Abstract

This report investigates on the functionality of MC68000 microprocessor flight board as a medium of system control. The system will able to generate a wireless connection environment for data transferring, with the use of Bluewave RS232 PCB DCE Terminal evaluation kit with Bluetooth utility, and thus to interface with a host computer for communication purpose.

In general, this report discusses the following areas: -

1. System overview.
2. Details of RS232 connections and its application.
3. A deep research on the use of Bluetooth technology and their specification.
4. System specifications, system design and coding for the powerful MC68000 microprocessor by using C language.
5. Implementation and analysis of the overall results.

This report also contains the information and guideline for future development of the project. Though the original objective of producing a proof of concept demonstrator was not finished due to the complexity and limited time, the report goes on to outline further work involving the device for extension at a later date.

Acknowledgement

I would like to take this opportunity to express my deepest appreciation and respect to Mr. David Meads who is my principle supervisor, for monitoring my work and maintaining my consistency with my project. I deeply appreciate for his patient, concern and advice. Without his excellent and experienced leading, this project would not have come to this completion.

I would also like to extend my special thanks to Ian Munro, which leads me frequently in the programming, especially to overcome all the difficulties patiently during the coding process.

I would also like to thanks to Tony Crook and Stephen Passmore who is the project lab assistant for guiding me on the process of implementation

Finally and most important, I would like to express my greatest respect and gratitude to my parents, for their patient and continuous support in throughout the whole degree programme.

Content

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Glossary of Common Terms & Abbreviations.

PC	=	Personal Computer
Hz	=	Hertz, a measurement of frequency
DUART	=	Dual Universal Asynchronous Receiver/ Transmitter
UART	=	Universal Asynchronous Receiver/ Transmitter
R/ W	=	Read/ Write
Bit	=	The smallest unit of a data, either 1 or 0.
Byte	=	unit measurement of data, which from by 8 bits.
ASCII	=	American Standard for Information Exchange
ANSI	=	American National Standards Institute
USB	=	Universal Serial Bus
RS	=	Recommended Standard
V	=	Volt, unit measurement of voltage.
LED	=	Light Emitted Diode
CD	=	Compact Disk
API	=	Application Program for Interfacing
bps	=	Bytes per second
spp	=	serial port profile
RAM	=	Random Access Memory
ROM	=	Read Only Memory
CMOS	=	Complementary Metal-Oxide Semiconductor
PI/ T	=	Peripheral Interface/ Timer circuit
I/ O	=	Input/ Output

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1. Introduction

World technology today has been highly demand and improved since the recent years. People are hunger for appliances, which are more user friendly and high convenient in supervision and multi purpose. In order for these aims to be satisfied, microprocessor and microcontroller has upgrade constantly to maintain its excellent performance in the related industries. Microprocessors are famous with its special industry standard for industrial control and multi-user computer systems, and even to all other embedded systems and devices.

The purpose of this document is to follow the design and development of a system to interface with Bluetooth hardware by using a MC68000 Flight-68K MKII Board. Since the technical solution at this stage is left for investigation, the report will be concentrate on the full progress process of this project.

1.1 Project objective.

The objective of this project is to: -

- Develop two individual circumstances under the same conditions for two Bluetooth adaptors to transfer and receive data to each other and show the data on the Hyper Terminal screen under the control of Motorola MC68000 microprocessor.
- Create a software environment to interlink between the hardware and to design the protocol.
- Develop software to control the application board to work as light indicator when transmission is taking part.

1.2 Project Development.

Due to the size, complexity and limited time scale involved, the overall design of this project will be separate into particular part for advanced research. The whole design procedure will be concentrate on the software basis as it required less of hardware development. The following methods are used to develop the system: -

Information Gathering - A background research on the required information and hardware, including the relationship between RS-232 and MC68000 flight-board, and the functionality of Bluetooth.

Physical Design – Research on the overall system design according to the required of the project objective.

Software Design – The coding procedure that will create a control system for the project, and it will be separate into several parts according to its own task: -

1. Interface of the Bluewave RS-232 wireless cable hardware to the MC68000 Flight-board.
2. Communicate with the COM2 port of PC and interface with the Hyper Terminal
3. Interface with the application board, which act as the process light indicator.
4. Transfer of bytes.

1.3 Report Scope

The major practice of this report is to investigate and study on MC68000 flight-board in interfacing with a Bluetooth hardware and thus to generate a communication between PCs. It will give an express idea to the reader and anyone to following up these advanced technologies in the future.

1.4 Report Layout

Chapter 1 **Introduction**

This chapter give an acknowledgement to the reader about the aim and objective of this project, it explain the details about this whole report. This chapter will end with report organization.

Chapter 2 **System Outline**

This chapter will give a straightforward overview on the overall project plan by guiding readers to the major system block diagrams that occupied in the design method.

Chapter 3 **MC68000 Microprocessor**

In this chapter, MC68000 microprocessor and MC68000 Flight-68K MKII Board will be introduced to the reader regarding to its specifications, major functions and applications. It will also give a basic idea on the Multi Application Board of MC68000 Flight-68K MKII Board and the applications of the major internal processor: - MC68230 and MC68681.

Chapter 4 **Introducing New Technology**

A concise introduces of Bluetooth technology and its application will be described in this chapter. Special attention will be paid to the ability of Bluetooth technology in order to help the user to understand about the practical of this project.

Chapter 5 **RS-232**

It is the aim of this chapter to give an understanding to the RS-232 link by looking at its details. RS-232 is the most frequently used link in this chapter. Understand the concept of RS-232 will help to penalize the whole project.

Chapter 6 **Project Development**

This chapter is the main and most important part through out the whole document. It will describe on the whole process of project developing, including the main system design, flow chart and software development.

Chapter 7 **Test Plan And Future Development**

This chapter will introduce the appropriate expansion and ideas for the future work of this project. It will deal with other features of the project that has been recommended, by have not been develop.

Chapter 8 **Project Management**

This chapter introduced the project management process through out the whole period including the time management and the scheduling task to be complete.

Chapter 9 **Conclusion**

This chapter aim to give a conclusion and summary on the whole documentation of this project. It will ends with a comment on how the objective and aims are to be achieved.

2. System Outline

2.1 Overview

This chapter aim to pioneer the reader to the main system design involved in this project. It will only give a rough idea to the reader on overall design phases and the use of its hardware. Full details of the project development will be discussed in chapter 6.

2.2 System Design

Basically, the idea of this project is: -

1. To transfer a data and character, which will be typed instantly from PC1, and transmit to PC2 and show on the screen of monitor with Hyper Terminal application.
2. To receive data and characters from PC2, and thus to show on the Hyper Terminal Screen of PC1.

2.3 System Hardware

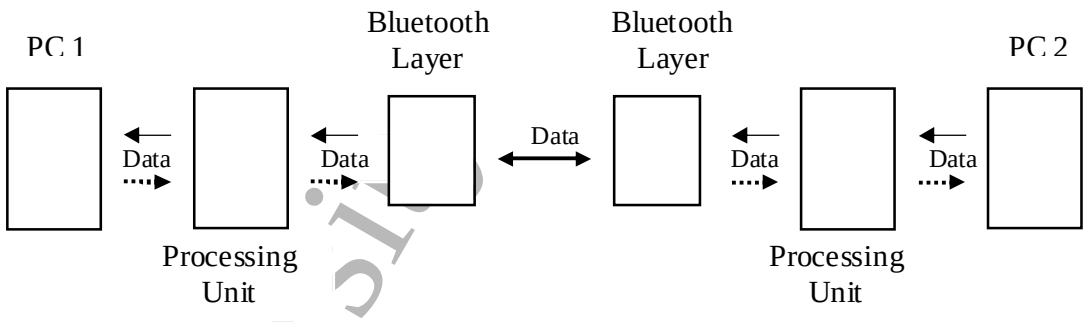

Figure 2.3 System Outline (Simplified)

The overall task of this design required to establish a dual way transmission and it involved the used of particular hardware, in order to be successful in operation. RS-232-links are widely used in this system as it has excellent communication ability in transmission of data.

2.3.1 Processing Unit

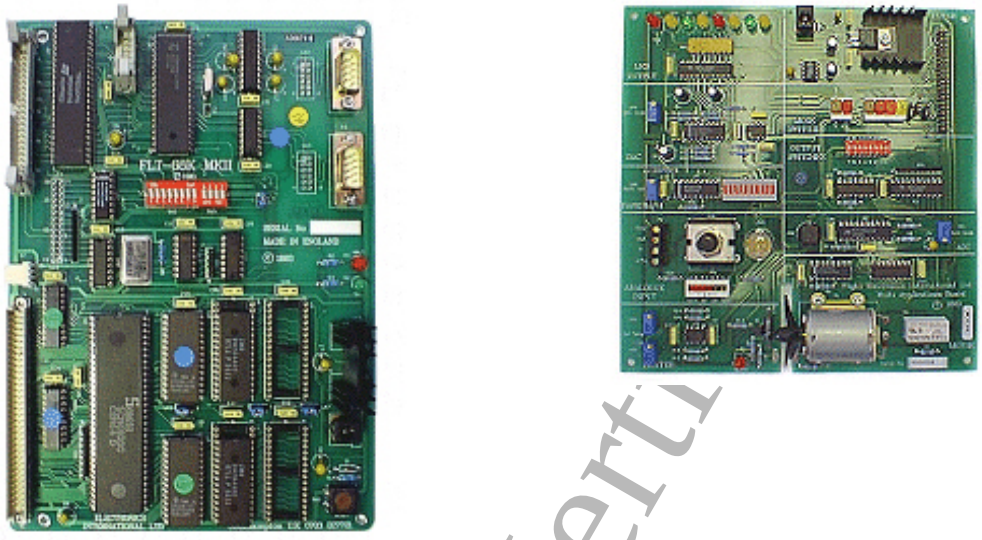

Figure 2.3.1 MC68000 Flight-68K MKII Board and Multi Application Board [Ref 1]

The processing unit is the main operating structure in this system. It will form by a MC68000 Flight-68K MKII Board and an application board. Application software will be construct according to the system requirement and will be download into the system for controlling appliance.

