Implementation of PIC Based LED Displays

Htet Htet Thit San, Chaw Myat Nwe and Hla Myo Tun

Department of Electronics Engineering
Mandalay Technological University

Abstract- This paper explains the project which is a special kind of LED Display Board for performing dance movement according to the rhythm of music. Nowadays, LED display boards are widely used in advertising and other applications. LED display boards can also be used indoors or outdoors. The objective of this system is to design a display panel by using several dozens of LED matrix display. The display pattern can desire to be changed easily and modified by the user. This LED display board is overall in two major components; which are the microcontroller and LED display panel. Microcontrollers with programs are developed to generate characters and graphics for this module. In this system, when the LED display board is “ON”, it will display the messages and then dance movements by the rhythm of music using a PIC microcontroller. It is not needed to change the LED panel, only to change the input data in PIC program. In this system, LED panel is controlled by a program in microcontroller from serial to parallel shift registers using the scanning method. PIC microcontroller is for generating the output signal to output display board by using a program. Then, it will be run on the LED display board. This is very useful in area like railway platforms, streets, banks, training institutes and other applications to show data information on the large LED boards. As a result, this LED display board is useful as indoors or outdoors as it is also economic. This display consists of maximum 72 bright LEDs which are rotated to show the display. In this system, this display can show data information which will require a whopping 512 LEDs. Therefore hardware and cost minimization is achieved.

PIC Basic Pro programming language will be used in PIC microcontroller. The simulation result will be tested with Proteus 8 Electronic Simulation Software.

Keywords: LED display board, PIC 16F887 Microcontroller, PIC Basic Pro Programming, Proteus 8

I. INTRODUCTION

Nowadays, uses of LEDs are increasingly made in many applications as a replacement for traditional light bulbs. It is a way of visual information where large LCD and other display become too much expensive. The displays are commonly seen single colored or having 2 or 3 colors. This system supports an efficient and scalable approach to LED displays. This system is comprised of a red color matrix display panel. It also includes an executive program that runs on the PIC microcontroller for the display control of data information on the display board. LEDs provide several advantages over traditional light bulbs, such as small size and longer life. A red color LED can be used to advertise even day-light conditions. The LED display board displays images and messages entered by using a microcontroller that initializes the led driver and rhythm of music drives together with this displays by using music circuit.

Today, LED displays are very popular of displaying information because it allows both static and animated images. In this project, the system is based on LED display board that is able to perform dance movement according to the rhythm of music. In many applications, LEDs must be driven with intelligent control circuitry. LED displays have been encountered in the public places, building machinery operator panel screens and alongside highways displaying advertisements on large display panels. In this work, about the basic structure of a monochrome (single color) LED matrix and it connects with a microcontroller to display static characters and symbols will be discussed. PIC microcontroller is used but this technique is applicable to any other PICs that have sufficient I/O pins to drive the LED matrix. Furthermore, it is also necessary to adapt the driver for LEDs in different brightness groups by means of hardware selection.

Displaying messages on a 16x32 LED matrix will be discussed. In this circuit, the simple producer will be used. When it is power on, the LED display board is shown messages and then performed dance movement according to the rhythm of music. This technique will be demonstrated for performing dance movement using music.
and can be implemented for scrolling in other applications. The program for PIC 16F887 is used as a heart to control for this system and is developed and written with PIC Basic Pro Programming Language. The system block diagram is shown in Figure 1.

Figure 1: Block diagram of LED display Board for advertisement using microcontroller

Literature Review

- Multi Level LED dot matrix display panel by Kim Ling Sheng

The author mentioned that

- In this design technique, 18 pieces of 8x8 LED dot matrix is used to design the display panel.
- This display panel is programmed by using Assembly language to program the PIC 16F877A.
- It displayed alphanumeric and graphic character.

II. Hardware Components

The first step was the evaluation of the requirements that needed to be met. The technical features for physical operation and possible applications of the system were discussed. Also, the functional specifications outlined of the purpose and features of the design would finally fulfill were also addressed. The main control circuit was initially tested with Proteus software because the microcontroller ports used for various tasks would ultimately change as the work developed. Thus, the pin connections could easily be changed as required. The microcontroller requires very few external portions for typical operation.

An illuminated display usually consists of smaller modules arranged together to form a larger screen, each module usually consisting of a 4 x 8 matrix of LEDs. This idea is used in this design of 16x32 LED matrix display. In this board, bright 512 LEDs matrix panel has on board controller circuitry designed. The goal of this paper is to create a display performing dance movement according to the rhythm of music. Red LEDs are used to design. In this LED display board, many LEDs are connected in serial form. The 16x32 LED display panel with 512 LEDs are arranged in 16 rows and 32 columns structure is shown in figure 2.

The rhythm of music using sound circuit is created the pleasant sound as soon as data is displayed together with sound in this system. This system is a fantastic way to illuminate any kind of sign and other applications.

