

Design and Implementation of a Wireless Bulletin Board

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ABSTRACT

Bluetooth is an important mean for wireless communication between multiple devices. Bluetooth is intended to support an open-ended list of wireless applications, including data, audio, graphics, and even video transmission between different devices. Therefore demand on Bluetooth will be high since most mobile devices nowadays are Bluetooth enabled. Besides Bluetooth enabled information provision system can be a solution to access information database server and can handle user's data request. This thesis is developed to enable information provision system for data transfer between the laptop and LED screen.

The LED screen is used to show the data that the user wants to display in a fixed or motion manner. The system is designed in such a way that the KC Bluetooth module at the screen side can only receive data from one specific sender.

The operation of transferring data depends on the protocol used in finding the specific device and making the contact between the transmitter and the receiver. The fundamental protocol used in this work is the Radio Frequency Communication (RFCOMM). This protocol is based on a serial communication between the two Bluetooth devices. The software part of the system is concerned with programming the Bluetooth with KC wireless in addition to another user-interface program that is designed for sending messages to be displayed on the LED screen.

Keywords: Wireless Communication, Bluetooth, BX-4A1, Bulletin board.

ÖZ

İki farklı cihaz arasında bilgi, işitsel, grafik ve video formatındaki veri aktarımını içeren bir dizi kablosuz uygulamayı destekleyen Bluetooth, birden fazla cihaz arasında kablosuz iletişimi sağlaması bakımından önem taşıyan bir araçtır. Günümüzün birçok taşınabilir cihazlarının Bluetooth uyumlu olmasından dolayı Bluetooth uygulamalarına olan talep yüksektir. Buna ek olarak Bluetooth uyumlu bilgi sağlama sistemi bilgi veritabanı sunucusuyla bağlantıya geçme ve kullanıcının veri taleplerini karşılama açısından bir çözüm olanağı sunabilir. Bu araştırma dizüstü bilgisayar ve LED ekran arasındaki veri transferini sağlamayı hedef alan bir bilgi sistemi geliştirme amacını taşımaktadır.

LED ekran, kullanıcının sabit veya hareketli bir tarz kullanarak veriyi dilediği şekilde göstermesini sağlar. Sistem, ekran tarafında yer alan KC Bluetooth modülünün sadece belirgin bir göndericiden data almasını sağlayacak biçimde tasarlanmıştır.

Veri aktarımı işlemi belirgin bir cihazı bulma ve verici ve alıcı cihaz arasındaki bağlantıyı kurma işleminde kullanılan protokole bağlıdır. Bu çalışmada kullanılan temel protokol Radyo Frekans İletişimi'dir (RFCOMM). Bu protokol iki Bluetooth cihazı arasında gerçekleşecek bir dizi iletişime dayandırılmıştır. Sistemin yazılım bölümü, Bluetooth cihazını KC kablosuz ve LED ekran üzerinde görüntülenecek mesajları gönderme amaçlı tasarlanan diğer bir kullanıcı arabirimi programı ile programlamayla ilişkilidir.

Anahtar Kelimeler: Kablosuz İletişim, Bluetooth, BX-4A1, Duyuru Panosu.

Words cannot express my gratefulness to my dear family for their care and support,
whose love is the source of my happiness and strength.

To My Family

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LIST OF ABBREVIATION

ACL	Asynchronous Connectionless
ASCII	American Standard Code for Information Interchange
FHSS	Frequency Hopping Spread Spectrum
GUI	Graphical User Interface
GAF	Generic Access Profile
HCI	Host Controller Interface
ISM	Industrial Scientific Medical
IrDA	Infrared Transmission
LED	Light Emitting Diode
LAN	Local Area Network
LMP	Link Manager Protocol
L2CAP	Logical Link Control and Adaptation Protocol
PDA	Personal Digital Assistant
PAN	Personal Area Network
PPP	Point-to-Point Protocol
PC	Personal Computer
QoS	Quality Of Service
RFCOMM	Radio Frequency Communication
SPP	Serial Port Profile
SRW	Short Range Wireless
SCO	Synchronous Connection Oriented
SDAP	Service Discovery Application Profile
SMD	Surface Mounted Device

TDM	Time Division Multiplexer
UART	Universal Asynchronous Receiver Transmitter
WPAN	Wireless Personal Area Network

Chapter 1

INTRODUCTION

For different device connections such as PCs, notebooks and PDAs, smart phones, mobile phones and digital cameras the Bluetooth technology is used for short-range-Wireless vice versa and data link communication with low power supply. Although the range and speed are low, the cost is reasonably cheap, which is considered as a creation of Wireless personal area network (WPAN). Therefore, the Bluetooth is almost in contact with most of the electronic devices surrounding a user, regardless of the location [1-10]. With a drastic development, Wireless communication has recently entered many applications, for example; the Wireless electronic bulletin boards used in many places such as in crowded cities, hospital, universities, governmental offices and upper markets, etc.

Wireless communication also helps users transferring necessary long-distance information, especially when the normal wire connected electronic bulletin board fails in transferring information to a user because of its limited distance of location due to high cost in addition to other technical difficulties. Therefore, Bluetooth technology was the proper solution for many reasons such as its low price, less power consumption and long covering distances depending on the power of the Bluetooth on its performance and its feasibility in connecting different electronic devices.

The suggested project in this thesis is for supplying a Wireless electronic bulletin board with information needed for users in universities, bureau, businesses, marketing.....etc. The application consists of two parts, a client and a server. The GUI in the client is designed to enable the user to send data easily. The GUI has many options, of the most important choice that the messages that need to be sent frequently saved in the form of a database, as well as these messages can be changed as needed. The GUI can also determine the time of the survival data shown on the display by selecting the time and send it by the GUI. In addition, it can determine how data display is fixed, moved or flashed....etc.

While on the server side, a circuit is interfaced between the Bluetooth, the BX-4A1 control and the LED screen. The Bluetooth is associated with the BX-4A1 control by using a serial port, and the BX-4A1 is associated with the LED screen by using a parallel port as shown figure 1.1.

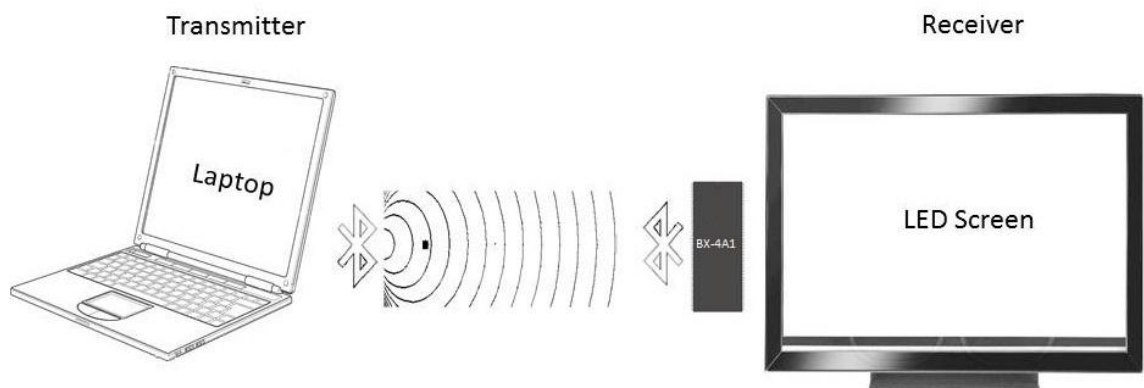


Figure 1.1. The transmitter and server set up

The Transmitter side consists of the following parts:

- Graphical User Interface (GUI): It is designed to enable the user to send data easily. There are many options in the GUI, of the most important choices that the messages that need to be sent frequently saved in the form of a database, as well as these messages that can be changed as needed. It can also determine the time to the survival data shown on the display by selecting the time and send it by the GUI, in addition determining how data display is fixed, moved or flashed.
- Bluetooth in Laptop (sender): The Bluetooth is built with a computer. At first, Bluetooth starts searching to find another Bluetooth, then after finding the receiver Bluetooth, it establishes a connection and starts to send data to be displayed on the screen.

Also the Receiver side consists of the following parts:

- Bluetooth Reception: Bluetooth data use class2 for micro model. The KC-22 data modules come standard with KC Wireless which includes support for serial port profile (SPP). The SPP is a very popular widely used profile for transmitting data in place of a serial cable.
- BX-4A1Control: The BX-4A1 is used as the interface between Bluetooth's receiver and LED screen because the Bluetooth is a serial port, and the LED screen is a parallel port. In addition, it is used to convert the received data from binary to character and then displayed on the LED screen.
- LED Screen: is used to display the data sent by the user via Bluetooth. We have chosen the LED screen because it's cheaper than other kind of screens

like LCD. In addition to that, it has high resolution. The chosen screen can display short message of about 4 or 5 words (depending on the number of characters on each word).

The system is inexpensive in price as well as its high performance in terms of security and user friendly. Therefore, the fundamental principles for such system are described as follows:

- 1- Low Cost: The building structure is of low cost, which is the main reason in Bluetooth's selection, also the electronic screen is of low price too and can be able to execute for the used purpose in any laptop computer.
- 2- More user friendly: The distinguished characteristic of the proposed system, since the user can read the information shown on the screen by directly looking into the person's eye only without doing anything else.
- 3- Security: Security is taken highly into consideration when executing this system, since there will be no entry by user side unless by entering the username and password. As Bluetooth can interact with any device containing Bluetooth, a receive program is prepared to receive the data from a specific Bluetooth, so that the displayed data is controlled by one operator person only.

1.1 Objectives

The general objective of this thesis is to design and implement a Wireless electronic bulletin board.

1.2 Thesis Outline

The outline of this thesis is organized in the following way: Chapter 2 covers general information about Bluetooth, the background and related work. Chapter 3 contains a detailed description of our system design and architecture. Simulation results and

discussion are in chapter 4 and finally chapter 5 covers the conclusion and future work.

Chapter 2

BACKGROUND

Due to the present technology development, especially in the field of communication and Wireless network, a lot of applications appeared for the facility of our daily life needs. Such applications include using the electronic screens for Wireless advertisements as a substitute of using normal papers fixed on advertisement board, which is an inefficient cultural habit in addition to be against a clean environment. As engineers we are focused to think of substitute solutions to let information be noticed by others. Furthermore, using such methods spread information all over places such as universities, libraries, banks, supermarkets, and etc. The main purpose is to provide the people with suitable information necessary and important in their lives. For example, in the university, it lets the students know about the data and time of their examination, or any other information they need as students.

2.1 Bluetooth Technology

Wireless communication is expected to be growing day after day avoiding difficulties in wire or cable connection for connecting different electronic devices such as PCs, notebooks and PDAs, smart phones, mobile phones and digital cameras. The Bluetooth is a short-range-Wireless, reliable, low-cost and power-efficient technology without the need of wired networking (figure 2.1) [10].

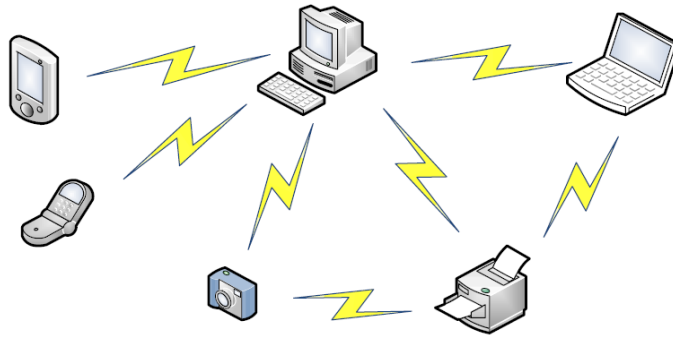


Figure 2.1. Bluetooth ad hoc network [10]

Although the range and speed are low but cost is reasonable, the Bluetooth is almost in contact with most of the electronic devices surrounding a user regardless of the location. Modern customer marked demands are for personal digital assistants (PDAs), also other devices such as mobile phone, digital camera, and laptop. Clearly such devices must be provided with high power with a short-range way for communication or data exchange between each other. Furthermore, an access is needed to be connected with printers or local area network (LAN). It is known that communication ways can be by cable, radio links or infrared link as shown in figure2.2. In addition it is well known that each type has its own advantage or disadvantage.

