per Driver (2A Peak)
- Applications Include Half-H and Full-H Solenoid Drivers and Motor Drivers
- Designed for Positive-Supply Applications
- Wide Supply-Voltage Range of 4.5 V to 36 V
- TTL- and CMOS-Compatible High-Impedance Diode-Clamped Inputs
- Separate Input-Logic Supply
- Thermal Shutdown
- Internal ESD Protection
- Input Hysteresis Improves Noise Immunity
- 3-State Outputs
- Minimized Power Dissipation
- Sink/Source Interlock Circuitry Prevents Simultaneous Conduction
- No Output Glitch During Power Up or Power Down

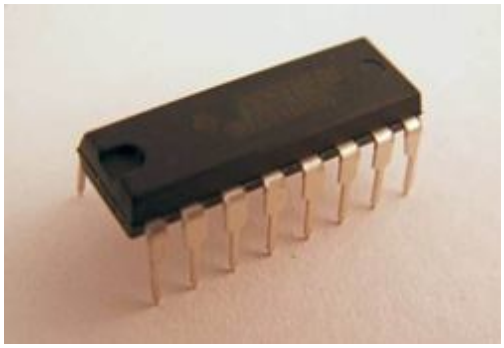

Figure 2.7: SN754410

2.7 Servo Motor - New Bluetooth Module for JVL MAC Motors

A range of integrated AC servo motors makes JVL a world leader in the field of motion control. The numerous features of these motors include a modular concept that makes it extremely easy to adapt the motors to a very wide range of applications.

JVL now introduce the first wireless integrated servo motor. Module MAC00-FB4 facilitates wireless control of the MAC motors, giving total freedom from cables.

The new module makes it possible to have a direct Bluetooth connection to the motor. Via the Bluetooth link, the motor can be set up and controlled with the same possibilities offered by a serial connection. Functionality is exactly as with the nano PLC module but instead of the serial connector, the FB4 module is equipped with an antenna. The module can be programmed via JVL's MacTalk software. Control is typically done from a mobile phone or a PC. On a PC, MacTalk can be used directly. Commands or programs can be sent from your own program.

In addition, the module offers the possibility for connection of a local zero-set sensor. Connection of supply and signals takes place through 3 robust M12 connectors.

The module has a standard antenna plug connection, to which the included antenna is connected. [13]

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, it will describe the methodology that is applied in this study. Methodology is a structured approach that uses procedures, techniques, tools and documentation aids to support and facilitate the process of design. Here the types of methodology that will be used during development are defined. This chapter will also define and manage the processes involve, constraint and barriers that shall come out and how to solve it, how to obtain the resources, and lastly, what the expected output will produce.

3.2 Project Planning Schedule

This phase combines the elements of the system planning and system analysis phases. The purposes are to identify clearly the nature and the scope of the system, opportunity or problem by performing preliminary investigation and to understand system requirement and build a logical model for a new system. Below are the summary of the preliminary investigation:

(i) Understand the problem or opportunity

The purpose of this research is to get a better idea and also better understanding of the existing system.

(a) Surfing via the internet to get more information regarding the existing system that used similar function that will develop.

(b) Discuss with supervisor the input that has been gathered from the research and study of the system.

(c) The input have been searched through the internet and also from the help of lecturer and requirement needed to do this research. Start finding the solution to overcome the identified problems.

(ii) Define the project scopes and objectives

The outline system is formed by discussing with supervisor about the objectives and scope of the system.

(a) Scopes of the system that has a potential to be develop was listed.
(b) Each module is outlined to make sure that the module is not too large.

(iii) Estimate project development time

It is important to have a draft time schedule as a guideline to ensure every single phase is running on time.

3.2.1 Flow Chart Description

The flow chart will be used as a guide line to develop this project. Figure 3.1 shows the progress or the sequence of the project. From the flowchart, data collecting and gathering are needed in order to complete this project. All the data

and information can be get from the books, journals, internet, website, and so on which are related with the project as a references. There are three main steps that are needed to complete this project. The three main steps are hardware development, circuit development and software development. The final step is to integrate all the three main parts to complete the project and achieve the objective.