MC68000 will be act as the main processing unit and supervised all the operating process of this system, including data flow process, capture data from receiver and store into internal memory and transfer data to the required destination. Data flow process will be fully control by the application software and thus to organize the scheduling task of transmission according to the system condition.

Application board is used as the light indicator when the system is in operation. It will indicate that a data is currently receiving by the system by showing the running light of LED from right to left, and the reverse order will show the transmitting process. [Ref 2]

Full details on MC68000 Flight-68K MKII Board and its application board will be discussed in chapter 3.

2.3.2 Bluetooth Layer

Bluetooth is a special design technology that use for short range communication between computing and communication devices, which enable them to interface wirelessly to each other. It has major advantages as low power consumption, low cost in developing and user friendly. For version 1.0 Bluetooth technology, it is able to provide a ten meters wireless communication, by converting data into radio waves for transmission over a single air-interface. The main appliances that are currently involved in the development of Bluetooth technology including mobile phones, notebooks, personal data assistant, computer and even any external device such as printer, speakerphone and headset. Bluetooth connection is entirely freedom under all kinds of environment within the limited range as it operates by using radio waves in 2.4 Giga Hertz frequency spectrums, and there will be no requirements for face to face connection or direct pointing as for infra-red. [Ref 3]

Figure 2.3.2 BlueWave Industrial Wireless Cable
[Ref 4]

The BlueWave Industrial Wireless Cable provides a point-to-point connection between any two RS-232 devices. It is a plug-and-play device and a Bluetooth wireless link is established instantly once hey are plug into each RS-232 connector and switched on. BlueWave Industrial Wireless Cable unit is fit for both commercial and industries applications, which required having a more freedom and wireless communication environment. [Ref 5]

Further details of Bluetooth technology and its hardware will be discussed in chapter 4.

2.3.3 RS-232

RS-232 link are the most popular used connections between computer appliances. It is popular because it is widely available, inexpensive and can be used for longer distance connections by using wider cables. Most of the computers today have at least one RS-232 communication port, and some of it even has two. RS-232 used UARTs system, which is able to transmit and receive data in the same time. In specific explanation, RS-232 is use to interface between the data Terminal Equipment (DTE) and Data Communications Equipment (DCE) in each connection to take up a serial data interchange. [Ref 6]

In this project, RS-232 link are used to interface between PC, MC68000 Flight-board and BlueWave RS-232 wireless cable. Further details of RS-232 will be discussed in chapter 5.

3. MC68000 Microprocessor

3.1 Overview

In the previous chapter, only some major key aspects of MC68000 have been introduced. This chapter will present a clear and details knowledge to the reader regarding to MC68000 Flight Board MKII technology, its internal architecture and technical applications, which will be apply in this project.

3.2 Brief Introduction on MC68000 Microprocessor

MC68000 microprocessor is the first achievement of M68000 16/32 bit microprocessor architecture, which is manufactured by Motorola Company. It has a 16-bit data bus and 24-bit address bus and the full architecture support for 32-bit address and data bus. Coding on MC68000 is compatible with others M68000 family microprocessors. The Motorola MC68000 family of microprocessors is now familiar as an industry standard for industrial organize and multi-user computer systems, which required the speed and power of an advanced 16/32-bit microprocessor. [Ref 7]

3.3 Introducing MC68000 Flight-68K MKII Board

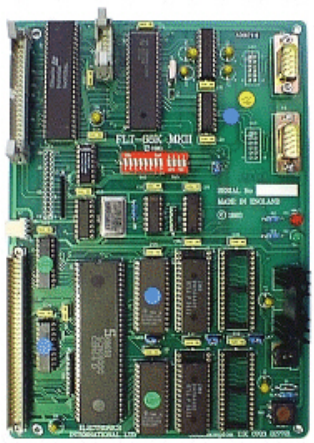

Figure 3.3 MC68000 Flight-68K MKII Board
[Ref 8]

MC68000 Flight-68K MKII Board is a training system that provides an introduction to the 16/32-bit microprocessor with the most familiar Motorola MC68000 architecture and functions. This is a very user friendly training system and it has been carefully designed to meet the requirement of publics in either commercial or industrial purpose.

MC68000 Flight-68K MKII Board has the capability to upgrade its RAM from 16k bytes to 512 bytes. A 64k byte firmware package is available on this MC68000 Fligh-68K MKII Board and it provides a mini environment for system development. An expansion bus is also available for transferring signals to the external drive via a 64 way connector.

The central processing unit of MC68000 Flight-68K MKII Board is a Motorola MC68000 microprocessor. As same as other M8000 family processor, it has a 16-bit data bus and a 24-bit address bus, which is able to access a linear address space of 16 megabytes. The whole process of MC68000 Flight-68K MKII Board will be drive by a 10 MHz clock that generated by an internal CMOS oscillator.

CPU	Motorola MC68000 microprocessor with 16-bit data bus and 24-bit address bus
System Clock	10MHz generated by a CMOS oscillator
RAM	16K bytes fitted as standard, expandable to 256K bytes RAM User RAM Address Range: 400400h-403FFFh (400400h-43FFFFh when expanded)
ROM	Two 27256 32K EPROMs containing the 64K bytes monitor program, expandable to 128K bytes with use of two 27512 64K EPROMs Monitor EPROM Address Range: 000000h-00FFFFh (000000h-01FFFFh when expanded)
Memory Expansion	Sockets for additional RAM up to 256K bytes On-board RAM Expansion Address Range: 440000h-47FFFFh

I/O Ports	MC68230 Peripheral Interface/Timer (PI/T) chip providing 16 digital I/O lines and a 24-bit wide counter with 5-bit prescaler, with full interrupt support Input/Output Address Range: 800001h-800035h MC68681 Dual Universal Asynchronous Receiver/Transmitter (DUART) providing two full specification RS232 serial ports with full interrupt support Input/Output Address Range: A00001h-A0001Fh Three interrupt sources (link selectable) Bus Expansion Connector offering access to all 64 lines of the 68000 CPU
Connectors	Two male 9-way D-type RS232 serial ports, one for connecting with display terminal or host PC, the other for connecting to a printer or for general use 40 way IDC header providing access to the MC68230 Peripheral Interface/Timer (PI/T) digital input/output and counter/timer lines 64 way male DIN41612 bus expansion connector offering access to all processor signals of the MC68000 CPU
Interrupts	Eight external user interrupt vectors, autovectored interrupts, and eleven trap instructions available to the user
Switch Faults	Ten fault switches offer six open circuit and four short to ground faults
Power Supply	The board operates from a single 9V power supply and has a current consumption of 700mA A 110/120V 50/60Hz or 220/240V 50/60Hz power adapter is included (please specify which is required when ordering)
Physical Characteristics	Dimensions: 1575mm wide, 2230mm deep, 160mm high without case Weight: 1.41lb including case

Table 3.3 Specifications of MC68000 Flight-68K MKII Board

[Ref 9]

Generally, MC68000 Flight-68K MKII Board will be divided into two operating circuit, which is the MC68230 peripheral Interface/ Timer circuit (PI/ T) and MC68681 Dual Asynchronous Receiver/ Transmitter circuit for different operations. [Ref 10]

3.3.1 MC68230 peripheral Interface/ Timer circuit (PI/ T) Operation

MC68230 peripheral Interface/ Timer circuit is a complex circuit that deals with variety of different operations mode required for peripheral interface/ timer system applications. The features of peripheral interface/ timer circuit including: -

- 24 individual Input/ output lines, including handshaking
- Port model of bit I/O, unidirectional 8 Bit and 16 Bit, and Bidirectional 8 bit and 16 bit.
- Programmable handshaking option.
- 24-bit programmable timer mode
- 5 separate interrupt vectors

There are 23 different register in this circuit and each register are set for different functions start with the location of $800001.
[Ref 11]

In this project, MC68230 peripheral Interface/ Timer circuit is used as the secondary controller to conduct the operation of Flight Electronic Multi Application Board for its Switch & Lamp Unit. These LEDs will indicate the process of data transmission and it required to have an appropriate setting to the several specific register in order to perform the required task.

3.3.2 MC68681 Dual Asynchronous Receiver/Transmitter circuit Operation

This device consists of two separate serial interfaces, which is fully compatible with the serial port profile (spp) of RS-232 links. One of the serial ports will be connected to the host computer and another one will be used to interface with any other serial devices. Features of MC68681 Dual Asynchronous Receiver/Transmitter devices including: -

- Two independent I/O port
- Software program baud rate generator
- Six parallel inputs
- Eight parallel outputs
- Separate counter/ timer mode

Again, this device has variety of register to be set and several of the register contain on the same location n off set value. This register should be set for appropriate values according to the requirement of user in order to drive the serial port for transmission. [Ref 12]

MC68681 Dual Asynchronous Receiver/Transmitter circuit will be used as the primary controller in this project controlling whole data transmission process. Data will be transfer according to the settings of application program and thus be control by the register in this serial asynchronous system.