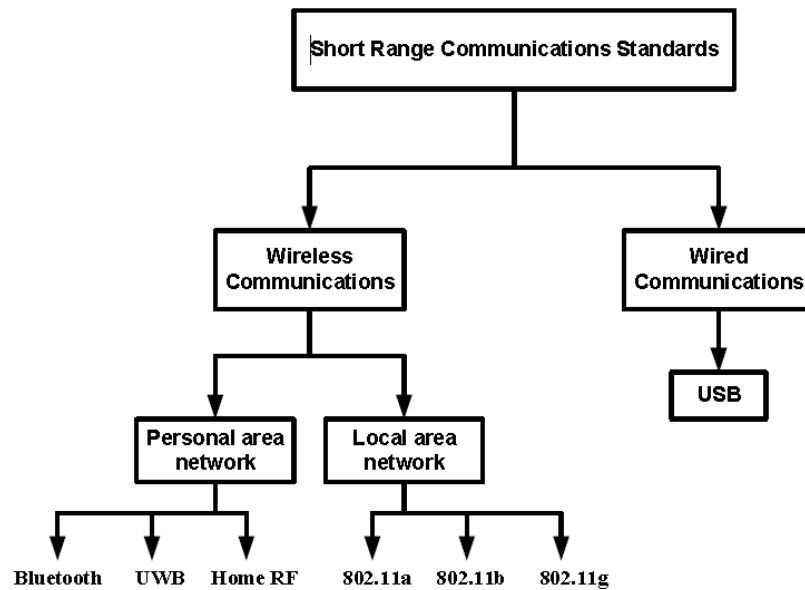


Figure 2.2. short range communication standard [9]

For fast connection, the infrared transmission (IrDA) is equivalent USB due to its point-and-shoot characteristics. Its application can be at a rate of 16 Mb/s for high performance ad hoc point-to-point connection. Applications include downloading of pictures from the camera to the laptops or paying money by the mobile phone via IrDA port, which exist for a long time using laptop, computers and PDAs with high cost. An alternative method for indoor use over short distance is Radio-based short-range-Wireless (SRW). Communication is fast (tens or hundreds of megabits per second), in addition to the lower cost without using the cable. The power in SRW does not exceed more than a few microwatts up to milliwatts with communication range from 10 to 100 meters. Furthermore, it makes connection available to portable devices like laptops, PADs, cell phones and etc. The two main methods of short-range-communication sharing each other away are: personal area network (PAN) and local-area networks (LAN). The technology that is not expensive, but with low power with low range and speed in the Wireless PAN type, with applications under 10 meters, replacing a component call USB [9].

Bluetooth and home RF are for short range Wireless communication. They can transmit data through nonmetal materials of in the range of 10m to 100m at rate of 720Kb/s (raw data rate in 1Mb/s). Because of the radio nature, the power may go up 100m for a point to multipoint communication system for two devices or hoc for several devices, but it can be concluded that Bluetooth application for single or multiple connection of data exchange at reasonable speed is the best solution where mobility is a key requirement [12][9].

2.2 The Bluetooth architecture/ protocol stack

All devices in Bluetooth communication use the protocol stack. Figure 2.3 shows the principle of the architecture

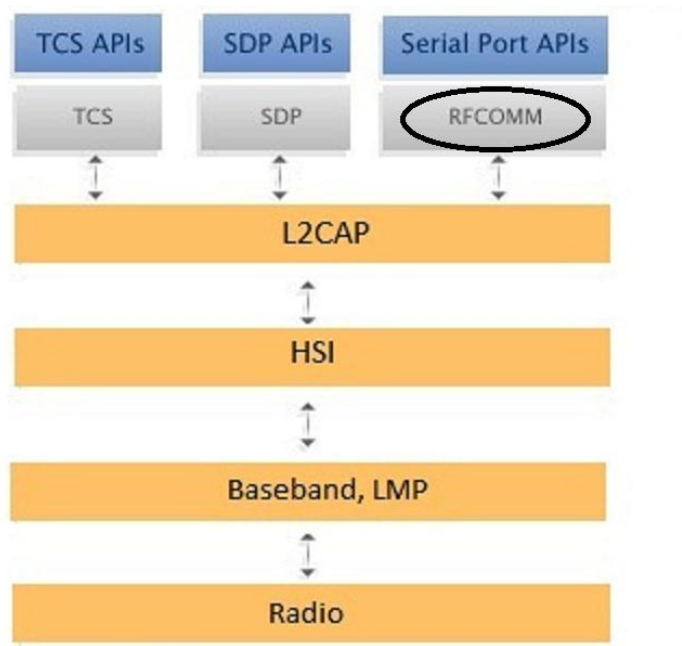


Figure 2.3. Bluetooth protocol procedure view [4-5]

The radio layer defines the Wireless connection where the 2.4GHZ frequency band is divided in to 79 channels (from 2.402 – 2.480 GHZ) with 1 MHZ apart to be able to hop between channels in a speed of 1600 time per second. Noting that the wave

length varies from 10m to 100m, when the power of the transmitter is increased, the length is increased up to 100m. It is clear then that every baseband layer is controlled and sends data packets over the radio link to provide data and voice transmission channel, while the baseband layer maintains synchronous connection oriented (SCO) links for voice which cannot be transmitted and asynchronous connectionless (ACL) links which insure data integrity. The link manager protocol (LMP) is for connection security and monitoring of quality service. The host controller interface (HCI) function is for dividing software and hardware which connect both components L2CAP and LMP but the L2CAP is for software only adapting Bluetooth format application and the lower layers are for hardware. The RFCOMM protocol provides roughly the same service and reliability guarantees as TCP. Although the specification explicitly states that it was designed to emulate RS-232 serial ports (to make it easier for manufacturers to add Bluetooth capabilities to their existing serial port devices), it is quite simple to use it in many of the same scenarios as TCP. The biggest difference between TCP and RFCOMM from a network programmer's perspective is the choice of port number. Whereas TCP supports up to 65535 open ports on a single machine, RFCOMM only allows for 30 [4-5]

2.3 The Bluetooth profile

The goal of defining profiles is to allow two devices from different manufacturers to work together, such as a PDA and a printer. A profile specifies a list of mandatory and optional features that a device should implement.

It also specifies the communication procedures to guaranty interoperability between different kinds of products (figure 2.4).

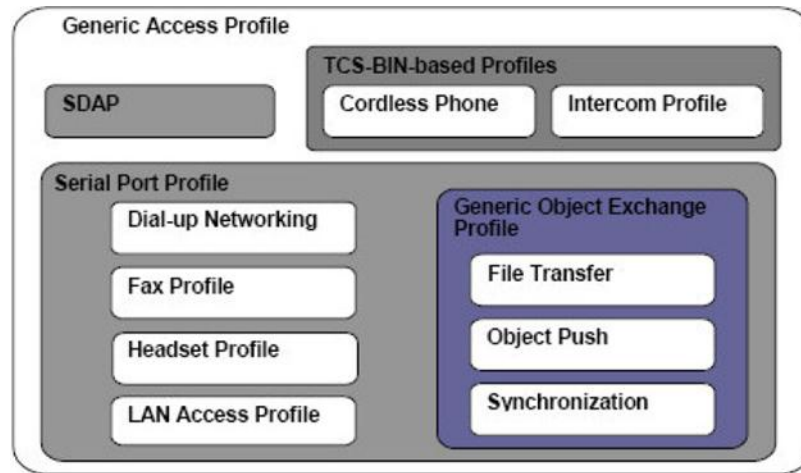


Figure 2.4. Bluetooth profile [4-5]

For defining the connection way with link management and device discovery the generic access profile (GAP) is used for defining the use of the lower layers of the protocols LC and LMP. For describing the characteristics for new services or services information or for service discovery application and profile SDAP is used. Connection is established using serial port profile (SPP) [4 - 5].

2.4 Bluetooth operation

In Bluetooth one of the devices named as master starts the link while the other(s) is/are slave(s). The network is defined as a piconet and if there is only one slave it is called point-to-point while if there are more slaves (up to seven) it is called point-to-multipoint. Slaves can not communicate with each other and participant cannot transmit simultaneously avoiding traffic jams. Piconet is distinguished if a Bluetooth device is a slave in more than one piconet or a master in one and a slave in another, in this case piconet is called scatter nets configuration (figure 2.5) [9].

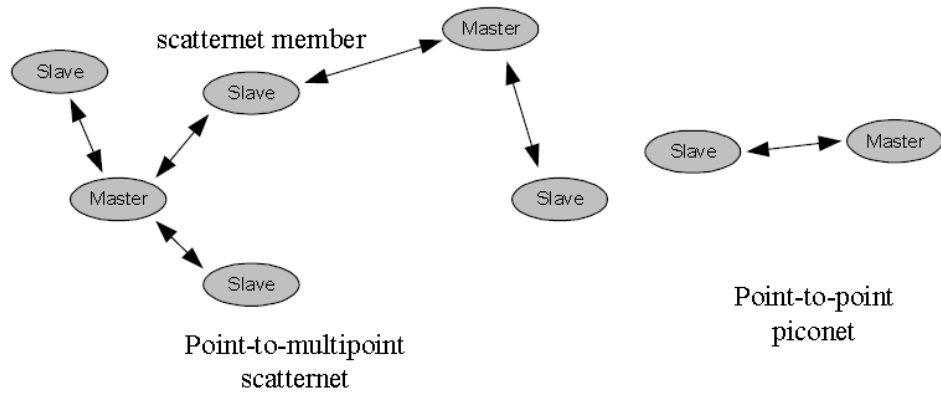


Figure 2.5. Different Bluetooth technologies [6]

The basic piconet channel is divided into a number of times (full duplex channel) with slot related to RF hop frequency. The master transmission of packets in slots with slaves for odd numbered time slot (figure 2.6) [6].

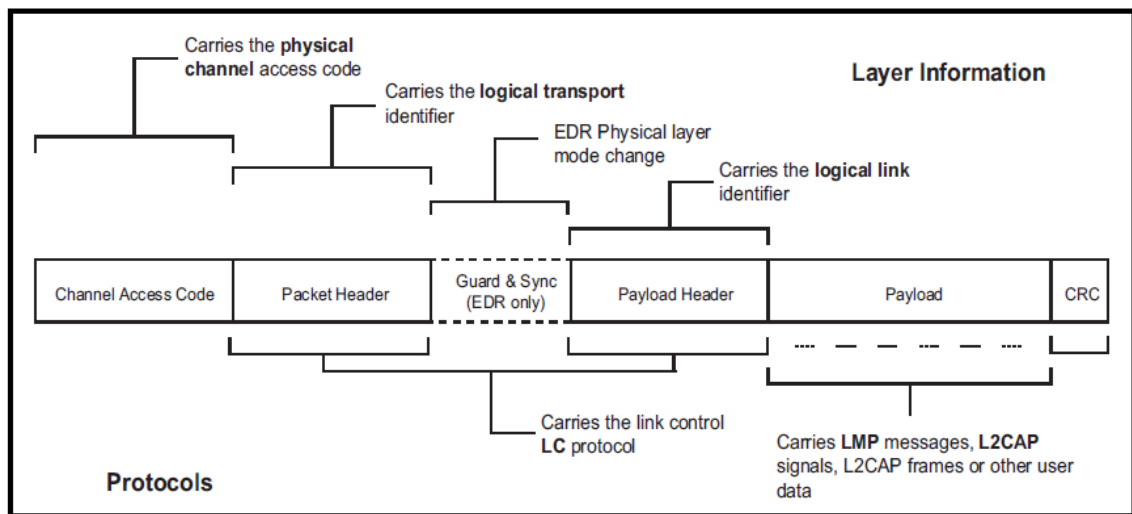


Figure 2.6. Bluetooth packed structure [6]

2.5 Radio Technology

As mentioned before Bluetooth uses 2.4GHz unlicensed frequency industrial-scientific-medical (ISM) band ranging from 2.402-2.480, which is divided into 79 channels with 1 MHz spacing that can be represented by the following formula:

$$f_k = (2.402 + K) \text{ MHz}$$

2.1

Here, K is the channel number within the range of 0 to 78. In case of connection radio, transceivers use the FHSS approach to hop from one channel to another at the rate of 1600 hops/s, which represent the time-slot length which is 625 μsec in every channel that matches a hop frequency allowing less interference with other devices working simultaneously at the same time. When interruption occurs, the devices resend the packet on a different channel. Both synchronous connection oriented (SCO) links, and asynchronous connections less (ACL) links can be defined by Bluetooth. The first provide a quality of services (QoS) guarantee, while the ACL link provides error-free transmission of data through which a loss, or erroneous, packet will be re transmitted, but without a QoS guarantee.

The Bluetooth specification supports the full duplex communication, with slotted time division multiplexing (TDM) protocol for processing both data and voice transmission which is Omni-direction. The radio wavelength range depends on the device class. The most mobile devices are class 2 with a 10 meter range, while the industrial type is class 1 devices with a 10-100meter range. The Bluetooth version 1.2 has data rate of 1 Mbps, but for version 2.0 + EDR device is 3 Mbps therefore the Bluetooth deals with small devices at a slower speed for 100 m range and poor for transmitting large files [10].

5.6 Related Work

Due to the advantages of Bluetooth-based on Wireless networking, applications spread quickly and in large scales for research work is published in this area. Some of these applications are highlighted briefly in this section as follows:

Application to locate shops via Bluetooth, Since it is difficult to locate a shop in a large shopping center instead of putting signs and symbols and screens for an announcement by the shop owners to help shoppers find specific shops easily. However, in most cases, this method fails to provide information to customers and either they be fixed in a specific place, or it fails for some other reasons. To solve this problem, one might provide information in a certain manner using advanced technology by Wireless communications using Bluetooth. Where there is a database that can communicate with Bluetooth's server which in turn communicates with the mobile user and providing the information that is needed by the customer. Such method is published by authors of reference [4].

Application started in 2004 for file transfer profile, that makes you feel comfortable when you are connected to your company's network or send/receive email while waiting in the doctor's clinic office, having your car serviced, or even travelling around the globe. All these are achieved by the development of an application implementing a Bluetooth profile. The application chosen is by Network Neighborhood, which implements the File Transfer Profile. This profile specifies a client-server type of application. The server makes itself available to other devices, accepts incoming connections and allows basic file transfer operations. To find the device with the corresponding service client should make a connection and allow the user to push-pull and manipulate the necessary files on the server, and should be able to inter-operate with other applications. Such application was contributed by Marcus and Erik [5].