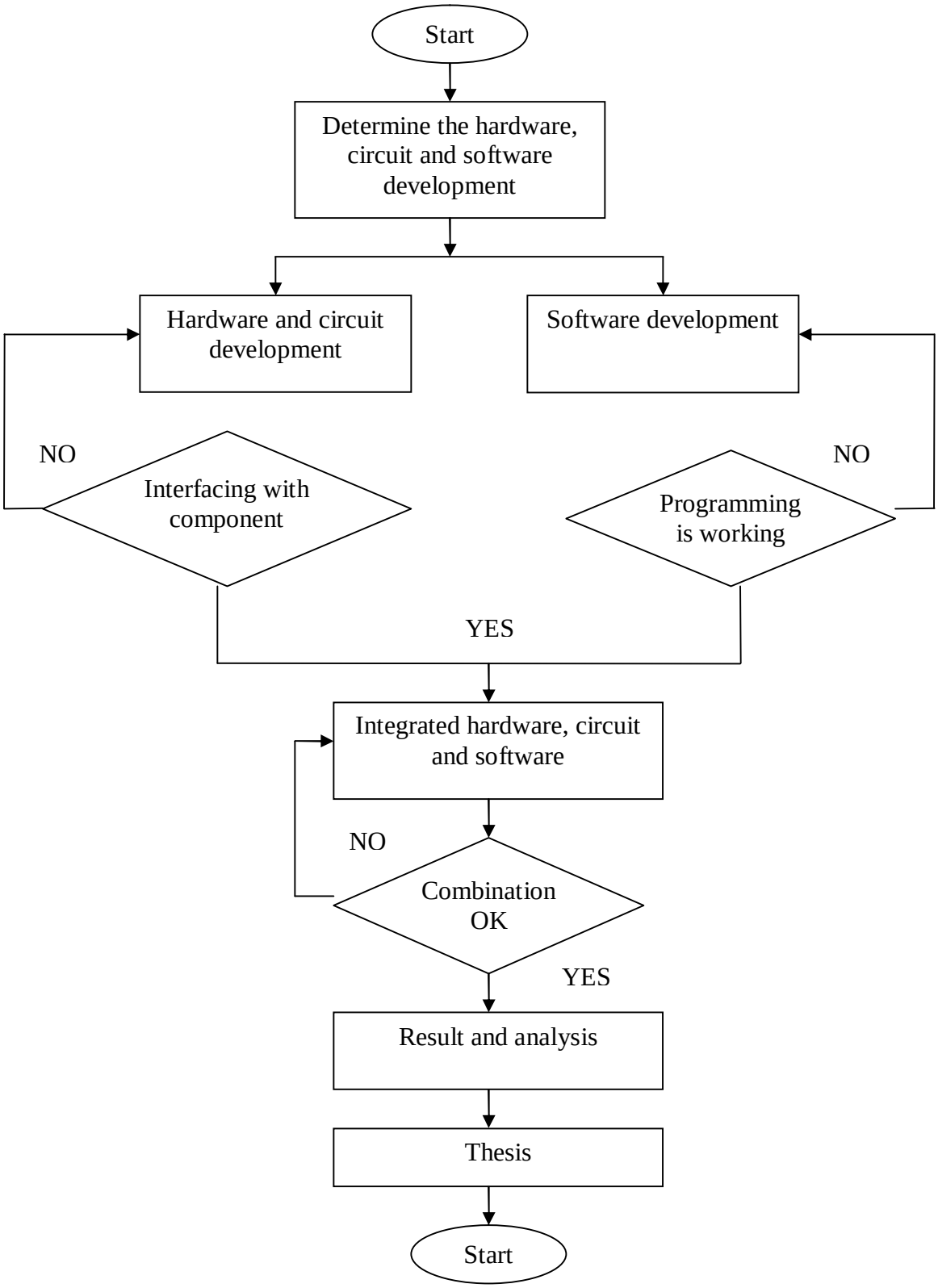

Figure 3.1: Flowchart of the project

3.3 Hardware Development

During this phase, the various component modules of the design are coded. This is to ensure the system functions correctly. This stage also is to make sure the technique that been applied which is ruled-base system is successfully implement. The structure must be arranged correctly in order to make the system run successfully without any error.

3.3.1 System Design

The Bluetooth module establishes connection with Bluetooth dongle through SPP. When user prompt a command from the personal computer, the data will be transmitted to the Bluetooth link via a Bluetooth dongle attached to the USB port of the computer. When the Bluetooth module receives the command data, it will be sent to the microcontroller using a UART interface. Upon receiving the command from the Bluetooth module, the microcontroller will process the input to determine the operation of the DC motor. The microcontroller will send the status of the devices operation back to the user via the Bluetooth link to inform the user about the status of the devices. Figure 3.2 below shows the flow of the project.

