

Designing and Implementation of PC Based Moving Message Display Board System with RF Link

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Abstract- There are several places which require essential and real time notice to be displayed like shops, colleges, railway stations, supermarket, restaurants, banks, schools, hospitals, main roads, tall buildings etc. By looking into the present trend of information transfer it is seen that essential and real time notice take time to be displayed on the ordinary displaying boards. This drawback is not anticipated in most of the cases and it is not very well avoided, it takes minutes or hours to change message on the ordinary display board. But the advancement in the technologies related to wireless communication has led to the emergence of several engineering designs to aid the human requirements. The aim of this paper is to design system that will allow user to change message timely. The designed system "PC Based Moving Message Display Board System with RF link" is a combination of wireless technology with 8x32 matrixes LED Display Boards formalized by designing and integrating the hardware and software with AT89S51 microcontroller, RF module, and 8x32 matrix moving LED display. The system that I design overcomes the difficulties appeared on other type of systems like moving text message display modules using wired entry via computer, keyboard or remote control entry (small distance) or re programmable display systems. The system also consist of the GUI, Visual basic 6.0 is used in designing this GUI. GUI has also linked with the database(Ms Access 2007) so that only the authorized user will have a access to the system ,also every single message sent by the user will be stored to the database ,the stored details are Username , Message ,date and time at which the message sent .At any time when administrator want to see who sent the message when and at what time , administrator can log in and check the display Log directly from the GUI . In this interface users are given chances to change only password and ability to send message to a display board. But administrator has more priorities, like change other user name, add new user, check message logs and delete unused user account. Message is entered in the computer by the use of keyboard and sent to the display board by the use of RF transmitter (SZ05) which is connected to the computer. Message is received by RF receiver (SZ05) which is direct connected with the AT89S52RC microcontroller. Microcontroller decodes the received data packet, then decoded information (message) is transferred to the display

board to be displayed, with the help of programmed AT89S52RC microcontroller the correct sent message will be displayed.

Key words: *Personal Computer (PC), Graphic user interface (GUI), Radio Frequency (RF), visual basics (VB), Light Emitting Diode (LED), Atmel (AT).*

1. GENERAL INTRODUCTION

Today's publicity trends are involving with new or unique methods. The presentation part plays vital role for publicity. There are different methods to display Messages/Information which are already developed like direct printing of images on hoardings using cloth, rolling screens electronic display systems, neon display systems, plasma displays, liquid crystal display system, seven segment display system etc. but among all the display system available in market today electronic display systems are dominating in presentation of advertisements.

Wireless communication, radio stations advertisement television and internet services have announced its arrival on big scale and the world is going mobile. We want to control everything without really moving and as quick as possible. This control of appliances is possible through Embedded Systems. The use of "Embedded System in Communication" has given rise to many interesting applications which ensure a comfortable and secure human life [1].

However, In developing countries like Tanzania in most places there is no internet access , Television broadcasting access, Radio station for advertisement, so the absence of these technologies require the use of manual board to write the information which need someone to be in the place so that he/she can write the information/message, this is very tedious.

In local display board users are limited to change the message or information when they are close to the display board. Hence it is obvious that they can't get enough time to display much information or change the information time to time. On the other hand a customer wants to see or student wants to see the timely information [2]. Due to limited time

and distance in accessing local display board only little information can be displayed per day or per month depends on the distance where the board is placed and sometimes it's even impossible to change the information if paper were used for displaying particular information. Hence ending up with the poor advertisement or delay of the information to the customer, student or intend group that users plan to deliver that information.

One of the solutions to the challenges is to have a remote controlled display board system whereby the displayed message can be remotely accessed from the computer. Users may not go physically to the Display boards system but they are provided with a remote access to it. Therefore the hurdle of costly Television, Radio, internet or traditional display board will be solved. However establishment and development of such Display board system are especially useful in developing countries due to insufficient funds of business people and poor internet, radio and television infrastructures.

