



**PROCEEDINGS OF  
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*Volume - 1*

**Electronics  
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# **ELECTRONIC ENGINEERING**

# Microcontroller-Based Message Display Signboard

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**Abstract**— The architectural design and construction of character message display signboard is the personal computer-based message display system by using microcontroller for general purpose. This system is based on microcontroller, digital logic circuitry, programming, as well as the LEDs and necessary power delivery. In this research work, proposed (16 x 128) LED matrix panel is constructed. Significant advantages of the proposed system are simple design, efficient technology and cost-effectiveness. Either Myanmar or English messages can be displayed occasionally for special purpose via personal computer. By storing the desired characters inside the EEPROM, ROM and other external flash memories, the required messages can be displayed. Thirty two numbers of characters can be displayed simultaneously at one time. The operator can change the messages occasionally for special purposes by means of the computer. Message display systems using other languages can be developed using this system without many changes in hardware configuration. It only needs slight modification in programming and character mapping.

**Keywords**— computer-based message display system, thirty two numbers of characters, English or Myanmar message

## I. INTRODUCTION

The digital electronic displays are very important in industry, home and public applications. There are several kinds of display systems constructed by microcontrollers. The Peripheral Interface Controllers (PICs) are generally compact construction, small size, low power consumption and suitable price. Display unit such as Light Emitting Diode (LED), Liquid Crystal Display (LCD) and Cathode Ray Tube (CRT) can be used as a basic element of a display unit. The LEDs are very light in weight, long life expectation and the cheapest cost among the three major display mediums. Super bright (high intention) LEDs are available to see from a long distance. In this research work, display panel, driver unit and main control unit are included. They are designed with Light Emitting Diode, Peripheral Interface Controller (PIC) and other electronic components and devices.

The following block diagram shows microcontroller-based message display system. In this system, Personal Computer (PC), serial interfacing unit (level converter I.C), external EEPROM (memory I.C), microcontroller (PIC), LEDs driver unit (serial in parallel out shift register I.C and decoders),

LED panel, and power supply unit (5 volts regulated power supply) are included.

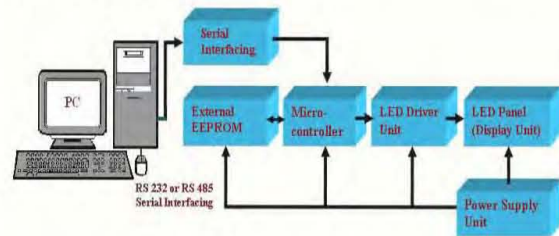


Fig. 1 Block Diagram of Microcontroller Based Message Display System

## II. METHODOLOGY

There are three modes in PC based message display constructed by microcontroller system. They are I2C EEPROM data reading mode (read mode), USART data fetch and display process (live mode) and USART data fetch and I2C EEPROM data write process (programming mode). The required data which is stored inside the 24C16 serial EEPROM are displayed in the LED panel. The message, which is sent by the Personal Computer (PC), is also displayed in the LED panel.

In this proposed circuit, PIC16F877 microcontroller, 74LS164 8-bit serial in parallel out shift register, 24C16 serial EEPROM, MAX232 level converter, thirty two numbers of (8x8) matrix LED panels and other electronic components and devices are included. In microcontroller portion, RB0~RB7 and RD0~RD7 are used for the signal control of the sixteen rows. The other RA0 and RA1 pins are used to insert input data and clock signal for the 74LS164 serial in parallel out shift registers. These sixteen registers are connected to all of the 128 columns. The left three pins of RA2~RA4 are used in mode selection. Pin RC3 and RC4 are used in I2C communication to external EEPROM. Pin RC6 and RC7 are also used to communicate Personal Computer (PC) by using MAX232 level converter.

The output signals for each row are amplified by the A564 PNP transistors and 4.7 kΩ resistors are used for biasing. The data output signals from the microcontroller gives one pulse to the 74LS164 register and then clock pulses are entering simultaneously. The required messages are shifted to each column one by one from left to right and vice versa. The circuit

diagrams of proposed message display system are shown in Fig. 2 and 3.

The LED matrix is common anode construction and the required signals pass through the 2N2222 NPN transistors. For biasing, 4.7 kΩ resistors are used. The USART module is used to transmit and receive data via MAX232 level converter.