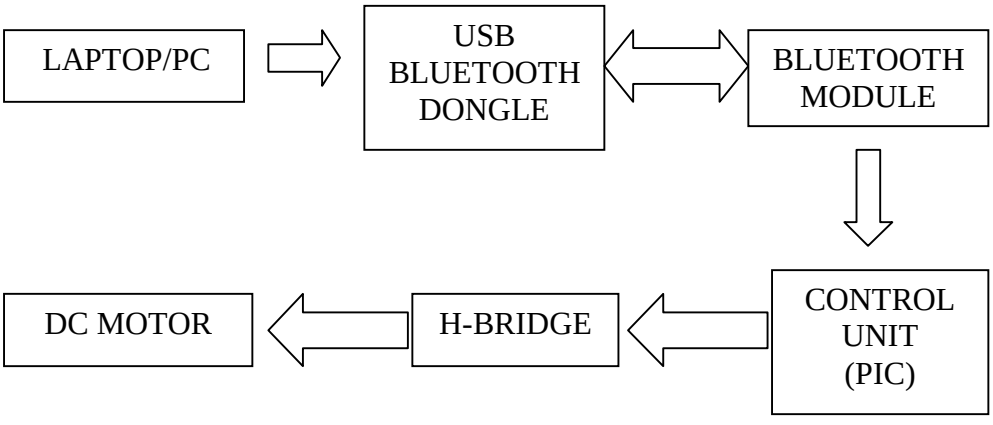

Figure 3.2: Block Diagram of Bluetooth Activated DC Motor

3.4 Circuit Development

In developing this phase, it is very important to choose the component that will be used to build the main circuit. It will make sure that the components that been used is suitable with the project need. The devices must fulfill the minimum specification in order to produce a good output.

This project has two main circuits that need to be developed which is depend on each other. The circuits that need to build are:

- Supply circuit
- Main circuit

3.4.1 Supply Circuit

The source of this supply circuit is +9V Dc. Voltage regulator 7805CT is used to get stable and exact +5V Dc supply. This is because the microcontroller PIC16F877A chip operating voltage range is 2.0V and 5.5V and current 25mA. “Heatsink” is used in voltage regulator to make sure the chip is operating in maximum temperature.

3.4.2 Controller Circuit

The controller circuit consists of microcontroller PIC16F877A chip. There are five ports in this microcontroller that can be used as input and output port which are port A, port B, port C, port D and port E. It must be programmed to assign the port became input and output. This main circuit will control the DC motor movement. This controller circuit needs +5V dc to operating. This has been explained in supply circuit above. In this project, DC motor will be connected to port B which is pin 33, 34, 35 and 36 in microcontroller chip.

3.4.3 Microcontroller (PIC16F877A)

The control unit consists of the PIC microcontroller and the pulse width modulator. Once the control signal from the PC reaches the PIC through the Bluetooth transmitters, its values are interpreted in the program and generate the necessary outputs. The PIC is programmed in a simplified PIC Basic. Figure 3.3 show the pin diagram that can be assigned for PIC16F877A. The primary function of the microcontroller is to process the data provided by the Bluetooth transceiver. The microcontroller is used for serial data communication. The frequency provided to the UART module must be known. A 4 MHz external crystal oscillator is used to clock the program data. The microcontroller in this project uses PORTB configured as the output port which connects the LED and the DC motor. While RX and TX pins at PORTC is used to interface the microcontroller with the Bluetooth module.

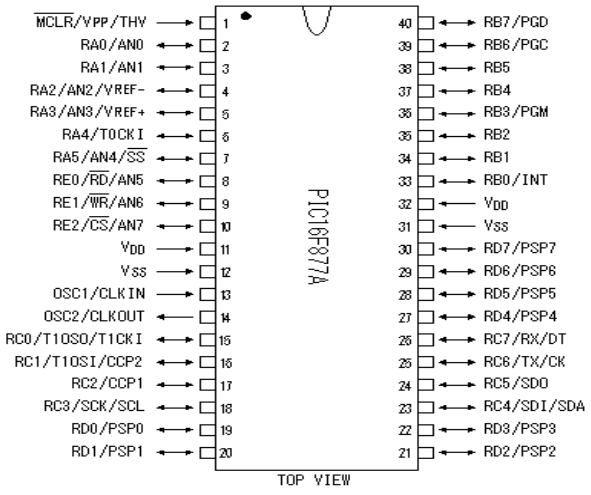

Figure 3.3: Pin diagram for the PIC16F877 microcontroller

3.4.4 9V Battery

This is the power supply for the circuit. It will be used to power the motor, as well as the logic chips of the system. The Bluetooth module and PIC microcontroller will be supplied with lower voltages. A 9 V lead acid battery will be used.

3.4.5 DC Motor Circuit

The most common method to drive DC motors in two directions under control of a computer is with an H-bridge motor driver. The DC motor is connected to the dc motor driver. In this project, IC SN754410 motor driver was selected. Figure 3.4 shows the circuit diagram of the motor driver.