There are three main models available for implementing wireless kind of displaying board, which are RF link (ZIGBEE or 433 MHz), GSM technology and Web based [1],[3]. Both models involve real-time control of the information to be displayed. But the two models GSM and WEB based are suitable for the environment with enough infrastructures that support that technology and also it needs user to pay money to the people who own those infrastructures like mobile company or internet provider companies, therefore if the area has no access to these technology it is impossible to implement this kind of system depend on that technology. Because Africa suffers from a problem of poor Telecommunication infrastructures, low bandwidth and high cost in Internet and mobile communication access then RF Technology (ZIGBEE and 433 MHz model) model is more appropriate to start with. These models can be implemented and operates only if there is a transmitter and receiver available. However from user's perspective Display board system with RF technology model has absolute no cost and easy to implement than that of GSM and internet based.

For small message presentations this moving display boards are very effective and efficient than any other display systems [3]. These kinds of systems are compact and economical for general applications. Moving Displays board are ideal for all type of commercial establishments like schools, shops, supermarket, Hotels, Restaurants, Banks, Airports etc., in these places you need to get maximum attention of people where vast amounts of information need to be conveyed to large audiences both in real time and efficiently, also in the world of outdoor and indoor displays. These displays attract customers to watch and pay attention to the display with curiosity while you're moving message is also conveyed simultaneously [1]. Very good and efficient advertising results are obtained from these unique displays with latest technology.

1.2 LITERATURE REVIEW

1.2.1 Visual Basic 6.0

Visual Basic is the software used to implements graphical user interface that allows the use of graphics for different applications. It provides visual interactive windows with user, like Dialogue box for (color, font ...), Input box, and Output box [4],[5]. Also it is able to create menu to simplify user application.

The "Visual" part refers to the method used to create the graphical user interface (GUI). Rather than writing numerous lines of code to describe the appearance and location of interface elements, you simply add prebuilt objects into place on screen. The "Basic" part refers to the BASIC (Beginners All-Purpose Symbolic Instruction Code) language, a language used by more programmers than any other language in the history of computing. Visual Basic has evolved from the original BASIC language and now contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI [6].

1.2.2 Database (Ms Access 2007)

A database is a collection of information that's related. Access allows you to manage your information in one database file [7].

Basically RDBMS (Relational Database Management System) is nothing but a standard [8]. For many years database industry was not having any standard for storing and retrieving information. As a result of this standard we came up the language called SQL or Structured Query Language [9]. We use SQL to communicate with RDBMS databases including but not limited to MS Access, Oracle, and MS SQL Server etc. MS Access databases used to have file extension as .mdb but in 2007 release the default extension is .accdb [9]. Using MS Access GUI (Graphical User Interface) we can now build very complex SQL queries very fast visually just by Click, Drag & Drop operation. While we are performing such tasks MS Access writes the SQL code for us in the background. According to the RDBMS standard, a database should be comprised of tables and data inside each of these tables should reside in the form horizontal rows called 'Records' and vertical columns called 'Fields' [10].

1.2.3 Rf Technology

Control networks consist of sensors, Displays, and other electrical devices that exchange information with each other over shared communication media. In order for information to be exchanged reliably the communication media must be highly robust and able to compensate for sources of interferences frequently found in the intended operating environment [11].

Commonly used communication media include twisted pair of copper (called twisted pair medium), power lines, fiber

optic cable, coaxial cable, wireless infrared and radio frequency (RF). Each medium has different strength and weaknesses. Designer typically selects a medium based on the intended operating environment costs and or reliability reasons [12].

This paper will discuss only RF technology because is the only technology used on the designing and implementation of the Designed system.

By definition, Radio frequency (RF) is a rate of oscillation in the range of about 3 KHz to 300 GHz [12] as shown in figure-1-1, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. RF usually refers to electrical rather than mechanical oscillations; however, mechanical RF systems do exist, examples of it are mechanical filter and RF MEMS. Although radio frequency is a rate of oscillation, the term "radio frequency" or its abbreviation "RF" are also used as a synonym for radio i.e. to describe the use of wireless communication, as opposed to communication via electric wires [13]. Examples include Radio-frequency identification ISO/IEC 14443-2 Radio frequency power and signal interface [11].

