UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS♦

JUDUL: **BLUETOOTH MESSAGE LCD DISPLAY**

SESI PENGAJIAN: 2008/2009

Saya **RAMEESH A/L GUNASEKRAN (850821-09-5037)**
(HURUF BESAR)

mengaku membenarkan tesis (Sarjana Muda/~~Sarjana~~ /~~Doktor Falsafah~~)* ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Universiti Malaysia Pahang (UMP).
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	**SULIT**	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD**	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
√	**TIDAK TERHAD**	

Disahkan oleh:

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:

NO 15 LORONG 3,
TAMAN BUNGA PADI,
01000 KANGAR,
PERLIS

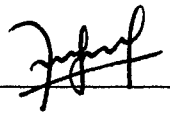
NURULFADZILAH BINTI HASAN
(Nama Penyelia)

Tarikh: **14 NOVEMBER 2008**

Tarikh: : **14 NOVEMBER 2008**

CATATAN:
- * Potong yang tidak berkenaan.
- ** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh tesis ini perlu dikelaskan sebagai atau TERHAD.
- ♦ Tesis dimaksudkan sebagai tesis bagi Ijazah doktor Falsafah dan Sarjana secara Penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).

"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Electronics)"

Signature : 

Name : NURULFADZILAH BINTI HASAN

Date : 14 NOVEMBER 2008

BLUETOOTH MESSAGE LCD DISPLAY

RAMEESH A/L GUNASEKRAN

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

Faculty of Electrical & Electronics Engineering
Universiti Malaysia Pahang

NOVEMBER, 2008

"All the trademark and copyrights use herein are property of their respective owner. References of information from other sources are quoted accordingly; otherwise the information presented in this report is solely work of the author."

Signature : 

Author : RAMEESH A/L GUNASEKRAN

Date : 14 NOVEMBER 2008

To My Beloved Family and With Grace of God

ACKNOWLEDGEMENT

In preparing this thesis I was in contact with many people such as lecturers, manufacturer's, lab assistance and fellow colleagues. My first appreciation would definitely my supervisor, Madam Nurulfadzilah Binti Hasan. Here I would like to express my sincere appreciation to guide me so far even though she was on maternity leave for several months. She gave me motivation at each time when I express my disappointment towards the research that I was been doing.

My special thanks to En Addie Irawan, my co-supervisor during my supervisor's maternity leave. The amount of knowledge that I have gained from him is just uncountable. He never fails to encourage me and even help me to fix problems when I am experiencing problems. There was lots of new information I have gained from him when I was under his supervision

I am also very thankful to my friend Vikneswaran who helped me along this project. His view and tips was useful for my project. Unfortunately it is impossible for me to state all of my friends in this limited place.

Last but not least I would like to thank my dad, mom and sister Kogine for their support along this project. They never fail to motivate me almost everyday in this semester. Thanks a lot.

ABSTRACT

The advancement in technology has driven the world towards efficient communication technologies where infrared is less used. Bluetooth is more appropriate to be used for communication because the signal will not be disrupted easily till a certain range of distance. Bluetooth message LCD display is a system that has been designed to enable user to spread news immediately from the place you are in a certain range. Many wired shout out box has been designed to spread news at workplace in common. This project acts as a wireless shout out box. With this Bluetooth Message conveyor it becomes possible to spread messages and news in a workplace for instance, which can be interconnected and transmitted using a single Microchip PIC16F877 microcontroller through a Personal Area Network (PAN). The network in this project consist a Bluetooth module and a Bluetooth dongle. This is the two wireless devise that communicate to display the message at a graphic LCD screen.

ABSTRAK

Kemajuan teknologi telah memesongkan dunia ke arah komunikasi yang lebih efektif dimana “infrared” jarang digunakan lagi. “Bluetooth” adalah lebih sesuai lagi digunakan bagi tujauan komunikasi kerana isyarat komunikasi tidak mudah putus sehingga jarak tertentu. “Bluetooth Message LCD Display” adalah satu sistem yang telah dibentuk untuk memudahkan penghantaran mesej serta merta dalam jarak tertentu. Terdapat banyak kotak mesej yang dibentuk untuk menyebarkan mesej di tempat kerja. Projek ini merupakan satu model kotak mesej tanpa wayar. Penghantaran mesej melalui “Bluetooth” memudahkan penyebaran mesej di tempat kerja. Mikrochip 16F877 memainkan peranan penting untuk penghantaran mesej melalui “Personal Area Network (PAN)”. Rangkaian projek ini mengandungi “Bluetooth Module” dan “Bluetooth Dongle”. Kedua-dua “Bluetooth Module” dan “Bluetooth Dongle” akan berkomunikasi untuk memaparkan mesej di “Graphic LCD Screen”.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

ADC	-	Analogue to Digital Converter
A/D	-	Analogue/Digital
DAC	-	Digital to Analogue Converter
GLCD	-	Graphic Liquid Crystal Display
GUI	-	Graphic User Interface
HDI	-	Human Interface Device
I/O	-	Input/output
PAN	-	Personal Area Networking
PC	-	Personal Computer
PCB	-	Printed Circuit Board
PIC	-	Programmable Intelligent Computer
Rx	-	Receive
SDP	-	Service Discovery Protocol
SPP	-	Serial Port Profile
Tx	-	Transmit
UART	-	Universal Asynchronous Receiver/Transmitter
USART	-	Universal Synchronous Asynchronous Receiver/Transmitter
USB	-	Universal Serial Bus

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Bluetooth is a device used to receive and transmit data. 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, personal computers, printers, digital cameras, and video game consoles over a secure, globally unlicensed short-range radio frequency. [2] In an infrared system, text message can only be sent if the module is placed side by side. In a Bluetooth system, text message can be sent from 100meter range the most. [8] Bluetooth can be replaced as an alternative to infrared. Therefore text message transmission via Bluetooth is reluctant.

1.2 Objectives

The objectives of this project are to:

i. To develop a message display system via Bluetooth.
ii. To develop the interfacing of microcontroller with a Bluetooth module and graphic LCD screen using PBASIC programming.

1.3 Project Scopes

This project concentrates on the development of the programming in PBASIC to transmit the data on a LCD screen via Bluetooth.

1.4 Methodology

Methodology or the work flow of the project basically gives a view on the flow of the overall project that have been carried out which involves the hardware design and the software integration of the project. Then the system is being tested to produce a result at the end of the project. The result that is being produced is analyzed to be compatible the proposed system earlier. This project in short is separated into three parts which is:

- Hardware Design
- Software Development
- Integration Between Hardware and Software

For the three parts that have been divided literature had been done at the first place. Once literature review is completed the hardware is designed and tested. Once the hardware testing is success then the software development was done. Finally both the hardware design and the software development is done to complete the project.

1.5 Thesis Overview

This thesis is combination of 5 chapters that contain the Introduction, Literature Review, Hardware Design, Software Design, Result and Discussion, and the last chapter is a Conclusion and further development of the system

Chapter 1 is an introduction of the project. In this chapter, we explain about background, objectives, scope of the project and the methodology. The concept of the project and the overall overview of the project also will also being discussed in this chapter.

Chapter 2 focuses on the literature review for the development and implementation of the overall project. It gives a brief review of the project being conducted so far in terms of the major devices used itself. Rather than that in this chapter we are going explain about the Bluetooth protocols that have being used in order to interface between the graphic LCD screen and PIC.

Chapter 3 is mainly on the Hardware Design and software design of the system of the overall system. In this chapter we are going to explain briefly of the hardware design for the interfacing of the Bluetooth Module, PIC and Graphic LCD screen. These are the three main devices being used in the project. The software design is mainly on the Bluetooth Module and the Graphic LCD screen.

Chapter 4 is the result and discussion. In this chapter the overall result of the project about the Bluetooth Message LCD Display project will be produced as evidence that the project is success in the end.

Chapter 5 is the Conclusion of the system and further development of the system if there is any.

CHAPTER 2

LITERATURE REVIEW

2.1 PBASIC

PBASIC is a microcontroller based version of BASIC created by Parallax, Inc. The language was created to bring ease of use to the microcontroller and embedded processor world. The English used is a basic language that is much easier to read and write than assembly language. The PICBASIC PRO Compiler (PBP) produces code that may be programmed into a variety of PICmicro microcontrollers having from 8 to 84 pins and various features in the chip itself including analog to digital converters, hardware timers and serial ports. The PICBASIC PRO compiler has most of the libraries and functions. PBP is not quite as compatible with the BASIC stamp because it is an improvised version for the language overall. One of these was added in the BASIC stamp such as IF, THEN, ELSE, ENDIF and GOTO. PBP defaults to create file to run PIC clocked at 4MHz. Only minimum parts are required as 2.22pF capacitor for the 4MHz crystal and 4.7k ohm pull up resistor at the MCLR pin and suitable 5V power supply. [1]

2.2 BLUETOOTH MODULE (SKKCA-11)

KC Wirefree Bluetooth module offer simple yet compact Bluetooth platform for embedded application. Since it comes with surface mount layout, starter kits have been developed to ease user to explore the possible development and application. This document describes the use and starting guide for KC Wirefree Bluetooth starter kit. 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. Furthermore, on board USB to UART converter offer easy yet reliable communication to PC for functionality test or even creating Bluetooth wireless connection. [3] The SKKCA-11 module used in this project is shown in Figure 2.1

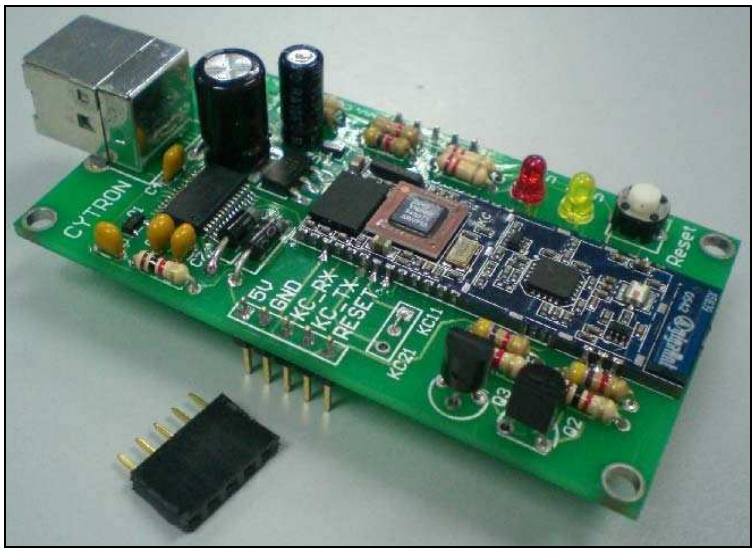


Figure 2.1 Bluetooth Module Used

In order to enable Bluetooth wireless link to be established, KC_RX pin should be pull high in normal case. Simple way to do this is to configure the microcontroller UART. Most microcontrollers' UART engine will ensure the Transmitter is high in idle case. Once configuration of UART is completed, we can start to search the SKKCA and create SPP connection. 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. Only those devices that have SPP (Serial Port Profile) are able to create Bluetooth wireless connection with SKKCA. The Serial Port Profile defines the protocols and procedures that shall be used by devices using Bluetooth for RS232 (or similar) serial cable emulation. The scenario covered by this profile deals with legacy applications using Bluetooth as a cable replacement, through a virtual serial port abstraction. [4][2]

In order for two Bluetooth devices to communicate with each other, they must share at least one common profile. If I want a PC to communicate with my SKKCA-11 Bluetooth module, need to make sure that they both support the same profile. SKKCA-11 supports the Serial Port Profile (SPP) which is one of the earliest and most widely supported profiles. The main elements of the Bluetooth stack are shown in the Figure 2.2 as with a typical diagram of the TCP/IP stack, there are a number of details that are can be obtained apparent from the stack. Specifically, there are a number of profiles that can be obtained roughly on top of the L2CAP layer that provide much of the power and also the complexity of the Bluetooth protocols.

These profiles are the basic entry into the stack for an application. Essentially, they define the set of services that are available to that application. Currently there are more than 25 different profiles defined or in the process of being defined by the Bluetooth SIG. However, the abstraction by a single profile can provide an application the use of the profile without such detailed knowledge. There are a number of profiles that are exposed in very familiar forms. The SKKCA-11 module, for instance, implements the SPP profile which enables it to appear like a traditional serial port. This virtually eliminates the need for the user to have specific Bluetooth knowledge and allows the PC to be integrated into applications very quickly. [7]

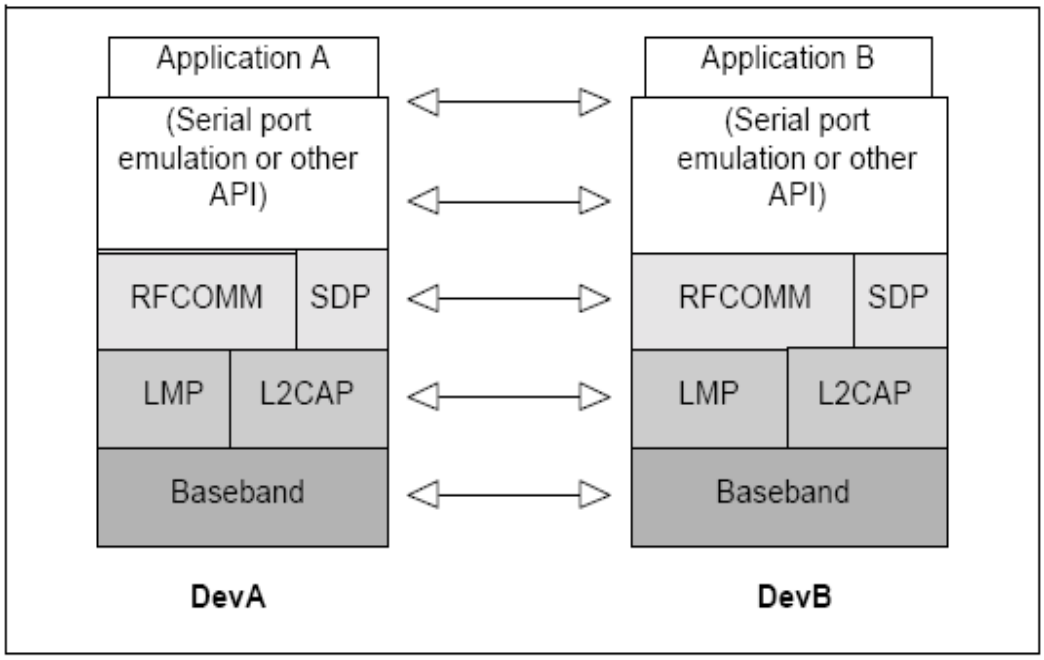


Figure 2.2 Protocol Models

2.2.1 Link Manager Protocol

The link manager protocol is responsible for link set-up between Bluetooth devices. This includes security aspects like authentication and encryption by generating, exchanging and checking of link and encryption keys and the control and negotiation of baseband packet sizes. Furthermore it controls the power modes and duty cycles of the Bluetooth radio device, and the connection states of a Bluetooth unit in a piconet. [8]

2.2.2 Service Discovery Protocol (SDP)

Discovery services are crucial part of the Bluetooth framework. These services provide the basis for all the usage models. Using SDP, device information, services and

the characteristics of the services can be queried and after that, a connection between two or more Bluetooth devices can be established. SDP is defined in the Service Discovery Protocol specification. Rather than that this SDP can establish the services that are being provided by the SKKCA-11 module. For instance the services that being offered are there Serial Port Services which communicate via serial port with the connected devise. It can send data to any device via serial port which is a common framework used to transfer data in unidirectional. [9].