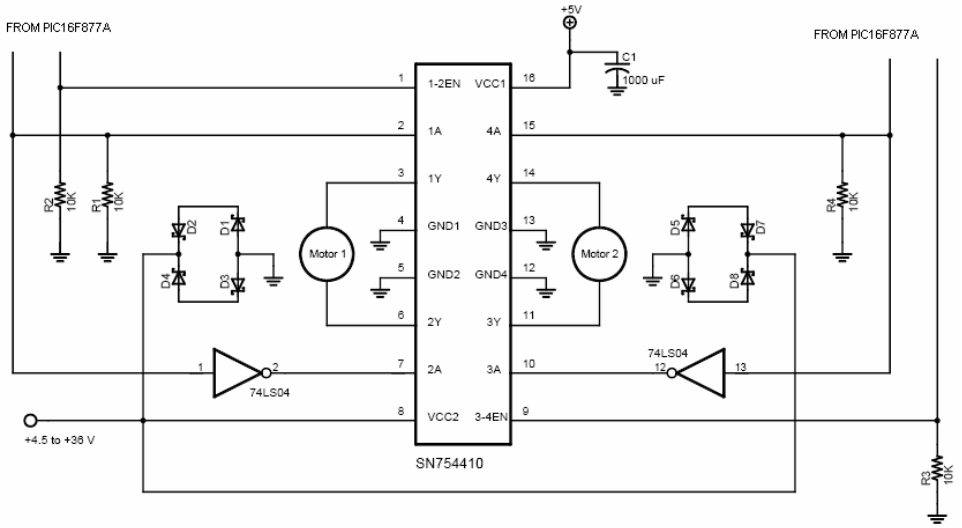

Figure 3.4: Circuit diagram of IC SN754410 motor driver

3.4.5.1 SN754410 Motor Driver

This SN754410 motor driver is a quadruple half-H driver that can be used for bidirectional control of two DC motors or to control a single stepper motor. It is the same motor driver used in our dual serial motor controller. It also have thermal shutdown and built in clamping diodes. Figure 3.4 and table 3.5 show the picture of SN754410 motor driver and its function table.

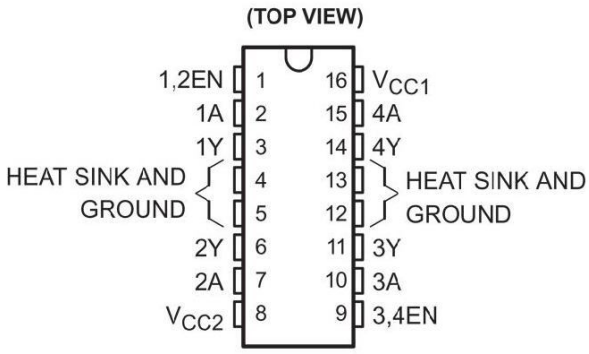

Figure 3.5: SN754410 Motor Driver

INPUTS*		OUTPUT
A	EN	Y
H	H	H
L	H	L
X	L	Z

Table 3.6: Function table

H = high-level

L = low-level

X = irrelevant

Z = high-impedance (off)

* In the thermal shutdown mode, the output is in a high-impedance state regardless of the input levels.

3.4.6 SKKCA-21 Bluetooth Module

KC Wirefree Bluetooth Starter Kit, SKKCA has been designed for 5V TTL logic interface, no extra voltage divider is necessary. With minimum interface, it is ready to connect to microcontroller for embedded Bluetooth development. The most important configuration is UART. UART depend on timing or the baud rate, therefore the most

important task is to configure the baud rate of microcontroller. Figure 3.5 below show the picture of SKKCA-21 Bluetooth module.

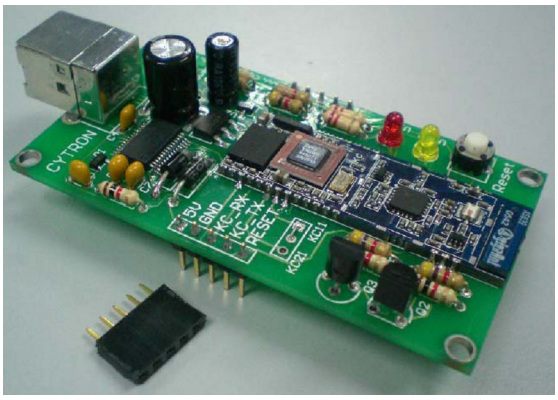

Figure 3.7: SKKCA-21 Bluetooth module

3.4.6.1 Configuring the SKKCA-21 Bluetooth module

The device must compatible with the system which is the Bluetooth module need to be configured. It has to be configured to correct baud rate (UART data speed) to enable the communication and display data from Bluetooth module. The Bluetooth module use AT command to configured. The AT command set was first developed for controlling modem. It is send from the host, which is the computer to the Bluetooth module through the UART interface.

3.4.6.2 Writing the AT-Command for SKKCA-21 Bluetooth module

The AT command is written in the Microsoft Notepad as shown in Figure 3.8 to change the device's baud rate to 9600 bps.