Much has been made in the popular press about the benefits and capabilities of new RF based control technologies. Though the use of mesh (repeater – based) networking and new protocol, these technologies are purported to offer the performance of the twisted pair solution but with the lower device installation costs [12]. Among the better known new RF based technologies are; Zigbee, Z- wave, Millennial Net and Dust. But in this paper only ZiGbee technology will be discussed.

1.2.3.1 Zigbee Technology

ZigBee is an IEEE 802.15.4 standard for data communications with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. The ZigBee standard provides network, security, and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard [14]. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. ZigBee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. ZigBee has been developed to meet the growing demand for capable wireless networking between numerous low power devices [15].

ZigBee is an established set of specifications for wireless personal area networking (WPAN) that is digital radio connections between computers and related devices. WPAN Low Rate or ZigBee provides specifications for devices that have low data rates, consume very low power and are thus

characterized by long battery life [15]. ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. The ZigBee Alliance, the standards body which defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles either published or in the works are: Home automation, ZigBee smart Energy, Telecommunication application and Personal home [16].

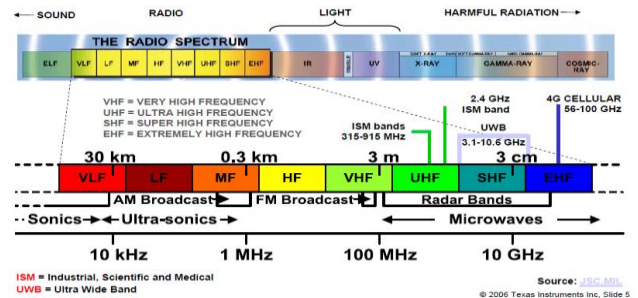


Figure 1-1: Electromagnetic Spectrum.

1.2.4 Led Dot Matrix Display

LED dot matrices are very popular means of displaying information as it allows both static and animated text and images. This kind of display can be used at gas stations displaying the gas prices, or in the public places and alongside highways, displaying advertisements on large dot matrix panels. In this paper monochrome type of LED dot matrix display (single color) is used and its interface with a microcontroller to display dynamic (moving) characters and symbols.

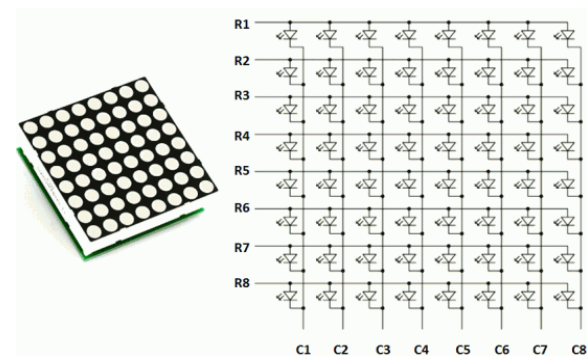


Figure 1-2: LED Dot matrix Connection.

2. SYSTEM OVERVIEW

Embedded system is a combination of hardware and software, which together form a component of a larger machine. An example of an embedded system is a designed PC based Moving message display board system with RF link. An embedded system is designed to run on its own without human intervention, and sometimes the system required responding to events in real time.

A specialized computer system that is part of a large system or machines typically, an embedded system is housed on a single microprocessor board with the program stored in ROM. Virtually all appliances that have a digital interface – watches, microwaves and VCRs utilize embedded systems. Some embedded systems include an operating system, but many are so specialized that the entire logic can be implemented as a single program [17],[18].

Pc based Moving message display board system with RF link is a system which comprise two part the first part is transmitter (GUI and transmitter circuit) part and the second part is display part (Receiver circuit, microcontroller unit and display system).The figures (Figure2-1 and 2-4) shown below are the block diagrams that shows two parts of the designed system.

2.1 Transmitter part

In transmitter part a normal PC with standard keyboard or a laptop is required. PC is connected with the SZ 05 transmitter by using USB to RS232 connector, since SZ05 can support CMOS and TTL technology then there is no need of using MAX 232 [19]. After data reach to the transmitter, it is transmitted to the receiver by using Air interface. See figure 2-1 below.

