International Journal of Engineering Management and Life Sciences (IJEMLS)
Volume: 02 Issue: 01 | Jan-Feb-2017 **ISSN: 2456-2580** **www.ijemls.com**

Design And Implementation Of An Alphanumeric Micro-Controller Based Gsm Scrolling Display System

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Abstract

There is the need for man to control electronic appliance(s) without necessarily moving an inch. This research paper discusses the design and implementation of a micro-controller-based global system for mobile communication (GSM) scrolling display system. The work uses the micro-controller (PIC 16F877A) as the control component in the construction of the device which makes simple, the design of the device due to the addition of the input/output port on the microcontroller. A GSM module was incorporated in the design which functions as the receiver of the message sent via short message service (SMS) on a GSM phone. There is an additional rechargeable battery back-up to compliment for power instability. The device is suitable for use at any location within the globe. The LED display system mainly consists of a GSM receiver and a display toolkit which can be programmed from an authorized mobile phone. It receives the SMS, validates the sending Mobile identification Number (MIN) and displays the desired information after necessary code conversion. The GSM-based system offers flexibility to display flash news or announcements faster than the programmable system. It can also be used at other public places like schools, gardens etc. without affecting the surrounding environment. The GSM network is inherently digital which makes it secured, relatively error-free and jamming-proof. Hospitals, banks, sports stadium, airports, railway stations, education sectors and stock markets etc find this device a useful tool to communicate electronically. It has an unparalleled advantage in drawing people's attention by prompting them to reflect many times on the scrolling lights, automatically displaying either messages of advertisement, place description or greetings at any time of the day. It can be used for both indoor and outdoor purposes. In fact it is the most alluring, unique, captivating and attractive means of information dissemination.

Key Words: Global System for Mobile Communication (GSM), Scrolling Display, Short Message Service (SMS), Mobile Identification Number (MIN), Light Emitting Diode (LED), Random Access Memory (RAM), Read Only Memory (ROM).

INTRODUCTION

The role of information dissemination in the society cannot be over-emphasized. In addition to its vital functions of enlightening, educating, entertaining, and facilitation of commercial activities through advertisement and marketing of goods and services, its use in surveillance and monitoring (security, traffic control etc) and description of places also remain indispensable.Various means of information dissemination which include broadcasting (radio and television), the internet, newspaper, bill boards, sign posts and neon displays, are employed, the choice of which depends on factors such as the targeted audience, the environment concerned, the purpose, available technology and economy(Kobert et al 2002, Sedha 2002).

The use of "embedded system in communication" has given rise to many interesting applications which ensure comfort and secures human life. GSM network is among the most widely used wireless communication networks today for calling or sending SMS. Microcontroller controls the system by doing verification and thus making it more secured than other display systems. This system is easy to use in day to day life by any-one and at any place (globally). This will overcome the difficulties of latency faced by the previous moving text message display modules using wired entry via computer, keyboard or remote control entry (small distance).

Moving message display boards were constructed using a circuitry which uses shift registers and timers that control a system of hardwired LEDs. Digital bill board can be realized from a micro-controller. The micro-controller can manipulate data (binary values) following an organized sequence of steps in a system of micro-processor circuits that send control or driving signals to LED matrix. Thus, digital billboard can be represented generally by the control unit and display unit as shown in Figure 1.

MICROCONTROLLER

A microcontroller is a computer control system on a single chip. It has many electronic circuits which can decode written instructions and convert them into electrical signals. The microcontroller also goes further, stepping through the instructions and executing them one by one (Sedha 2002, Hehta 2013).

Constituents of a Microcontroller

A microcontroller is a single integrated circuit, having some important features which include central processing unit ranges from 4 bit processor to 32 or 64 bit processors. It has Volatile RAM for data storage, ROM, EPROM, EEPROM, flash memory for programming as well as storage of the processing parameters, Bi-directional I/O pins allowing control and detection of logic state, serial communication interfaces like I2C, Serial peripheral interface and controller area network for system interconnect, peripherals like timer, counter, PWM generator, watchdog timer, clock generator, ADC, DAC and finally in circuit programming and debugging support.It is also capable of consuming low power.