2.3 PIC MICROCONTROLLER

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC1640 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Programmable Interface Controller", but shortly thereafter was renamed "Programmable Intelligent Computer". Basically in the Bluetooth circuit the PIC acts as an intermediate to Bluetooth module and graphic LCD screen to receive and transmit data. Data will be stored and decode before being sent to the graphic LCD screen in word form. [5]

The microcontroller is a system that requires regulated 5.0 V power source to work in environment. Rather than the power supply source, the microcontroller must also fulfill the following criteria:

- Allow for low power consumption
- Easily integrated with other hardware using a hardware UART module
- Readily be programmable

The microcontroller chosen for this project is 16F877 from Microchip Technology and the pin diagram is shown in Figure 2.3. The microcontroller work in

low supply voltage range from 4.5 V to 5 V and is a low power consumption device with an operating current of 1.6mA in active mode. The microcontroller also provides a hardware UART module interface with the SKKCA-11. [10]

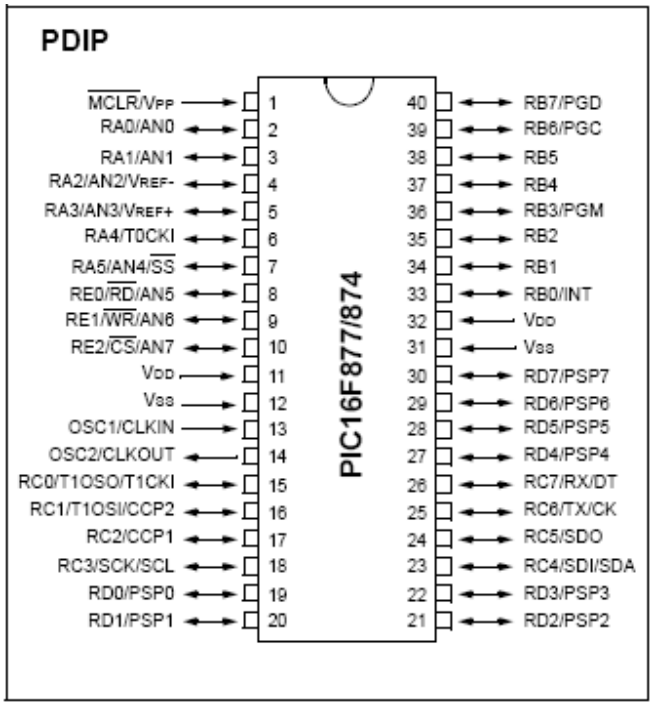


Figure 2.3 Pin Diagram

2.4 GLCD SCREEN

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. It is often utilized in battery-powered electronic devices because it uses very small amounts of electric power. LCD with a small number of segments, such as those used in digital watches and pocket calculators, has individual electrical contacts for each segment. An external dedicated circuit supplies an electric charge to control each segment. This display structure is unwieldy for more than a few display elements. The LCD that is

used in this project is a parallel type with only 5V input voltage. The suitable Graphic LCD screen for the PIC and Bluetooth module that have been chosen is shown in Figure 2.4. [6]

Figure 2.4 Graphic LCD screen used

2.4.1 Parallel Interface

The graphic LCD is in parallel mode by pulling up PSB pin. And can select 8 bit or 4-bit bus interface by function set instruction DL control bit. MPU can control (RS, RW, E, and DB0 to DB7) pins to complete the data transmission. In 4-bit transfer mode, every 8 bits data or instruction is separated into 2 parts. Higher 4 bits（DB7 to DB4）data will transfer First and placed into data pins（DB7 to DB4）. Lower 4 bits（DB3 to DB0）data will transfer second and placed into data pins （DB7 to DB4）. (DB3 to DB0) data pins are not used. [11]

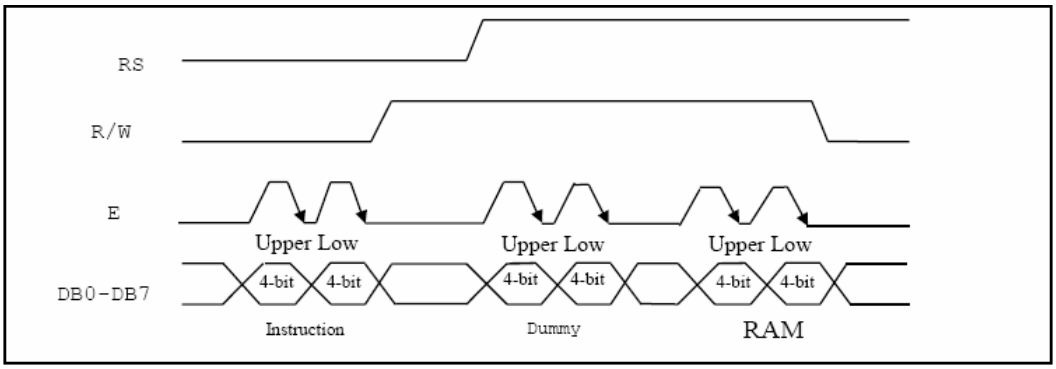


Figure 2.5 Timing Diagram of 4-bit Parallel Bus Mode Data Trans

CHAPTER 3

SYSTEM DESIGN

3.1 Basic Board Development

The entire system is separated to two interfaces. PIC acts as an intermediate in this system between the SKKCA-11 Bluetooth module and GLCD screen. As shown in Figure 3.1 the Bluetooth module acts as an input of the system and the GLCD screen acts as an output of the overall system. The PC sends data prompted by user via Bluetooth dongle to the Bluetooth module. The data that received by the Bluetooth module is transmitted to the PIC. The PIC will receive the data serially and transmits it to the GLCD in parallel mode. This is the basic functions of the overall system.

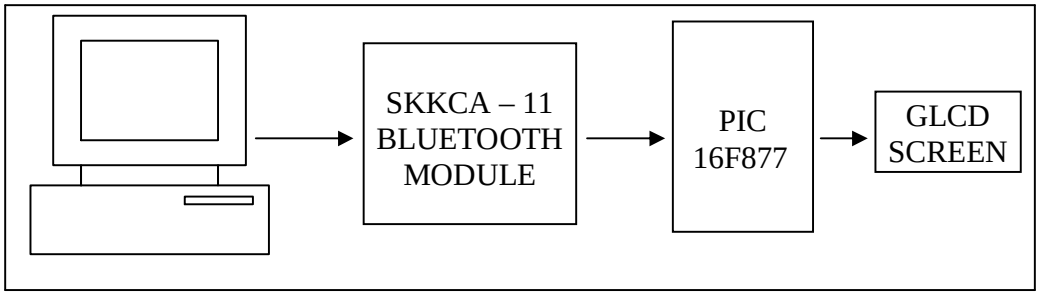


Figure 3.1 Hardware configuration of the system

3.2 Design Implementation

After basic board has been planned the physical implementation begins. The project is being divided into several stages. At each stage the functionality and the circuit connection being checked thoroughly so that there will be no difficulties experienced later on during software development. Every stage is combined at the end to make the project function as a one. The stages of the project are briefly described below:

- Stage 1 – Assemble the microcontroller circuit.
- Stage 2 – Interface the SKKCA-11 Bluetooth Module with PIC.
- Stage 3 – Interface the GLCD Screen with PIC.
- Stage 4 – Program the PIC and configure the Bluetooth Module.

3.2.1 Microcontroller Circuit

The main reason microcontroller used in this project is to process the data provided by the Bluetooth Module. The PIC16F877 is used for serial data communication and the frequency provided to the UART module must be precise. Therefore a 20MHz external crystal oscillator is used to clock the program data.

The microcontroller's hardware UART module is used for serial communication; therefore there must be some configurations for microcontroller too. 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. As required by the microcontroller the module's baud rate, number of data bits and number of stop bits are all set using the AT command for the microcontroller, it is set to 9600 bps, 8 and 1

respectively. The data that have being sent using the UART module is in 8 bit UART transmit buffer register. Figure 3.2 shows the PIC 16F877 schematic diagram

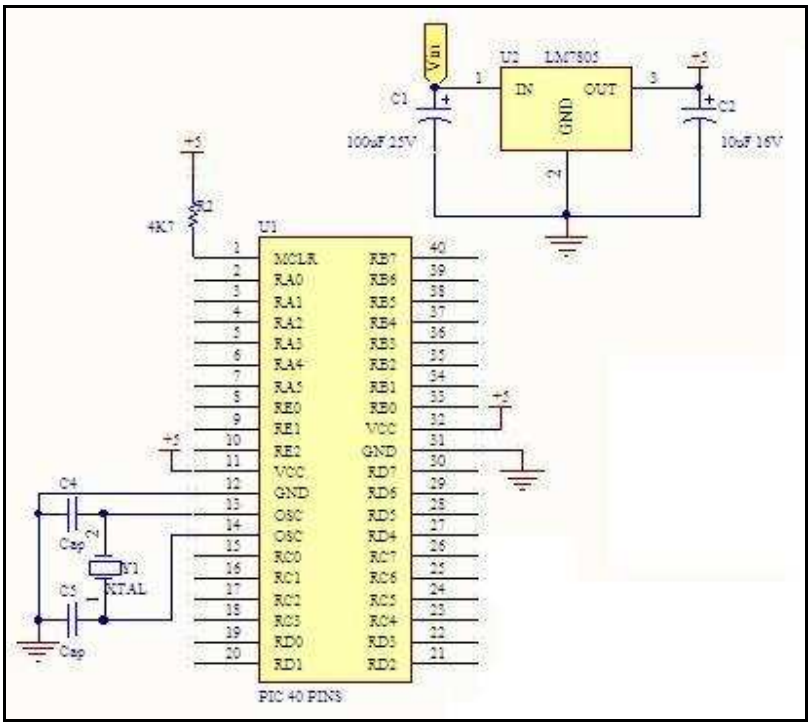


Figure 3.2 Schematic Diagram for PIC16F877 microcontroller

3.2.2 Bluetooth Module Circuit

SKKCA-11 modules can communicate with dongle to transmit and receive data. The SKKCA has been designed for 5V TTL logic interface with no extra voltage divider is necessary. As this Bluetooth module is designed to ease development with embedded Bluetooth application there are 5 pins provided on SKKCA–11 for the following purpose as shown in Figure 3.3.

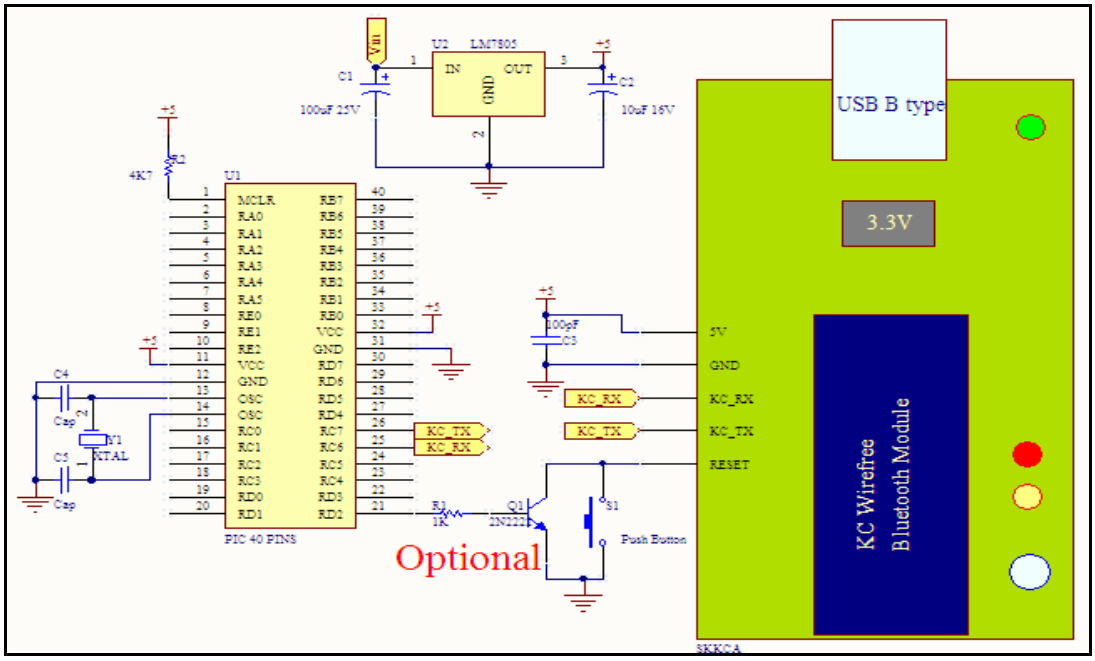


Figure 3.3 Schematic diagram of the SKKCA – 11 Bluetooth Module

The label ‘5V’ on the module is the power input for the SKKCA functions as an external power source for the SKKCA since the typical voltage for the module is 5V. On board the 3.3V voltage regulator will regulate the voltage to 3.3V for the KC Wirefree Bluetooth Module that is mounted on SKKCA. The power is not necessary if SKKCA is connected through USB cable. The label ‘GND’ on the module is the ground signal to the module.

The label ‘KC_RX’ on the module is KC Wirefree Bluetooth UART receive signal. This is KC Wirefree Bluetooth module’s receiver pin and it should be interfaced to 5V logic UART. This is an input pin from SKKCA. It should be connected to microcontroller’s transmitter pin. The label ‘KC_TX’ is the KC Wirefree Bluetooth UART transmit signal. This is KC Wirefree Bluetooth module’s transmitter pin and it should be interfaced to 5V logic UART. This is an output pin from SKKCA. It should be connected to microcontroller’s receiver pin. The label RESET is the KC Wirefree Bluetooth RESET pin. It should be connected to a push button to ground, or NPN transistor.