3.4 Introducing the Flight Electronics Multi Application Board

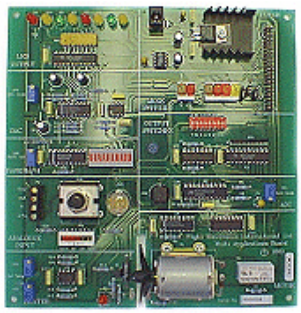

Figure 3.4.1 Flight Electronics Multi Application Board
[Ref 13]

The Flight Electronic Multi Application Board is intended to use with a wide range of original microprocessor training board. It provides the user with a beginning to the computer control via microprocessor. An eight lever switches facilitate data to be fed directly to the computer in digital form. This board provides a useful way of simulating I/O conditions from the user for program testing and debugging ideas. For the connection figure, Flight Electronic Multi Application Board will be connected to the 40 pins connector by using a 40 way ribbon cable. Power will be provided with a 240V normal main adaptor supply, and optionally an 110V is available. [Ref 14]

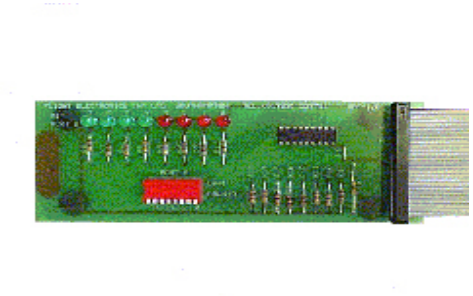

Figure 3.4.2 Switch & Lamp Unit
[Ref 15]

On Flight Electronic Multi Application Board, Switch & Lamp Unit will be used as the main function in this project. The switch and lamp unit connects to the 40-way parallel input/output connector of the FLT-68K and is controlled by the FLT-68K's Parallel Interface/Timer (PI/T) chip An 8 colored LED will be used as on or off mode, to indicate the '1' and '0' form of binary code. In this project, these LED will be on and runs from left to right in binary form, which indicates a data is currently transmitting to the other terminal. It will be showing that a data is currently receiving from the other terminal when the LEDs are on and running from right to left. When LEDs are of, it indicates that no transmission is in operation.

4. Introducing New Technology

4.1 Overview

This chapter aims to introduce the Bluetooth technology to the reader regarding to the required information, which should be understand in order to bring this project in to success. Several Bluetooth hardware will be introduced in this chapter as it placed several important roles through the whole process of project development.

4.2 Bluetooth Technology

Bluetooth technology was started to be in research since 1994 and first come into success in July 1999. It is design by a group of people which form as the result of cooperation of many companies within an organization. This group of people is leading by a legal agreement among all the members but it is not a company or a formal body, and the name of this group of people is acknowledged as "Bluetooth Special Interest Group (Bluetooth SIG)". The origin of the Bluetooth SIG were form by Ericsson, Intel Corporation, International Business Machines Corporation (IBM), Nokia Corporation and Toshiba Corporation and now, the special group contains over 2000 members. [Ref 16]

Bluetooth technology is a radio frequency based cable replacement technology, and design to replace the complexity and high costing of cables. It is optimized for low power consumption and also low cost in developing. A Bluetooth communication will required no face-to-face connections between hardware, and even direct pointing as for infra-red as operate by using radio-wave. In other words, Bluetooth technology is enable to work under any circumstances and it is entirely freedom under all kinds of environment within the limited range. A device has to be Bluetooth facilitated (i.e. contain a Bluetooth chip) to be able to operate a Bluetooth connection with other devices. [Ref 17]

4.2.1 Bluetooth Specification

Bluetooth technology is performed by using the radio waves in 2.4Giga Hz, and it utilizes a bandwidth between 2.402 – 2.480 Giga Hz. The bandwidth is broken into 79 channels and is limited to 1 Mega Hertz per channel. The operating speed of Bluetooth is faster

than an Integrated Services Digital Network (ISDN), but slower than an Infra-red. Bluetooth connections are highly secured as it has consists of various levels of confirmation, including pin code admission and up to 128-bit encryption.

Bluetooth devices can be categorized in 3 Efficiency classes: -

- Class1 : Highest efficiency with maximum coverage distance up to 100 meters (300 feet).
- Class 2: Medium efficiency, maximum coverage distance is about 50 meters (150 feet).
- Class 3: Lowest power efficiency with the coverage distance of about 10 meters (30 feet).

[Ref 18]

4.2.2 Radio Frequency Communication

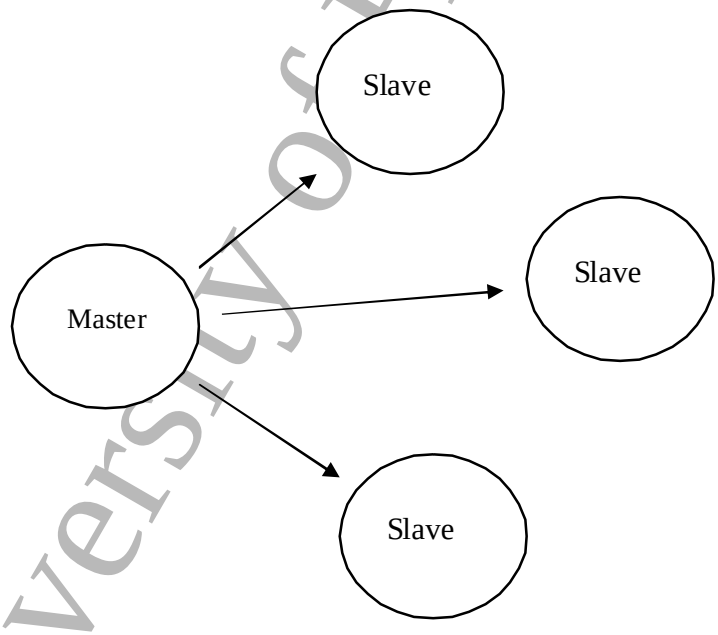

Figure 4.2.2 Master and Slave Role in a piconet.
[Ref 19]

When a Bluetooth link is established, a device will be act as the master and other will be play apart as the slave mood. A master will have the ability to communicate with 7 active

slave and up to 255 parked slave. A parked slave device is form as it is in standby state and waits for further acknowledgement.

Master device do not play any special roles in the communication. It determines the frequency hopping pattern and the stage for the hopping sequence. All communication between master device and active slave will form a inter connection called as piconet. A master device in a communication system can be operate as a slave or parked slave device in another piconet, and interconnection between piconets are acceptable. In some circumstances the master-slave relationship is not necessary. Although it has advantages or necessary to give a deices a particular position, it is not critical to establish a single specific role for each device. [Ref 20]

4.2.3 Power Factor of Bluetooth Technology

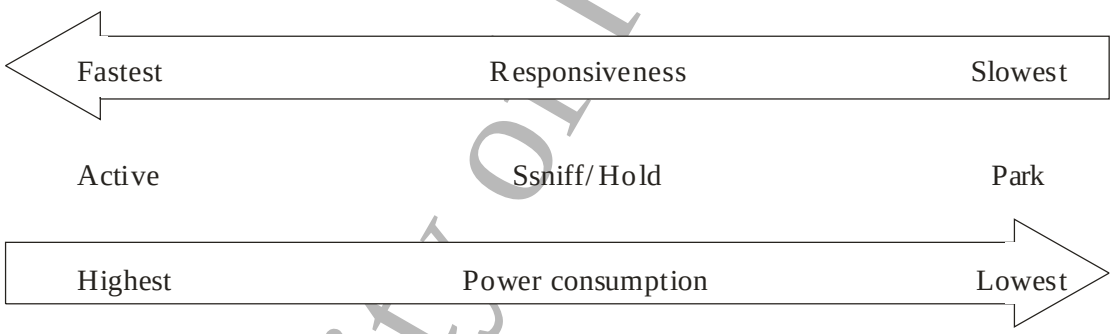

Figure 4.2.3 Relative Responsiveness versus Power Consumption.
[Ref 21]

Figure above show the relative responsiveness versus power consumption in a Bluetooth communication for a slave and parked slave mode. Both responsiveness and power consumption will be affected by the major factor such as the communication traffic and the amount of sniff and hold period. Sniff or hold mood is one method for reducing power consumption when active slave has accomplished its task and under standby mode for next interval signal to be given. Sniff mode will allow the reduce of power consumption by dropping the average duty cycle of the radio but will also reduced the

responsiveness of its own. In hold mode, the device will stop to be in operation in a fixed interval and waiting for the next cycle to achieve. [Ref 22]

4.3 Bluetooth Hardware.

There are numerous Bluetooth hardware promoted in the market due to special demand and highly improve technology. For this project, several Bluetooth hardware has under consideration and analyzed for its specific condition and ability, and thus to locate in this project for wireless communication principles.