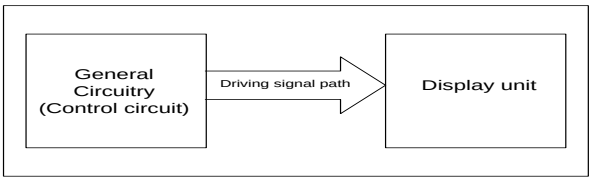

Figure 1: General Model of Moving Message Display Board

The basic microcontroller system is as shown below in Figure 2.

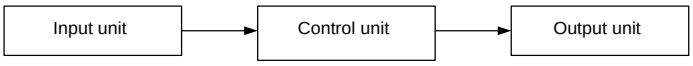

Figure 2: Block diagram for the basic microcontroller system2

The Input Unit:

The input component consists of digital devices such as switches, push buttons, pressure mats, float switches, keypads and radio receivers, e.t.c. It also consists of analogue sensors such as light dependent resistors, thermistors, gas sensors, pressure sensors, e.t.c.

The Control Unit:

This is of course the microcontroller itself. The microcontroller monitors the inputs and as a result of the program written into it, turns output ON and OFF. The microcontroller stores the program in its memory and executes the instructions under the control of the clock circuit.

The Output Unit:

This consists of output devices such as light emitting diodes, buzzers,motors, alphanumeric displays, radio transmitters, 7-segment displays, etc.

Microcontroller is similar to microprocessor but with addition of I/O ports, memory, counter, a clock and interrupt circuitry. It is the additional circuitry that makes the microcontroller such a unique device. The microcontroller is designed primarily to operate on data that is fetched through serial or parallel input ports.The data is operated under the control of software stored in ROM and external device control though signal fed via the output port.

Microcontroller is designed to operate with the minimum of external circuitry to perform control-oriented task using a control program ROM. The instruction set for the microcontroller is simpler than that of the microprocessor, since most of its instructions will move code and data from internal memory to Arithmetic and Logic Unit (ALU). The use of many inputs/output pins allow data to be moved between file microcontroller and external devices often as single bits. The operation on single bit such as logical operation, flag settings/clearing, e.t.c. is unique to the microcontroller. Microcontrollers are available in various sizes, the most of which is 8-bit although, 16-bit is popular for higher performance specifications (Kobert et al 2002, Leo 1984, Gaj 2014).

Features of Basic Microcontroller:

The basic arrangement is shown in Figure 3 below.

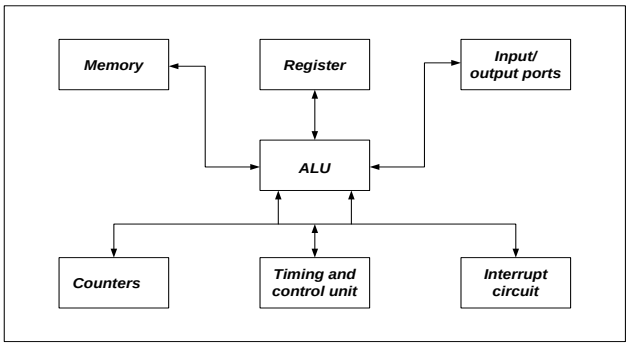

Figure 3: The basic arrangement of the internal structure of the microcontroller.

The Arithmetic and Logical Unit (ALU):

The Arithmetic and Logical Unit (ALU) performs arithmetic manipulations such as binary additions, subtractions and possibly multiplications and divisions. Logic functions such as AND, OR, NOT and Ex-OR can be implemented. The ALU consists of gates, which are organized to receive binary inputs and provides binary output according to the instruction codes. The register group contains the data that the processor needs while performing the task of executing a program. The registers include the Program Counter (PC), the Accumulator and Stack Pointer(Jijay et al 2014, Leo 1984).

The Input/ Output Unit

The input/output interface allows the connection of input data via a keyboard and sensors which can transpose information into electrical signal. For output data, this could be a monitor to display instructions, data and output that can feed external devices such as relays and LED. The amount of I/O provided in any particular microcontroller system is

determined by the range of applications envisaged. In this design, input from the keyboard is accepted during the data programming and the display output during the running of the programming is displayed (Dahul and Preeti 2013, Frachee et al 2013).