3.2.3 Graphic LCD Circuit

Graphic LCD is connected to PIC in order to display the data that have been transmitted via Bluetooth. Data is being sent from the PIC in parallel to the Graphic LCD screen. The display of the Graphic LCD is controlled by the PIC. Table 3.1 shows the pin description for the interface between Graphic LCD and the PIC 16F877.

Table 3.1: Graphic LCD pin assignment

Pin No	Symbol	Level	Description
1	VSS	0V	Ground
2	VDD	5V	Supply Voltage for Logic
3	VO	-	Input Voltage for LCD
4	RS	H/L	H: Data Signal, L: Instruction Signal
5	R/W	H/L	H: Read Mode, L: Write Mode
6	E	H/L	H: Output Data, L: Latches Data
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7
15	PSB	H/L	H: Parallel, L: Serial
16	NC	-	Connect Nothing
17	RSTB	L	Reset Signal
18	NC	-	Connect Nothing
19	K	0V	Backlight Cathode
20	A	5V	Backlight Anode

The Graphic LCD supports two kind of bus interface. It is the 4 bit and 8 bit parallel interface. Since 4 bit interface have been decided to use, therefore the pin number 7, 8, 9, and 10 is not used because data is only sent using the upper 4 bit. Figure 3.4 is the pin connection for the Graphic LCD with the PIC 16F877.

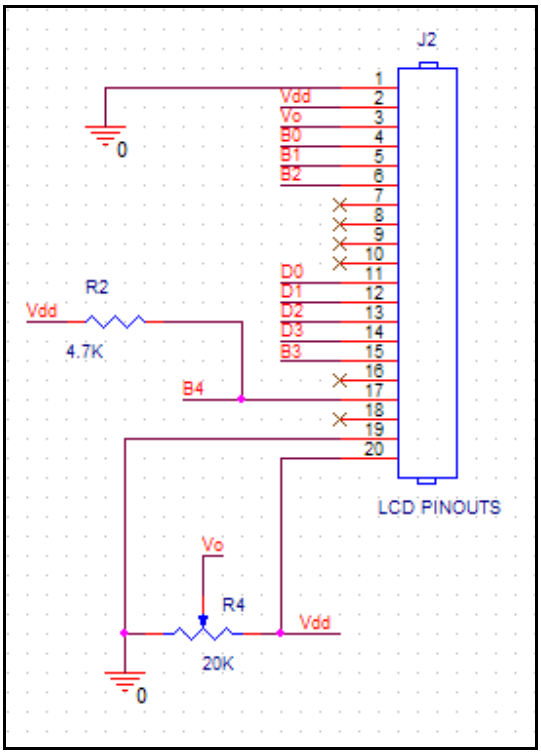


Figure 3.4 Schematic diagram of the Graphic LCD with 16F877

3.2.4 PIC Programmer UIC00A Circuit

UIC00A offers low cost yet reliable and user friendly PIC USB programmer solutions for developer, hobbyist and students. It is designed to program popular Flash PIC MCU which includes PIC12F, PIC16F and PIC18F family. It can also program 16bit PIC MCU. On board ICSP™ (In Circuit Serial Programming) connector offers flexible method to load program. This programmer supports on board programming and

there is no necessity of plug in and plug out of the PIC each time. It allows user to program and debug the source code while the PIC is on the development board. UIC00A is designed to be plug and play with USB connection. This programmer obtained it power directly from USB connection; therefore no external power supply is required. The UIC00A is designed to be used as a portable programmer therefore it is designed on and PCB (Printed Circuit Board) with surface mounted component which is in small size of 5cm x 2.5cm as shown in Figure 3.5.

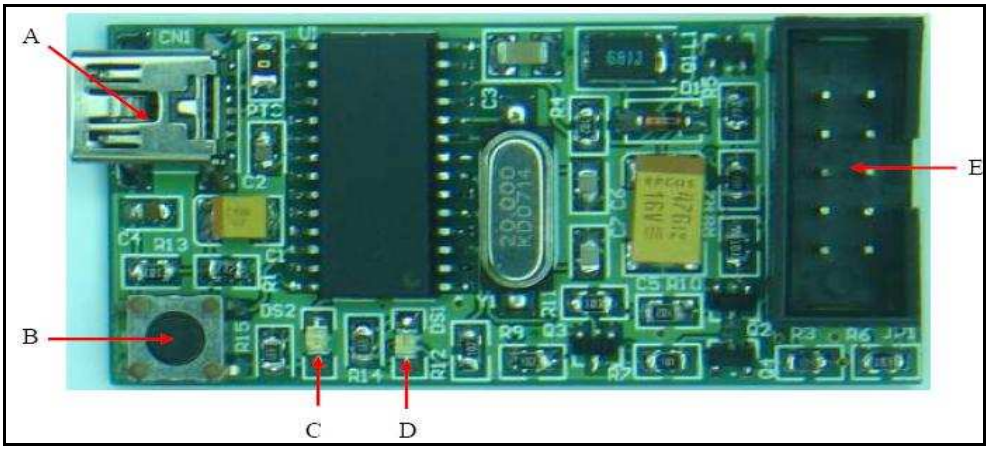


Figure 3.5 UIC00A Board Layouts

UIC00A is compatible with PICkit 2 programmer software. The PIC model that is supported to be programmed using the UIC00A is in appendix B. The label above has its own function. Mini USB port at “A” is for USB connection to PC desktop or laptop. Switch at “B” is a push button which is used to initiate the write device function when the write button on the PICkit 2 is checked. Green LED at “C” is used to indicate the main power supply of UIC00A. It should turn ON once USB connection from UIC00A to computer or laptop is ready. Red LED at “D” is used to indicate busy function such as UIC00A is in program mode or is alerting that a function is in progress. IDC box header at “E” is for programming cable. One end of programming cable is connected to this header, while the other end is connected to the development board as shown in Figure 3.6.

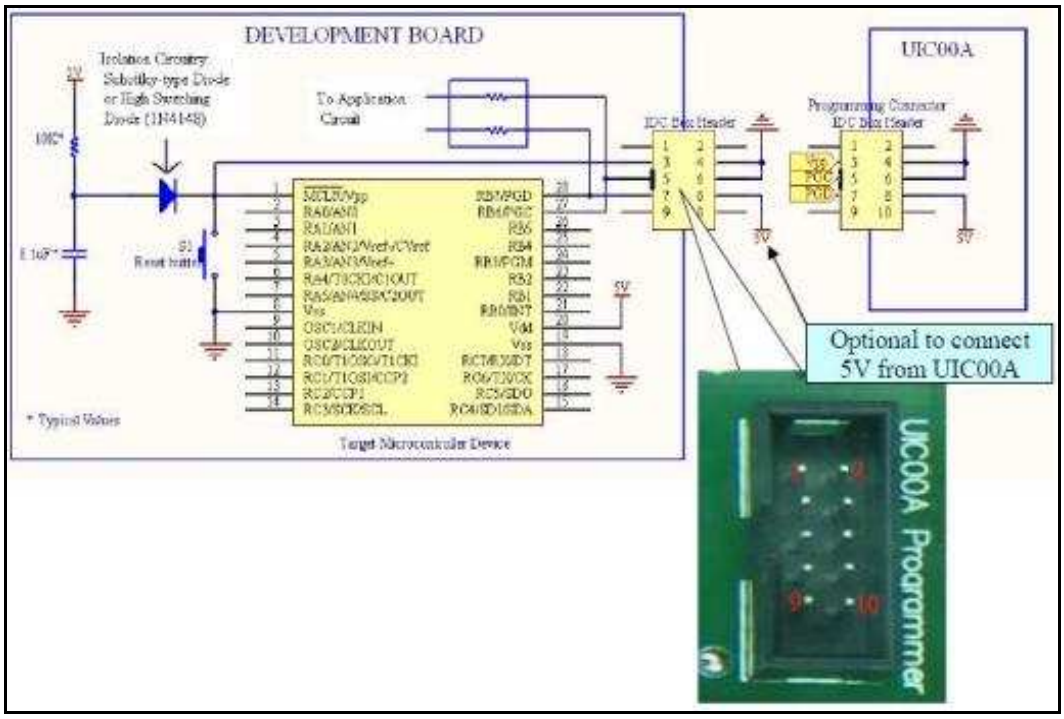


Figure 3.6 Schematic Diagram of UIC00A with PIC

During programming mode, VPP voltage will be raised to about 13.25V. It is recommended to isolate the supervisory circuit if interfaces with MCLR pin by using Schottky-type diode or high switching diode (1N4148) to prevent VPP voltage slew rate from slow down and exceeds the rise time in the programming specification. That is the main reason the diode is connection to MCLR pin at the PIC as shown in the diagram above. The minimum connections from UIC00A to target board or PIC are four. These include Vpp, PGD, PGC and Ground. The schematic diagram above explains all the connection need to be made to the PIC.

3.3 Hardware construction

The hardware construction of this project can be divided into 3 main processes that are:

i. Printed Circuit Board (PCB) Layout
ii. PCB Layout Exposure
iii. PCB Etching & Drilling

3.3.1 Printed Circuit Board (PCB) Layout

The PCB layout for this project is done using OrCAD Release 9.1 software. OrCAD software consists of a few subprograms. The subprograms which will be used are OrCAD Capture CIS and OrCAD Layout which is used for schematic drawing and PCB layout respectively. Figure 3.7 and Figure 3.8 shows the two main menus respectively of the subprograms used in this PCB layout.

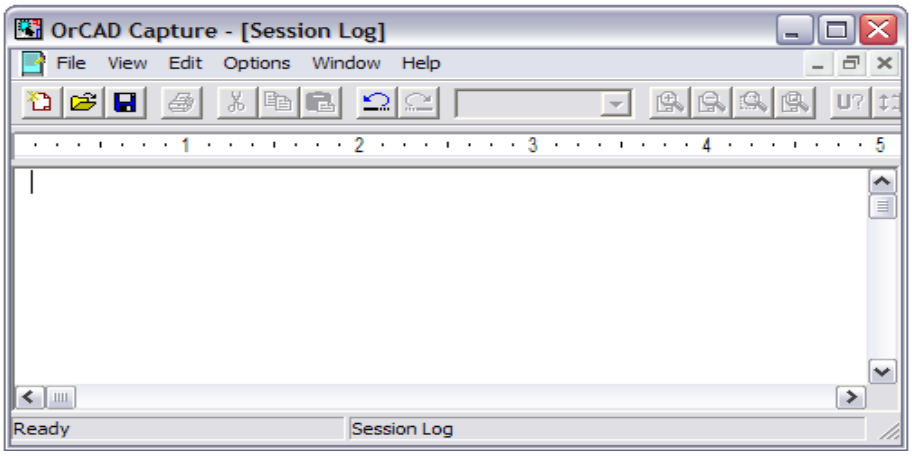


Figure 3.7 OrCAD Capture CIS Log Window

Figure 3.8 OrCAD Layout Window

First of all schematic diagram need to be drawn. To draw a schematic diagram new project need to be created and schematic page will appear. The toolbar on the right is the toolbar for creating schematics. The most used toolbar are the select, place part, place wire, place junction, place power, place ground and place no connect as can be seen in Figure 3.9. Figure 3.10 shows the full schematic of the project.