Traffic safety is one of the outstanding Bluetooth technologies, that save lives and reduce accidents on the roads, where modern streets are crowded with cars, and large vehicles. So it was necessary to design and build Wireless communication system,

which can serve as a traffic safety where information is transferred through the Wireless communication devices installed inside a cell phone on the road inside the vehicle using Bluetooth's technology. This system can be considered as one of a variety of applications at the moment in the traffic safety measures, that was implemented by Bean Duane [6].

To substitute the classical way for advertising or announcing information in public places, this thesis provides a method by using Wireless electronic screen board due to its economic, efficiency, modernity and highly reliability in practical use.

Chapter 3

SYSTEM DESIGN AND IMPLEMENTATION

In this chapter a description of the procedure and required steps will be explained to fulfill the aim of the thesis. A Detailed description is made for the system with endorse information that can be shown in three divisions which are: Architecture, Hardware and Software as follows:

3.1 Architecture

The system structure is one of the most important subjects. This structure plays a main tool for putting all the different system parts together. In addition to that, it reflects the possibility of executing the system function at different levels. The construction of the design includes different levels that encourage for future expansion and make maintenance easier for application. Therefore, the design for this system applied for two parts, the client and the server parts.

3.1.1 The Client Part

This part is responsible for providing the connection with the server part, through the Bluetooth serial port. In this application, the Bluetooth serial port is used as joint connecting between the client and the server. In general, the duty of the Bluetooth in the client part is to search for the Bluetooth existing in the server and initiating the order for constructing the connection. When connection is accepted by the Bluetooth present in the server, the client starts transmitting data to be displayed on the LED screen. To help the user control the system in an active and efficient manner, the cli-

ent is designed to be one of the desktop applications and to be the user front interactive.

3.1.2 The Server Part

This part is responsible to accept the connection with the client part through the Bluetooth serial port as described before. After that the server will receive messages sent from the client then display it on the LED screen.

3.2 The Hardware

The chosen Bluetooth was from KC wireless company for microelectronics. This is because the KC Wireless Bluetooth piece is efficient and easy to use. Part of the Hardware represents the server that is composed of three parts. These are: KC Wireless Bluetooth and BX-4A1 control in addition to the LED screen, all of them are connected together.

3.2.1 The Bluetooth Module

KC Wireless Serial firmware is a fully embedded RS-232 serial cable replacement application that provides point-to-Point wireless communication and control between two Bluetooth devices using the Serial Port Profile (SPP), or Dial Up Networking Profile (DUN). This document describes major modes of the firmware, and a detailed reference for every command.

KC Wireless Serial embedded Bluetooth Serial Port Profile firmware application is designed to operate KC Wireless Bluetooth Hardware modules using an easy to operate at style text command interface. Devices deploying KC Wireless Serial firmware are designed to operate as a standalone wireless solution, and does not require a host controller. No additional software or drivers are required if connected to a personal computer or microprocessor controller device.

KC Wireless Bluetooth devices using KC Wireless Serial are 100% compatible with and qualified as standard Bluetooth Serial Port Profile (SPP). KC Wireless Serial can communicate with any Bluetooth qualified devices that supports Bluetooth SPP. The KC Wireless serial Bluetooth is depicted in figure 3.1 [12].

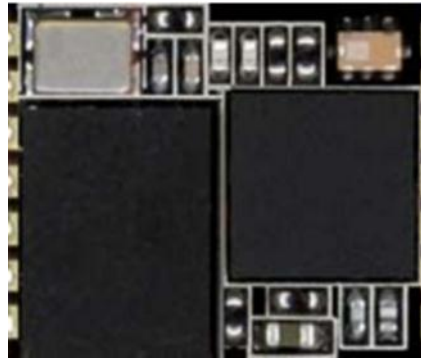


Figure 3.1. KC Wireless serial Bluetooth [12]

3.2.2 BX-4A1 Controller

BX-4A1 serial communication mode, cheap and easy to operate, widely used in all kinds of Medium and small size of LED display. The BX-4A1 is depicted in figure 3.2 [13].



Figure 3.2. BX-4A1 [13]

3.2.3 LED Screen

A LED screen is a video display which uses light-emitting diodes. A LED panel is a small display, or a component of a larger display or screen. They are typically used outdoors in store signs and billboards, and in recent years have also become com-

monly used in destination signs on public transport vehicles. LED panels are sometimes used as form of lighting, for the purpose of general illumination, task lighting, or even stage lighting rather than display.

There are two types of LED panels; conventional (using discrete LEDs) and surface-mounted device (SMD) panels. Most outdoor screens and some indoor screens are built around discrete LEDs, also known as individually mounted LEDs. A cluster of red, green, and blue diodes is driven together to form a full-color pixel, usually square in shape. These pixels are spaced evenly apart and are measured from the center to center for absolute pixel resolution.

Most indoor screens on the market are built using SMD technology which is a trend that is now extending to the outdoor market. An SMD pixel consists of red, green, and blue diodes mounted on a chipset, which is then mounted on the driver PC board. The individual diodes are smaller than a pinhead and are set very close together (figure 3.3) [14].

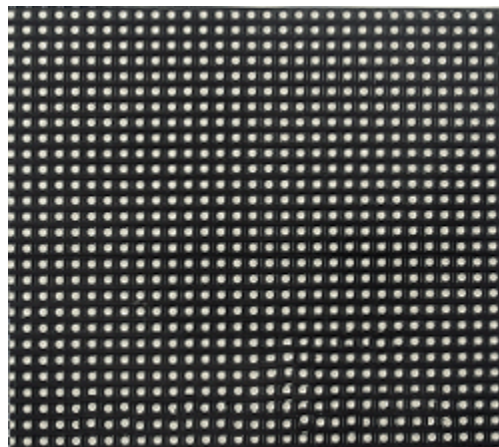


Figure 3.3. LED screen using SMD technology [14]

3.3 The Software

To let the system really exist, different tools were used with different programming languages such as using KC Wireless program and Visual Basic as explained below.

3.3.1 KC Wireless

This program is used to adjust the Bluetooth preparations before using them in the operation of data transmission. In addition, this program is used to construct the connection between Bluetooth existing (computer's Bluetooth and the KC Wireless Bluetooth).

3.3.2 Visual Basic

It is a programming language from Microsoft Company. This language was used due to it being easy and commonly used. The GUI is designed using this language that serves as an interface for the user to send messages to be displayed on the LED screen. The following flow charts explain how the program operates (figure 3.4),(figure 3.5).

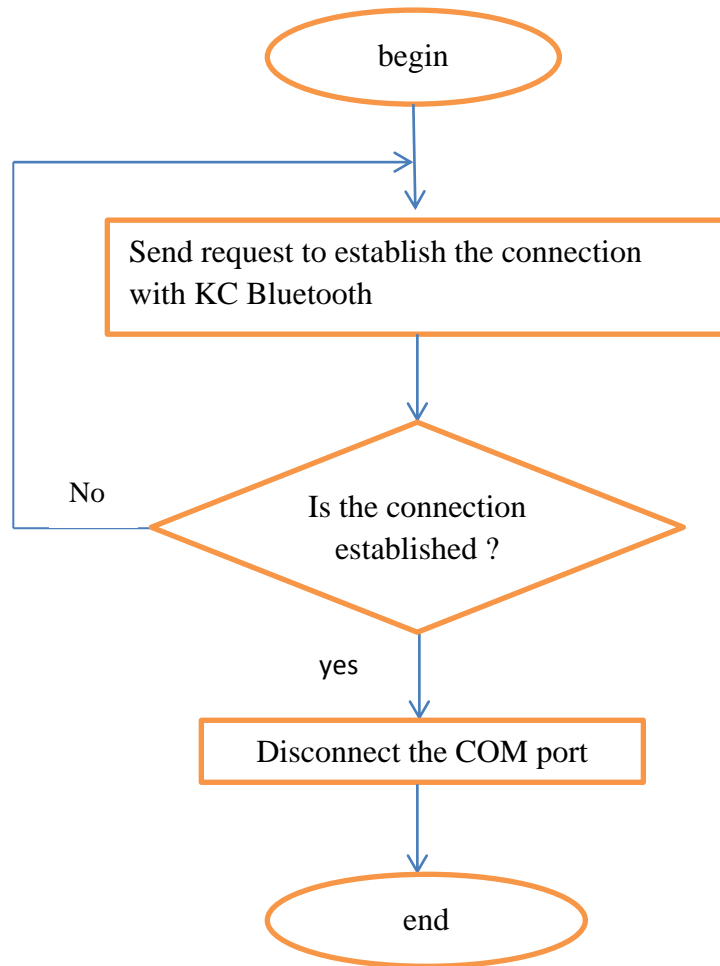


Figure 3.4. Flow chart for connection set-up

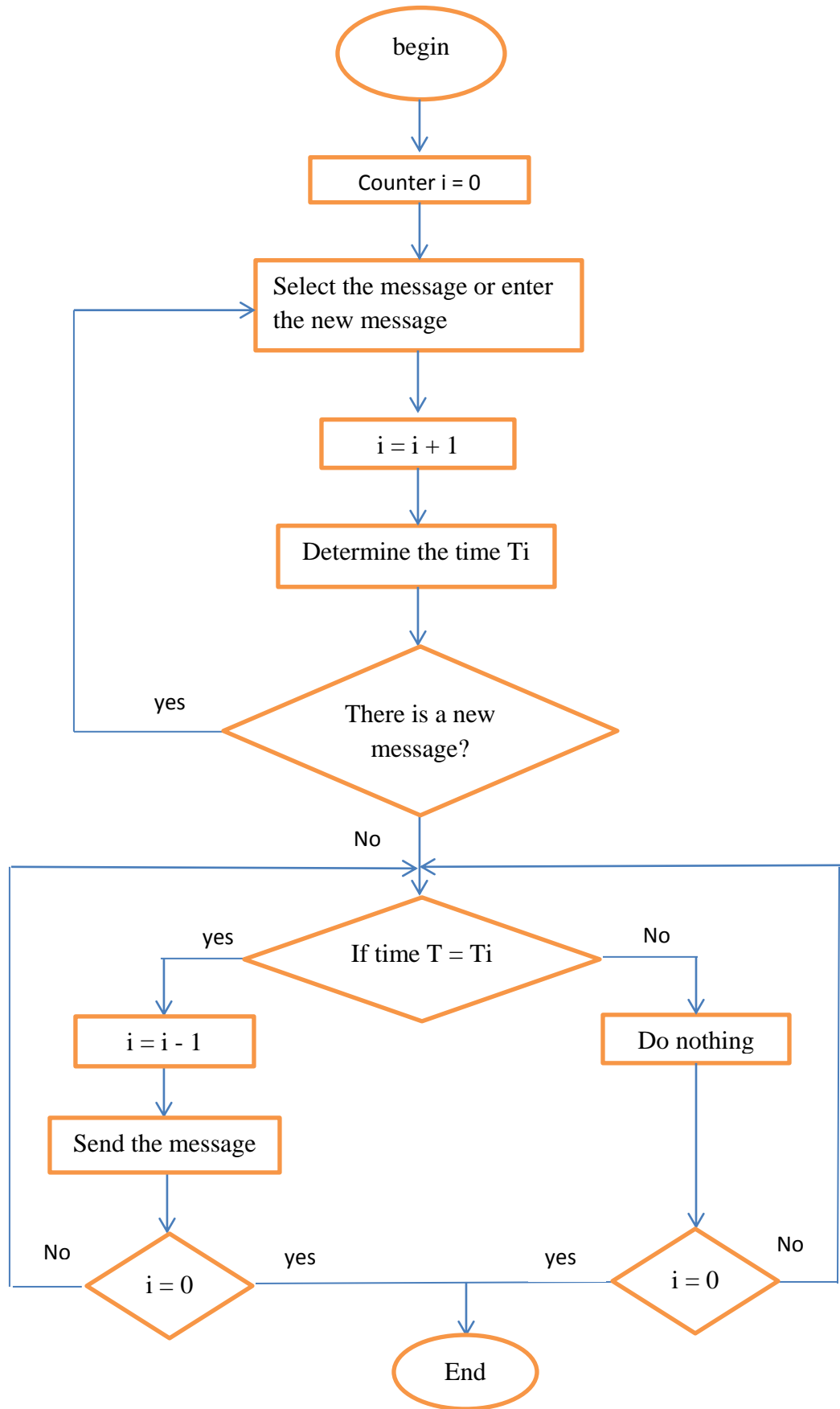


Figure 3.5. GUI flow chart

3.3.3 Getting Started

For the first Bluetooth programming operation (when it was just manufactured but not programmed) the programming will be executed via cable using the KC Wireless program. Once connected, cycle the power of the KC wireless module, and a startup message will be seen.

AT- ZV -CommandMode-

AT- ZV BDAAddress 00043e3861ef

With KC wireless program the VERSION button can be clicked to send a version command.

AT+ZV Version

AT- ZV kcSerial v2.4 (Build xx)

Bluetooth devices can now be discovered which are in discoverable mode by clicking on the DISCOVERY button in KC wireless program.

AT+ZV Discovery

AT- ZV InqPending

AT- ZV DiscoveryPending 2

AT- ZV Device 0c6076a62849 "TIPA - PC" all COD=0x0

Now, an attempt can be made to make a SPP connection to a device (if provided it supports the SPP profile).