AT+ZV ChangeBaud 9600

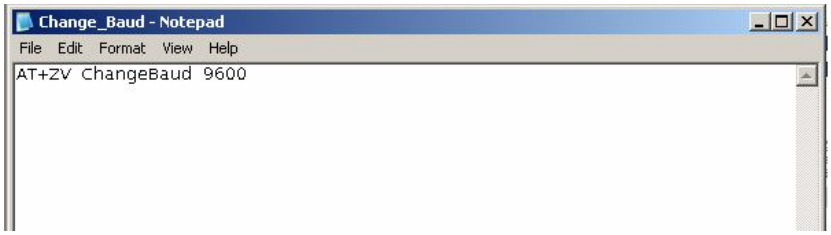

Figure 3.8: Changing baud rate command written in the Microsoft Notepad

Hyperterminal is used to create connection. In order to facilitate using hyperterminal with Bluetooth module, it is not able to accept typed command corrections. Any errors will require the command to be completely re-entered. Figure 3.9 below shows the change of baudrate using hyperterminal.

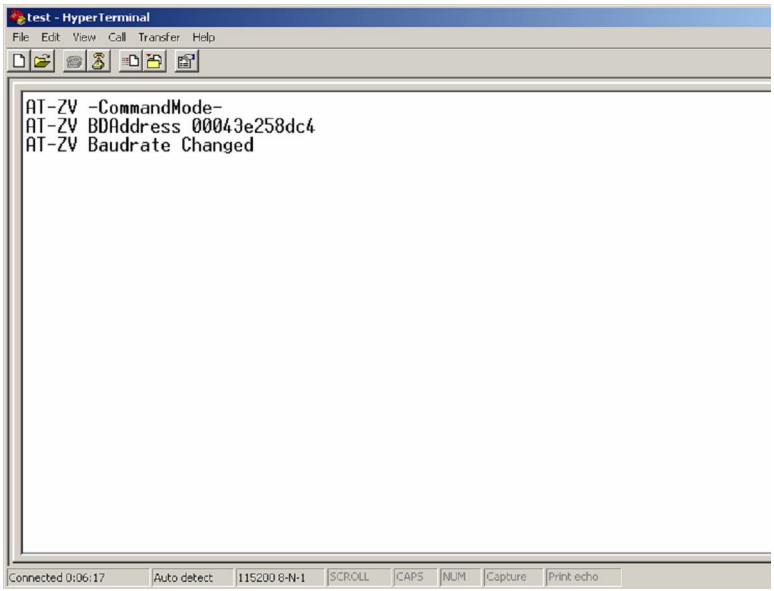

Figure 3.9: Baud rate Successful Changed

3.4.6.3 HyperTerminal

Hyper Terminal is a communication program that comes free with Windows. It can also be used to set up a connection for data transfer between two computers such as user desktop computer and a portable computer by using the serial ports and for serial-port control of external devices or systems such as scientific instruments, robots, or radio

communications stations. HyperTerminal can also be used as a troubleshooting tool when setting up and using a modem. Commands can be sending through HyperTerminal to make sure that the modem is connected properly.

3.5 Bluetooth Dongle

The Bluetooth USB dongle allows data transfer between devices. It allows sharing of files with other Bluetooth PCs, dial up the internet through other Bluetooth PCs with internet connection or Bluetooth mobile phone. In this project, Bluetooth dongle is used to interface it with the Bluetooth module. Bluetooth dongle can be easily attached to computer as it is designed as USB. Figure 3.10 shows the picture of Bluetooth dongle.

Figure 3.10: Bluetooth Dongle

3.6 12VDC Motor

The motor can be tested by connecting the 9V battery as a power supply and running it at full load. This will confirm that the motor itself is functioning properly before the rest of the circuit is connected to control it. A voltage source from the lab can be used to supply the motor with various sized voltages to insure its functionality.

3.10 74LS04 Hex Inverter

The hex inverter is used to simplify the inputs to control the motor. Figure 3.8 shows 74LS04 hex inverter pin configuration diagram. It shows that it is a 14 pin chip containing six separate inverters. There is only one Vcc and one ground pin is provided indicating that they used for all six inverters. The logic symbol, Figure 3.9 is shown for each inverter, as well as its function table, Table 3.10.