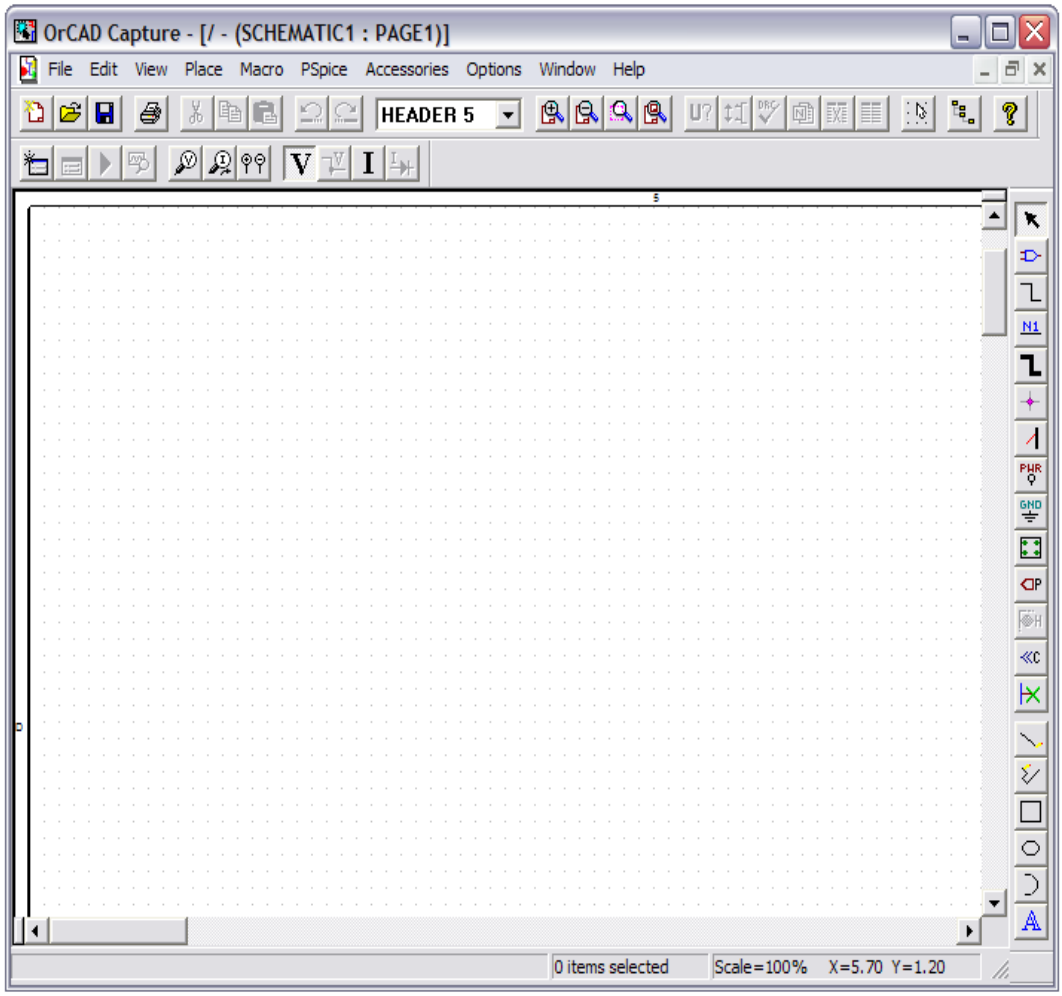


Figure 3.9 OrCAD Capture Schematic Page

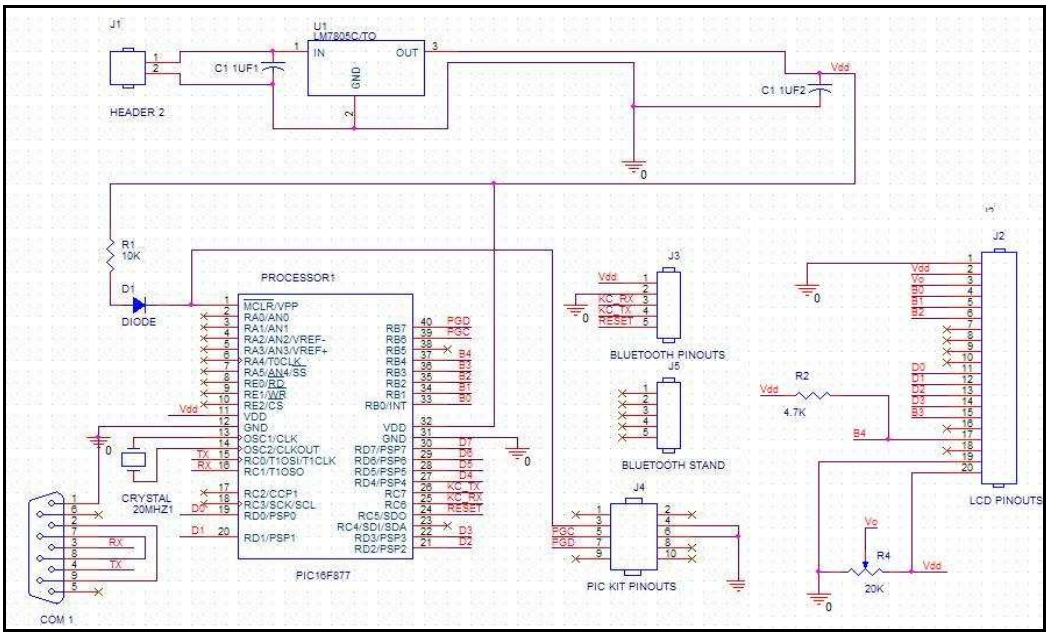


Figure 3.10 Full schematic

Next a netlist is needed so that the schematic could be imported to OrCAD Layout. To do so there is “Tools” in the menu bar, we need to click it and click the create netlist option. This will create an output on the same name but different type of file. Figure 3.11 is the create netlist window that will appear once the option is clicked.

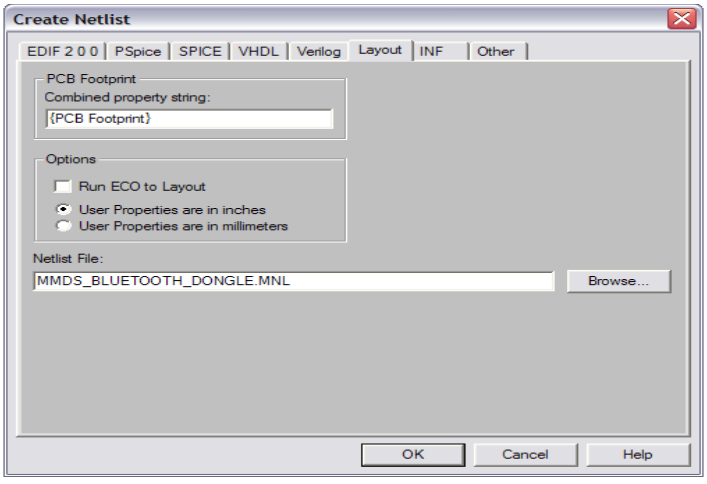


Figure 3.11 Create Netlist Window

In the ‘OrCAD Layout window’ click ‘New’ and a ‘Load Template’ windows will appear. There will be various file on that window but the file DEFAULT.TCH must be choose and then click open as shown in Figure 3.12

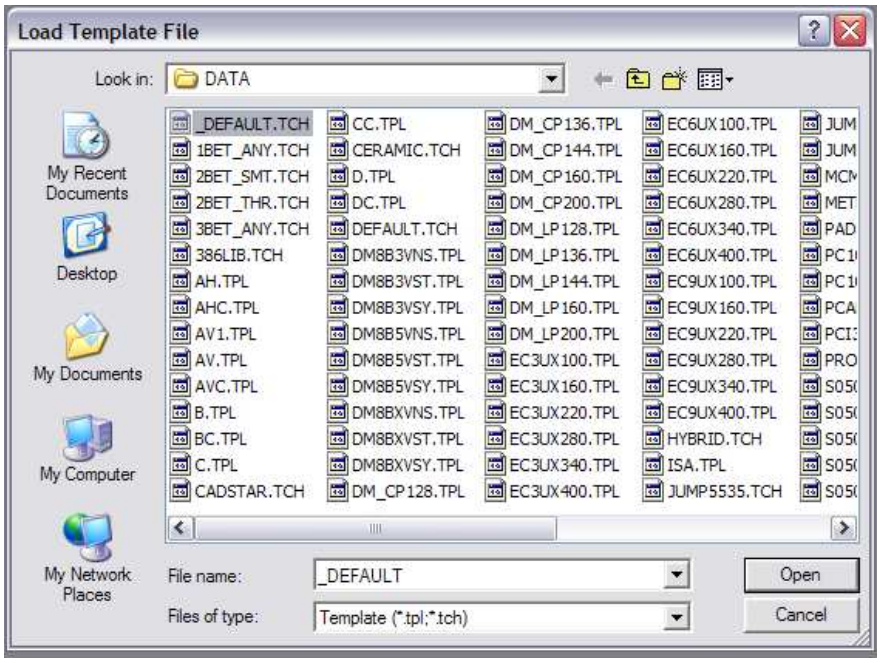


Figure 3.12 Load Template File Window

Once open is clicked the Load Template Source Window will be displayed. Locate the netlist file that has been generated before in the OrCAD Capture. In this project the file is saved as ‘MMDS_Bluetooth_Dongle’. Therefore these file need to be searched. Once the file has been generated just save the file. After the file is saved the ‘Automatic ECO Utility’ and the ‘Link Footprint To Component’ will be displayed. The ‘Automatic ECO Utility’ will automatically examine the netlist that have been imported to create footprint for the component. If the footprint could not be found then user must create the footprint of the component manually. Once all footprints for the component is done then the Layout window will appear as in Figure 3.13 which has manually arrange and ‘Autoroute’ at the ‘Auto’ option at the menu bar by user. The final routing of the board is as shown in Figure 3.14.

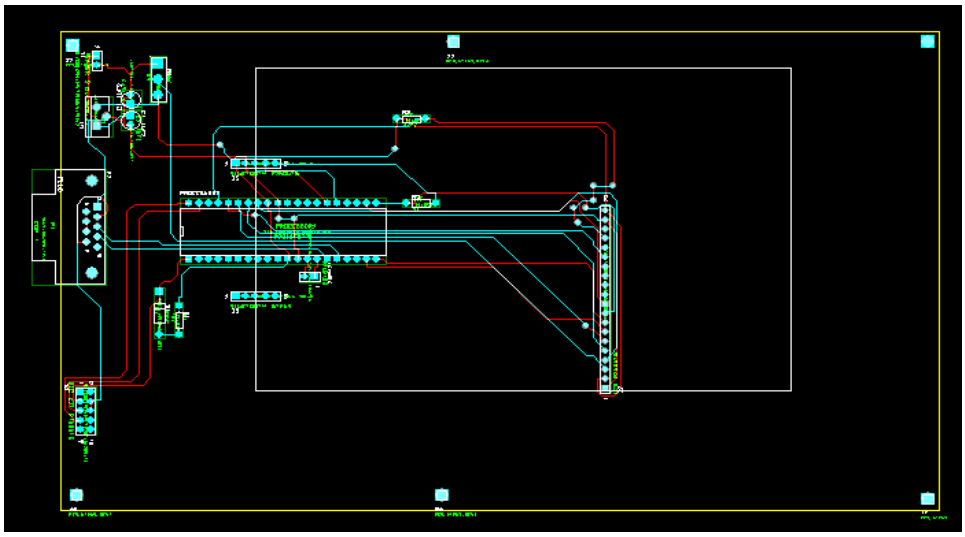


Figure 3.13 Layout Window

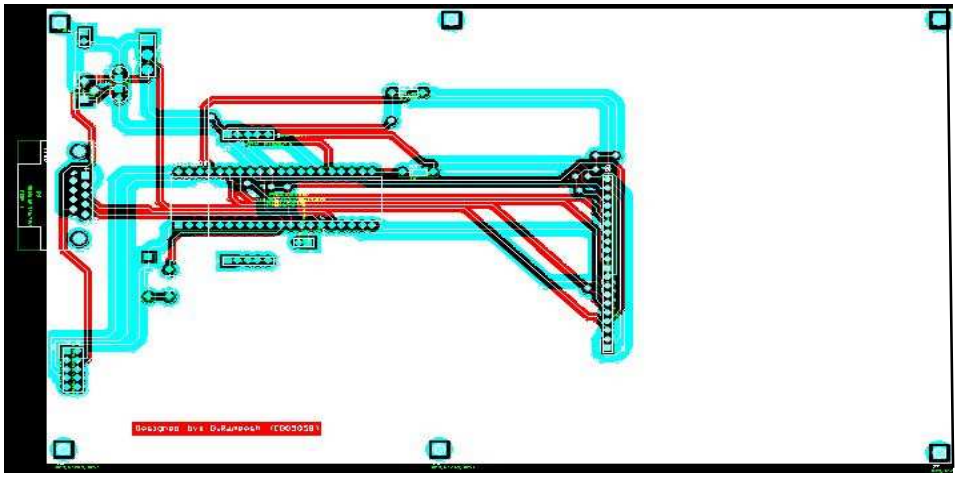


Figure 3.14 Final Routing

3.3.2 PCB Layout Exposure

In the process of exposure only the bottom layer need to be printed on the transparency. Since the board in this project is a dual layer therefore we need to print the bottom layer in one transparency and the top layer in another transparency. The transparency should be printed as black as possible so that light could not be seen passing through the printed layer. On the copper board we need to laminate a film which in a form of plastic. Then place the printed transparency on the laminated film surface and capture the layout on the film using UV light rig which functions as a Photostat machine. Once both sides is capture with the layout of the project design insert the board into the development machine where the film will be removed at unnecessary part of the layout as shown in Figure 3.15.

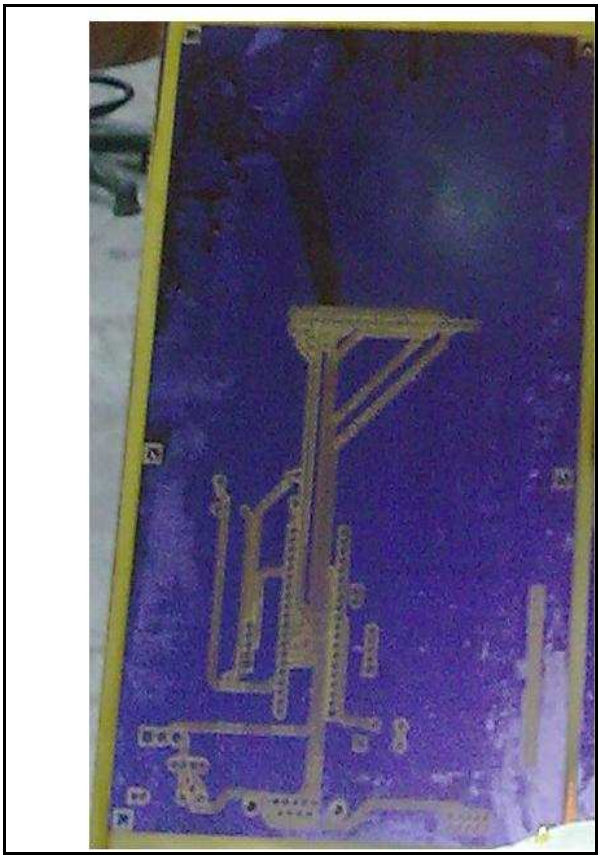


Figure 3.15 After the board is out of the development machine

3.3.3 PCB Etching and Drilling

Etching is a process where the excess copper is removed to leave the track or traces using acid based solution. In this matter there is a machine for etching process. We just need to insert the board into the machine and the excess copper will be removed using Ferric Chloride (FC). The excess copper is only removed at the area where the film is removed. The area with the film attached to it, the copper will remain. Finally the board can be drilled and the components can be soldered to the board.

3.4 Programming the Microcontroller

The PIC 16F877 is programmed in PBasic language. There are various languages can be used to program the microcontroller such as assemble language, low level language, C language and High-Tech C.

PBasic is a high level language which consists of a series of instructions in the form of mnemonics. PBasic is one of the oldest and one of the easiest programming languages to learn. PBasic languages have been developed by the microEngineering Labs Inc. This PBasic language provides low level access to memory, provide language constructs that map efficiently to machine instruction and require minimal usage of memory. The language has become available on a very wide range of platforms, from embedded microcontrollers to supercomputers.

3.4.1 Compiling the program

Before the program is downloaded into the microcontroller, it must be compiled into machine code. It is the only language that a microcontroller can read and execute. In this system data and instruction is being executed as programmed.

PICkit 2 programmer software is used to transfer the program into the PIC 16F877 in this project. A compiler is a set of program that translates text written in a computer language to another computer language [12]. In PICkit 2 only Hex file can be loaded in order to program the PIC. The original language is written on a MicroCode Studio as shown in Figure 3.16 and once the written program is compiled the Hex file automatically generated.