The Graphic user interface designed can be run in a normal PC, once user want to use it, he/she will be asked enter the password, if the password is correct then the it goes to option menu but if it is incorrect password user will be asked to enter the password again. On the Main menu option form there are several function can be performed, like check Logs (this is reserved only for administrator), also there is an option for the user to change the password, and the other option is for the last form where by the user will have an option to send the message. Once the message sent it is stored in the System database, so that when any mistake done it will be easy to identify which user did that mistake and at what time. See figure 2-3 below.

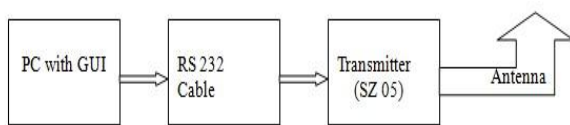


Figure 2-1: Transmitter Block diagram.

2.1.1 Transmitter Circuit

Once the message is sent it is taken to the transmitter. The interface between transmitter (SZ05) and the PC is RS 232. Figure 2-2 below shows the connection of the RS232 and SZ05. Once Message received will be send serially one bit to another, and this transmission there is no addition of parity check bit only 9 bit are received, which are data and 1 end bit. The formation is 8+0+1 (This is according to my

configuration). Therefore the message can be transmitted to receiver through air interface (Wireless connection), but due to manufacture specification the distance between transmitter and receiver is not more than 2Km if there is a line of sight, unless the distance must be kept not more than 800m.

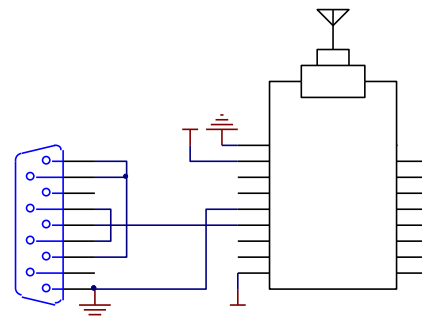


Figure 2-2: Transmitter circuit

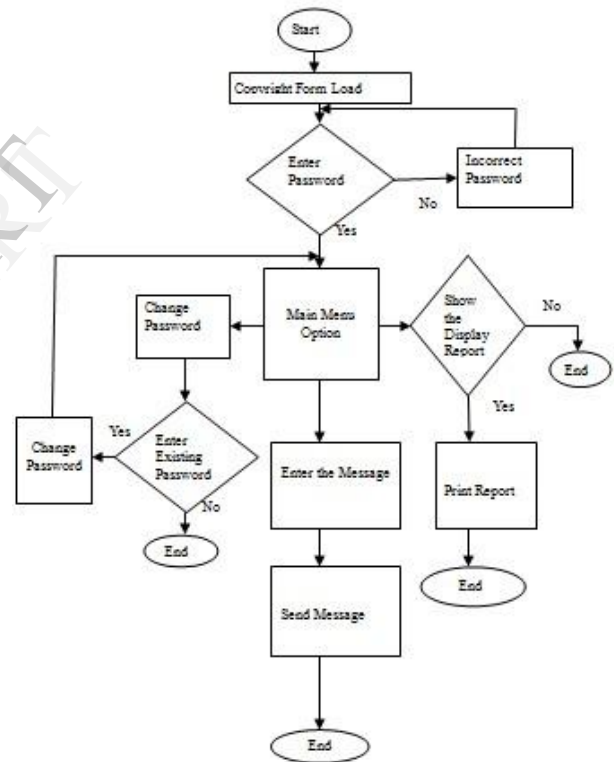


Figure 2-3: GUI Flow chart.

2.2 Receiver Part

Received data are taken to MCU which check validity of data if data (each letter) received is defined in the program inside its ROM then it will process that data for Display. MCU is the One which drives columns and rows bits for proper display.