4.3.1 Introducing The Bluetooth Developer's Kit for Windows

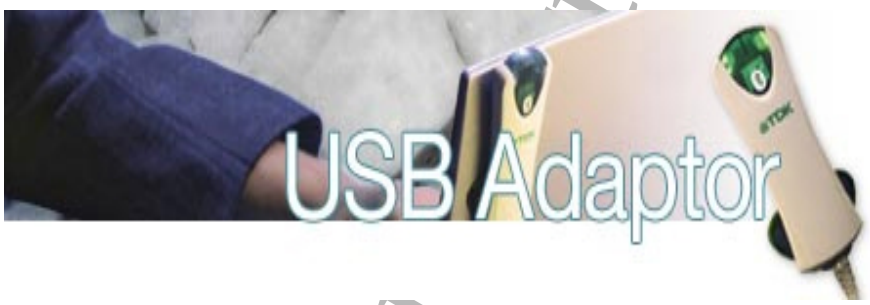

Figure 4.3.1 TDK Bluetooth USB Adaptor.
[Ref 23]

The Bluetooth Developer's Kit for Windows are produce by TDK System Ltd. It is design to assist with PCs, notebooks and laptops for device discovery, bonding and accessing data in wireless messaging, communication between external device such as modems and printers, mobile phones and other Bluetooth applications.

The main operating hardware of this developer's kit is 2 Bluetooth USB adaptor. It supports Bluetooth 1.1 compliant and compatible with other advanced Bluetooth interface. It has an intelligently designed APIs (Application Program for Interfacing) for concise interfaces with other Bluetooth devices and also traced utility for configurable, real-time monitoring of all stack layers. The application software of this product is conduct in an application program for interfacing (API) in a CD, which is required to be installed by the user. [Ref 24]

The Bluetooth Developer's Kit for Windows comes with following components: -

- Software Developer's Kit software.
- Technical Documentation.
- 2 TDK Bluetooth USB Adaptors.

System requirement for Bluetooth Developer's Kit to be operated is describe as below: -

- Windows 98 SE / Me / 2000 (SP 2) / XP
- Microsoft Visual C++ 6.0 (SP 5)
- USB port
- CD-ROM drive for installation

[Ref 25]

After several consideration, the TDK Bluetooth Developer's Kit was not applied into implementation due to the following basis: -

1. There is a connection failure between the USB adaptor and MC68000 Flight-board. USB to serial RS-232 converter required in order to generate a communication between two interface, and this involve an additional cost and time to assemble this converter.
2. Cost of purchasing is over the limited budget of £200.
3. An account was unable to form due to paper work between University's account department and TDK System Ltd. The account may takes up to 1 months to set up and it will not be possible to be delivering within 2 months.
4. Application Program for Interfacing (API) for this hardware was unable to compatible with the PC compiler to access with the used of MC68000 Flight-board.

4.3.2 Introducing the BlueWave RS232 DTE Terminal

Figure 4.3.2 BlueWave RS232 DTE Terminal
[Ref 26]

BlueWave RS232 DTE Terminal is a serial connection hardware that provides an instant connection to the master device. A RS-232 connector is required for the master device to communicate with this device. This hardware requires neither software nor hardware modification to the existing system and will provide a wireless range of communication up to 100m.

Excellent features of BlueWave RS232 DTE Terminal including: -

- A plug-and-play device, no additional setting or redesign required.
- Connect directly to the RS-232 port of master appliances.
- Pins are compatible with regular RS-232 for hardware handshaking.
- Able to communicate with up to 7 other Bluetooth device.
- Baud rate are adjustable, and up to 115kbps.
- A Bluetooth Version 1.1 Compliant.
- Compatible with other Bluetooth devices.

[Ref 27]

Specification of BlueWave RS232 DTE Terminal: -

Supply Voltage	3.3V – 6V (regulated or unregulated power supply)
Carrier Frequency	2400MHz to 2483.5MHz (USA, Europe)
Modulation Method	GFSK, 1Mbps, 0.5BT Gaussian
Transmission Power	Class 1 (max 20dBm)
Hoping	1600 hops/sec, 1MHz channel space
Receiver IF Frequency	1.5MHz centre frequency
Output Interface	UART (3v), EIA 232 (5V)
Humidity	95% non-condensing
Compliant	Bluetooth™ Specification v1.1
Baud Rate	To 115200baud
Operating Range	100m (328 ft)
Dimensions	40 x 30 x 5 (mm)
Antenna	Internal or external via SMA Connector

Table 4.3.2 Specification of BlueWave RS232 DTE Terminal.
[Ref 28]

This device was also unable to obtain and utilize in this project due to the mistaken order of product and time arrangement failure from the provider.

4.3.2 Introducing The BlueWave Industrial Wireless Cable

Figure 4.3.3 BlueWave Industrial Wireless Cable
[Ref 29]

The main interfacing system of this project goes to this device, the BlueWave Industrial Wireless Cable. Similar to BlueWave RS232 DTE Terminal, it is a plug-and-play device. BlueWave Industrial Wireless Cable consists of a Bluetooth RS-232 master module with a female connector and another Bluetooth RS-232 slave module with a male connector. Both of these device are Bluetooth version 1.1 standard and it approve the serial port profile (spp) and operates as a wireless RS-232 cable. It has built-in LED, which used to display status of current Bluetooth connections. The LED status is described as below: -

LED Indication	Mode	Bluetooth Connection
Single flash	Data	None
Slow flash (1Hz)	Command	None
Quick flash (2Hz)	Command	Active
LED off steady	Data	None
LED on steady	Data	Active

Table 4.3.3(a) LED status of BlueWave Industrial Wireless Cable
[Ref 30]

BlueWave Industrial Wireless Cable comes with the great features such as: -

- Up to 330m line of sight Bluetooth wireless link
- Up to 230.4kbps baud rate connection with hardware handshaking.
- Direct connection from power up.
- Fully compatible with serial port profile of RS-232.
- No external software or installation is required.
- Manufacturing strength aluminum attachment and antenna.

As same as BlueWave RS232 DTE Terminal, the BlueWave Industrial Wireless Cable has the same specification except for some minor upgrading: -

Supply Voltage	110-240 AC Power Adaptor
Carrier Frequency	2400MHz to 2483.5MHz (USA, Europe)
Modulation Method	GFSK, 1Mbps, 0.5BT Gaussian
Transmission Power	Class 1 (max 20dBm)
Hoping	1600 hops/sec, 1MHz channel space
Receiver IF Frequency	1.5MHz centre frequency
Output Interface	EIA 232 (5V)
Humidity	95% non-condensing
Compliant	Bluetooth™ Specification v1.1
Baud Rate	To 230.4kbps baud rate
Operating Range	100m (328 ft)
Antenna	External via SMA Connector

Table 4.3.3(b) Specification of BlueWave Industrial Wireless Cable.
[Ref 31]

BlueWave Industrial Wireless Cable has the ability to interface with other devices by using the slave module and the range are from minimum speed of 1.2kbps baud rate up to 230.4kbps baud rate. In order to be user friendly, the system allowed user to configure the settings according to the system requirement by only few straightforward procedure that excluding the need for external complicating program development.

Baud Rate	115.2kbps
Data Bits	8
Stop Bits	1
Parity	None
Bluetooth Mode	Enables instant connection
Bluetooth Name	wireless cable
PIN code	1111
Mode	Data mode. Unit act as a cable.

Table 4.3.3(C) Original configurations of BlueWave Industrial Wireless Cable.
[Ref 32]

BlueWave Industrial Wireless Cable was finally be purchased and put into practice in this project. It highly fulfills the required functionality of this project with its advanced technology and the following special features: -

- Compatible with all serial port profile (spp) of RS-232, which used as the key connection for MC68000 Flight-board.
- Able to transfer data asynchronously for any transmission through RS-232 format and link.
- Providing a separation of master and slave module, and thus simple and fully equipped for communication between two PC.

5. RS-232

5.1 Overview

This chapter aim to introduce the reader to the world of RS-232, including its specification, characteristic and major utility. It will give the reader a further understanding on the usage of two individual RS-232 port and its connectors in this project.

5.2 RS-232 Specifications

RS-232 (Recommended Standard-232 model) is one of the most common use links for interfacing between two devices, and with a limit of 50 to 100 feet and it depends on the peripherals and cable that is used. Another popular use of the RS-232 link is to connect to an adaptor that converts the interface to another type, such as from RS-232 to USB (Universal Serial Bus).

The Telecommunications Industry Association (TIA) has distribute the details about RS-232, including signal functions, pin locations and other specifications, and it has been upgrade promptly since it was publish in 1960s. A version that was produce by Electronics Industries Association (EIA) has been taking over and now the latest version since 1997 is YIA/ EIA-232F and this interface is compatible with RS-232. [Ref 33]

Interfacing	**Format**	**Number of devices (maximum**	**Length (maximum, feet)**	**Speed (maximum, bits/ sec.)**
RS-232 (EIA/ TIA-232)	Asynchronous serial	2	50 - 100	20k (115k with some drivers)

Table 5.2 RS-232 Specification.
[Ref 34]

5.3 Features

1. RS-232 is popular. Every PC will have one or more RS-232 adaptor to link to other device such as printers, modem, microcontroller or microprocessor, and even to another PC.
2. Linking system can be 50 to 100 feet long, depends on the peripheral and cable used.
3. It is easy to convert a 5V serial port to an RS-232 link and microprocessor and microcontroller system.
4. There will only three wires for a 2-way link system. A RS-232 normally consists of 9 pins, including a ground connector. The cost of cables and large connectors will be reduced.

[Ref 35]

5.4 Signal and Connectors.

Pin	Signal	Type	Description
1	CD	control	Carrier detect
2	RD	data	Received data
3	TD	data	Transmitted data
4	DTR	control	Data terminal ready
5	GND		Signal ground
6	DSR	control	Data set ready
7	RTS	control	Request to send
8	CTS	control	Clear to send
9	RI	control	Ring Indicator

Table 5.4 RS-232 Pins Location

[Ref 36]

For RS-232, only pin 2, 3, 4, 5 and 8 will be used in common applications.