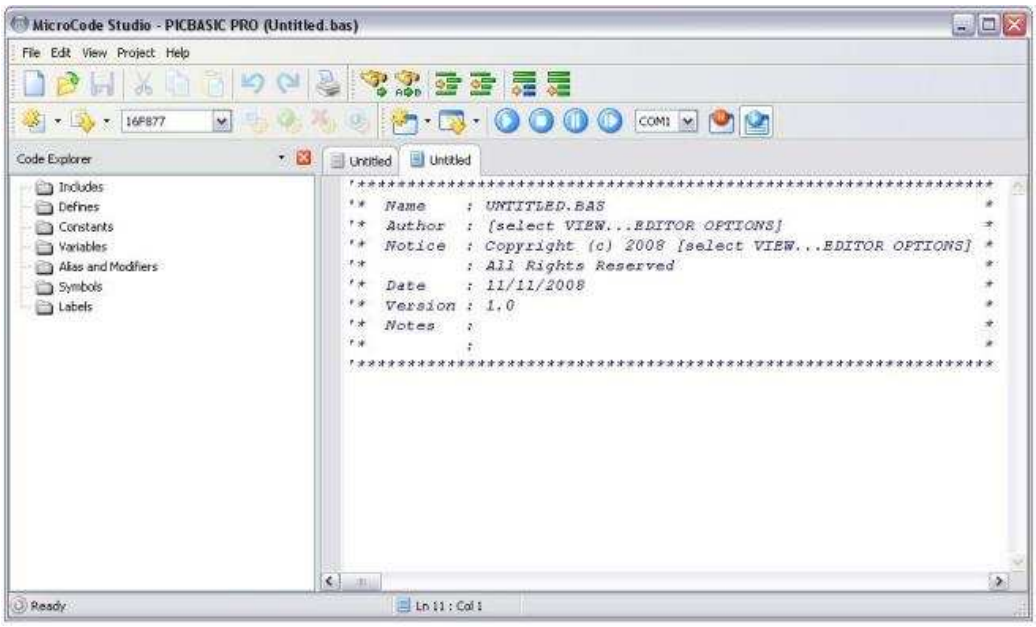


Figure 3.16 MicroCode Studio screen form

The software needs to be configured for the type of compiler, and the type of programmer we are using. When the software is first invoked, it searches for the PBasic compiler on the hard disk and the compiler path is set automatically once the compiler is

found. We can now write our program and when finished, compile the program and Hex file is generated in the folder of the program that has been saved.

3.4.2 Load Hex Files into PIC 16F877

Once the PBasic file has been compiled, Hex file is generated and the file is loaded into the PICkit 2 programmer which is attached to the USB port of the computer. To download the Hex file first of all the PICkit 2 programmer software need to be opened. If the device is successfully detected, the model name will appear at Device Configuration area as in Figure 3.17. Once the model name appear Hex file can be loaded by clicking File at menu bar and click import Hex file as shown in Figure 3.18.

Figure 3.17 PIC successfully detected box

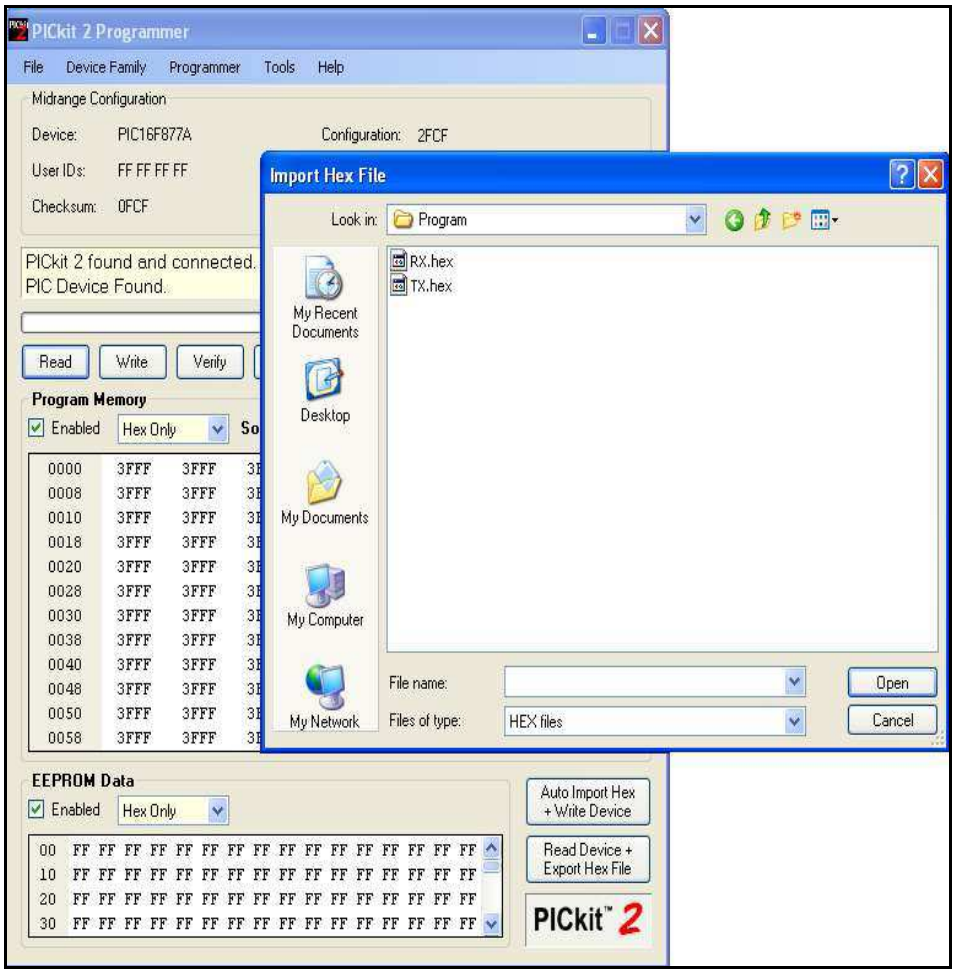


Figure 3.18 Import Hex file display

After Hex file has been successfully imported, the target device can be programmed by clicking on Write. The PIC will be erased and programmed with the new Hex code imported. The operation status will display on the status bar and the status bar will turn to green if writing is successful as shown in Figure 3.19.

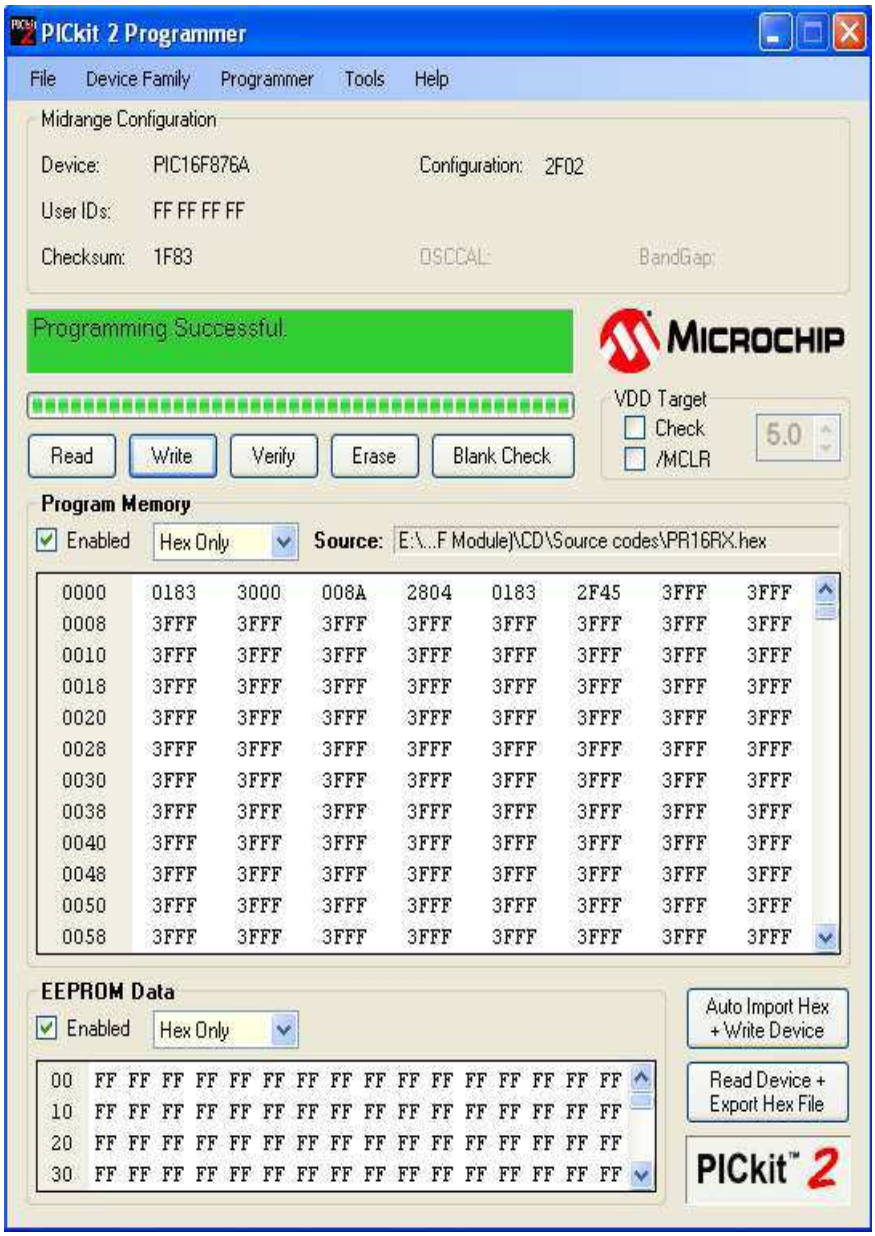


Figure 3.19 Status bar display when the program successfully loaded

3.5 Configuring the SKKCA – 11 Bluetooth Module

The SKKCA – 11 Bluetooth module need to be configured to make the device compatible with the system that have been designed. Most of the configuration has been installed in the device itself as default by the manufacturer. However there are some parameters need to be modified on the firmware to change the default parameters of the device to suit the project. AT command is used to configure the Bluetooth module.

3.4.1 Writing the AT Command for SKKCA-11 Bluetooth Module

There are two parameters that can be changed in the SCCKA-11 Bluetooth Module. The two main parameters are the baud rate and the device's local name. The local name is the default name that appears on the device discovery when the existence of the device is searched. By default the baud rate is 115,200 bps and the device's name is "KCWirefreeDevice". In this project only the baud rate has been configured to 9600 bps and the device's name is left as default.

In this project PIC is not able to send and receive unless the baud rate of the Bluetooth Module is configured to 9600 bps. That is the maximum rate of transferring data speed by PIC. Both the PIC and Bluetooth Module can only communicate if the baud rate is same. The baud rate can only changed using the HyperTerminal. To solve this, the HyperTerminal text script for AT type commands is written in Microsoft Notepad software and is sent to the Bluetooth module via "Send Text File" function in HyperTerminal.

Changing the device's baud rate to 9600 bps require this AT command is written in the Microsoft Notepad: AT+ZV ChangeDefaultBaud 9600.

Changing the device's local name, this AT command is written in the Microsoft Notepad: AT+ZV DefaultLocalName UMP.

Both commands are written separately but in this project the device's local name was not being changed. Figure 3.20 shows the Microsoft Notepad window for changing the default baud rate.

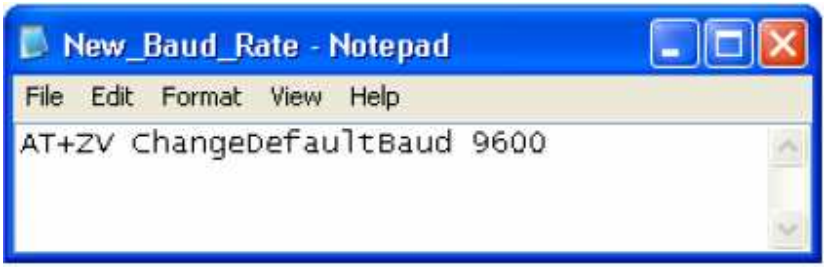


Figure 3.20 AT command for changing baud rate

Once the changes have accepted, the response at the HyperTerminal is: AT-ZV Baud rate Changed as shown in Figure 3.21.

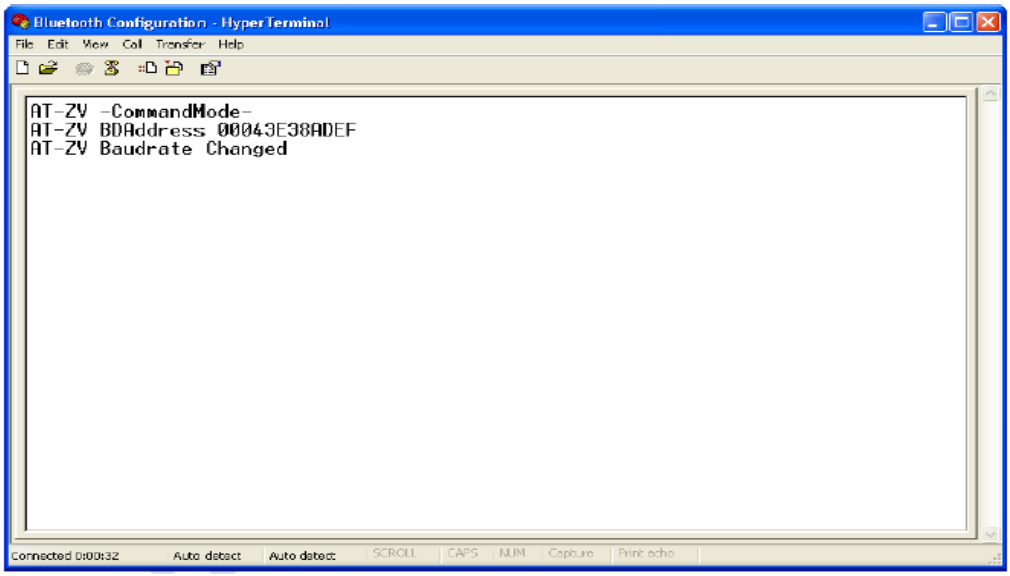


Figure 3.21 Baud rate successfully changed

3.4.2 HyperTerminal

Windows operating system provides a tool for communication purpose with external device through serial port which is recognized as HyperTerminal. It is a very basic application that windows offer because the functionality of this program just allow user to establish the connection and receive either text or binary. To make the statement clear it is just because HyperTerminal is limited in allowing the user to control the communication channel once establish. It does not allow user to stop or pause the established connection without terminating the connection. In addition, it provides limited tools in allowing user to communicate from the host PC to the target device. The defect of this HyperTerminal could be discovered because user need create a separate text file with command and then the file need to be evoked within the HyperTerminal before the channel has been created. It is impossible to interrupt while the connection between HyperTerminal and the target device is established.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

The overall result of the research that has been done will be explained in this chapter. The discussion is more on the performance between the Bluetooth Module SKKCA-11 and the Bluetooth dongle that have been used as transmitter and receiver.