A. Expansion of LED Usage

In selecting the LEDs to use for the display the most available units were chosen for their comfort of supply. To create a large matrix that forms the display screen was needed by these units. The modules of this design are the 4 x 8 dot matrix units which are widely available in a variety of sizes. Fig 2 shows the configuration of this 4 x 8 dot matrix unit. These displays were also preferred as they have pins that are connected in a similar design to integrated...
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circuit. The pin configuration made it easy to connect the LED modules on board controller circuitry designed, as well as making connections to the pins straightforward. The matrix LEDs has a common anode connection for each of the 8 columns and a common cathode for each of the 4 rows.

Nowadays, the use of LEDs matrix for displaying system is made increasingly with its usage expanding. LED displays can be found in airports, railway stations, shopping malls, hospitals and etc. A result of its ability to convey information to large audiences quickly and efficiently is been by the usage of LED display. LED displays are often controlled by digital technology the information, so it can swiftly and easily be updated. The LED displays have led to a great flexibility in many applications. An additional advantage of using this system; LEDs are a very efficient form of illumination.

![Fig. 2 Configuration of 8x4 dot-matrixes](image)

This system has been developed which allows for LED design based on microcontroller and other component selections for these design. The PIC microcontroller is used to control all function of this system. Large sized LED display panel is used to display data or information in public area. In this board, bright 512 LEDs matrix panel has on board controller circuitry designed. It has 1 octal transceiver (buffer), 16 shift registers, 1 transistor (decoder) and 4 LED display drivers on board controller circuitry. This system is implemented by LED board because it is easy to construct than other LED Dot Matrix. This idea is used in this design of 16x32 LED matrix display. In order to connect a microcontroller with serial port to LED display panel, 1 octal buffer is used for two way asynchronous communication between data buses. Typically, the serial port of PIC microcontroller is used with a buffer to provide a serial communication link to another unit. All 16 shift registers are cascading to run through a same serial clock. The similar columns (cathodes) of all serial matrices are connected together so that there are 32 combined columns in totals. The 32 columns of LEDs are driven individually by 16 shift registers. The shift registers is to convert the serial data input to parallel data output.

### B. Serial-In Parallel-Out Shift Registers:

The 74HC595 IC is an 8-bit shift register and this IC can shift 8 bits to the outputs with only 3 wires, that are Data (Ds) and two shift inputs (SH-CP, ST-CP). In order to display the LEDs in 16-moduled is controlled by multiplexing of the I/O to the microcontroller is required. The 74HC595 IC is a series of serial-in to parallel-out shift register used to convert serial bits to a parallel output port to the LEDs. By shifting the shift registers (74HC595) together, the large parallel output port required to address each LED accomplish. This means the serial output of the shift register sequence is cascaded to form the input of the next shift register. The shift registers used are a74HC595, serial-in 8-bit parallel-out IC, which is shown in Fig. 3.
The devices have two separate registers within it, a shift register and a storage register; each register is provided with a separate clocking input: SH_CP and ST_CP. In operation, data is fed serially into the register through data source (DS) pin and is shifted on the positive-going transitions of the SH_CP input when connected in this cascading manner. The parallel outputs of the shift registers are not rated to handle enough current to illuminate the LEDs that they control. To get full illumination of the LEDs in the system, each will be pulsed with 50mA. As a result, the transistor drives 4 LEDs drivers. LED drivers are used to control the row of LED modules. These control the intensity and the brightness of the display. The row (anodes) are driven separately and one driver circuit has separated 2 channel because it drives 2 rows of LEDs and hence there are16 rows altogether. LED drivers are used to supply each all the LEDs with enough current to fully illuminate them. The LED drivers used are MW4953 that contain to control the intensity and brightness of the display. It controls the color of the display and decides which LED is to be lighted to display specific characters. The MW4953 is comprised of eight source current transistor array.

III. System Design

As the technology and light output of LEDs continues to improve, applications for color and white brightness LEDs are expanding into entirely new markets. LED display board is a 16x32 red LED design for wide range of applications. This LED board is divided into 4 portions. This system is to perform dance movement according to the rhythm of music. Advertising is one way that this has been achieved. It is very convenient by seeing from distant place people. The system begins with an introduction to the concept of LED display board and how it may be constructed LED display and PIC microcontroller.

A. Software design for the System

As shown in fig 1, the construction of LED display board consists of two parts: the hardware and software implementations. Both software and hardware will be accomplished using PIC 16F887 microcontroller. The microcontroller was chosen for reasons of speed memory storage, number of I/O ports and digital ports ability. This program is written by PIC basic pro language because it is easy to understand than other programming languages. This structure is applied in serial form. The LED matrix used in this work is of size 16x32. In below, how to display in a standard 16x32 pixel format is discussed. Figure 4 shows which LEDs are to be turned on to display the row value of each column for displaying images and figure 5 shows the program flowchart of the LED displays.