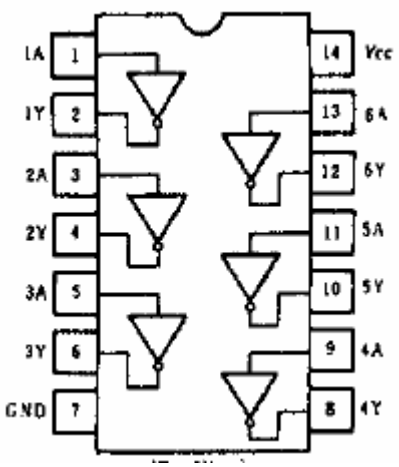

Figure 3.11: 74LS04 Pin Configuration

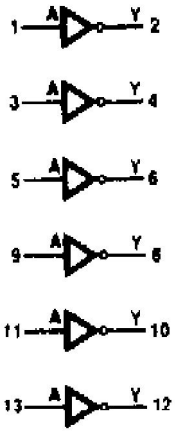

Figure 3.12: Logic Symbol

INPUT	OUTPUT
A	Y
L H	H L

H = HIGH voltage level

L = LOW voltage level

Table 3.13: Function Table

3.8 Crystal Oscillator

Crystal oscillator is most common type of clock source. It is come in all different flavors and frequencies. 20MHz, 16MHz, 10MHz, 4MHz are the common frequencies that were used. There are also some frequencies like 14.7456MHz, 9.216MHz, and 32.768 kHz that are available because these frequencies are multiples of speeds needed for serial communications and for timing. 4 MHz crystal oscillator is used in this project. Figure 3.6 shows the picture of 4 MHz crystal oscillator and Figure 3.7 shows the oscillator circuit.

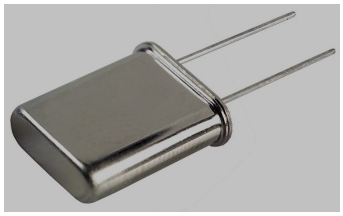

Figure 3.14: Crystal 4 MHz

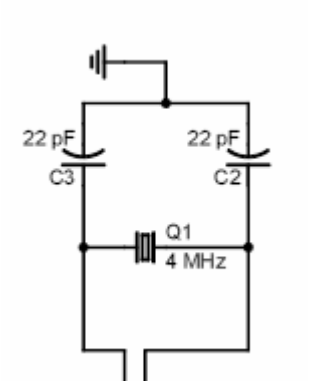

Figure 3.15: Oscillator Circuit

3.9 Software Development

A process model for software engineering is chosen based on the nature of the project and application, the tools to be used and the controls and deliverables that required. For this study, the PIC16F877A was chosen and it is programmed in basic instruction set. It is necessary to build a block diagram for the programming build because it will guide and generate the idea to build the program for this project. Figure 3.8 shows the block diagram of software development process of this project.

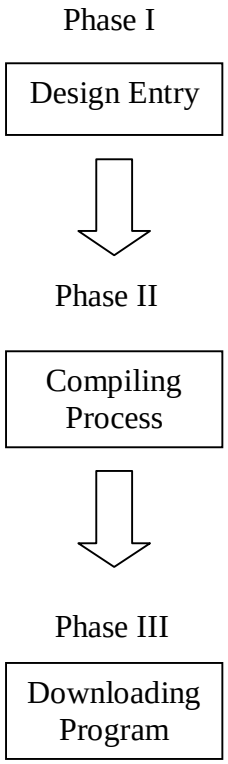

Figure 3.16: Block diagram of software development process

3.9.1 PICBasic Pro Language

PIC Basic Pro had been choose as the programming language because of the simplicity in developing the DC motor driver program. Its command requires the PIC pin to be output signal and the output period can be controlled by programming.

3.9.2 Programming the Microcontroller

The PIC16F877A is programmed in PICBasic pro language. Other programming languages that can be used to program the microcontroller are

assembly language, which is a low level language and C language. The PICBasic Pro Compiler produces code that may be programmed into a wide variety of PIC microcontroller having from 8 to 84 pins. These microcontrollers use flash technology to allow rapid erasing reprogramming to speed program debugging. With the click of the mouse in the program software, the flash PIC can be instantly erased and then reprogrammed again and again.

3.9.3 Compiling the Program

The compiling process is the process to confirm all of the source codes are corrected. The compiling process includes selecting device and compiler software. It must be compiled before the program is downloaded into the microcontroller. First, the basic source file for the program is created by using Windows Notepad. This source file will be created in or moved to the same directory as the pbp.exe file. The next step is to compiled program into the PIC microcontroller and testing it. The PICBasic Pro compiler will generates .hex file that will be used to PICmicro Programmer which is the USB programmer.

3.9.4 USB Programmer

USB programmer is a device that can be used to program a PIC microcontroller such as PIC16F877A, PIC16F87, PIC16F84 and other microcontroller that is compatible and suitable for this device. Figure 3.9 below shows the picture of the USB programmer. One side of the cable is connected to the programmer and the other side is connected to the USB port of the computer.

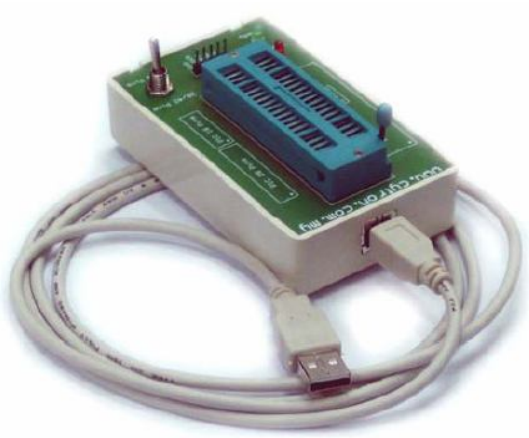

Figure 3.17: USB Programmer

3.10 Summary

Methodology consists of two main criteria; hardware development and software development. For hardware development, transmitter and receiver circuit need to be completed. Designs of the circuit need to be done before implement it on real board. In software development, it has three phases that should be going through carefully; design entry, compiling process and downloading program.