There are two types of LED array construction. They are common anode for LEDs in a row and common cathode for LEDs in a row. The biasing polarity is mainly different in these constructions. In digital logic circuit, common anode construction is more widely use than the other construction. In this project, thirty two number of 5mm (0.2 inches) common anode general Purpose (8x8) Dot Matrix Alphanumeric Display panel is used.

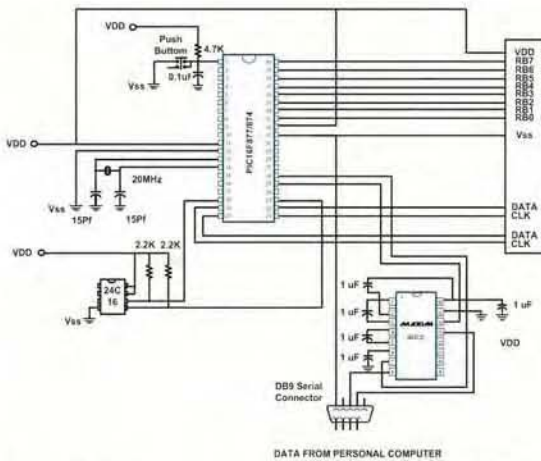


Fig. 2 Control Circuit Diagram of Proposed Message Display System

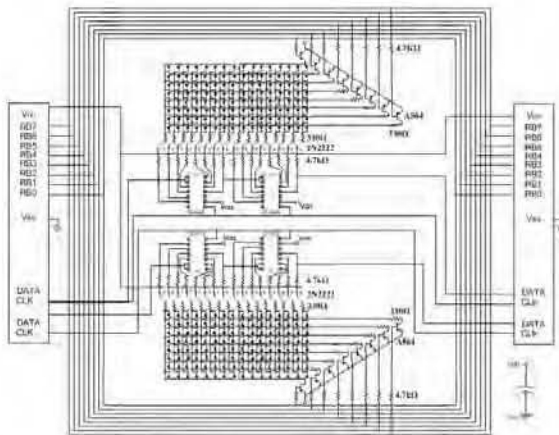


Fig. 3 Driver Circuit Diagram of Proposed Message Display System

This panel can emit two color, red or green, at one time. The red color has low power consumption and brighter than green color and in this research red color is used.

#### A. Design Calculation for the LED Driver Circuit

In the proposed message display circuit, two types of transistors are used for the switching mode. They are 2N2222 NPN and A564 PNP switching transistors. The following is

calculation of base and collector resistance values of 2N2222 NPN transistor, for the column-scanning unit.

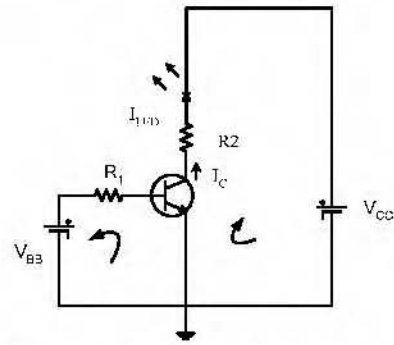


Fig. 4 Common Emitter Circuit for Column Scanning

$$I_{LED} = 10 \text{ mA (typical value)}$$

$$V_{LED} = 2 \text{ V}$$

$$V_{CE} = 0.2 \text{ V (from the data sheet of 2N2222 NPN transistor)}$$

By Kirchhoff's voltage law,

$$V_{CC} = I_{LED}R_2 + V_{LED} + V_{CE} \quad (1)$$

$$R_2 = \frac{V_{CC} - V_{LED} - V_{CE}}{I_{LED}}$$

$$R_2 = \frac{5 - 2 - 0.2}{10 \text{ mA}} = 280 \Omega$$

So, 330 Ω standard value of series resistor is chosen.

One LED is connected in each transistor. Therefore,  $I_C = I_{LED}$

$$I_C = 10 \text{ mA}$$

$$= 10 \text{ mA} < I_{Cmax}$$

According to the data sheet of 2N2222 NPN transistor,

$$I_{Cmax} = 180 \text{ mA}$$

If the transistor is used as switch,

$$I_B = 0.1 I_C$$

$$I_B = 0.1 \times 10 \text{ mA} = 1 \text{ mA}$$

Forward voltage drop of the light emitting diode,  $V_{BE} = 0.8 \text{ V}$

By Kirchhoff's voltage law, voltage across  $R_1$  is  $V_{R1} = V_{BB} - V_{BE}$

$$V_{R1} = 5 - 0.8 = 4.2 \text{ V}$$

By Ohm's law,

$$V_{R1} = I_B R_1 \quad (2)$$

$$R_1 = \frac{4.2}{1 \text{ mA}} = 4.2 \text{ k}\Omega$$

So, 4.7 kΩ standard value resistors must be chosen.