AT+ZV SPPConnect 00043e3861ef

AT- ZV ConnectionUp

AT- ZV -BypassMode-

Now, it is in Bypass Mode and any data which is sent into the UART will appear on the remote units' UART, and vice versa. Bypass Mode operates as a wireless serial

cable. Once it is in Bypass Mode, it may decide whether we want to issue another command (possibly to close the connection). To accomplish this, a special sequence of characters called the Escape Sequence must be sent (no carriage return or linefeed needed) to get you back into Command Mode. In order to do this, send these 6 characters [Hex: 5E 23 5E 24 5E 25]:

3.3.4 Modes of Operation

3.3.4.1 Command Mode

The Command Mode is the default mode when wireless is not connected. This interactive mode accepts all KC wireless operational, configuration and control commands which are received from the local device's UART port in an ASCII text format. Extensive list of AT style text commands are available for execution in Command Mode. Connections can be initiated from this mode. Command Mode can also be used while wireless is not connected. A special Escape Sequence must be sent while in Bypass Mode in order to switch into Command Mode when there is no wireless connection. A simple AT command (AT+ZV Bypass) will switch the device back to Bypass Mode.

3.3.4.2 Bypass Mode

The Bypass Mode is the default mode when there is no wireless connection, allowing completely transparent data traffic between Bluetooth's devices. In this data-transfer mode, AT Commands will not be recognized or executed. All UART input is simply transmitted as data bytes to the remote device.

3.3.4.3 Remote Command Mode

Remote Command Mode is a unique and powerful remote control mode only available from KC wireless. Any serial Bluetooth device can send our AT commands without wireless to a remotely connected KC wireless device. Once a wireless con-

nection is established, the Remote Command Mode escape sequence can be sent to a remote KC wireless device, where it will switch into Remote Command Mode (if enabled). The Remote Command Mode is similar to the Command Mode, except that the AT commands are received wirelessly and executed by the remote KC wireless device. Response messages and readings from the remote KC wireless device are transmitted wirelessly to the local unit issuing the commands. A simple AT command (AT+ZV Bypass) can be sent and the remote device will switch back into Bypass Mode. The local device must be in Bypass Mode or a similar transparent data-transfer mode; so that the AT command strings are sent wireless to the remote KC wireless device without local interpretation or execution.

3.3.5 The Bluetooth adjustment preparations

After finishing the operation of the Bluetooth programming for the first time, using the cable and making it back up the serial port profile (SPP) characteristic as explained before, preparations should be started for it to work without using the cable (wireless). Using KC wireless program will be explained in the following steps:

- 1- The Bluetooth will be transferred from the Bypass mode to the remote common mode by the command ~~~~3 so that the Bluetooth is able to receive the data and interact with it as executed commands but not as displayed data. (figure 3.6)

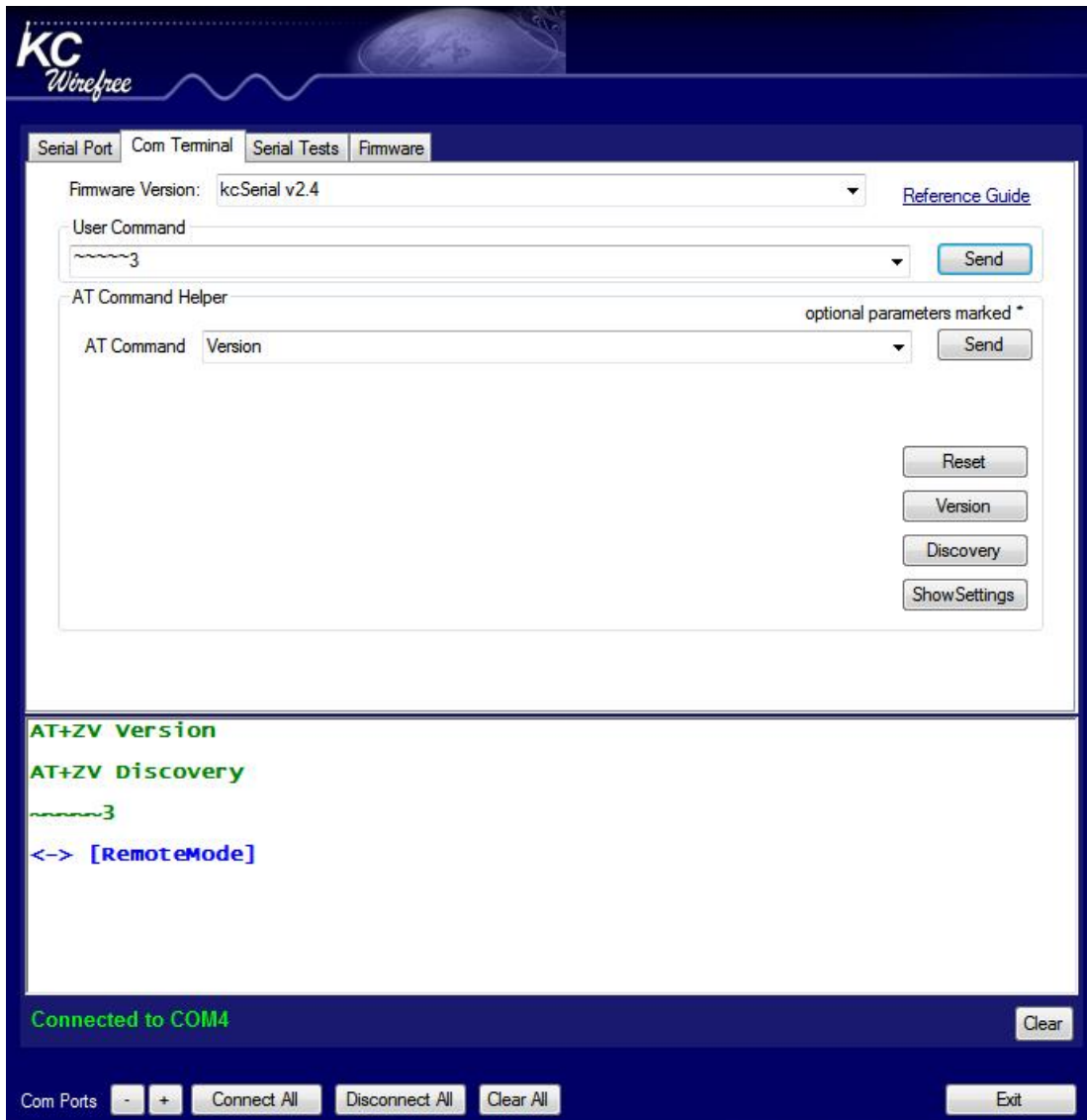


Figure 3.6. The transfer from Bypass mode to remote mode

- 2- The Bluetooth baud rate is changed into 57600, so that it agrees with the LED screen baud rate through the change in baud command (figure 3.7).



Figure 3.7. Determination of the baud rate

- 3- By using the discovery command the KC wireless Bluetooth will display the instruments that contain Bluetooth and display their physical address (figure 3.8)

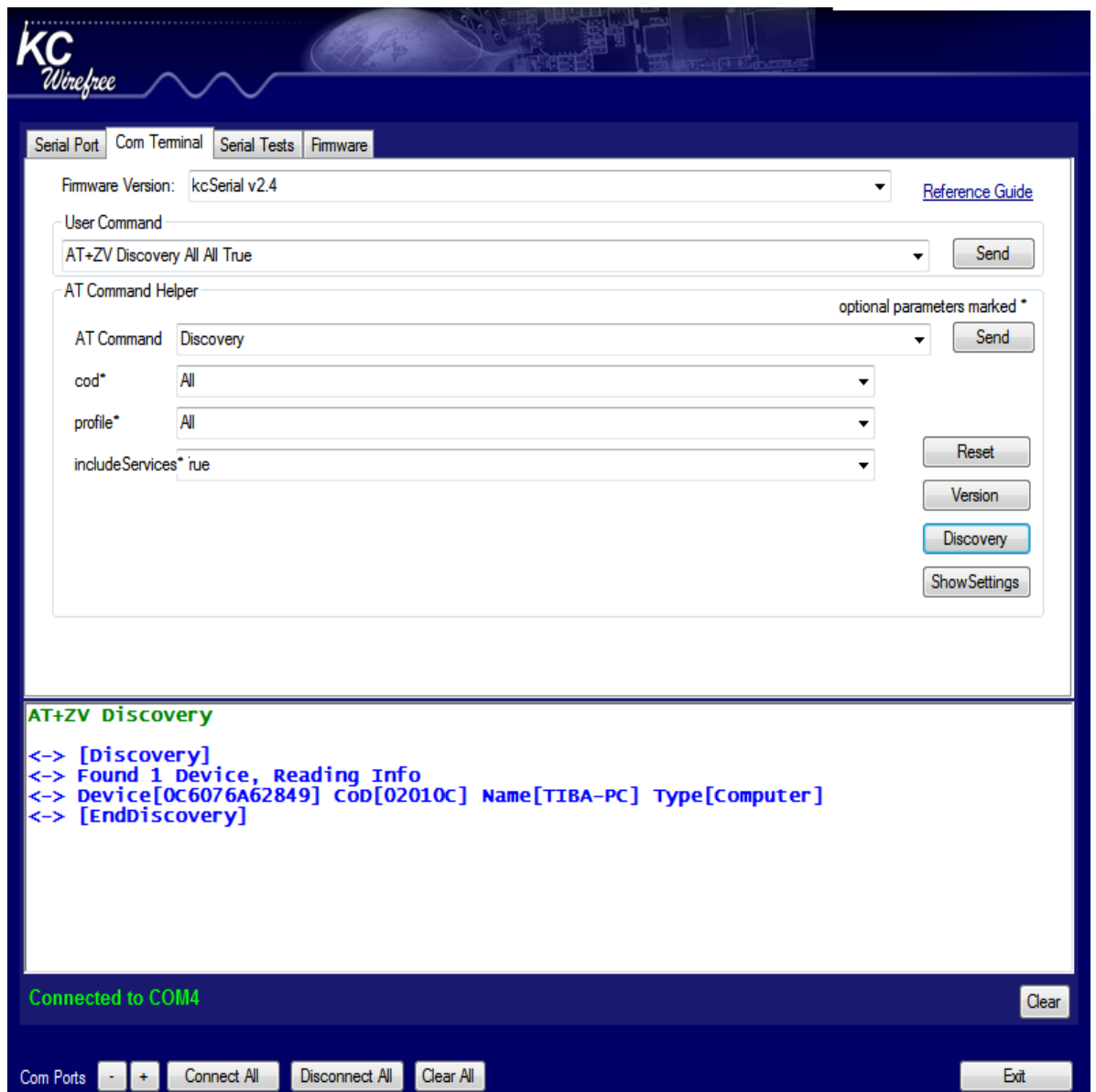


Figure 3.8. Finding another Bluetooth devices

- 4- For the smart cable setup command the KC wireless Bluetooth is programmed for receiving not only from a specific computer by taking the Bluetooth physical address that can be received from but also putting it on the AB address zone, with limiting the number of trials to be sure of doing connection between the KC wireless Bluetooth and the computer Bluetooth via the attempted zone and the duration time via the time zone (figure 3.9).

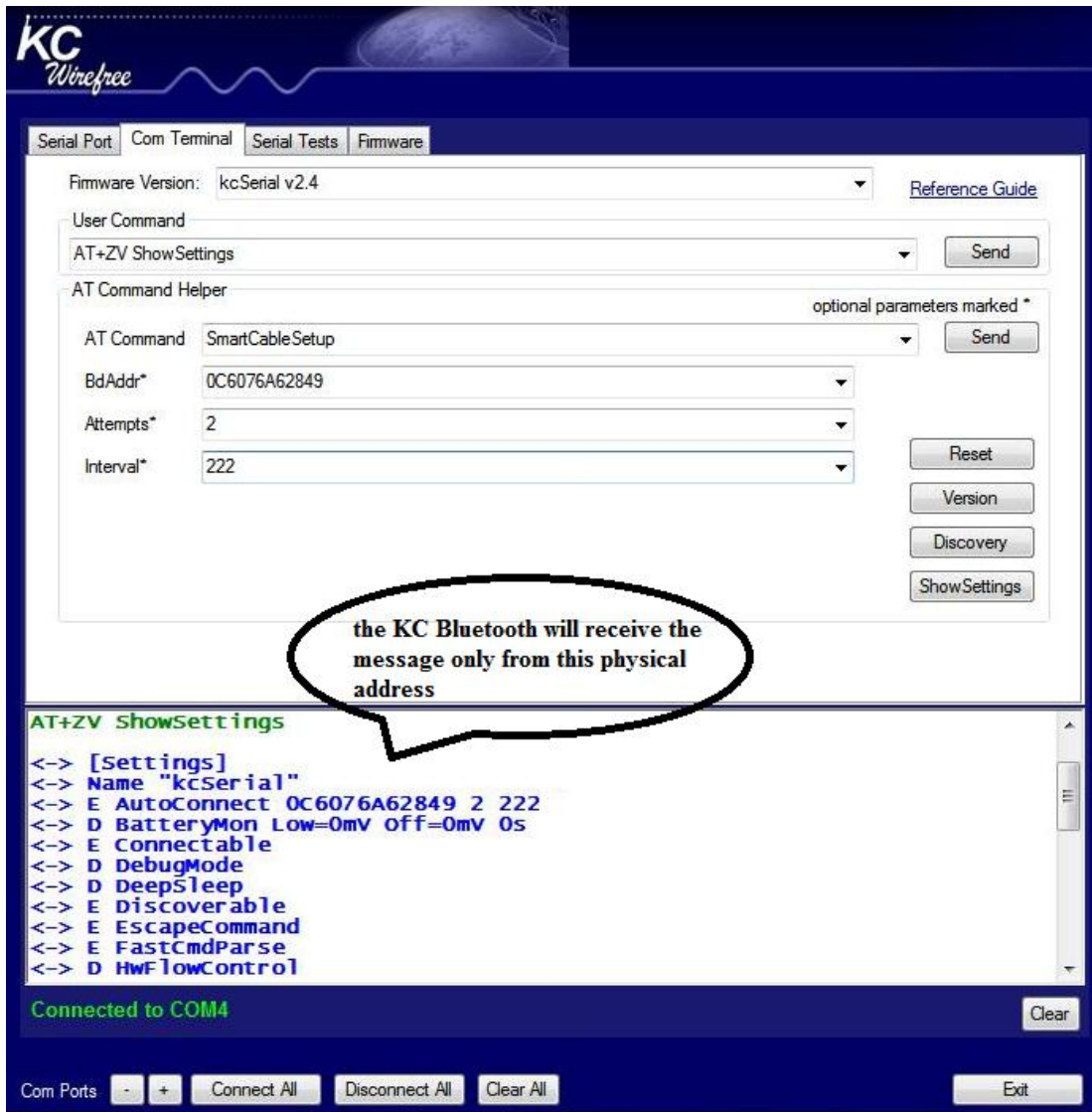


Figure 3.9. Determination of the specific device

- 5- KC wireless Bluetooth is adjusted by the following procedure; after return to the Bypass mode by disconnecting then reconnecting, therefore transfer from remote mode to the Bypass mode can be provided (figure 3.10).