Pin 2 - Receive data from the transmitter.

Pin 3 - Transmit data to the receiver.

Pin 4 - Data terminal ready, which drive a positive 5V from the PC and thus to allow hardware handshaking to take place, in order to receive data.

Pin 5 - A 0V common ground connection.

Pin 8 - Clear to sent, providing hardware handshaking in the other direction, to indicate a signal for sending data.

5.5 Data Format

Data that will be sent or receive through a transmission can be represent in all kinds of format, including commands, codes, text message or information. These data will be encoded as binary or text data form.

5.5.1 Binary Data

The value of the binary are from 0 to 255, which are square numbered of 0 through 7, with represent of either 1 or 0 multiplied by a power of 2. For example, a byte of 1111 1111 will be translated to value 255, or FF in hexadecimal. In a transmission process, the least-significant bit (LSB) will always be transfer first, and then only follow by the most significant bit (MSB).

5.5.2 Text data

Although binary data is useful in many linking system, the operation still required an additional format to send message or files that enclose with text. Text data are use for the purpose of sending data that contain of text. There are several formats of text data which is being use in the linking system: -

ASCII code (American Standard code for Information Exchange)

- This format consists of 128 codes and just required to use seven data bits. The remaining bit will either be a 0 or a parity bit.

ANSI code (American National Standard Institute)

- This format uses 256 codes, and special and inflection characters are represent by the higher code,

There are other formats of codes which use 16 bits per characters, and it tolerate with 65,536 different characters.

5.6 Formats of RS-232 link

For RS-232 links with multiple device, it required the system to have a clock, or timing reference to control the transmission of data through a network or share path way. Each transmitter and receiver will act according to the time signal to complete the transmission. There are two types of serial data formats, which uses clocks in diverse ways: -

5.6.1 Synchronous Format

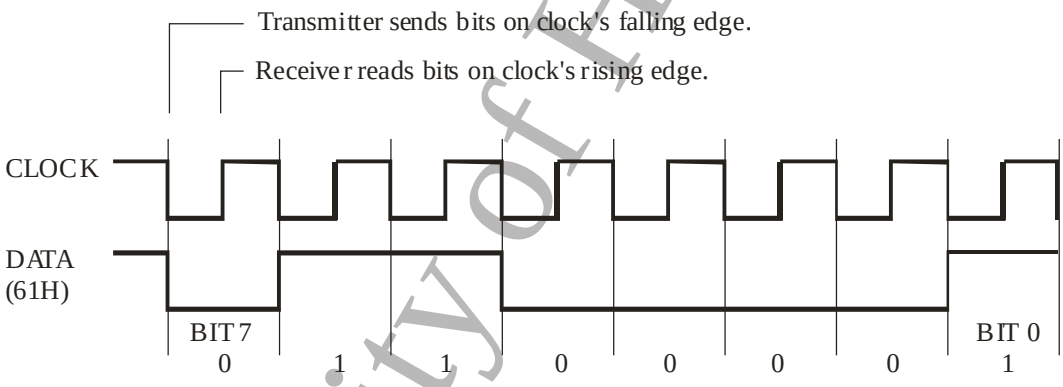

Figure 5.6.1 Synchronous Transmission.
[Ref 37]

In this format, the network will share an external clock, or a same clock which is generated by a particular of the device. All the transmission bits will be transmitting according to the clock signal, which have a fixed frequency. Receiver will act according to this signal and decided when to receive a bit. Synchronous format are widely use in short linking system, with the maximum 15 feet cable. It used a multiple ways to indicate the operation steps, including adding a stop and start bit, and also to contribute a chip-

select signals. Many synchronous protocols send data begins with a most significant bit (MSB) first, then only follow by the least significant bit (LSB).

5.6.2 Asynchronous Format

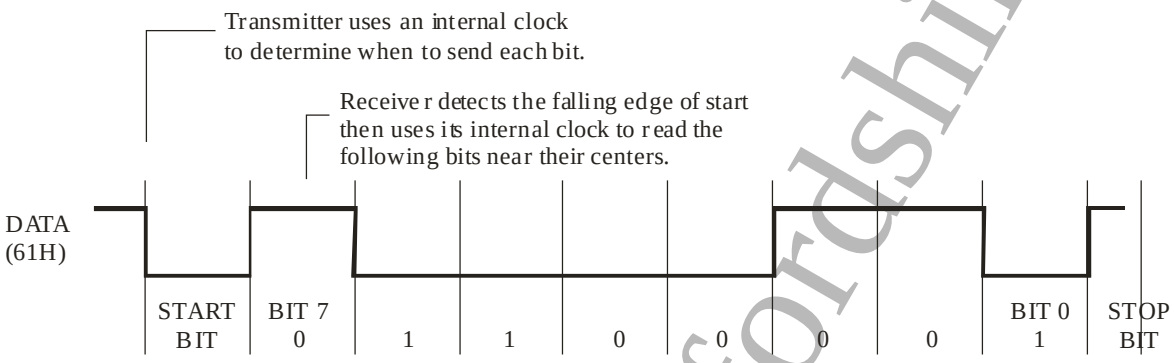

Figure 5.6.2 Asynchronous Transmission.
[Ref 38]

For asynchronous format, the system will not include a clock signal. Each of the linking system will produce an individual clock signal through the operation. The most common asynchronous link format is 8 – N – 1, which sent each data byte as one start bit, following by a eight bits data, begin with the least significant bit (LSB), and then continue with the most significant bit (MSB), and finally ends with one stop bit. There will be no parity during the operation.

5.7 Prevent Missing Data

Missing data is one of the unexpected errors that will occur during the linking process. When more than one task is operating synchronously in the same time, some internal failure will cause a missing data to be happen and thus lead to a failure performance.

In RS233 network system, there are 5 major methods to solve this linking error: -

1. Handshaking
2. Buffers
3. Polling and Interrupts
4. Acknowledgement
5. Error-checking

One or more methods should be taken to avoid the failure and maintain the consistency of the performance.

5.7.1 Handshaking

Handshaking is a signal that indicates the transmitter when it is necessary to sent, or indicates a ready to receive signal to a receiver. There is either a hardware handshaking or software handshaking available in each RS-232 linking system. A receiver will automatic bring a line high when ready to receive data. In this time, the other transmitter will follow the instruction and start sending data. Whenever there is a line low in the receiver, the transmitter should be able to detect it and stop sending data till the line return high to accomplish the transmission.

5.7.2 Buffers

The buffer can be in either software or hardware, or both also. It is another way to prevent from missing data, and buffer can be more useful to transmitting process, which they can store data that will be sent out as the communication is available. Each serial linking has a built-in 16 bytes buffer that built on the UARTs. The data will be temporally store in this buffer on receiving process before the software is able to read it. For transmitting process, UART will automatic supervise the transmission of the byte bit by bit, in the arrange order. There is a necessary a software protocol when hardware protocol is not enough. Software protocols are programmable, and it will allow the user to specify the size according to the system memory.

Microcontroller and microprocessor will have a smaller and limited size of buffer, or even no hardware buffer. For a RS-232 link to be use in a microcontroller or microprocessor system, the user will have to apply other ways to prevent missing data.

5.7.3 Interrupts and Polling

Interrupts can be program to effect and detect the events, which take part in the operation such as transmitting, receiving, changing of handshaking and errors. This programming is called as event-driven. An interrupt will automatically generate necessary actions to react

the feedback of the system and to active or passive a port. When ever there is an external events happen during the operation, the interrupt will automatic execute to jump to the exacting routine.

Polling is use for transferring short data, or expecting an immediate data to be received when sending a data. This polling system is called as procedure programming, and required no additional hardware interrupts. This method will pool the port for a periodically checking on the condition and signals of the operations to detect all immediate events.

5.7.4 Acknowledgement

An acknowledgement is a byte that identified the system a transmission is currently operating. It will be receive either by a receiver or transmitter node. This node will detect the acknowledgement far through the whole transmission and response to it. When the receiver or transmitter receive a reply from the node, they will automatic be admit and thus sent or receive the data. If there is no reply, the transmitter or receiver will retry or take another action in to the operation. Acknowledgement are effective to networks, where all the linking are sharing the same path way.

5.7.5 Error-checking

One of the simple forms of error-checking is by duplicating the operation. The transmitter will sent a data twice and the receiver will confirm whether both are the same data. If they are match to each other, the data is successfully being sent. Else it will request to send again. This duplicate task takes twice of the time to transmit data and is useful for sending occasional and short data.

Another error-checking process called a checksum, and operates by adding an error-checking byte to the transmission. The system will perform the calculation from an arithmetic or logical operation at the specified byte through the message. The receiving process ends with calculating the final result, and if the result is not same, then the system will realize that the transmission is not success.

A CRC (cyclic redundancy code) is another error-checking ways by using calculations, but it required on more complex math and is also more consistent than a checksum. [Ref 39]

6. Project Development

6.1 Overview

In chapter the system outline has been defined, this chapter goes on to show the actual physical design and software development of this project. It is the aim of this chapter to give a clear explanation on every practical task that involved in project progress and how each task is accomplished.

6.2 Project Design

The whole project will be design according to following aims and objectives: -

- Develop two individual circumstances under the same conditions for two Bluetooth adaptors to transfer and receive data to each other and show the data on the Hyper Terminal screen under the control of Motorola MC68000 microprocessor.
- Create a software environment to interlink between the hardware and to design the protocol.
- Develop software to control the application board to work as light indicator when transmission is taking part.