CHAPTER 4

RESULT AND ANALYSIS

4.1 Introduction

This chapter focused on the findings and result such as output from the testing phase, discussion, advantages, constraints in completing the project and recommendation for future enhancement of the system. Hopefully the discussions can bring benefits and ideas to the future developer to upgrade and enhance the performance and the functionality of the system.

4.2 The Project Result

Result from the testing, performance of the Bluetooth Activate DC Motor can be evaluated whether the device are functioned or not. From the Bluetooth dongle, it sent transmit data to Bluetooth SKKCA-21 module. After the module had received the data, then it connects with the microcontroller to run the DC motor.

The result that got from this project is the LED on the main board is functioning; meaning that the port B as an output for the DC motor. The Bluetooth module and motor were both functioning but sometimes the Bluetooth may not compatible and cannot send data.

4.3 Target Output

The target output, when the data send the device will be controlled automatically by the microcontroller not by manually as a result testing. The DC motor supposed to spin after the Bluetooth dongle send data to the Bluetooth module. It will stop spin after there is no connection between the Bluetooth transmitter and receiver.

4.2 Assumption and Enhancement

In order to develop this project, numbers of constraints must be faced. The constraints might be varying according to the situation and stages. In terms of collecting data, designing the circuits, soldering the equipments, chip programming and fix the error programming. All of these constraints needed to be solved in order to achieve the objectives.

4.2.1 Constraints

There were many constraints identified during the development phase and it should be taken note for in order to avoid it from happening again in the future research. The constraints are:

(i) **Learning the basic PIC16F877A microcontroller**

In order to investigate the capabilities or to test a given microcontroller, obviously it is essential to build the proper circuitry.

(ii) **Collecting Data**

All requirements of the microcontroller, such as types of microcontroller, electronics goods and others need to study. Not all the knowledge that gets from

theory learning is same with the practical learning, here certain things needed to explore by your own. Output maybe gets after trial an error sessions.

(iii) **Designing the Circuits and Soldering Equipments**

After the circuits that had been design and done, it needs to be tested to make sure that there is a connection between the electronic components and the microcontroller. The circuit needs to be re-soldering again if there is no connection. Sometimes the chip that had been soldered many times can cause damaged.

(iv) **Chip Programming**

The hard parts in this system are when the programming is not able to be loading into the microcontroller PIC16F877A chip. Sometimes there is an error that occurred while compiling and running the program. The programmer needed to troubleshoot the errors and fix it until its success. Many obstacles happened, such as the compiler cannot be installed in the computer, there is too much errors needed to fix, the computer hanged or the data is corrupted.

4.3 Circuit Result

The most important part to complete this project is the circuit. It is obtained from all the research and gathering information from literature review and methodology which is chapter three and chapter four respectively. Figure 4.1, Figure 4.2 and Figure 4.3 below show the picture of circuit that has been build.

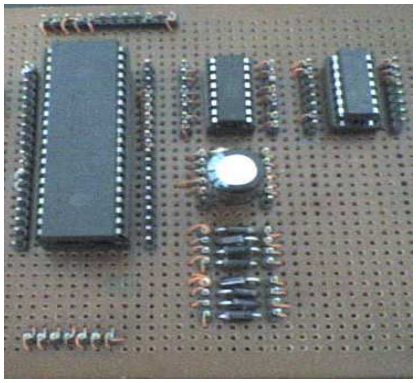

Figure 4.1: Main Circuit

Figure 4.2: Supply Circuit

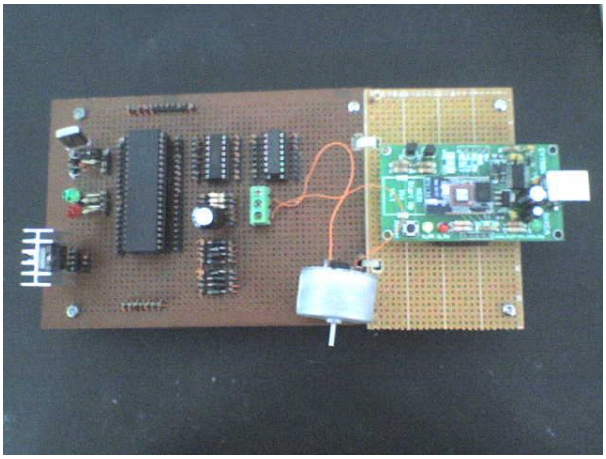

Figure 4.3: Complete circuit

The PIC can be tested by send test output signals, generated in the PIC program. The digital input and output from the PIC can be tested by connecting an LED to test that it is in fact being lit when it should be. This will have to be done before the testing of the user because the communication depends on the PIC functioning properly. Figure 4.3 show the PIC16F877A is tested which is lighting up the LED.