Note that all the data are sent serially and are also received in serial manner and MCU is programmed such that each letter comes out at a time and once the second letter

displayed the first one is shifted and that creates movement until all words displayed. That's why it is called Moving message display. Figure 2-4 shows block diagram of the Receiver part and Figure 4 show the flow chart of the MCU operation.

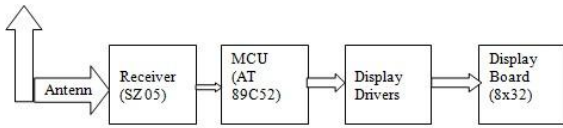


Figure 2-4: Receiver Block diagram.

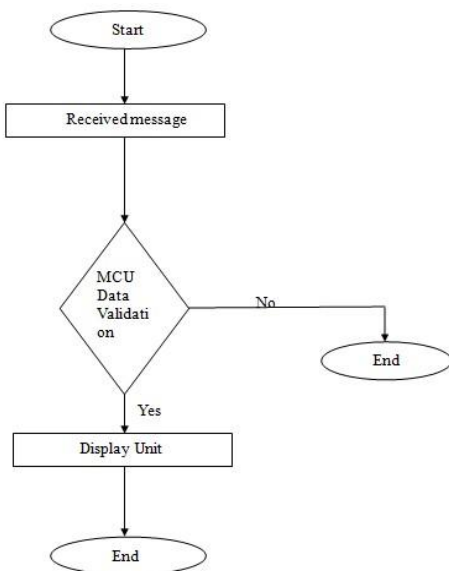


Figure 2-5: MCU operation Flow chart.

2.2.1 Receiver Circuit

Once data are taken serially to the microcontroller .This Microcontroller has the program which is capable of translating the ASCII data received. It is this data that used to drive the column and rows of the display. Microcontroller also need a restart switch, so that when there is a jam or any interrupt user has the chance to restart and allow Microcontroller to refresh and receive another message. Figure 2-6 shows the connection of Receiver, restart circuit and MCU connections.

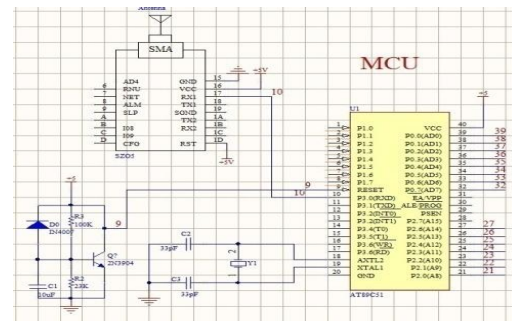


Figure 2-6: Receiver Circuit.

2.3 Display Circuit

Receiver circuit which is the main controller of the system is connected to display system. Microcontroller has a function to control rows and column drivers of the display system in order to get the desired word/message. So in this designing microcontroller pins (39, 38, 37, 36,35,34,33 and 32) are connected to row driver (74LS573), which is a register. Also pins (25, 24, 23, 22 and 21) are connected to column driver (74LS154) which is Demultiplexer. All schematic circuits are shown in Figure 2-7 and 8 below.

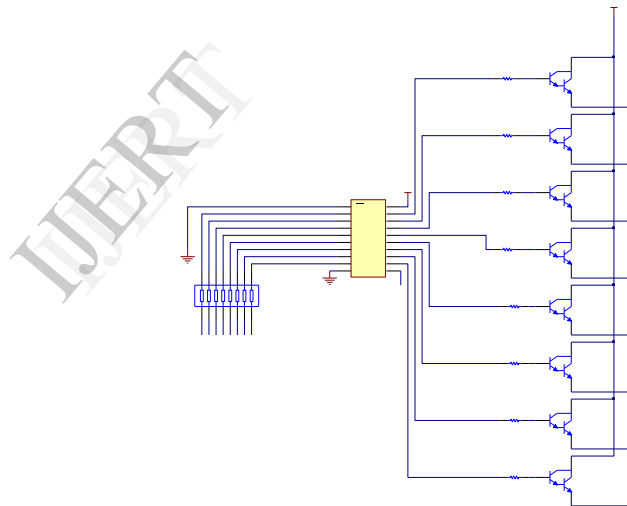


Figure 2-7: Rows driver connection.