In order to achieve these aims and objectives, a logical plan is first conducted to design a connection aspect between all hardware. This system design will give a guideline to interface all devices and thus to communicate with each other.

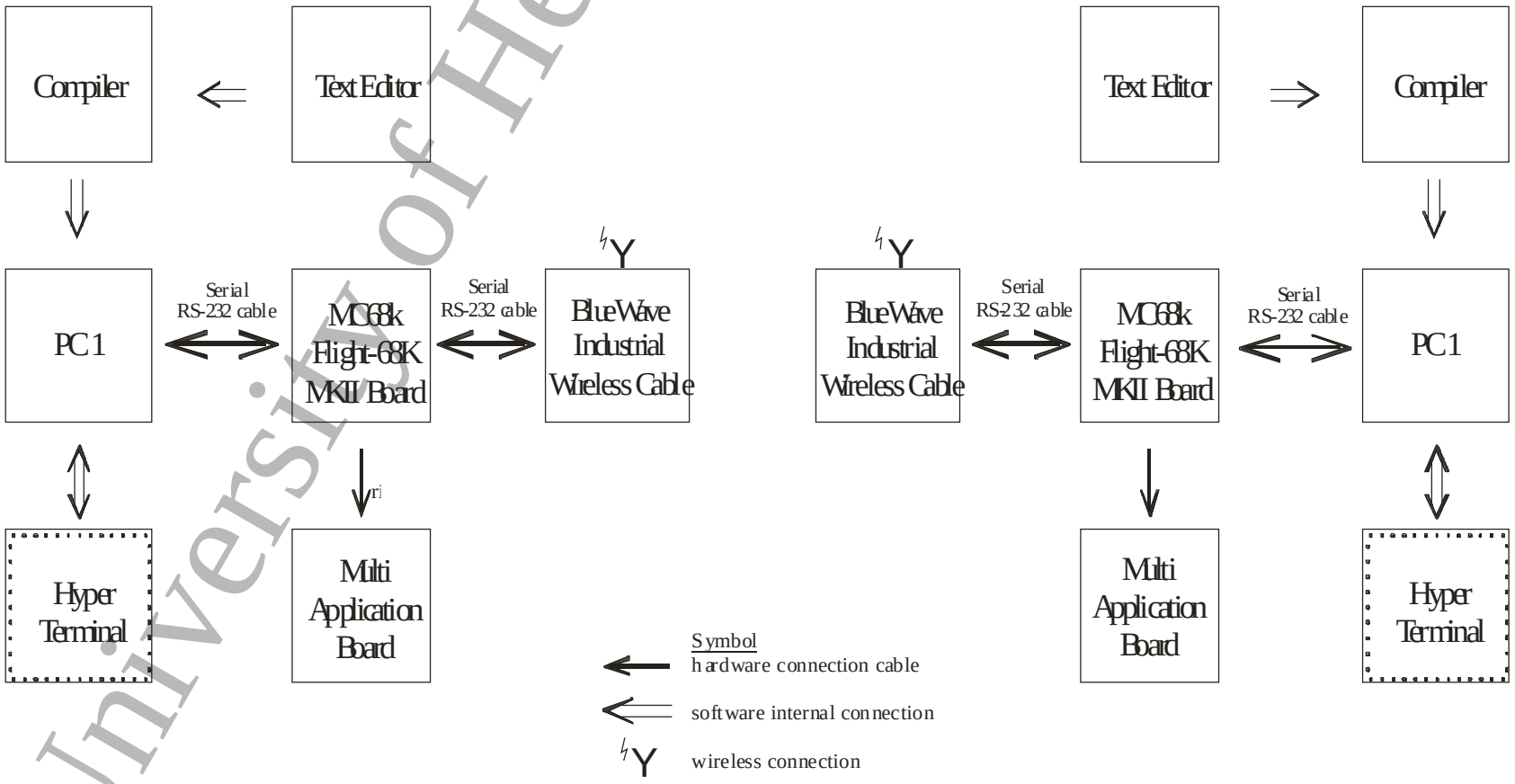

Figure 6.2.1 System Block Diagram

Figure above show the connections that apply in this project. Basically, there are two same system models to be in operation. PC1 will act as the master module and PC2 will be act as slave module. All hardware will be under same condition and installed with same operation program. An internal software connection will be appearing to interface between center processing unit with software compiler, text editor and Hyper Terminal operations.

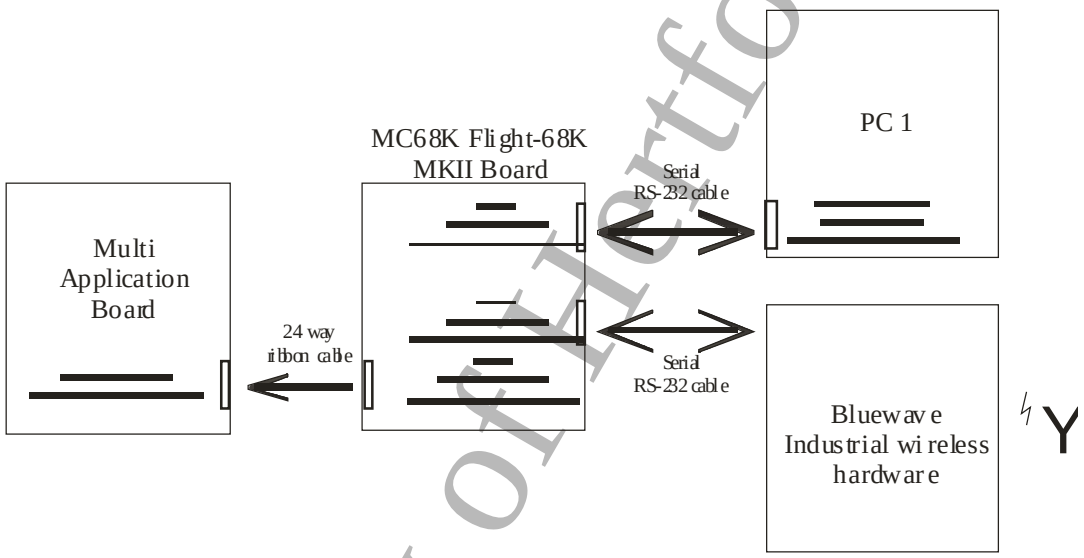

Figure 6.2.2 Interfacing Between Hardware

As shown above, a serial links will appear between MC68000 Flight-68K MKII Board with host computer and BlueWave Industrial Wireless Cable. An RS-232 cable will be used to interface from COM2 port of host computer to LK2 9-pin D-type RS-232 male connection on MC68000 Flight-68K MKII Board. An original built-in RS-232 link cable on the BlueWave Industrial Wireless Cable then will be connect to the LK3 9-pin D-type RS-232 male connector of MC68000 Flight-68K MKII Board. The purpose of this serial link is to interface the host computer to MC68000 Flight-68K MKII Board and thus to generate commands and operation to BlueWave Industrial Wireless Cable for transmission of data.

For connection between MC68000 Flight-68K MKII Board and Multi Application board, a 24 way ribbon cable will be apply to connect from LK4 of MC68000 Flight-68K MKII Board to the terminal port of Multi Application Board. This is to link between MC68681 circuit device with the Multi Application Board and thus to utilize the switch and lamp unit to operate as a light indicator during the process of transmission.

6.3 Hardware Development

This project is software based achievement and only a minor pin converter is develop to switch the pins of BlueWave Industrial Wireless Cable slave module from male to female connector in order to interface with LK3 9-pin D-type RS-232 male connector of MC68000 Flight-68K MKII Board.

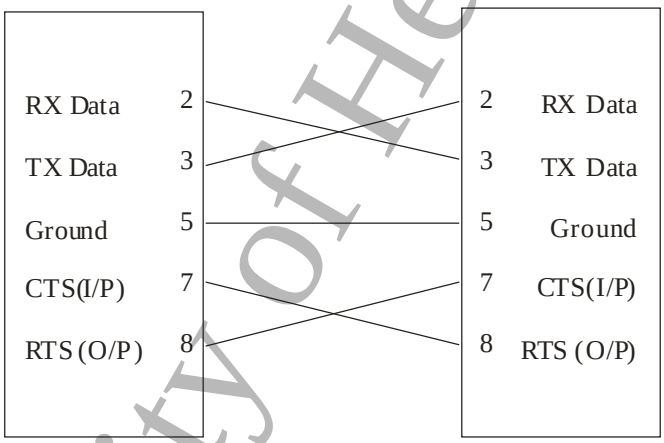

Figure 6.3 Pin Converter

As shown above, a simple hardware development will be conduct by using two RS-232 connector. Male module of each connector will be connected and solder with different color according to above settings. Only 5 major pins were used in this serial link and each of it is identified by using different color wires. This converter will be used to modify the slave module of BlueWave Industrial Wireless Cable into a female connection point for interfacing with LK3 9-pin D-type RS-232 male connector of MC68000 Flight-68K MKII Board and function as same as the master module device.