4.2 Establishing Communication between Bluetooth Module and Dongle

In order to communicate with each other between the SKKCA and the dongle, communications need to be established. To establish the communication, the dongle need to enquiry and discover the existence of the neighboring devices. Moreover it needs to collect information about the level of state that the neighboring device is affordable to establish frequency hoping connection with those neighbors. Hence the information that has been gathered during the enquiry process establishes bi-directional data sending ability.

When the Bluetooth module has been powered up within the range of the dongle, conversation is evoked between the SKKCA and dongle. Once the communication takes

place in the network Bluetooth system create a personal-area network (PAN) also known as piconet.

The BlueSoleil Bluetooth application software or any software that come with user's Bluetooth dongle is used as the Human Device Interface (HDI). This project uses BlueSoleil software. The HDI is used to establish connection between the SKKCA and the dongle. Once the BlueSoleil is launched the following appears as shown in Figure 4.1 and Figure 4.2 shows the Bluetooth dongle that is used in this project.

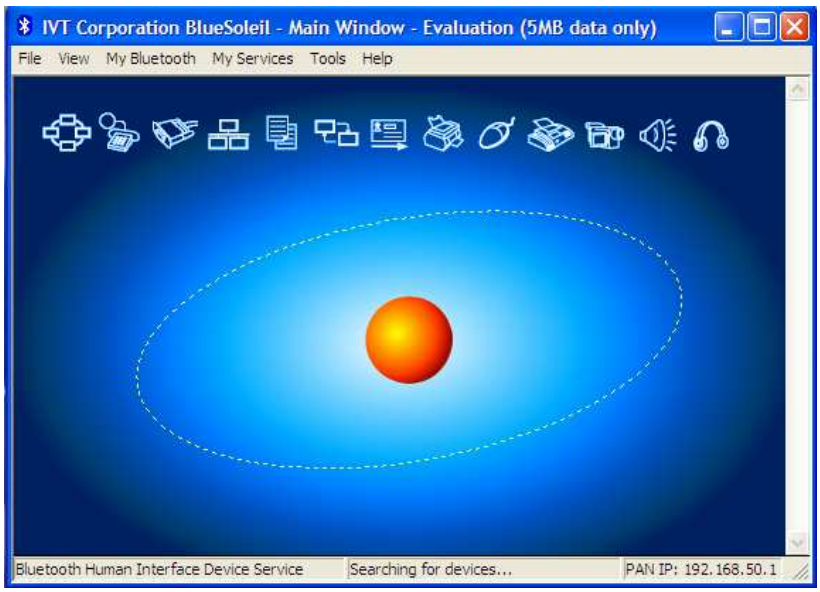


Figure 4.1 Human Device Interface (HDI) software window

Figure 4.2 Bluetooth Dongle used in the project

The button “F5” on the keyboard should be pressed in order to start searching for Bluetooth device nearby. The software could detect SKKCA if it is working properly within 100 meter radius. Once detected, the name of the SKKCA it will appear as a Bluetooth node in BlueSoleil window as “KCWirefreeDevice” shown in Figure 4.3.

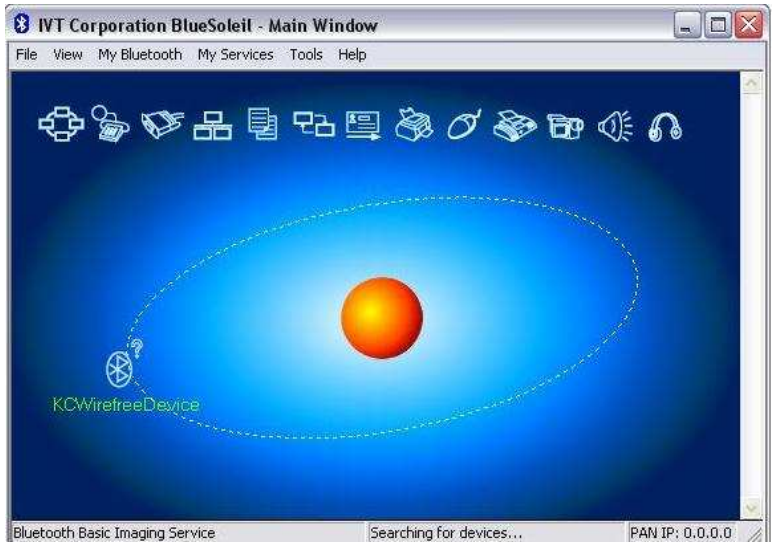


Figure 4.3 Existence of SKKCA display window

There will be a question mark at the “KCWirefreeDevice” icon which indicates that the service discovery has not being searched yet. When we double click on the SKKCA Bluetooth icon show on the circle, BlueSoleil will start inquiring for available service or profile offered by SKKCA. After some time around 1 to 3 seconds Bluetooth Serial Port Service should be highlighted as shown in Figure 4.4.

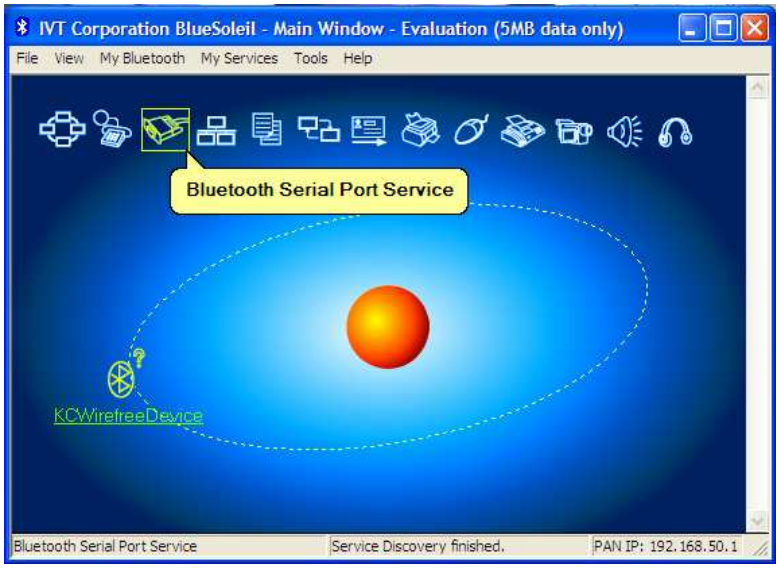


Figure 4.4 Service Discovery

Double click on Bluetooth Serial Port Service. BlueSoleil will try to create Bluetooth Wireless link with SKKCA and offer serial port service. If everything is working perfectly, a window will pop up showing dialogue box of the virtual COM port which is connected to computer. In this case, a COM8 has been created as shown in Figure 4.5. Figure 4.6 shows the BlueSoleil windows when user establishes the Bluetooth link between the SKKCA and the dongle.

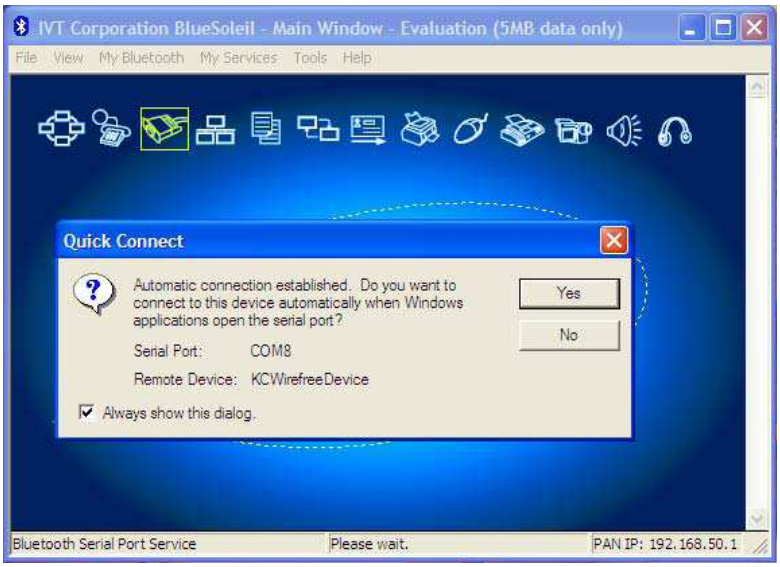


Figure 4.5 Virtual COM port dialogue box

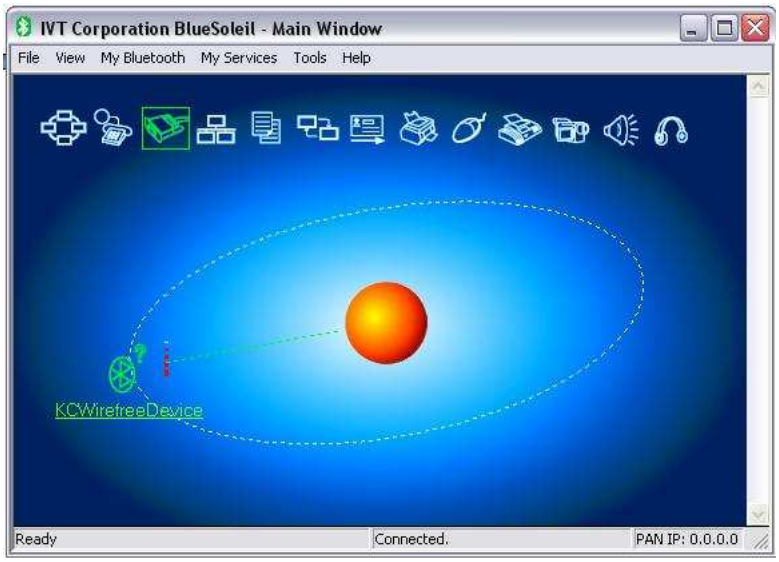


Figure 4.6 Connection between SKKCA and dongle being established

4.3 Bidirectional Data Sending Using SKKCA

When the connection between SKKCA and dongle is being established they can communicate with each other bidirectional. To send and receive data CommApp software windows application is used. The CommApp software windows application is as in Figure 4.7.

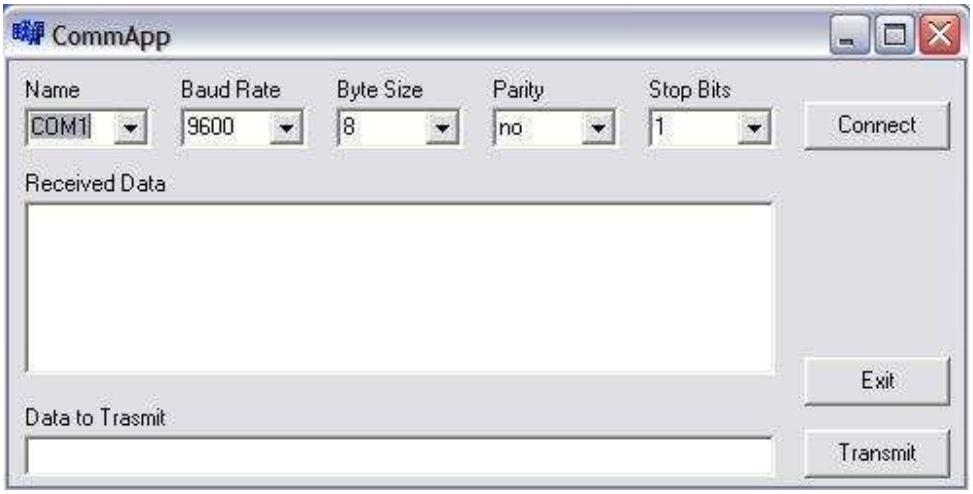


Figure 4.7 CommApp software windows

As shown in Figure 4.4 the COM port will be selected on its own by the BlueSoleil software. In order to connect the SKKCA and the dongle using the CommApp we just need to select the name of the port as in Figure 4.6 and click the connect button at the application itself. At the other computer that is attached to the SKKCA we just need to check the USB Serial Port that has been assigned automatically at the Device Manager as shown in Figure 4.8 where port 4 has been assigned in this case.

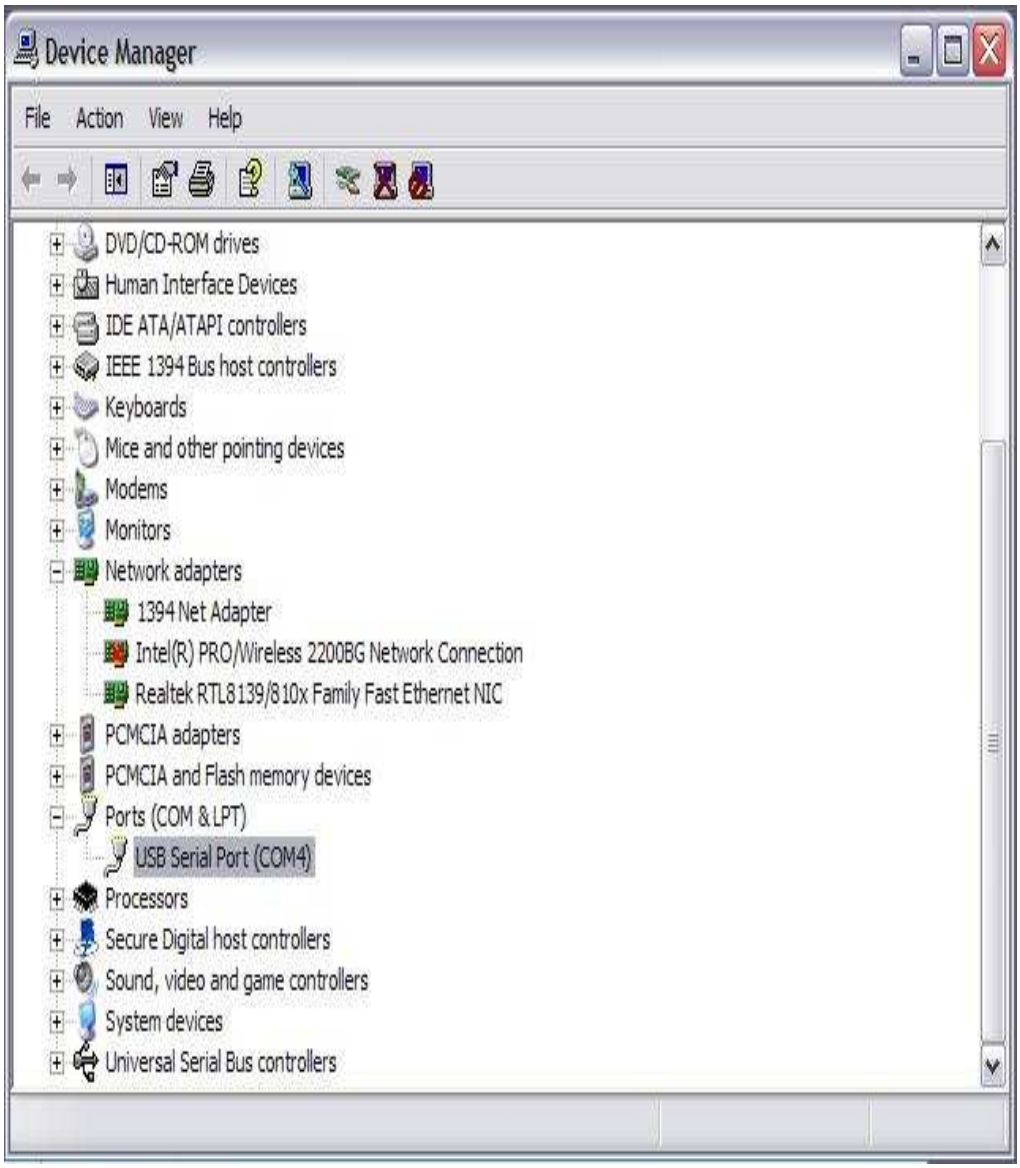


Figure 4.8 USB Serial Port assignments

Once the USB Serial Port assignments has been discovered, just click open the CommApp software window. For SKKCA just select the name of the port as “COM4” and for the dongle just selects “COM7”. This is the common ports that enable both the SKKCA and the dongle to communicate with each other in this particular project. Once the port name has been selected just click the connect button. Once its connected data can be send from both end as we want it to be by typing the information and click the

transmit button. Figure 4.9 and Figure 4.10 shows the data that have been sent and received by SKKCA and the dongle.