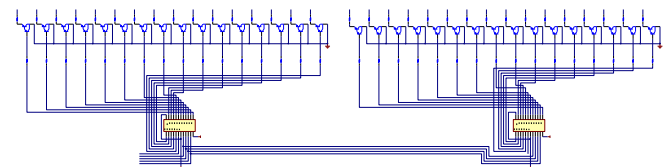


Figure 2-8: Column Driver connection.

Also the display 8x8 matrix has a special connection, all the rows are connected together , but the column are not connected together , because is where the current sinks, so by connecting all together it will have a large current drop and also it will be impossible to control . In order to display a word each column must be controlled differently. See figure 2-9 below.

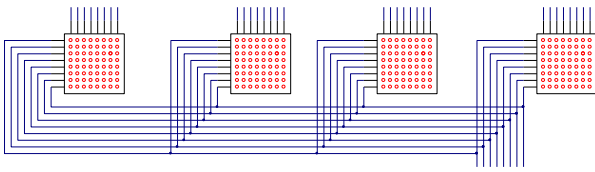


Figure 2-9: LED Dot matrix connection (8x32).

3. RESULTS AND DISCUSSION

3.1 Working Principle of the system

The Principle of Operation of the “PC BASED MOVING MESSAGE DISPLAY BOARD SYSTEM WITH RF LINK” is mainly depends upon the following four functions.

1. Serial interface between the ‘PC’ and ‘SZ05 using RS-232 communication protocol’, and then there is wireless interface between SZ05 transmitter and SZ05 Receiver.
2. Row and Column selection of the LED Dot Matrix Board are done by using Micro controller along with the help of 4-16 decoders, but this is due to the proper received message from the PC.
3. Whatever the message is to be displayed is given to the PC through standard PC keyboard. The message to displayed is only of English capital letters and numerical from 0 to 9. This message is transferred to the micro controller from the PC by using SZ 05 which is connected with PC by RS-232 serial communication in the form of ASCII code for the corresponding letter typed in PC. The message typed in the pc with the keyboard is converted to ASCII with the help of designed GUI. The Baud Rate used for the serial communication here is 9,600 bps.
4. The corresponding ASCII code for the character typed is transferred to micro-controller through the level converter (MAX-232) which is inside SZ05. The micro-controller reads the corresponding letter typed with the help of RXD pin. The program for selecting the rows and columns is written in the C language is stored in micro-controller itself.

3.2 Graphical User Interface.

Once User double clicks the exe file of the designed GUI it will load the copyright form. This form shows the ownership and the name of the designer (see Figure 3-1). It takes less than one second for the second form to be load. Second form is the Log in form the form, in this form user asked to enter its User name and Password (see Figure 3-2). Only if User name and Password Matched with the one stored in the database will be considered as the correct one , then Main menu Option form will be loaded unless, User

will be asked to enter the correct information again (see Figure 3-3).