Calculation for the row resistors are the same as column scanning unit.

### III. SOFTWARE IMPLEMENTATION

All In this portion, software simulation is presented by using Microchip MPLAB IDE Version 7.00 simulation

software. Software flow chart is expressed in the following Fig. 5.

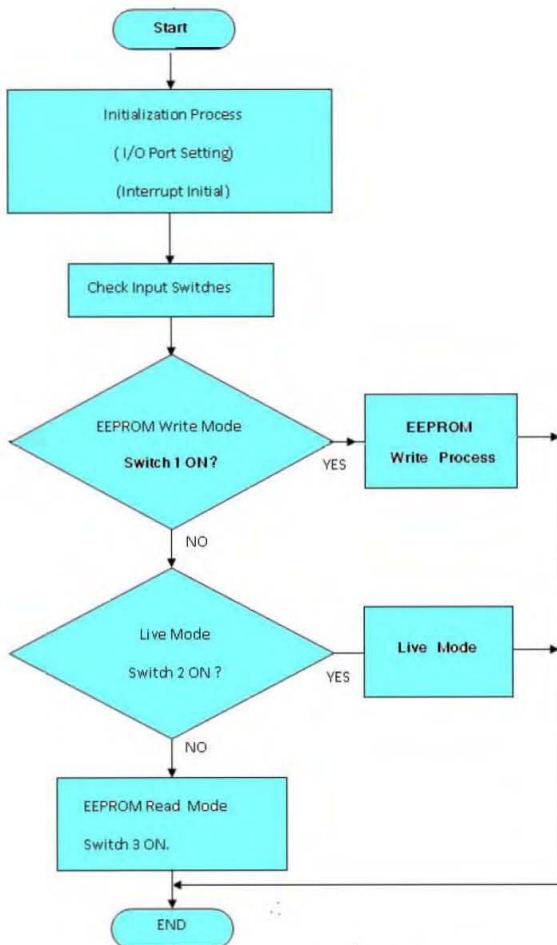


Fig. 5 Software Flowchart of Overall Process

A. LED Display Process

(1) Data RAM Screen Layout

Figure 6 illustrates the (16x128) data RAM structure in microcontroller.

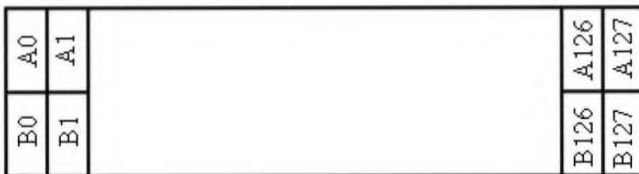


Fig. 6 The Data RAM Structure

(2) Screen Load Process

When a message is displayed on the LEDs of 16 x 128 screen sizes, the blink condition of 2048 LEDs is controlled in 256 bytes of the RAM file memory. Set all bytes 0xFF will glow all LEDs and 0x00 will be dim. Data from external EEPROM and USART was filled right most column (2 Byte) first. Then call a subroutine named SCAN to display on LEDs. This process is shown in Fig. 7.

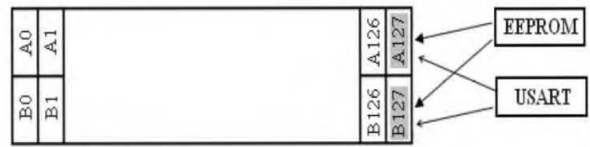


Fig. 7 Data Insertion form EEPROM and Computer to RAM

Read EEPROM and Fill display RAM

Example:

```
CALL    RANDOM_READ
MOVWF  A127
CALL    RANDOM_READ
MOVWF  B127
```

(3) Screen Shift Process

After specific scan times, LED display shift process is executed. By this process, it shifts the message to be displaying to the left for one column. It is illustrated in Fig. 8.