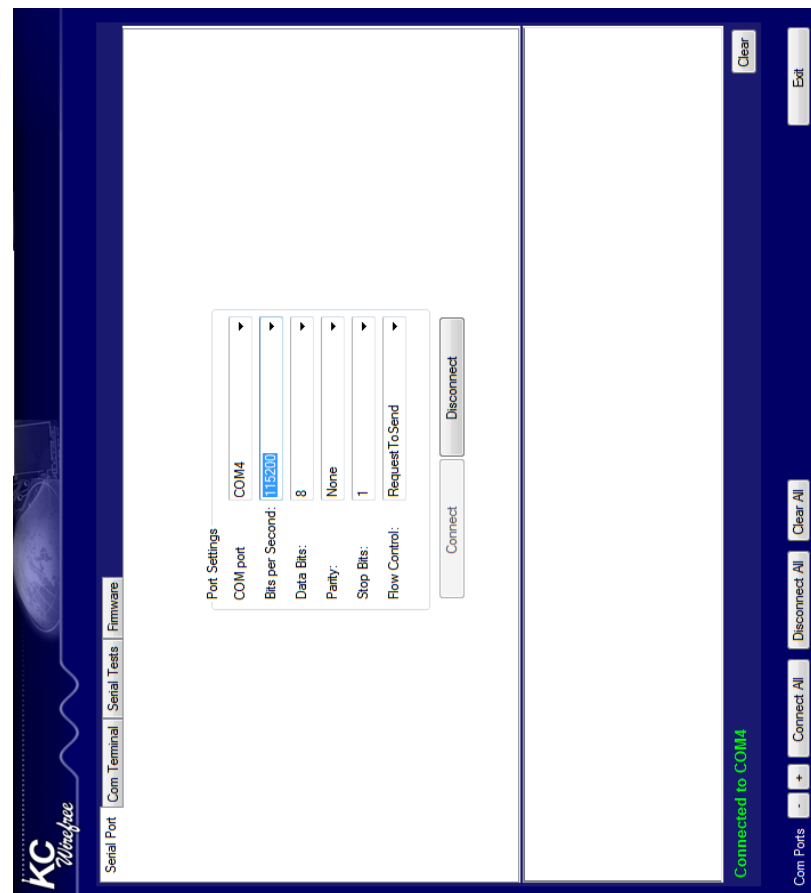


Figure 3.10 Return from remote mode to Bypass mode

3.3.6 Graphical User Interface

The graphical user interface is designed by using the Visual Basic program as explained before in an easy and simple way since the GUI exists as an icon on the desktop or in the toolbar. This is explained in chapter four in detail (figure 3.11).

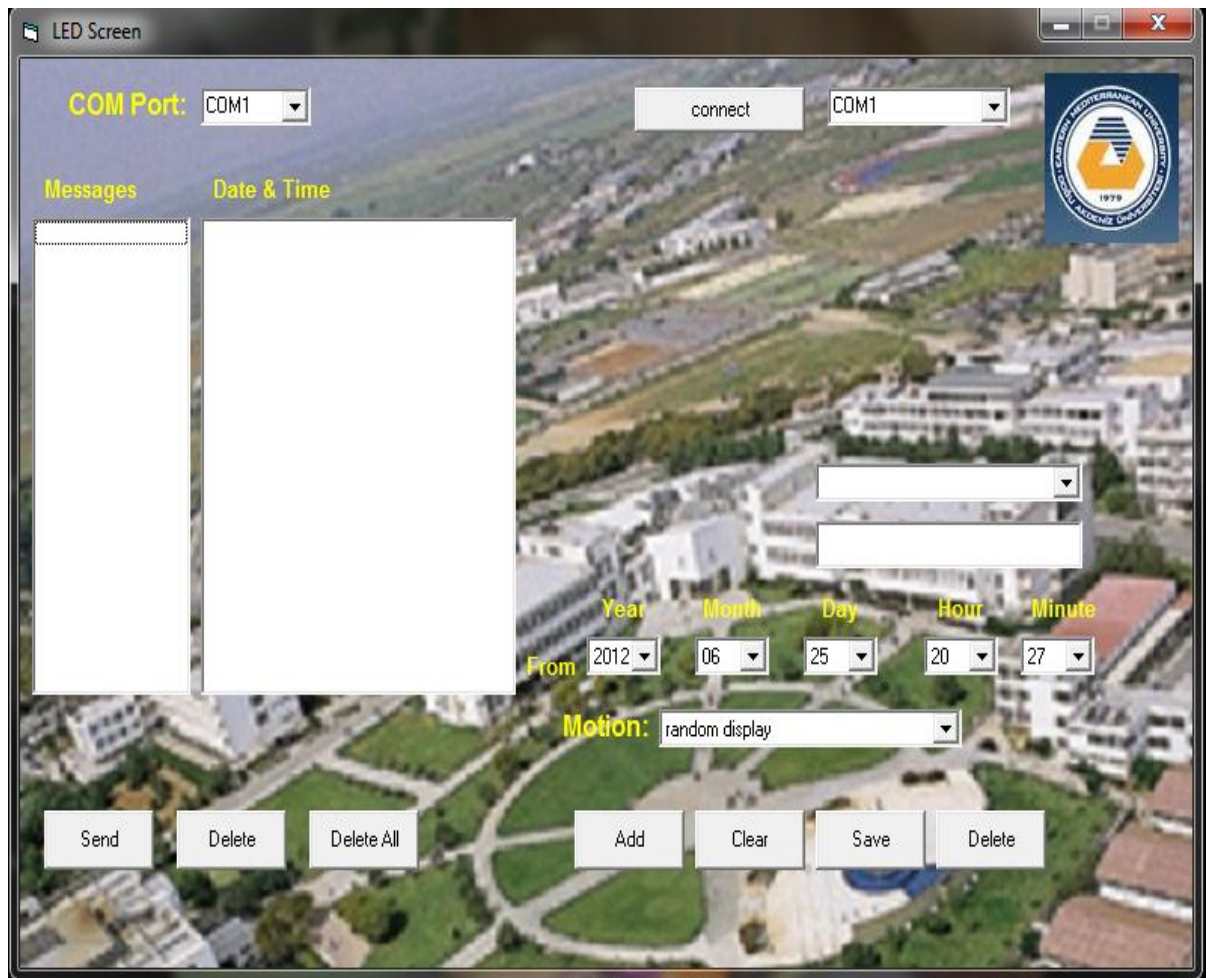


Figure 3.11. GUI interface

Chapter 4

SIMULATION METHODOLOGY

This chapter describes the setup of simulation experiments for the performance evaluation of the Wireless bulletin board. The environment in building our simulation model was LABVIEW[15]. Which is a high-performance language for technical computing, and it is a graphical programming environment. The Simulation is an environment for Wireless communication system and simulates the communication between the client and the server. The suggested simulations are for sending data from the client PC and the other receiver PC receives the data and displays it on the screen.

Since the Bluetooth recognizes more than one device and to make it the receiving data from the intended client only, the program is initially operated with in the PC client. The program is designed to take the physical address of the Bluetooth and it is displayed on the screen, and putting it in the PC receiver to make a connection with the client only. It is also defined the channel that both the sender and the receiver Bluetooth worked on it.

4.1 Client's Program Code

The client consists of two windows: Block diagram and Front panel. The Block diagram contains the code where the program code is divided into five sections (figure 4.1) which are described below:

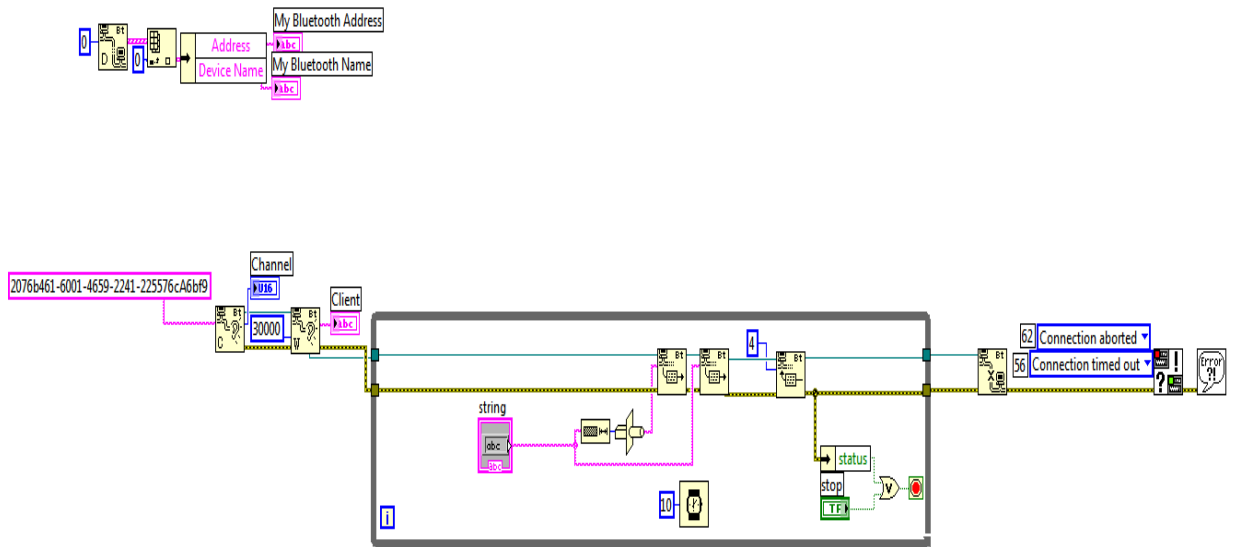


Figure 4.1. The block diagram of the client's program code

- The program code takes the physical address of the Bluetooth as well as identifies the channel that is connected with the Bluetooth server. This is done by passing a time out value of 0 to the Bluetooth Discover function.
- The Client Bluetooth creates and waits for a listener for connection, and the time is set out about 60 seconds to end the connection in case there is no responding for the call.
- Sending data to the channel is specified once when a connection has been detected. Numeric data is casted into string data and sent via Bluetooth Write. The first Bluetooth Write sets the amount of data to be sent and the second Bluetooth Write sends the data. The Bluetooth read waits until the client is done reading and sends a confirmation (This is to make sure that the server and client are in sync). Error checking in the loop will stop it if a connection error occurs.
- Close connection after all data sent.

- Convert connection error for warning if any error occurs during the connection.

The front panel is a GUI for the suggested simulation and it is used to write the specific wanted data to be sent to the receiver. The bottom *stop* is used to end the connection (figure 4.2).