6.4 Software Development

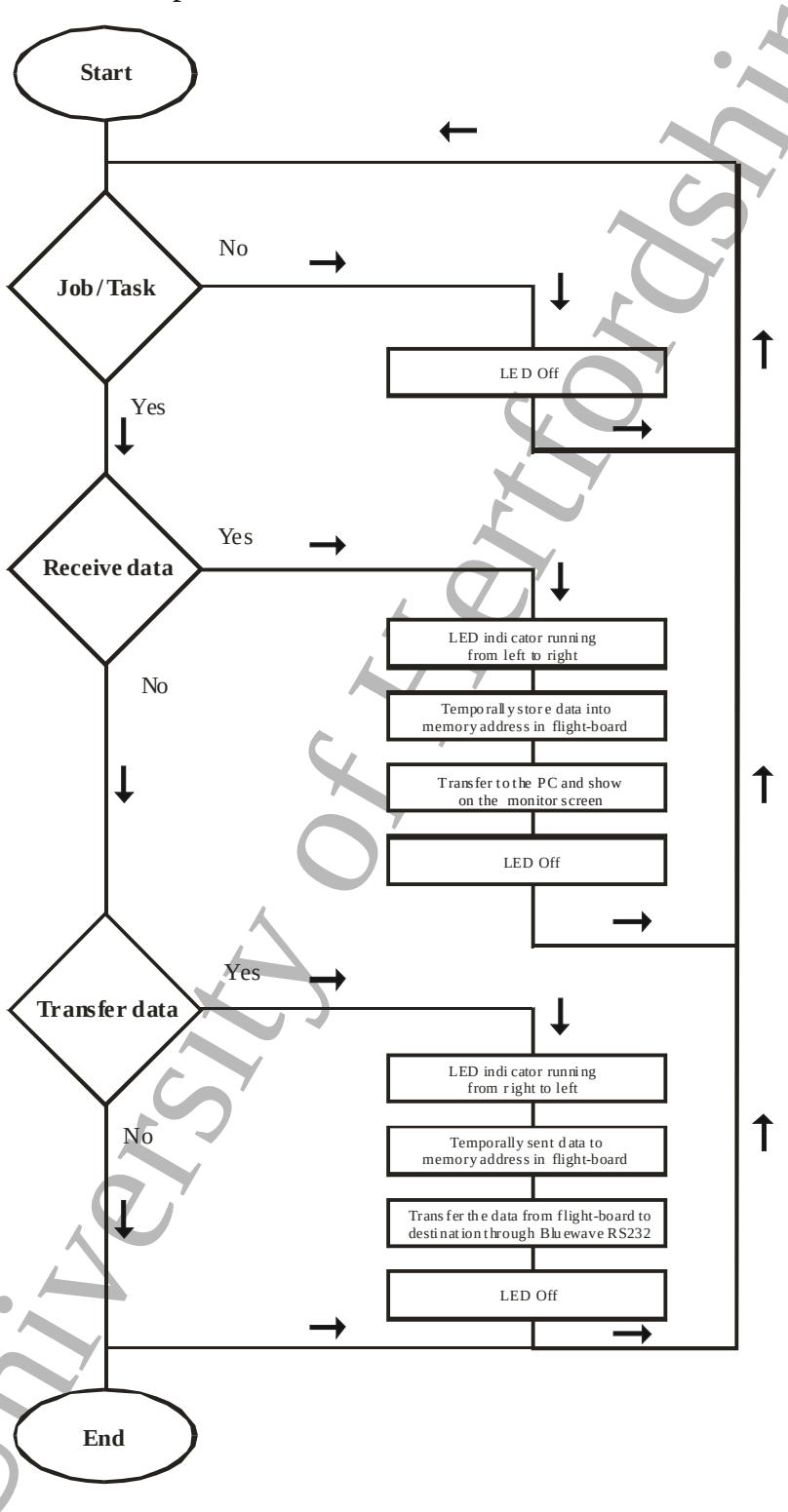

Figure 6.4 Flow Chart of Software Development

According to the flow chart above, the software development for this project will be design and implement according to the three main function below: -

1. To generate a software environment for MC68681 Dual Asynchronous Receiver/Transmitter circuit to operate as a medium of data transmission between host computer and BlueWave Industrial Wireless Cable.
2. To drive the LEDs on switch and light unit of Multi Application board to work as a data receiving indicator by activating the running light from left to right.
3. To drive the LEDs on switch and light unit of Multi Application board to work as a data transferring indicator by activating the running light from right to left.

In order to implement this functions into operations, a series of program has been develop by using C programming language to compile with the original MC68000 programming method. The overall system will be divided into two major part, which is the controlling process of data transmission by MC68681 Dual Asynchronous Receiver/Transmitter device and light indicator by MC68230 peripheral Interface/ Timer device.

6.4.1 Programming on MC68681

The aim of this coding is to provide a direct connection from host computer to BlueWave Industrial Wireless Cable via MC68000 Flight-68K MKII Board. This will establish an asynchronous data transmission to the system thus to control the overall data flowing process.

```
char *MRAPTR    = 0xA00001;
char *MRBPTR    = 0xA00011;
char *CRAPTR    = 0xA00005;
char *CRBPTR    = 0xA00015;
char *OPRPTR    = 0xA0001D;
char *IPCRPTR   = 0xA00009;
char *OPCRPTR   = 0xA0001B;
char *ISRPTR    = 0xA0000B;
char *CSRAPTR   = 0xA00003;
```

```
char *CSRBPTR       = 0xA00013;

#define MRA (*MRAPTR)
#define MRB (*MRBPTR)
#define CRA (*CRAPTR)
#define CRB (*CRBPTR)
#define OPR (*OPRPTR)
#define IPCR (*IPCRPTR)
#define OPCR (*OPCRPTR)
#define ISR (*ISRPTR)
#define CSRA (*CSRAPTR)
#define CSRB (*CSRBPTR)
```

The above commands are program heading, which used to define an register with an appropriate name and to establish the memory location for each register. This is the most important steps and it will effect the overall operations of each register by directing it to the actual memory location. These memory location will have its own interconnection with original processor and will trigger its individual responsible operation when a command is given.

```
main()
{
        MRA = 211;
        MRB = 48;
        CRA = 133;
        CRB = 133;
        OPR = 252;
        IPCR = 15;
        CSRA = 187;
        CSRB = 187;
}
```

The above coding is the main body instruction for MC68681. It will give an initial value to each register to command for different internal settings to each dependable memory location and its operation. With the above command, the MC68681 is set to be: -

- Transmitter is enabling, with each providing a 1 bit stop bit length.
- Receiver is enabling .
- Systems are to be asynchronous to each data transmission.
- Auto configure to the current transmission status.
- Input and output port is enabling.
- Set to sent each data byte as one start bit, following by a eight bits data, begin with the least significant bit (LSB), and then continue with the most significant bit (MSB), and finally ends with one stop bit. There will be no parity during the operation.

Each register are given different off value to represent a special function in the memory status and related controlling operations. Offset value for each register can be change based on the requirement operation of user. It is highly recommend that every single offset value in its individual register should be examined promptly to ensure a successful process is established in communication with other devices.

6.4.2 Programming on MC68230

The aims of this coding are to control the MC68230, which control the multi application board to works as the light indicator in this project.

```
char *PACRPTR     = 0x80000D;
char *PADDRPTR    = 0x800005;
char *PBCRPTR     = 0x80000F;
char *PBDDRPTR    = 0x800007;
char *PBDRPTR     = 0x800013;
char *PADRPTR     = 0x800011;

#define PACR (*PACRPTR)
```

```
#define PADDR (*PADDRPTR)
#define PBCR (*PBCRPTR)
#define PBDDR (*PBDDRPTR)
#define PBDR (*PBDRPTR)
#define PADR (*PADRPTR)

void delay (unsigned char L);
```

As same as MC68681, the above coding is used to set the register for a name with an appropriate memory location. The last command is a function that defines a delay authority.

```
main()
{
        unsigned char count = 255;
        unsigned char L = 10;
        PARC = 0X80;
        PADDR = 0X0;
        PBCR = 0X80;
        PBDDR = 0XFF;
```

Command above will set the Port A data direct register to act as an input port and the Port B data direct register as an output port. This will control the data flow of the operations during the system operating process.

```
while (1)
        {
                delay (L);
                PBDR = count--;
        }
```

The above coding mentioned that, when there is a data transmitting process, the LEDs will be running from right to left in binary form, where data in PBDR will be decrease from 128 to 1, then go back to the original looping of 128 again until the function receive a command to stop.

```
while (2)
        {
                delay (L);
                PBDR = count++;
        }
```

When the condition is 2 indicate there is a data receiving process, the LEDs should be running from left to right in binary form where data in PBDR will be increase from 1 to 128, then go back to the original looping of 1 again until the function receive a command to stop.

```
}

void delay (unsigned char L)
{
        unsigned char E;
        int D;

        for (E=0;E<=L;E++)
                for (D=0;D<10000;D++);
}
```

The function interruption indicates a delay and break in every process of running light system. The greater the value of looping, the fastest the running LEDs will be.

6.4.3 Software setting for BlueWave Industrial Wireless Cable

In order to have a same baud rate as the MC68000 Flight-68K MKII Board, the BlueWave Industrial Wireless Cable need to configure its own setting to operate at 9600 baud, no parity, 8 data bits and with a stop bit. The operation steps below shows the configuration for BlueWave Industrial Wireless Cable: -

1. Connect the BlueWave Industrial Wireless Cable into the COM2 port of the host computer and switch on the device.
2. Open Hyper terminal application and configure it to the original setting of BlueWave Industrial Wireless Cable- 115200 bps, no parity, 8 data bits and 1 stop bits.
3. Type "++++" then enter.
4. Type "AT+BWB=3" to set baud rate to 9600 bps.
5. A message will then return to indicate that configuration was been update successfully.