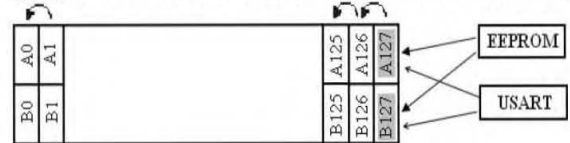


Fig. 8 Screen Shift Process in RAM

Example:

```
MOVF   A1, W
MOVWF  A0
MOVF   A2, W
MOVWF  A1
MOVF   A3, W
MOVWF  A2
```

Fig. 9 and Fig. 10 show the software simulation process.

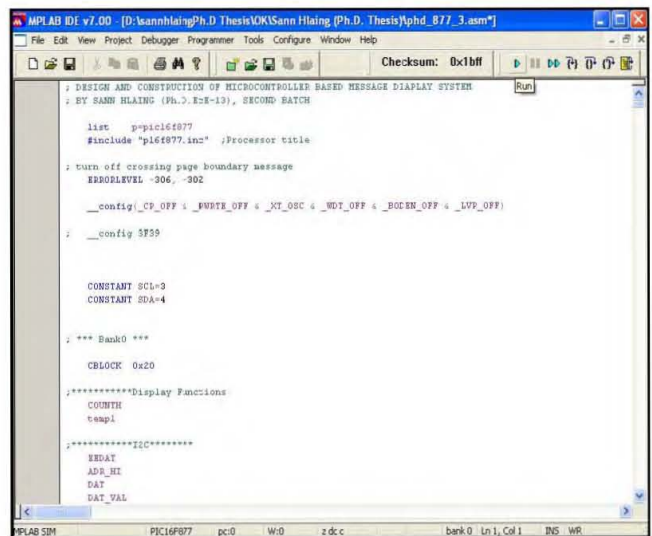


Fig. 9 Software Simulation of Proposed Project



After completing this process, the input data from the computer is tested by the oscilloscope. This is interface with MAX232 level converter by using USART module. The measurements of changes from RS232 to TTL/CMOS logic voltage level measurements are illustrated in Fig. 17 and 18.

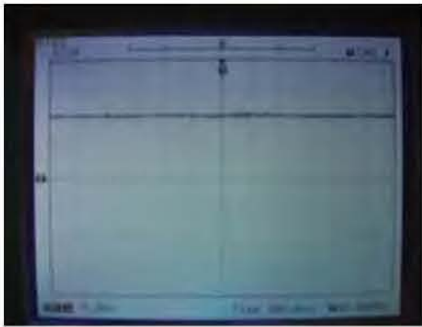


Fig. 17 The Transmitting Voltage Level from the Personal computer

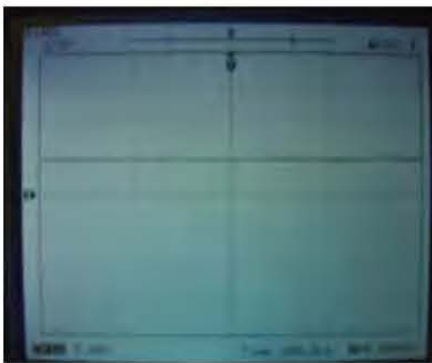


Fig. 18 The Receiving Voltage Level of MAX232 Level Converter

The final output result photos are shown in Fig. 19 and 20.



Fig. 19 Final English Character Message Display Result



Fig. 20 Final Myanmar Character Message Display Result

## V. DISCUSSION, CONCLUSION AND RECOMMENDATION

In this research paper, design and construction of microcontroller-based message display system has been presented. Although this research gives many advantages a few problems were also encountered in the fabrication of large area PCB board. Leakage of currents and short circuits are possible in the fabricated PCB. High quality lighting medium was also needed.

In this paper, water clear normal bright LED arrays are used for the display medium. If high current (HC) type semiconductor devices and the super bright single LEDs are used, the light will be brighter. By using the LED panel, it is easy to change the displaying colour. And it is easy to find the faults of the displaying circuit portions. The significant advantages of the proposed systems are simple design, high performance and cost-effectiveness.

This designing process includes hardware and software portions. In the proposed message display signboard, (16x128) matrix LED panel is used for display medium. It is directly connected with the Personal Computer (PC) and controlled by the PIC 16F877. It is also shifted by using 74LS164 serial in parallel out shift register. MAX232 level converter is used to convert the RS232 to TTL/ CMOS logic voltage. Thirty-two numbers of characters can be displayed simultaneously from right to left and vice visa.

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