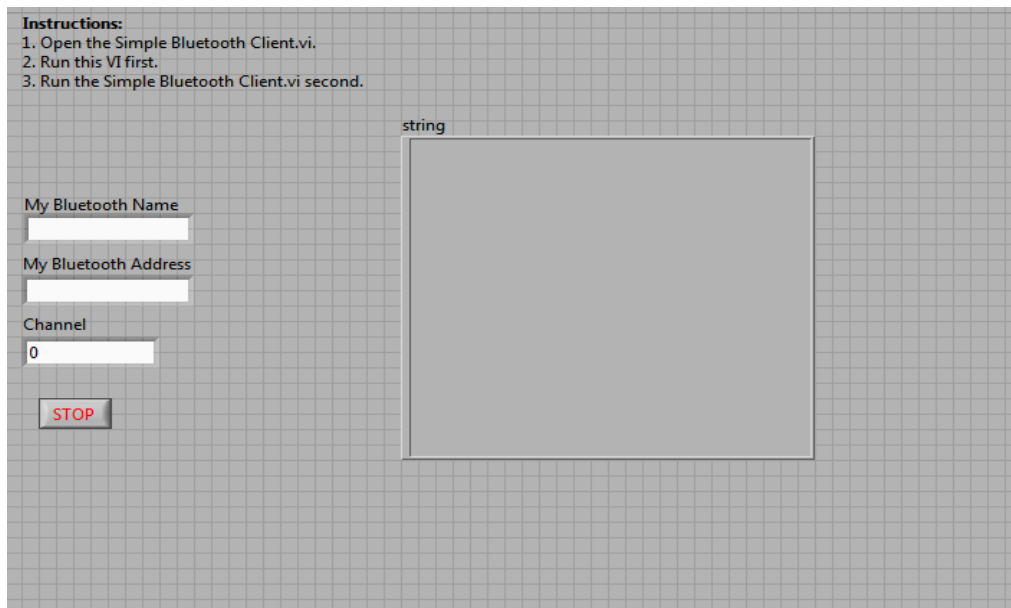


Figure 4.2. The client's GUI front panel

4.2 Server's Program Code

The server also consists of two windows: the Block diagram and the front panel. The Block diagram contains the code where the program code is divided into four sections (figure 4.3) which are described below:-

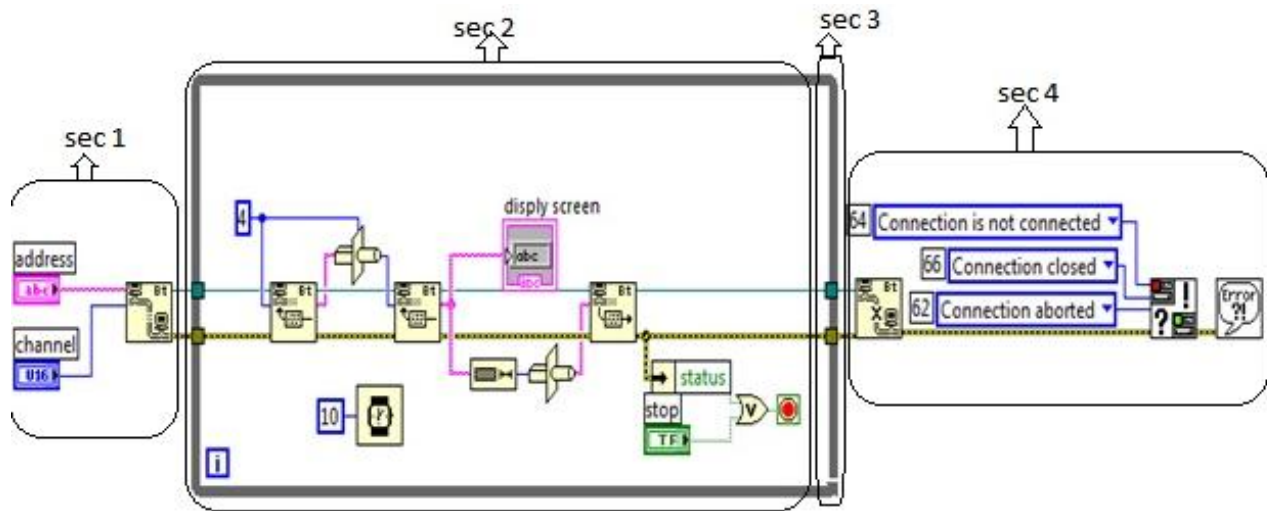


Figure 4.3. The block diagram of the server's program code

- The Bluetooth receiver searches to find Bluetooth's sender with specific physical address. After it finds the Bluetooth sender, the Bluetooth receiver requests connection with it.
- Read the data on the channel specified and cast the data into a numeric representation. The first Bluetooth Read acquires the size of the data and the second Bluetooth Read reads the data and passes it to a buffer. The Bluetooth write sends a confirmation to the client (This is to make sure that the server and client are in synchronous with each other). Error checking in the loop will stop the loop if a connection error occurs.
- Close connection after receiving all data.
- Convert connection error to warning if any error occurs during the connection.

The front panel is a GUI for our simulation, and it is used to display data that received from the client. The bottom *stop* is used to end connection (figure 4.4).

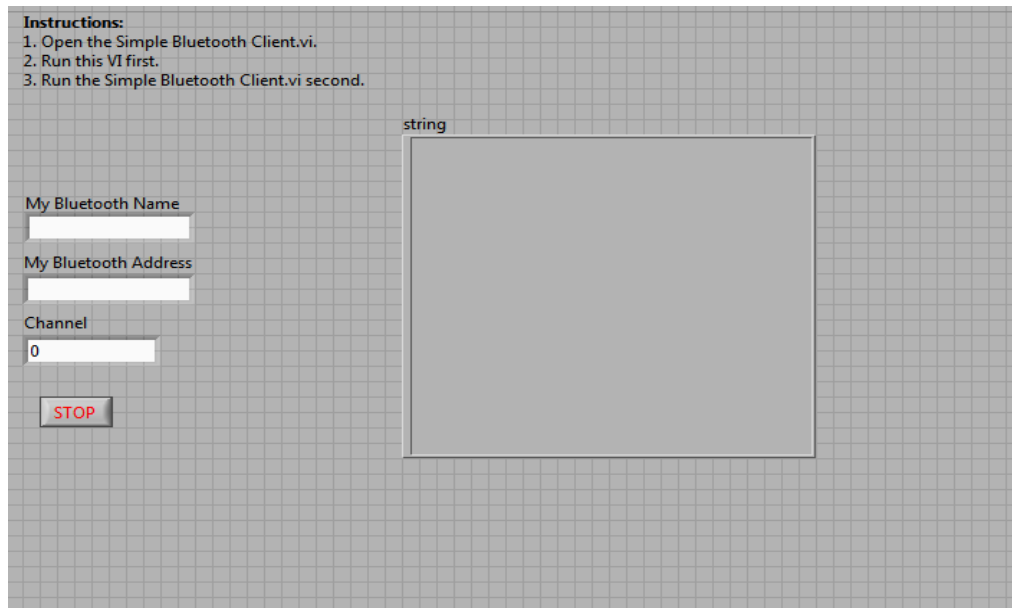


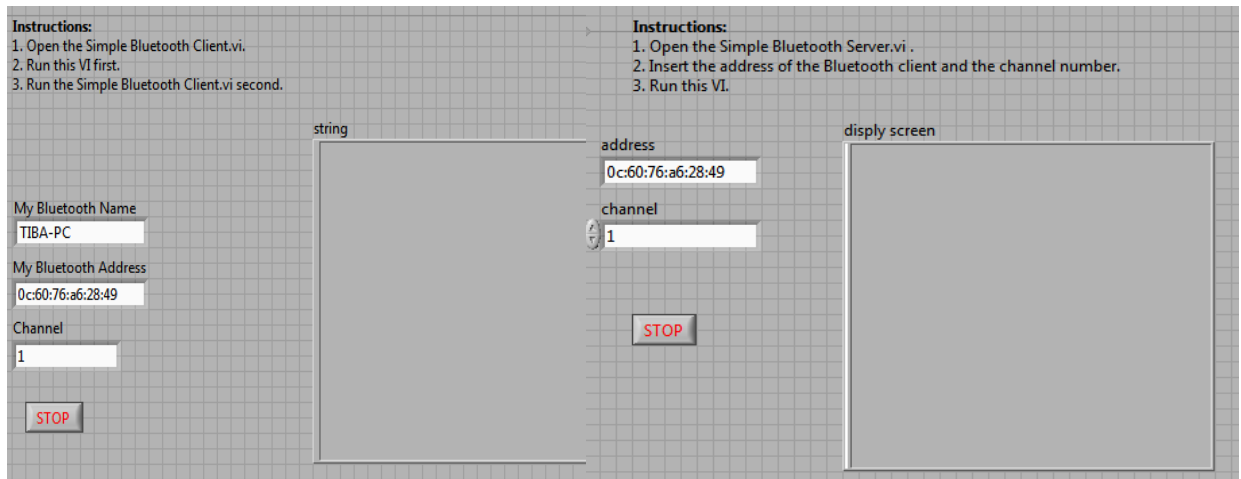
Figure 4.4. The server's GUI front panel

4.3 The Procedure of How the Simulation Works

As it is noted at the beginning of this chapter, the simulation is carried out using the LABVIEW simulation which is composed of two programs; one of them represents the client while the other one represents the receiver. Each program is executed on a different computer because it is impossible to make the simulation of the Bluetooth on a single computer since the Bluetooth deals with COM port (we cannot send and receive data in the same computer).

To run the simulation program the following steps are followed:

- 1- First, the client program is run, because it is designed to show the physical address of the Bluetooth and the number of channel that the Bluetooth uses on the front panel.
- 2- The physical address of the Bluetooth is taken from the client's computer and transferred to the server's front panel, which is considered as a type of production so that the server can only receive from the client (figure 4.5).



Client's front panel

Server's front panel

Figure 4.5. Transfer client's physical address to server

- 3- After that the client's program is executed in the first step then the server program as the second step. When a connection is established between the two computers, the data can be sent.
- 4- If within 60 second no contact is shown between the computers, then the program execution will stop automatically and the contact will be restarted again.

4.4 Procedure of How the Hardware Works

There are two programs to deal with the hardware. The first program is the KC Wireless which is used for adjusting the Bluetooth preparations. The second program is used for sending messages and displaying it on the LED screen. At the beginning, the Bluetooth in the computers is run, then we search for the KC Bluetooth (figure 4.6)

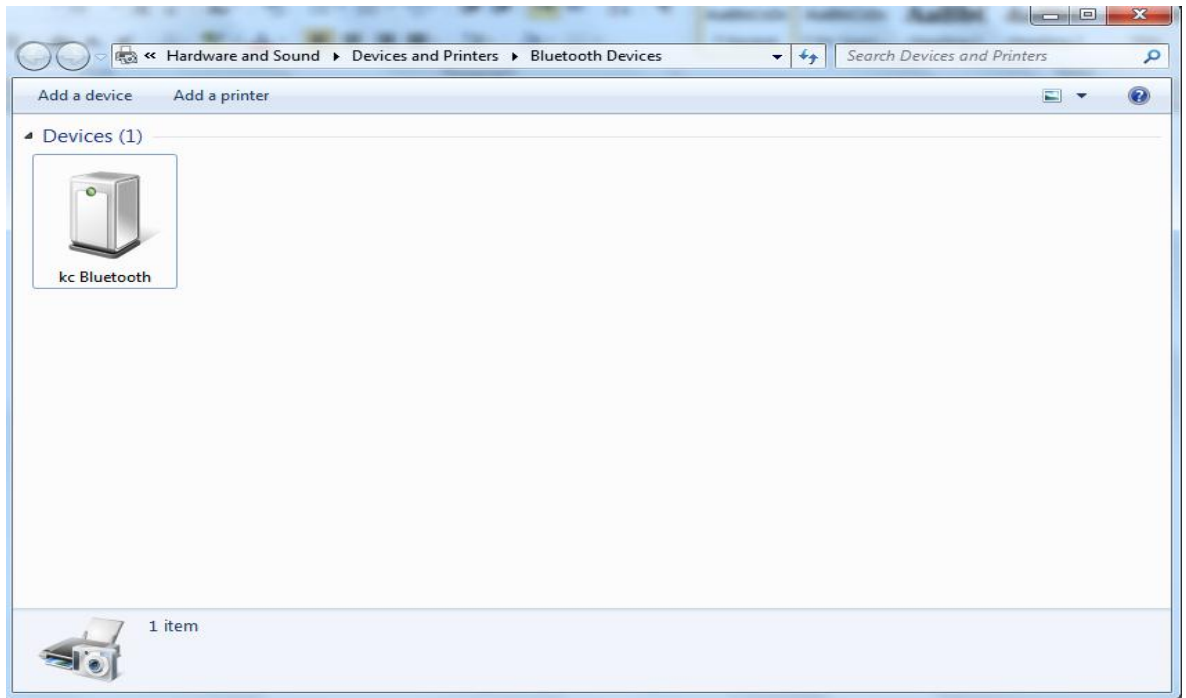


Figure 4.6. Searching to find KC Bluetooth

After finding the KC Bluetooth we find the COM port number that deals with the computer Bluetooth (figure 4.7). In this case the COM port number is COM 4.

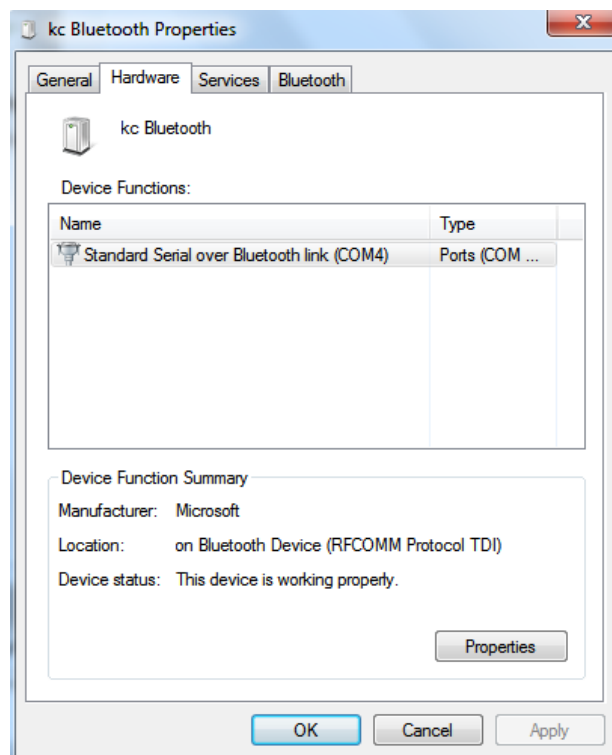


Figure 4.7. Find the COM port number

After that, the KC Wireless program is executed to limit the required preparation for the KC Bluetooth to work in the serial port window as follows:

- 1- COM port: The previous founded computer port is included.
- 2- Bit per Second: The bit per second is assumed **57600** depending on the baud rate of the LED screen.
- 3- Data Bits: will always be **8** according to the instruction of the company manufacturing the KC Bluetooth.
- 4- Parity : always **none** according to the instruction of the company manufacturing the KC Bluetooth.
- 5- Stop Bit: always **1**.
- 6- Flow control: always **none**.