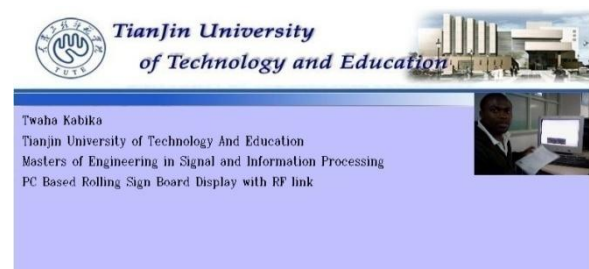


Figure 3-1: Copyright Form

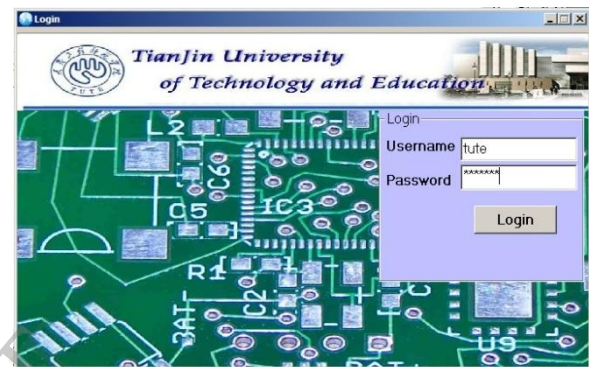


Figure 3-2: Log in Form

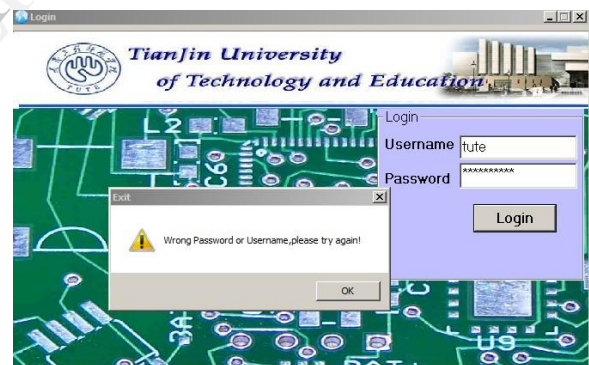


Figure 3-3: Incorrect Password or User Name alert.

On the main menu option user is there are several option that can be conducted but one Check logs option is reserved only for administrator, other user they have given access to send message, change password or can cancel the operation .Only ‘tute’ is defined as the administrator of this system ,so only once user Log in with this name will have the ability to check the Logs (message, Date and time).since on this example I Log in as ‘tute’ the all the Options are active , but if I log in as ‘twaha’ or ‘Michael’ the check logs option will become inactive (see Figure 3-4&5). And if administrator tries to check the Logs this is how the form look like (see Figure 3-6).

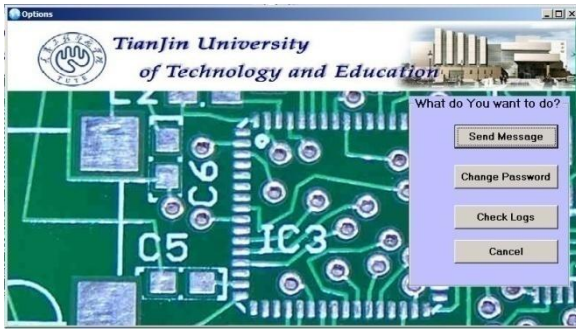


Figure3-4: Main menu Option Form.

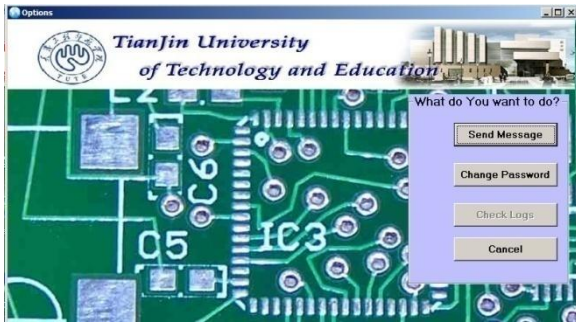


Figure 3-5: Main Menu Option Form with an inactive Check logs command button.

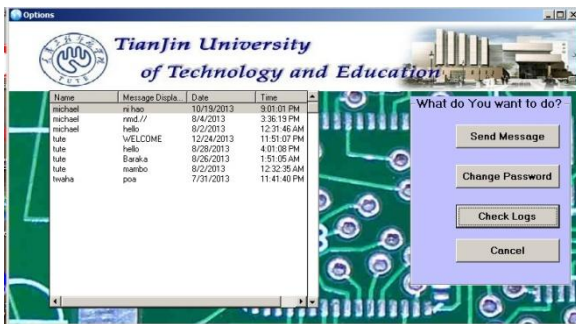


Figure 3-6: Main Menu Option Form that shows Check Logs information.