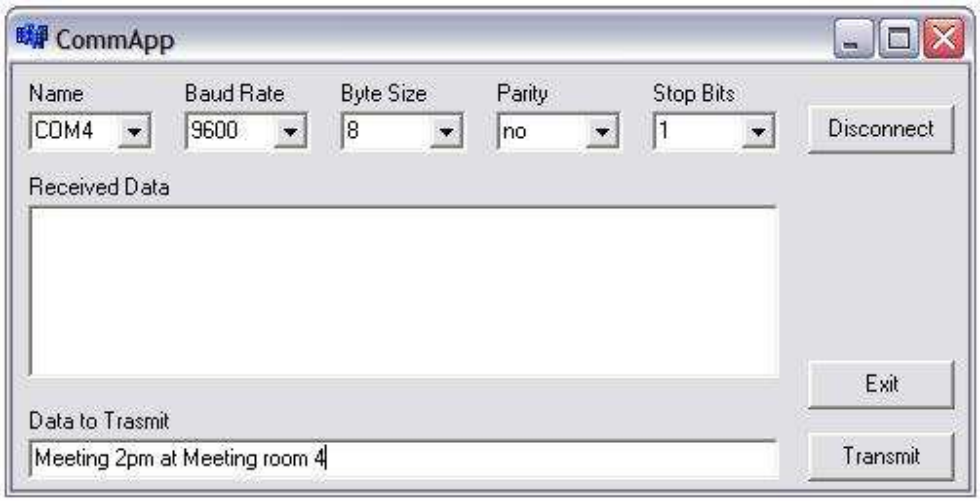


Figure 4.9 Data that have been typed to transmit

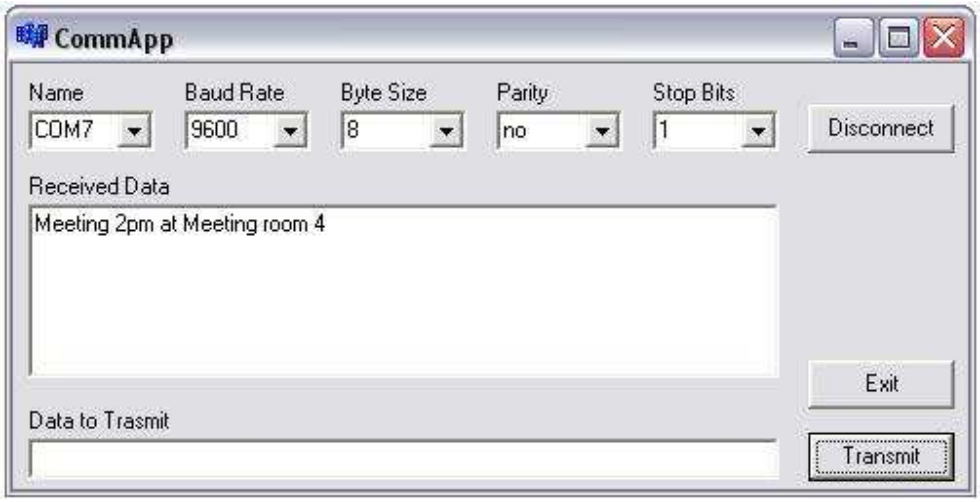


Figure 4.10 Data received once had been transmitted

4.3.1 Connection Limitation

There can only be one master module be connected with the slave module that can be established at the same time. To make it simpler, if there is another personal computer that has a Bluetooth connection located within the range of the slave module, the computer cannot establish a connection with the slave module if the first computer has already been connected to it. This is to avoid the conflict between users when controlling the device at the slave mode. In this project SKKCA is known as slave module and the dongle is known as the master module. Therefore, no other master module can establish connection with the SKKCA if connection as being established by the SKKCA with other master module rather than the dongle that is being used in this project.

4.4 Performance of the System

When testing is done to test the performance of the SKKCA, it was clear that the objective of this project is accomplished within the scope. But the graphic LCD screen fail to display the data that is being transmitted via Bluetooth, however the CommApp software acts as an alternative for the graphic LCD screen in this project. Figure 4.11 is the top view and Figure 4.12 is the bottom view of the completed hardware for the project.

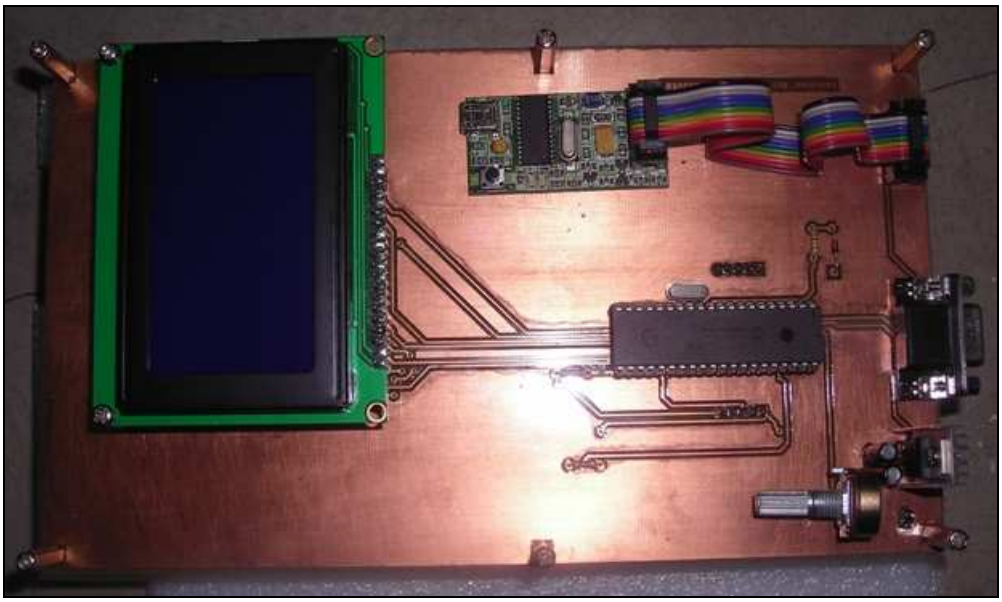


Figure 4.11 Top view of the completed hardware

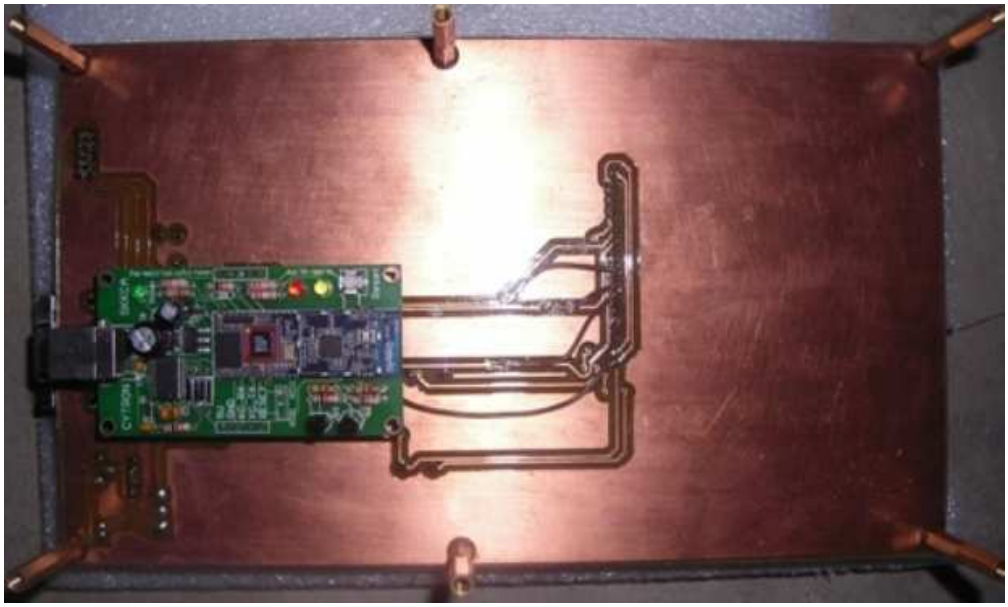


Figure 4.12 Bottom view of the completed hardware

4.4.1 Device Response Time

The time taken for the slave module to execute the control instruction prompt by the user is within a blink of an eye, which is less than 0.1 second. The device status is displayed in the CommApp windows immediately after the instruction is executed, which is also about 01 second. The fast response time make the system reliable to the users.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This project was success in transmitting and receiving data between the Bluetooth module and the dongle. Half of the project requirement has been successfully fulfilled. Initial theoretical research shows that Bluetooth technology can be used to for implementation on message sending platform. The hardware of the project has been successfully integrated between PIC, Bluetooth Module and the Graphic LCD screen although many problems have to be faced at the early stage of the project.

The software was also completed to program the PIC in order to create communication between the Bluetooth Module and the dongle. Finally the message sending could not be displayed on the LCD screen because there were difficulties in the LCD programming. That was the crucial stage in this project, that failed this project to work hundred percent. Anyhow an alternative has been used in this project to display the data that have been sent between the Bluetooth Module and the dongle. Moreover the messages that have been sent are in bidirectional. The alternative source that has been used is the CommApp windows that help to transmit and receive data.

5.2 Recommendation

There are still rooms for improvement in this project to the entire system design. Some of the possible enhancements are discussed in this topic. Improvise the system will give more reliability to the user and add some extra credits to the system's market value.

5.2.1 Using the Actual KC-11 Bluetooth Module

The control mechanism for the actual Bluetooth module is more easier compared to the SKKCA-11. SKKCA-11 is a Bluetooth Module where the KC-11 module is mounted on it. Therefore all the information on the KC-11 datasheet differs from the SKKCA-11. Some important information is not stated on the SKKCA 11 datasheet and being discovered late in this project.

5.2.2 Graphic User Interface (GUI)

Using the CommApp to communicate is not an appropriate platform for user to control the system. A GUI is more reliable and the system could be user friendly since it offer more interactive environmental for user to understand because users are from various background and knowledge.

In the GUI there must be an interface with the USB ports. Avoid users to select the name of USB ports and set it as default. Just create message box to receive and transmit data in a separate area and just place a "SEND" button below the transmit message box. For the user to ensure the message have been sent or not just crate, it may

include a connection status and device status for displaying a status of what the slave module was doing.

5.2.3 Timer Control

Since this project is suggested to be used in the small organization or office. The timer control is advisable to be included in the project. Timer control allows user to set the duration for the system of this project to run. In an office there are lots of work to do, therefore once user set the duration they is no necessity for the user to turn off the system. Once the time expires, the system will be automatically switched off; the same situation applies to turn on the system.

5.3 Costing

In this project the costing was taken into consideration. The system was planned to be built in low cost therefore extra initiative has been taken to purchase the electronic component to assemble the system. Table 5.1 shows a list of components and the quantity required to complete the project.

Table 5.1: List of Component and cost involved

No	Components	Specification	Cost / Unit (MYR)	Quantity	Cost (MYR)
1	PIC 16F877	Microcontroller	30.00	1	30.00
2	SKKCA-11	Bluetooth Module	300.00	1	300.00
3	TG12864E	Graphic LCD screen	110.00	1	110.00
4	UIC00A	USB ICSP PIC programmer	50.00	1	50.00
5	LM7805	5V Voltage Regulator	1.00	1	1.00
6	Capacitor	1uF Capacitor	0.20	2	0.40
7	Resistor	10k ohm	0.10	1	0.10
8	Resistor	20K ohm	0.10	1	0.10
9	Resistor	1K ohm	0.10	1	0.10
10	Potentiometer	4.7K ohm	1.00	1	1.00
11	1N4148	Schottky Type Diode	0.20	1	0.20
12	Crystal	20MHz	0.30	1	0.30
13	IC Socket	40 pins IC Socket	4.00	1	4.00
14	Header Pins	Straight Pin Header (Male)	1.20	7	8.40
15	Box Header	IDC type (Female)	3.00	1	3.00
16	DB9 Connector	Female Solder Type	3.00	1	3.00
17	PCB board	Measured 12cm x 20cm	10.00	1	10.00
18	Heat Sink	Aluminum type	2.00	1	2.00
19	PCB Stand	2.5cm Length	0.50	6	3.00
TOTAL (MYR)					526.50

5.4 Commercialization

Bluetooth technology has created a blast in the market lately. Bluetooth is getting more popular due to many benefits that can be gained from it. There are currently many devices uses Bluetooth technology such as mobile phones, laptops, headphone, and many more. Bluetooth make human life easier to exchange data and pass information.

The Bluetooth Message LCD display is project that has been created to act as a shout out box in a small organization. When this project is mature, it has significant impact on many people's life. In the world today new technologies are merely a threat and feels that it would harm them in future. But this Bluetooth Message LCD display is a just an information conveyor. It can be applicable at any organization within limited range only. This would be a different approach because costumer has the choice of weather or not to buy the product to make life simpler in conveying messages wireless.

Thus it is essential to further develop this project as it has a value in the market but in a cable form. Wireless using Bluetooth will find the right approach to the market and established through different devices in the market. The Bluetooth Message LCD display will be a starting point of good business opportunity and could be spread to the entire world.