6.4.4 Summary of Project Development

After all software coding and configuration has been set up, the device will be connected by using the appropriate cable. Application program will be compile, then debug and run. A Hyper Terminal screen will be operates under this condition. When user type in an character in the HyperTerminal application and it appears on both screen of master and slave PC, and the LEDs in Multi Application Board are running accordingly, it indicates that the project was successfully done and the objective of this project is fulfilled.

7. Test Plan and Future Development

7.1 Overview

The aim of this chapter is to introduce several detail investigation plan for this project. It is highly recommended to the reader that the schedule will give a further understand on the overall project operations although it has not been apply due limited time scale. Future development plan are also included for the reader to discover and achieve a higher result in this project.

7.2 Test plan

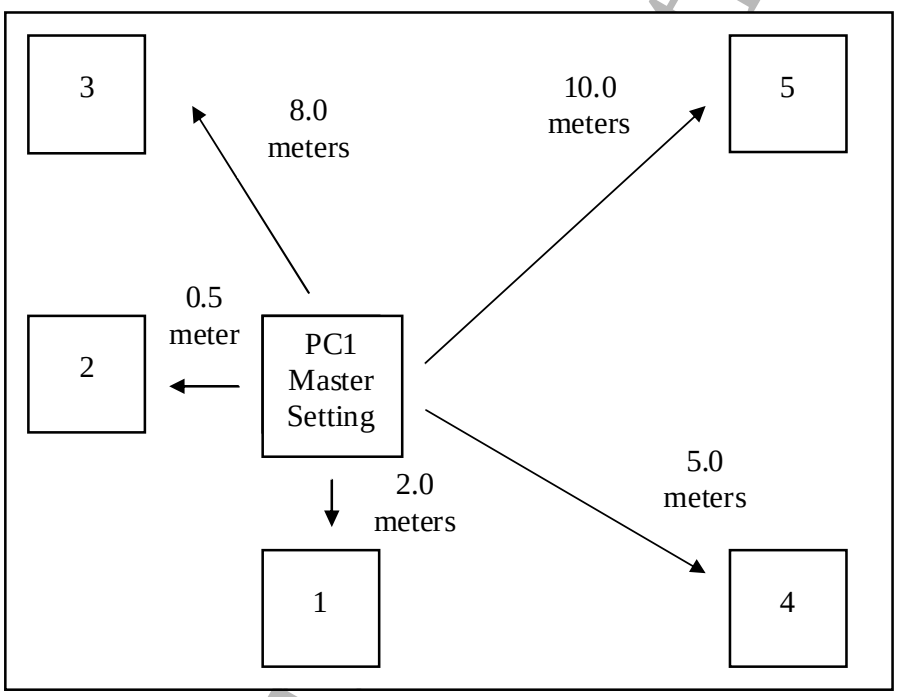

Figure 7.2 Test Plan

The final implementation of the system will be test by using multiple locations on slave module and test for the speed of transferring versus distance. In details, this test plan is used to investigate on the capability of Bluetooth technology on transferring data over certain limited distance without face-to-face connections. Master setting will be positioned at the center of Room LD403, and slave module will be installed according to Figure 7.2 for different distance and investigate the transferring rate for each location.

First, a fix byte size data will be sent from master PC to slave PC. Data will be set according to the user and this data will continuous to be transmitted to slave PC until transmission is complete. These procedures will be repeated again by slave PC to transmit the appropriate data back to master PC for all distance. All evaluation will be scan by using oscillator and details of reading will be record down and form a transferring speed versus distance graph.

Unfortunately, this test plan has not been implement to the actual project system due to the complexity and limited time, and it will goes for continuation by future undergraduate at a later date.

7.3 Future Developments

7.3.1 Setting offset value for registers

Setting up the register in each individual circuit is the most important issue in developing the program operating software. There is an error occur during communication within two PC in the current operating program. This was cause by a failure offset value among the registers and it has not been solve due to the complexity and limited time for trouble shooting. In future, all offset value of register in MC68230 and MC68681 should be check and upgrade, in order to carry out a successful operations and optimum performance.

7.3.2 Increase RAM for MC68000 Flight-68K MKII Board

For future development, the user should expand the RAM to a higher memory status to allow a more effective and speed up process to operate on MC68000 Flight-68K MKII Board. By having a higher RAM on the board, the system will be able to generate more operations for process control system.

7.3.3 Upgrade Original Operations

Original system can be design and upgrade to a higher level of operation system. As it communication between a master slave module, the system can be upgrade into a high

security communication system. The master PC will act as the main security system and all users will be request to enter their identification password on the slave PC and sent to master PC. On the other side, master PC will check all the details of the request user for their background and membership through the data base by using the received identification password and thus to decide whether they are qualified or opposite.

In another future planning, master PC can be act as an automatic calculation system for any system that required high security. In the same manner, user will be request to enter an amount on the screen, and this figure will be received by the master PC. After receiving data, master PC will do a line of calculation according to the amount that has been enter and thus to generate a request computation. When final result is being generate, the user of master PC will then type the result on the screen and sent it back and show on the screen of slave PC.

8. Project Management

8.1 Overview

This chapter will define the detail through out the whole process of project management. It aims to show the steps and level of management and changes or upgrading that occur during the overall route, and in conclusion ends with project documentation.

8.2 Time Management

The whole process development is to be complete within 181 days and it falls into six distinct levels: -

- **Feasibility Study (12 days) -** to set the aim and objective for this project, and to blueprint a systematic plan to drive the process of development.
- **Project Analysis and Information Gathering (38 days)** – involve in effort of analyzing the project system and collecting the necessary information
- **Further Study and Analysis (40 days)** – to have a deep understanding into the internal factors of project hardware and thus to plan the corresponding system.
- **Prototyping (54 days)** – to construct software coding and to finalize all analysis on necessary hardware development.
- **Final Implementation (32 days)** – to unite all hardware and apply an interconnection between al hardware with assembly program, and also to complete the developing process by making appropriate final adjustment and upgrading.
- **Documentation (60 days)** – to finalize all project information into an appropriate report that including all project details and related knowledge, and end up with a conclusion.

The final time management procedure has some minor changes for prototyping, final implementation and documentation caused by the unexpected delay and problem that occur for hardware purchasing. Analysis and coding was only start be done presently due to project hardware was been purchased only during middle of February. All final aims of objective are set to associate with new hardware.

8.3 Task Management

During whole project developing process, each working period has been given several tasks to investigate: -

Project Analysis and Information Gathering

- Basic behavior of Bluetooth.
- The Fundamental of Motorola MC68000.
- TDK Bluetooth USB Adaptor.

Further Study and Analysis

- Coverage of Bluetooth and its application.
- Internal system configurations for Bluetooth interface.
- Motorola MC 68000 and its application.
- Architecture of Motorola MC68000 microprocessor.
- Function and Internal application of MC68000 Flight-68K MKII Board.
- Study and analysis on the function and internal architecture of BlueWave Industrial Wireless Cable (due to change of hardware).

Prototyping

- Developing relevant programming for trial to the MC68000 Flight-68K MKII Board on similar functions.
- Testing the operations of BlueWave Industrial Wireless Cable.
- Developing the actual program for project.
- Essential modification to the MC68000 Flight-68K MKII Board.

Final Implementation

- Applying actual program to the MC68000 simulator board memory.
- Combination between MC68000 Flight-68K MKII Board and BlueWave Industrial Wireless Cable.
- Detailed testing.
- Final adjusting, tuning and upgrading.

Unfortunately, this project management is unable to keep track accordingly due to the delay of hardware purchasing and late delivering of hardware only during middle of February. The whole project management will be shown on 3 different Gantt chart in Appendix A, Appendix B and Appendix C, which indicate the change 3 different hardware and system design. The overall project supervision process was running under a wobbly situation where most of the scheduled process has only been done by the end term of overall process.

9. Conclusion

9.1 Report Overview

In this project report, all related information and also details about the project development and project management was fully describe through out the whole documentation of this project,

First the author has given a guideline to the reader about the aims and objective of this project. A simplified system outline was shown to give a first rough idea about the project system development., and how it is design according to its title.

Continuing with the following chapter, the major technology that will be apply in this project is been introduced. The author has explained in details about MC68000 microprocessor system and its application, the new Bluetooth technology and the RS-232link. All these information will give a user a more understanding and wide thinking to this project.

In the middle part of this project report, the user aims to explain about the project development procedures and project management through out the whole process of project complementation. This is again an important issue for a overall project development and it including all the efforts in designing, implementing and trouble shooting of each individual part of the project.

The documentation stops with an overall project summary that reviews all information of this report. It will again discover about the overall project and ends with a self comment from the author.

9.2 Summary

This project development has been started since middle of October 2002 and it finally comes to the final stage of overall project. During the whole process of project developing, Variety task has been done to research and investigate on the appropriate field in order to collect the required information to design and present a guideline to this project title as 'MC68000 To Bluetooth'. All kinds of problems and changes have occurs during the process of project development and this finally leads a lack of a final demonstration model of the principle. The main problem that the author has face over the whole period is the constant changing, delay of purchasing and collection of the hardware and this all was only be done during middle of February 2003. The objective and aims of the project is keep changing during the whole period to meet the requirement of project and also thus to suite new hardware. This lead a very complex and limited time situation to the author to accomplish this project and go for prototyping.

As a summary of the overall documentation, this project is say to be a great challenging and very encouraging task to a undergraduate student. The overall project will bring the reader and also the author to a world of new technology, with the advance devices. This project have the ability for further expansion and it required to learn, understand deeply and reflects to the world of electrical and electronic engineering.

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