Figure 4. Row value of each Column for Displaying Images
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In this system, maximum 72 LEDs will be lighted at once. The LED display board is displayed images for performing dance movement according to the rhythm of music when it is power on. The complete circuit diagram of the proposed system is depicted in figure 6.

PIC 16F887 microcontroller is used as control unit. PIC 16F887 microcontroller consists of 40 pins. It contains 5 Input/output (I/O) ports with 33 I/O pins. Those input/output ports are Port A, B, C, D and E. The next 7 pins are two Vss, two Vdd, two clock input pins and master clear(MCLR) input. By using the sophisticated PIC 16F887, the LED display board uses fewer components that would have been required in the system. This microcontroller can be reprogrammed because it uses flash-read only memory for program storage. The LED display board contains power supply unit, PIC 16F887 and other components. The power supply unit is a combination of a 20 MHz crystal, two 22pf capacitors. 12v input voltage is supplied to the power supply unit and the output is 5v. Pin11 and 32 of the 16F887 are connected to the Vcc while pin 12 and 31 are connected to the ground. Pin13 and 14 are connected to 20MHz oscillating crystal. In this system, PORTC and PORTD are used for output pins and PORTB is used for input. PORTC and PORTD are connected to the transceiver. PORTB pin33is connected to the sounder. Port C pin 4, 5 and 6 are connected to input 3, 6 and 7 of the 74HC245 while Port D pin 2 and 3 are connected to input 2 and 3 of the 74HC245. Enable 1 and 2 are always enabled by connecting them to the Vcc. The 5V power supply is connected to Vdd, Vss and ground.
In this LED displays, Pic Basic Pro Language is used for PIC 16F887 microcontroller because this compiler software is easy to install and its commands are easy to understand. The software is required for displaying dance movement according to the rhythm of music. A microcontroller is nothing without software to run it. To program the PICs, a binary file of coded 1s and 0s is required. This system is simulated by using Proteus 8 software and the programming language used is Pic Basic. The program flowchart of the LED displays is illustrated in figure 5.

The data information is stored in EEPROM. PIC microcontroller initializes the data information when it is power ON. It needs to set RAM for clear and set the scan time is 50. Firstly, the sound is OFF, the images will be loaded images MTU and EC. After loading: it means that the sound is ON; the images will be loaded by displaying dance movement according to the rhythm of music.

The aim was to make sure that all the LEDs on the display panel was lighting correctly. In figure 7, the tested circuit can successfully display images on the LED display panel but this system is not available to test by using many LED display panels and all of contained ICs in Proteus.

Figure 6. Overall Circuit Diagram for the LED Displays

IV. Software and Hardware Result

A. Software result

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Figure 7: Simulation result of LED display Board for Advertisement
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B. Hardware result

A display panel consists of 16 modules arranged together to form a larger screen, each module usually consisting of a 4x8 matrix of LEDs. LEDs display board is composed with many red LEDs. This display board has 16 rows and 32 columns (512 LEDs). To get full illumination of the LEDs, each will be pulsed with 25mA. The maximum required current is 1800mA. In this system, 72 LEDs will be lighted at once. Fig 8 shows the implementation of the designed LED display board for advertisement.

![LED Display Board](image)

Figure 8. Test Result for some LED Displays

This design can be divided into several modules. They are LEDs matrix, sound system and power supply. There are some devices and components used in the design to implement each unit. These devices used in this system are as follows:

- 16F887 microcontroller
- LEDs matrix
- Octal bus transceiver (74HC245)
- Shift register (74HC595)
- LED driver (MW4953)
- Power supply

In this LED displays, PIC Basic Pro Language is used for PIC 16F887 microcontroller because this compiler software is easy to install and its commands are easy to understand. The software is required for displaying dance movement according to the rhythm of music.

V. Discussion and Conclusion

This display board is a single color LED matrix board which can be used for advertising and other display applications. In this paper, PIC 16F887 microcontroller is used to control the display board. Red LEDs are used on board controller circuitry designed and it is connected in serial form. Although many LED Dot Matrices have in economic; the LED display board is done. Because the board is easy to set up for wide range of applications today. The designing process of this system includes the hardware and software portions. In software portion, a program of PIC microcontroller is written in PIC Basic Pro language and it will control all function of display board. In hardware, LED displays and sound circuit are included. This paper is designed to construct using with the devices which can buy easily in the market, easy to apply with a person who interested in electronic field.

In conclusion, the circuit diagram is complex but the design and construction are quite simple and there is no complication. Red LEDs are used to create the display board and these LEDs are connected in serial form. This LED display board is basically low cost. Since microcontroller IC is used in this display circuit, the circuit is more
compact and power consumption is very low. It needs software for changing the information to display. This LED display board is also widely used in advertising and information devices. This display board can be commercially produced by modifying. This concludes the construction and programming of the LED display board.

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