After the contact is made, the green message under the screen will appear showing connection to COM port, which means that the contact operation with the KC Bluetooth is successfully passed (figure 4.8).

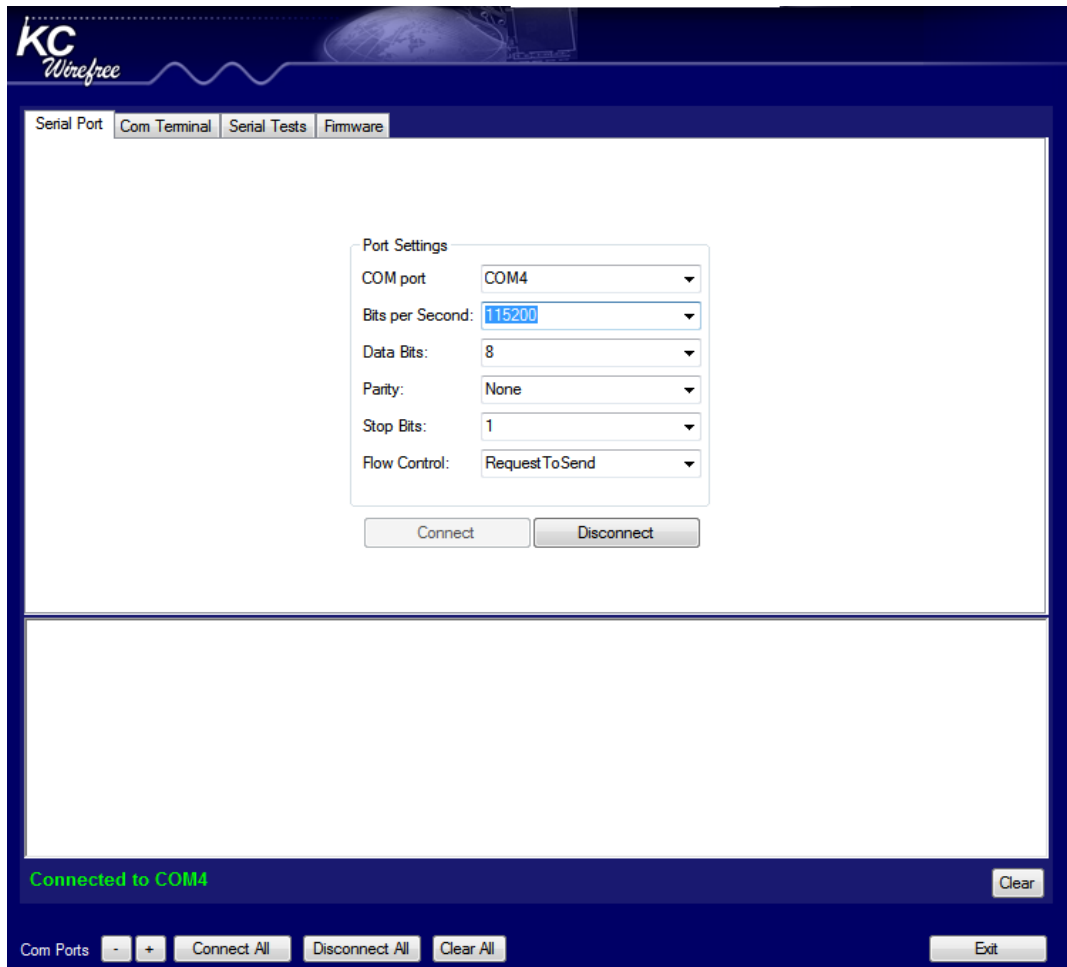


Figure 4.8. KC Bluetooth parameters

Then disconnection is made to isolate the KC Wireless program from the COM port because when the second program is run for sending a message there will be a mixed contact with the COM port and that is avoided since it is not possible for two programs in the COM port run in the same time (figure 4.9)

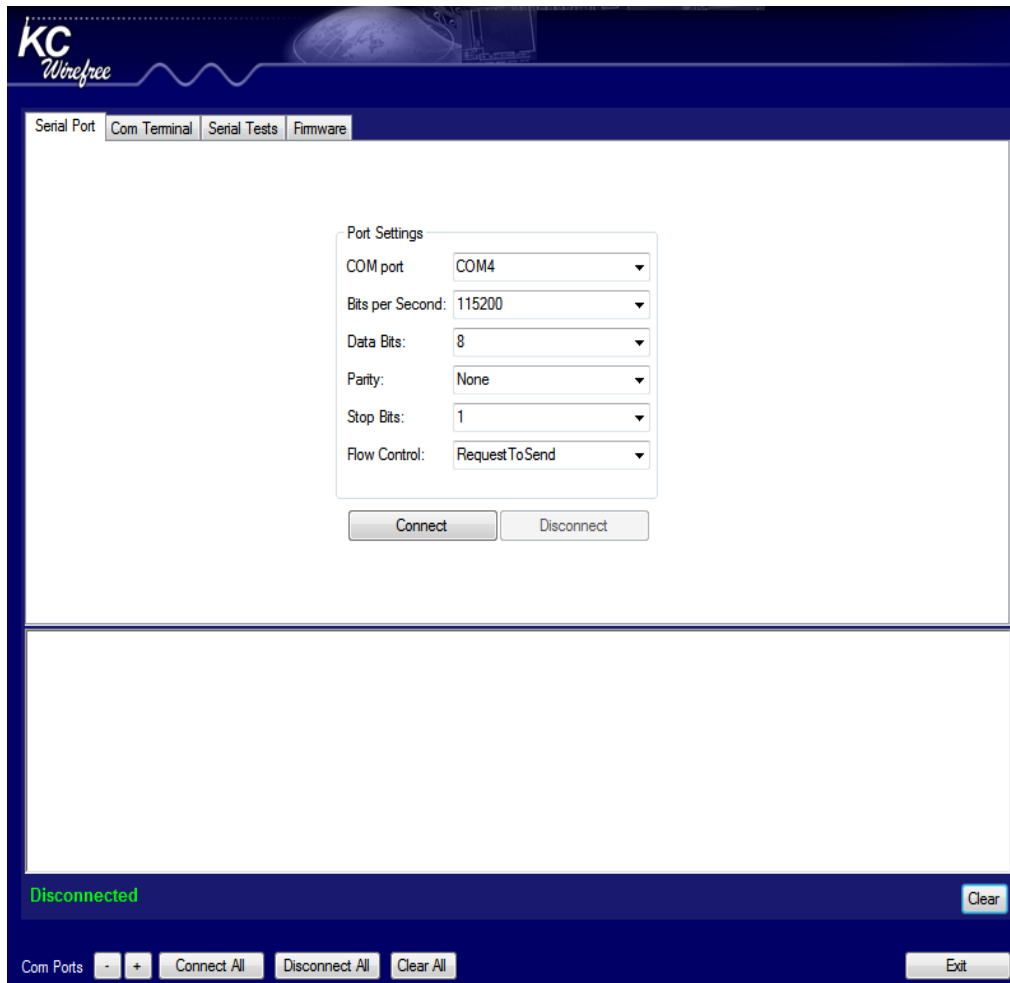


Figure 4.9 Disconnect KC Wireless program

Or we can establish the connection between devices directly from the GUI without using the KC toolkit program as shown in (figure 4.10).



Figure 4.10 Establish the connection

After making sure that contact between the computer and the KC Bluetooth is done, the second program will be started following the steps below:

- 1- To open the GUI, we must enter the correct user name and password as a kind of protection measures (figure 4.11)



Figure 4.11 Security dialog

- 2- Nominate the COM port number for the Bluetooth (in order to do this the KC Wireless must be disconnected from the COM port) (figure 4.12).

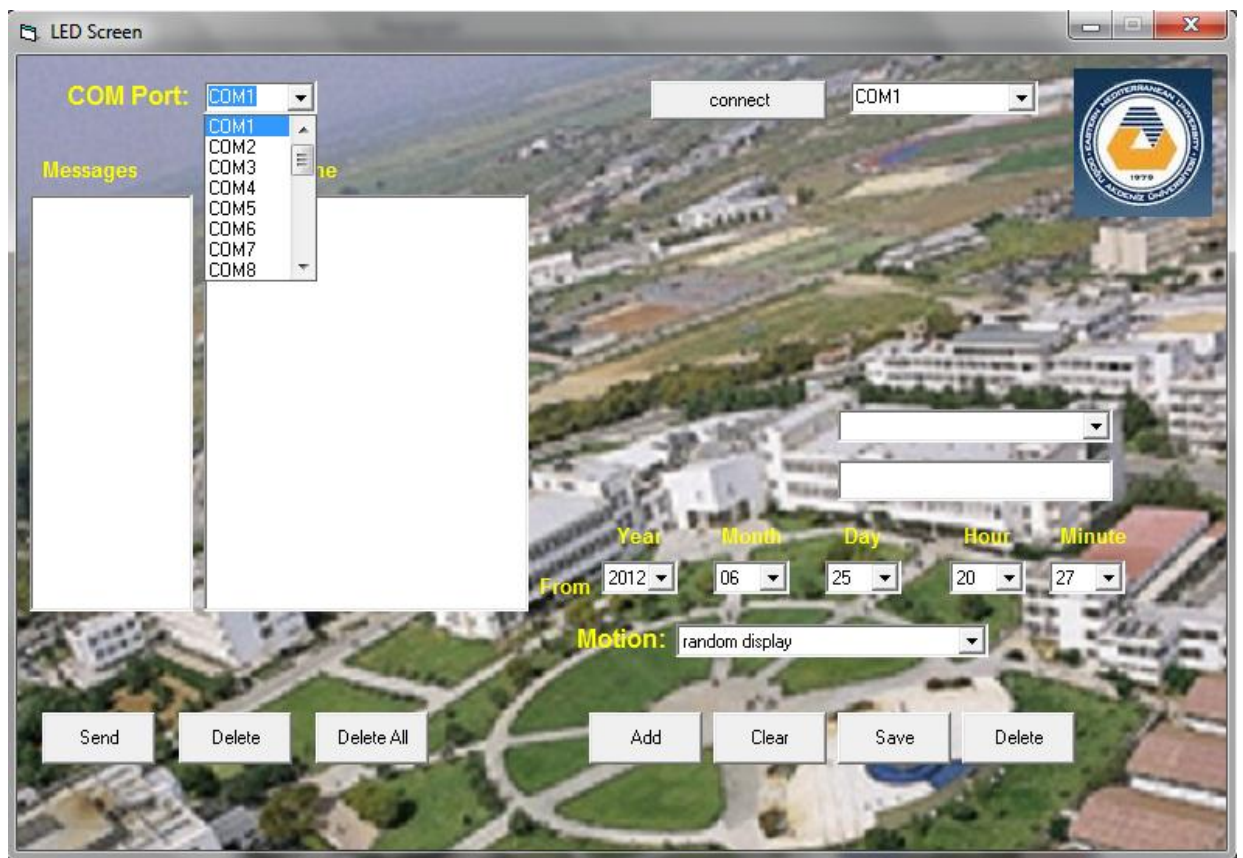


Figure 4.12. Determine number of COM port

- 3- A message is chosen. Either from the stored message in the program or a new message is written (figure 4.13)

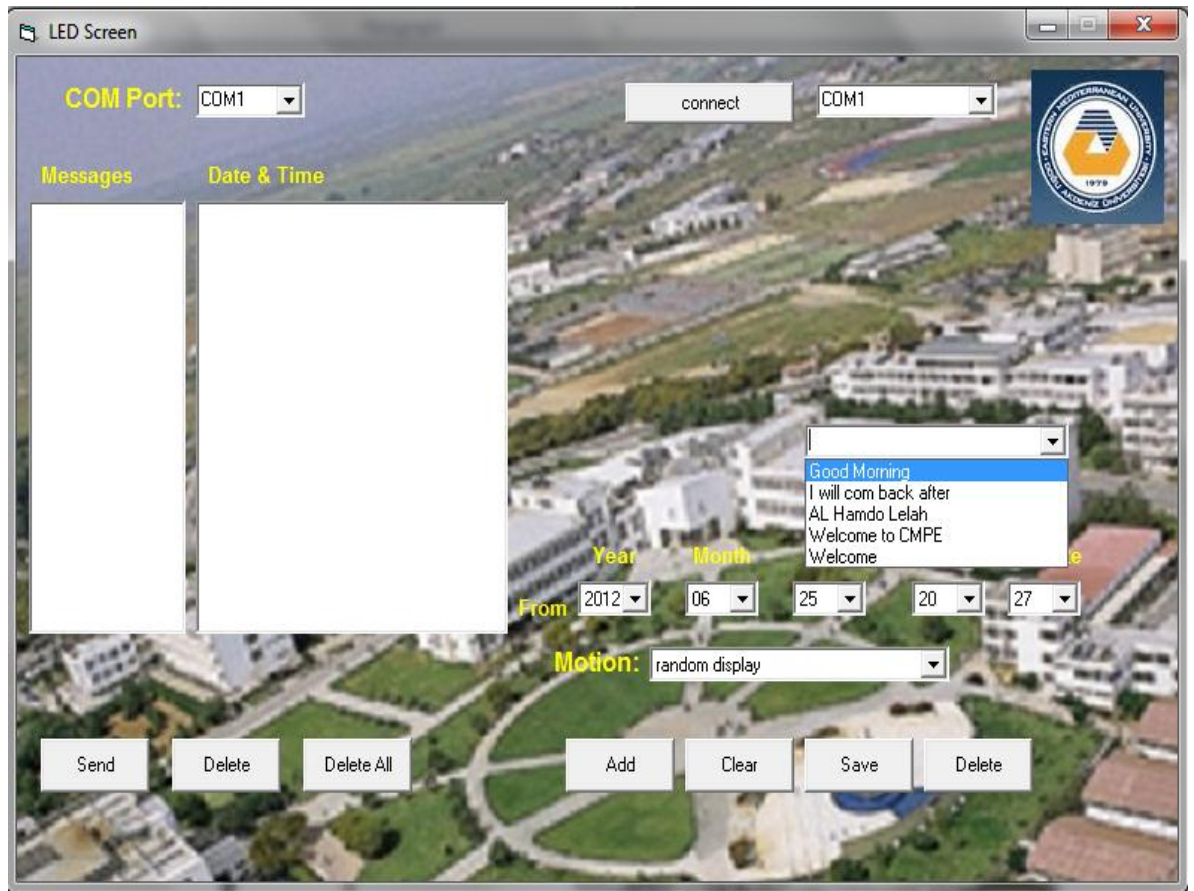


Figure 4.13. Select the message

- 4- The program start is fixed by sending a message to the screen. For example if a message wanted to send at 12:30 this time is fixed in the program (figure 4.14).