REFERENCES

[1] Microchip Technology Inc.
PICBASIC PRO™ Compiler

[2] "Bluetooth". Newton, Harold, (2007).
http://en.wikipedia.org/wiki/Bluetooth

[3] KC Wirefree "SKKCA 11" Datasheet: Bluetooth OEM Module. 2007.
http://www.cytron.com.my/attachment/KC%20User's%20Manual.pdf

[4] Michael Oryl (March 2007).
http://www.cytron.com.my/listProductCategory.asp?cid=269

[5] "Microcontroller". Wikipedia, The free encyclopedia: Microchip Technology (February 2006).
http://en.wikipedia.org/wiki/PIC_microcontroller

[6] "LCD". Wikipedia, The free encyclopedia. (August 2007)
http://en.wikipedia.org/wiki/LCD

[7] Ford-Long Wong, Frank Stajano, Jolyon Clulow (April 2005).
http://www.palowireless.com/infotooth/tutorial/k5_spp.asp
#Protocol%20Stack

[8] Juha T. Vainio (2000-05-25), Bluetooth Special Interest Group, LMP Specification

[9] Taoufik Ghanname (2007-02-14), Bluetooth Special Interest Group, SDP Specification

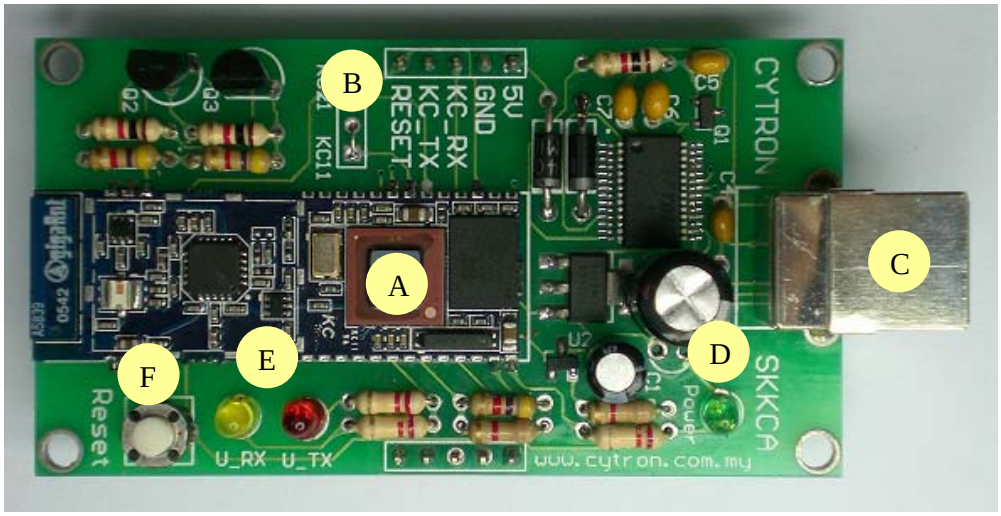
[10] Andreas Becker (2007-08-16). http://www.cmccord.co.uk/FYP/4.htm#4.0

[11] TINSHARP "TG12864" Datasheet (2007), http://www.cytron.com.my/attachment/TG12864EManual.pdf

[12] "Compiler". Wikipedia, the free encyclopedia. September (2007) http://en.wikipedia.org/wiki/Compiler

APPENDIX A

4. BOARD LAYOUT



Label	Function
A	KC Wirefree Bluetooth module
B	5 ways header pin for external power and interface to microcontroller
C	USB B type socket
D	On board 3.3V power indicator LED. It is green color
E	Two LED indicator for USB's transmitter and receiver status
F	On board reset button for KC Wirefree Bluetooth module

A – Either KC21 or KC11 will be mounted. This is KC Wirefree Bluetooth module

B – 5 ways header pin for external power supply and interface to microcontroller. If this kit is connected to microcontroller board, it should be powered with 5V. Please refer to hardware installation for detail connection.

C – USB B type socket. If connection to PC or laptop is required, please connect one end of USB cable (B type) to this socket, while the other end to PC or laptop.

D – 3.3V power indicator. This small green LED indicates the status of 3.3V output from on board regulator. It should be ON if either external 5V power or USB connection is connected to SKKCA.

E – These are a pair of small LED, red and yellow in color. These LEDs are connected to on board USB to UART converter. It indicates the receiver and transmitter activity. It will only work if SKKCA is connected to PC or laptop through USB cable. Red LED indicate USB's transmitter send data, while yellow LED indicate USB's receiver receive data.

F – Reset button for KC Wirefree Bluetooth module. Pressing this button will reset on board KC Wirefree Bluetooth module.

5. PRODUCT SPECIFICATION

SKKCA is designed to ease development of embedded Bluetooth application. The specifications are as listed below:

Label	Definition	Function
5V	Power Input for SKKCA	External power source for SKKCA, the typical voltage is 5V. On board 3.3V voltage regulator will regulate the voltage to 3.3V for KC Wirefree Bluetooth module. The power is not necessary if SKKCA is connected through USB cable.
GND	Ground or negative	Ground of power and signal
KC_RX	KC Wirefree Bluetooth UART Receive signal	This is KC Wirefree Bluetooth module's receiver pin, it should be interfaced to 5V logic UART, no divider is necessary. This is an input pin to SKKCA. It should be connected to microcontroller's transmitter pin
KC_TX	KC Wirefree Bluetooth UART Transmit signal	This is KC Wirefree Bluetooth module's transmitter pin; it should be interfaced to 5V logic UART. This is an output pin from SKKCA. It should be connected to microcontroller's receiver pin
RESET	KC Wirefree Bluetooth Reset pin	Reset pin of KC Wirefree Bluetooth module. It should be connected to a push button to gnd, or NPN transistor.

Absolute Maximum Rating

Symbol	Parameter	Min	Max	Unit
5V	Power source for SKKCA	5.0	5.5	V
GND	Operating voltage	0	0	V
KC_RX	Receiver pin of KC Wirefree Bluetooth module	4.5	5.5	V
KC_TX	Transmitter pin of KC Wirefree Bluetooth module	-	-	V
RESET	Reset pin of KC Wirefree Bluetooth module	0	3.3	V

SKKCA can only be powered by either USB or external power (5V).

SKKCA have eliminated the hardware flow control of KC Wirefree Bluetooth module, thus if hardware flow control is required in development or application, it is advise the get the original Bluetooth module.

NOTE: DO NOT connect USB to SKKCA if it is connected to microcontroller. SKKCA can only be connected either USB or microcontroller.

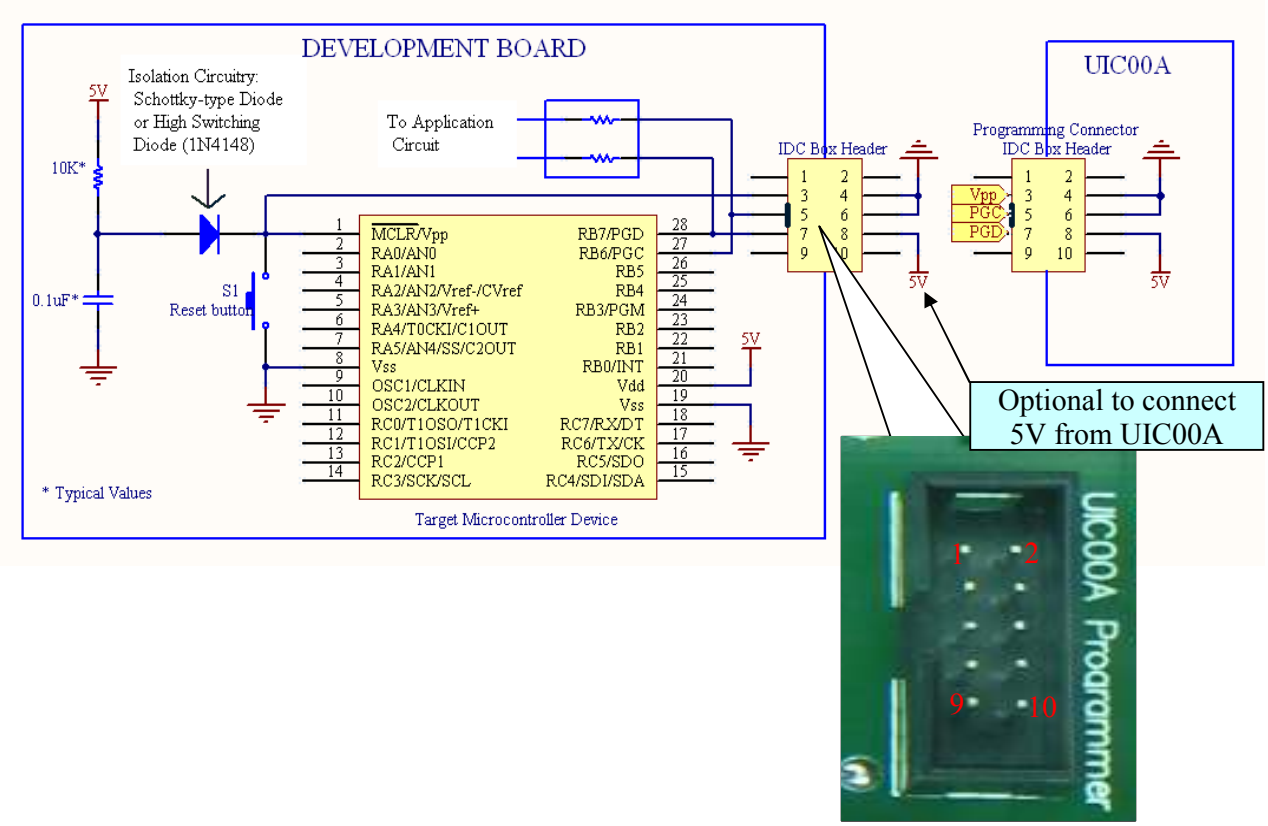
APPENDIX B

7.2.1 Using UIC00A with application circuit (development board)

UIC00A can program PIC microcontroller installed in the application circuit using In-Circuit Serial Programming (ICSP). In-Circuit Serial Programming requires five signals:

- V_{PP} – Programming voltage. When applied, the device goes into programming mode.
- ICSPCLK/PGC/RB6 – Programming clock; a unidirectional synchronous serial clock line from the programmer to the target.
- ICSPDAT/PGD/RB7 – Programming data; a bidirectional synchronous serial data line.
- V_{DD} (5V) – Power supply positive voltage, it can be either from programmer or application circuit. This is optional to target PIC. If target PIC is powered externally (recommended) this pin should **NOT** be connected to target PIC.
- V_{SS} (Gnd) – Power supply ground reference.

However, the application circuit must be designed to allow all programming signals (Vpp, ICSPCLK/PGC/RB6 and ICSPDAT/PGD/RB7) to connect to the PIC microcontroller device without distorting the programming signals. Figure below shows a typical circuit as a starting point when designing an application circuit for the ICSP. Those unconnected pins (1, 2, 9 & 10) of Box header should **be leaved unconnected** on application circuit.



Note: PIC microcontroller in the figure above is for reference purpose only. Refer to chapter 3 for supported PIC models.

Please be aware of:

- During programming mode, V_{PP} voltage will be raised to about 13.25V. It is recommended to isolate the supervisory circuit if interfaces with MCLR pin by using Schottky-type diode or high switching diode (1N4148) to prevent V_{PP} voltage slew rate from slow down and exceeds the rise time in the programming specification (typically 1µs). There should **not** be capacitive component (capacitor) connected to MCLR **directly**.

- RB7/PGD or RB6/PGC pin are recommended to use as output controlling non critical device such as LED, LCD, 7 segments or buzzer. It is recommended to isolated ICSP signals from application circuit by using series resistor (range 220 ohm and above) as shown in figure above. Furthermore, **NO** capacitive component (capacitor) should be connected to these 2 pins directly.

- During ICSP programming, PIC microcontroller needs to be powered. It is recommended to power the target externally; USB is not able to support large power usage. If target PIC is powered externally V_{DD} (5V) should **NOT** be connected to target PIC.

- The **minimum connections** from UIC00A to target board or PIC are **four**. These include **Vpp**, **PGD**, **PGC** and **Vss (Gnd).**

- Thus, the 5V from UIC00A is an **optional connection**. If user is powering up the target board with external power, this pin is not necessary to connect from UIC00A to target board.

- For usage example, please refer to DIY Project (PR7 onwards) in Cytron website.

3. SUPPORTED PIC

UIC00A is compatible with PICkit 2 programmer software. It has been tested to load program using UIC-S socket board. Below are the PIC models that being tested using UIC00A:

Mid range devices	18F devices	dsPIC devices *
PIC16F777	PIC18LF4539	dsPIC30F4011
PIC16F877	PIC18F4320	dsPIC30F4013
PIC16F76	PIC18F2320	dsPIC30F1010
PIC16F74	PIC18F448	dsPIC30F4012
PIC16F747	PIC18F4331	dsPIC30F3013
PIC16F886	PIC18F2420	dsPIC30F2012
PIC16F916	PIC18F2320	dsPIC30F3012
PIC16F737	PIC18F2523	dsPIC30F3011
PIC16F73	PIC18LF2550	dsPIC30F3010
PIC16F767	PIC18F2682	dsPIC30F2010
PIC16F627A	PIC18F1330	dsPIC30F2020
PIC16F873A	PIC18F4220	
PIC16F627	PIC18LF4520	
PIC16F84A	PIC18F2423	*** UIC-S cannot be used for**
PIC16LF84A	PIC18F252	**dsPIC devices**
PIC16F84A	PIC18LF252	
PIC16f506	PIC18F4420	
PIC16F616	PIC18F458	
PIC16F627	PIC18F2610	
PIC16F627A	PIC18F2520	
PIC16F628	PIC18F2550	
PIC16F628A	PIC18F4455	
PIC16F716	PIC18F258	
PIC16F737	PIC18F4680	
PIC16F818	PIC18F248	
PIC16LF876A	PIC18F2550	
PIC16F877A	PIC18F2455	
PIC16LF877A	PIC18F2410	
PIC16F877	PIC18F2685	
PIC16F886	PIC18F2680	
PIC16F917	PIC18F2450	
	PIC18F2525	
	PIC18F2431	
	PIC18F2685	
	PIC18F2620	
	PIC18F2221	
	PIC18F1220	
	PIC18F1230	
	PIC18F1320	
	PIC18F452	
	PIC18F2525	
	PIC18F4620	
	PIC18LF4539	