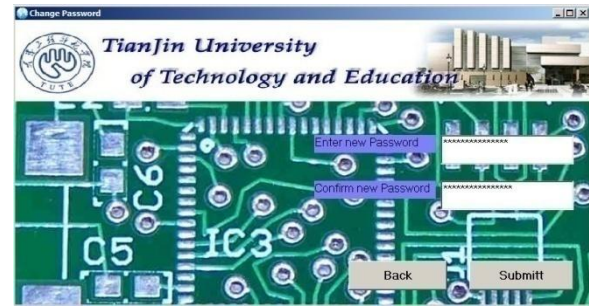


Figure3-7: Change Password Form

Other option which is very important is the send message option. This option is granted to all users so once users need to send message to the Display system he/she must take this option. In this option there is a place where users need to write the message he/she wish it to be displayed and the click the button SEND . After that message will be send, if the message is successfully sent the system will give the user a note that your message has successfully sent (see Figure 3-8).

Apart from that this SEND button is also encrypted with the codes that fetch the send message and store it on the database. The message stored with its corresponding date and time.



Figure 3-8: Form that show successfully send message



Figure3-9: Full system set up showing Moving Letter A and B received from PC.

As we see on figure 3-4 and 3-5 above either administrator or normal user can change its password as many time as he/she want, but this system offers only password can be changed, there is no option for users to change User name and on this system only administrator have the ability to change the other user's name or to add and delete any user account. But this user name change and delete and addition of new account are done on the Database.

On the change password Form, user will be asked to enter the new password twice, and then click submit. Once user accomplish that the user password information will be changed in the database, therefore the so user will not be able to log in by using his/her old password only the new password will be recognized by the system. Figure3-7 shows the form that offer user to change the password.

4. CONCLUSION

This designing is successfully done and well implemented. All parts are checked and tested correctly.

Refer to the aim and objectives of this dissertation, this project have facilities to integrate RF module with a moving Dot matrix LED display board thus making it really wireless. This system has two parts transmitter and receiver, in transmitter part there is a PC with graphical user interface that allow user to enter the message. In order to make the system more secured, user must enter the user name and password, to verify himself if he is among the person who are allowed to you the system. On the receiver part once the message received by the receiver is taken to microcontroller which stores it, validates it and then displays it on the moving Dot matrix LED display module. The validation depends upon the stored letters on the microcontroller in EEPROM which are compared with the incoming letters. This system contains only the English capital characters (A-Z) and numbers (0-9). The numbers and characters are stored in EEPROM can be edited only by the program i.e. if you want the system to Display Chinese character then you need to consult me so that I can define the Chinese character. This means in this system only offer one language and you can't change the language. Display system can be placed not more than 2000m if there is a line of sight but if there is not line of sight the distance will decrease up to 800m.

Designing of a PC Based Moving Message Display Board system with RF link has solved the cost problem in small advertisement sector and also assure a real time display of the message. In contrary to the previous system like GSM based this system only need initial cost for implementation, but there is no any other cost during the run of the system. Since the entire device used need 5v to operate it also save the power. Therefore this system will be a great assert to small companies, shops, hotels, school etc in advertisement area.

5. FUTURE ENHANCEMENTS

Below are some of the areas which need to be improved in the future enhancement of this system:

1. Multiple displays – sometimes a user might need to display one message in different location. So on the next designing someone might consider that as the challenge, and not only multiple displaying a single message but also system must be able to display different message in different display in real time.
2. Type of display – the one used in this system can only display letters and numbers. In next design designer must think of using the better display which is able to display static pictures and video for better advertisement.
3. Feedback – in the current design the system has no feedback, which means if there is any kind of failure in receiving the message, sender will never no and since display is very far it is not even simple to go and check.

So in order to avoid this system must be included with the feedback system that will alert user once the message is received (correct or error messages).

4. Power source – in future design designer might think using the other power source like solar power source which is cheaper and well convenient, since the designed system focus to help African society the use of solar will be of a great advantage since in most of African places power is also a major problem.
5. Due to small and limited memory of the used MCU, current system display only Capital letters. Therefore by using external memory or other microcontroller with more memory capacity will help the system to display Both Capital and small letters.

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