Figure 4.14. Determine the time

5- Since there are a number of motion, one of them has to be fixed (figure 4.15)

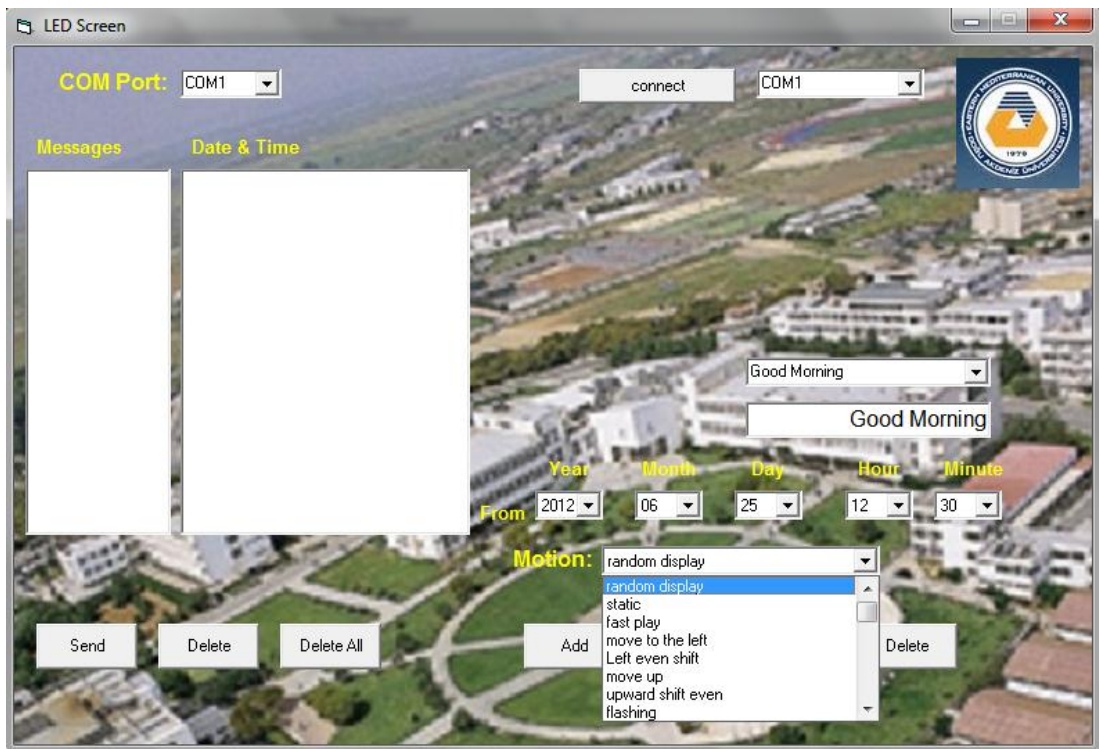


Figure 4.15 Select motion

6- Press the button Add to prepare the message for sending (figure 4.16)



Figure 4.16. Prepare the message to send

After doing this, press send then the program start sending the message which was set in advance (which was 12:30) Figure (4.17).



Figure 4.17. The message was sent successfully



Figure 4.18. The LED screen display a message

Chapter 5

CONCLUSION AND FUTURE WORK

5.1 Conclusion

Communication technology is developing not only year after year but also day after day due to the need for fast transfer of information for the daily life. For example, electronic screens were used for advertisement as a substitute for fixing papers on advertisement board, then to avoid connecting wire or cables, Wireless services showed better acceptance because of fast, easy and efficient use.

Bluetooth is one of the Wireless developing methods for connecting different electronic devices such as PC, notebook, smart phones and digital cameras. The Bluetooth is a short range Wireless, reliable, low-cost and need low power technology applied for different life needs such as in shopping center, file transfer profile, medicine, tourism...etc.

This thesis addressed the design and implementation of a Wireless bulletin board. The hardware part consists of the interface between the KC Wireless module and LED screen. The software part is concerned with programming the Bluetooth with KC Wireless in addition to another program that is designed for sending messages to be displayed on the LED screen. As result of this work, the user can easily display a message in motion or fixed manner through a user friendly GUI to the LED screen. Moreover, the user can save frequently used in a database. Timing of the begin and

end of the message display can also be controlled by the user. This control can be applied for more than one message simultaneously.

Advantages of this system include the ability of users to display information remotely for distance ranging from 10 – 100 meters depending on the power of the Bluetooth and its feature. This is in addition to the fact that such system has features like low-cost, more user friendly, and contributes to the main goal of the world wildlife fund (WWF) for saving the environment.

5.2 Future Work

The suggested system and programs of this work can be developed to be able to communicate with any random mobile device with Bluetooth facility. When doing so the system becomes more user friendly and more applicable.

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[12] www.kcwirefree.com

[13] http://www.gongchang.com/The_multi_area_LED_display_asynchronous_

[14] <http://www.vegasledscreens.com>

[15] <http://www.ni.com/labview>

APPENDIX

Appendix A: program's code

```
Private Sub btnOk_Click()
If txtName.Text = "cmpe" And txtPassword.Text = "cmpe" Then
frmMain.Show
Frmlogin.Hide
ElseIf txtName.Text = "" Or txtPassword.Text = "" Then
MsgBox "Enter your name and passward", vbCritical
Else
MsgBox "invalid user name or passward", vbCritical
End If
End Sub

Private Sub Command1_Click()
End
End Sub

Private Sub txtPassword_KeyPress(KeyAscii As Integer)
If KeyAscii = vbKeyReturn Then btnOk_Click
End Sub

Private sch(30, 6) As Integer
Private portname As String
Private Sub btnAdd_Click()
If txtmsg.Text <> "" Then
lstmsgs.AddItem (txtmsg.Text)
lstmsgs2.AddItem ("(" + fryr.Text + "/" + frmon.Text + "/" + frdy.Text + " " +
frhr.Text + ":" + frmn.Text + "---" + cmbmotion.Text + ")")
sch(lstmsgs.ListCount - 1, 0) = CInt(fryr.Text)
sch(lstmsgs.ListCount - 1, 1) = CInt(frmon.Text)
sch(lstmsgs.ListCount - 1, 2) = CInt(frdy.Text)
sch(lstmsgs.ListCount - 1, 3) = CInt(frhr.Text)
sch(lstmsgs.ListCount - 1, 4) = CInt(frmn.Text)
```

```
sch(lstmsgs.ListCount - 1, 5) = cmbmotion.ListIndex
```

```
sch(lstmsgs.ListCount - 1, 6) = 0
```

```
End If
```

```
End Sub
```

```
Private Sub btnClear_Click()
```

```
txtmsg.Text = ""
```

```
End Sub
```

```
Private Sub btnDelete_Click()
```

```
cmbtemp.RemoveItem (cmbtemp.ListIndex)
```

```
Open App.Path & "\list.txt" For Output As #2
```

```
For i = 0 To cmbtemp.ListCount
```

```
Print #2, cmbtemp.List(i)
```

```
Next
```

```
Close #2
```

```
End Sub
```

```
Private Sub btnSave_Click()
```

```
If txtmsg.Text <> "" Then cmbtemp.AddItem (txtmsg.Text)
```

```
Open App.Path & "\list.txt" For Output As #2
```

```
For i = 0 To cmbtemp.ListCount
```

```
Print #2, cmbtemp.List(i)
```

```
Next
```

```
Close #2
```

```
End Sub
```

```
Private Sub cmbtemp_Click()
```

```
txtmsg.Text = cmbtemp.Text
```

End Sub

Private Sub cmdcon_Click()

If cmdcon.Caption = "CONNECT" Then

 puerto.CommPort = Val(cmbssel.ListIndex + 1)

 puerto.PortOpen = True

 Timer2.Enabled = True

 cmdcon.Caption = " DISCONNECT"

Else

If cmdcon.Caption = " DISCONNECT" Then

 Timer2.Enabled = False

 puerto.PortOpen = False

 cmdcon.Caption = " CONNECT"

End If

End If

End Sub

Private Sub cmdDelete_Click()

If lstmsgs.SelCount <> 0 Then

 x = lstmsgs.ListIndex

 lstmsgs.RemoveItem x

 lstmsgs2.RemoveItem x

End If

End Sub

Private Sub cmdDeleteAll_Click()

 lstmsgs.Clear

 lstmsgs2.Clear

End Sub

```
Private Sub cmdSend_Click()
```

```
Err.Caption = ""
```

```
portname = cmbPorts.Text
```

```
Timer1.Enabled = True
```

```
End Sub
```

```
Private Sub Form_Load()
```

```
Open App.Path & "\list.txt" For Input As #1
```

```
Input #1, s
```

```
Do While Not (s = "")
```

```
cmbtemp.AddItem s
```

```
Input #1, s
```

```
Loop
```

```
Close #1
```

```
fyr.ListIndex = 0
```

```
frmon.ListIndex = Month(Now) - 1
```

```
frdy.ListIndex = Day(Now) - 1
```

```
frhr.ListIndex = Hour(Now)
```

```
frmn.ListIndex = Minute(Now)
```

```
cmbmotion.ListIndex = 0
```

```
cmbPorts.ListIndex = 0
```

```
End Sub
```

```
Private Sub Timer1_Timer()
```

```
Dim Filename As String
```

```
For i = 0 To lstmsgs.ListCount - 1
```

```
If sch(i, 0) <= Year(Now) And sch(i, 1) <= Month(Now) And sch(i, 2) <= Day(Now)  
And sch(i, 3) <= Hour(Now) And sch(i, 4) <= Minute(Now) And sch(i, 6) = 0 Then
```

```
sch(i, 6) = 1
```

InitDLLResource frmMain.hWnd

'-----

iControlType = 321

iScreenNo = 1

iWidth = 64

iHeight = 32

iScreenType = 1

iPixelMode = 1

iDataDA = 0

iDataOE = 1

iRowOrder = 0

iFreqPar = 0

iBaud = 57600

iSocketPort = 5005

a = -1

'a = AddScreen(iControlType, iScreenNo, iWidth, iHeight, iScreenType,
iPixelMode, iDataDA, iDataOE, iRowOrder, iFreqPar, sCom, iBaud, sSocketIP,
iSocketPort)

a = AddScreen(iControlType, 1, iWidth, iHeight, iScreenType, 1, 0, 0, 0, 0,
portname, 57600, "192.168.0.224", 5005)

If a Then

Err.Caption = "Error1"

GoTo out

End If

'-----

a = -1

a = AddScreenProgram(1, 0, 0, sch(i, 0), sch(i, 1), sch(i, 2), 65535, 65535, 65535,
0, 0, 0, 0, 0, 0, sch(i, 3), sch(i, 4), 65535, 65535)

If a Then

```

Err.Caption = "Error2"

GoTo out

End If

'-----

a = -1

a = AddScreenProgramBmpTextArea(1, 0, 0, 0, iWidth, iHeight)

If a Then

Err.Caption = "Error3"

GoTo out

End If

'-----

Open App.Path & "\data.txt" For Output As #1
Print #1, lstmsgs.List(i)
Close #1

Filename = App.Path & "\data.txt"

a = -1

a = AddScreenProgramAreaBmpTextFile(1, 0, 0, Filename, "Arial", 8, 0, 1, sch(i,
5), 30, 10)

If a Then

Err.Caption = "Error4"

GoTo out

End If

'-----

a = -1

a = SendScreenInfo(1, 0, 41456, 0)

If a Then

Err.Caption = "Connection Error"

sch(i, 6) = 0

GoTo out

Else

```

```
Err.Caption = "OK"
```

```
End If
```

```
'-----
```

```
out: FreeDLLResource
```

```
End If
```

```
Next
```

```
End Sub
```