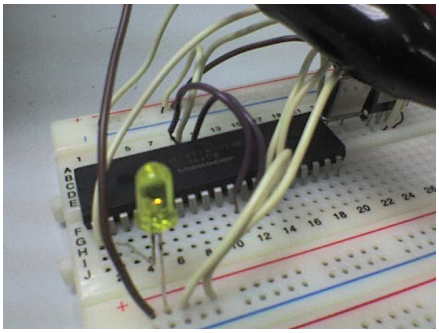

Figure 4.4: Testing PIC16F877A

4.4 Setup PC for Bluetooth interface

Before the USB dongle can be used, the driver and the software IVT BlueSoleil have to be installed. After that, the USB dongle have to link with the Bluetooth module. After the software has been successfully installed, the USB dongle is then plugged and run the software. Figure 4.4 show that the USB dongle is connected to the Bluetooth module.

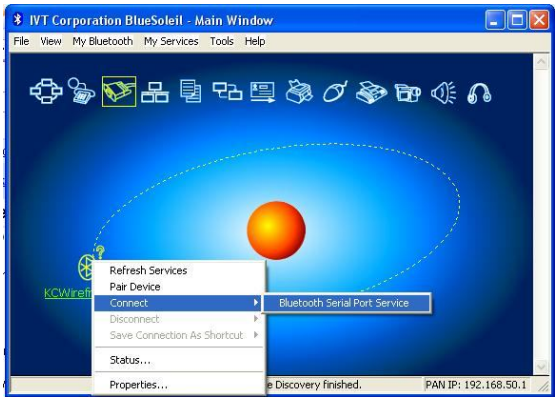

Figure 4.5: USB dongle connect to the Bluetooth Module

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The objectives of the project of the project which is to use Bluetooth communication link in transmitting and receiving process is achieved. However the objective to activate and control dc motor from a distance did not completely achieved. The UART interface of the microcontroller needed to be initialized before the Bluetooth module work together with the microcontroller to operate as a whole.

5.2 Recommendation

There are some future research to be considered in improving and searching for the details of this project. Hardware is the most important part for a system to work. Without correct hardware interface, a system may not work correctly or even caused damage to other components when the power is turned on. The main hardware to be taken care is the voltage regulator. As stated, Bluetooth module is powered with only 3.3V (2.7V to 3.6V). Thus the operating voltage must be ensured that it is within range. To begin, computer is the best and simplest device to interface to.

Besides that, the computer has to be configured to the correct baud rate (UART data speed) to be able to receive and display data from Bluetooth module. There are still improvements needed in this entire system design. Some of the possible enhancements are discussed in this topic. It is hope that the improvise system will give more reliability to the user and some extra credits can be added to the system's market value.

5.3 Enhancement

For future development, there are several recommendations that should be considered for the future enhancement. There are:

(i) Expand the scope

As the Bluetooth module that been used in this project is a short range connectivity and communication, it can be replaced by any other latest technology in the future. This will make the system more variation and more usage.

(ii) Programming

To begin programming the PIC, there were a few things that needed to be setup in the code to ensure that the PIC would function properly. Lots of care should give to ensure a certain level of modularity and portability among components.

5.3 Costing and Commercialization

Overall cost for this project is shown in Table 5.1. The cost consist the list of parts and components that is obtained before starting this project. After finishing the project, the total cost is actually higher than the list shown table. An extra care was given when selecting and purchasing the electronics components.

Item	Quantities	Cost per Item (RM)	Total (RM)
PIC16F877A	1	40.00	40.00
SN754410	1	9.70	9.70
74LS04	1	4.50	4.50
1N5817	8	2.80	22.40
LED	2	0.30	0.60
Crystal 4MHz	1	2.00	2.00
Capacitor 22µF	2	0.40	0.80
Capacitor 1000µF	1	0.40	0.40
Resistor 4.7KΩ	1	0.20	0.20
Resistor 150KΩ	2	0.20	0.40
Resistor 10KΩ	4	0.20	0.80
SKKCA-21	1	230.00	230.00
		TOTAL	311.80

Table 5.1: List and Cost Items

From the test and result that has been done, if further studies and research is being improved and the scope can be expanded, this project can be used for commercial purpose. Besides, this type of system is still less commercial in market.

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APPENDIX A

Datasheet PIC16F877A

APPENDIX B

Datasheet 4 MHz Crystal Oscillator

APPENDIX C

Datasheet 74LS04

APPENDIX D

Datasheet SN754410