Light Emitting Diodes (LED)

A LED is a P-N junction device (diode) that gives off light radiation when biased in the forward direction. LED chip materials are combinations of elements from the III and V columns of the periodic chart. The light emitting phenomenon makes use of the recombination within the P-N junction instead of thermal radiation. LEDs have a long life time. By controlling the forward current, the radiant flux of the LED can be easily controlled. The response time of an LED is very high (a few hundred nanoseconds) and can be pulsed at greater forward currents, to obtain high intensity radiant peaks. The resin packaging of LEDs allow for superb mechanical integrity and can withstand dropping, vibration and shock(Fanas et al 2013, Caj 2014, Brachee et al 2014).

LEDs are widely used as indicator lights on electronic devices and increasingly in higher power applications such as flashlights and area lighting. A LED is usually of a small area (less than 1mm2) light source, often with optics added to the chip to shape its radiation pattern and assist in reflection. The colour of the emitted light depends on the composition and condition of the semiconductor material used, and can be infrared, visible, or ultraviolet (Gaj 2014, Hehta 2013).

DESIGN OF THE SYSTEM

The power supply unit is the unit from which the maximum 5V d.c. voltage ever needed in the circuit is supplied. The unit comprises of the following components as shown in Figure 4 below.

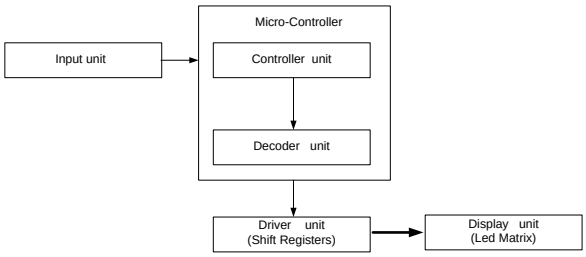

Figure 4: Design of the system

i. A transformer which steps down the a.c supply voltage to suit the requirement of the solid-state electronic devices and also provides isolation from the supply line

ii. A full wave bridge rectifier which performs the transformation of the a.c. voltage into a pulsating d.c. voltage in a process known as rectification

iii. Capacitors which filter out (remove) fluctuations or pulsations (called ripples) present in the rectifier output voltage.

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A fixed 1C voltage regulator (78L05) mounted on the internal circuit board to provide a stable + 5V d.c. output from the unregulated 12V d.c. fed into its input from the a.c/d.c. adaptor.

Using a 240V transformer on a 50Hz supply, transformer secondary r.m.s voltage output is 12V.

$$Peak\ voltage, V_p = V_{rms} \times \sqrt{2} \quad (1)$$

$$V_p = 12\sqrt{2} = 16.97V \quad (2)$$

$$Supply\ frequency, f = \frac{1}{period\,(T)} = 50Hz \quad (3)$$

$$Period, T = \frac{1}{f} = \frac{1}{50} = 0.02s = 20ms \quad (4)$$

The total voltage drop, V_d, for the two diodes involved in the rectification process in either of positive or negative cycles,

$$V_d = 2V_{BE}\,[V_{BE} = 0.7V\ for\ a\ silicon\ diode] \quad (5)$$

$$V_d = 2 \times 0.7V = 1.4V \quad (6)$$

Actual peak voltage value, $V_{LM} = (V_m - 2V_{BE})V$ (7)

$$V_{LM} = (16.97 - 1.4)V \quad (8)$$

$$V_{LM} = 15.57V \quad (9)$$

Change in peak voltage value over the discharge period, $\delta V = V_{LM} - V_{dc}$ (10)

$$V_{dc} = 10V \quad (11)$$

The filter capacitor should not discharge down to 6V in accordance with the input voltage specification of the voltage regulator.

$$\delta V = (15.57 - 10.0) = 5.57V \quad (12)$$

Change in time over the discharge period,

$$\delta t = 10ms \quad (13)$$

Total current consumption for this design is not expected to exceed 600mA

Hence the value of the filter capacitor is obtained thus:

$$C = \frac{600mA \times 10ms}{5.57V} = 1077.20\mu F \quad (14)$$

For safety reasons, the value of the capacitor was chosen to be twice the calculated value i.e. 2154.4µF.

The nearest available capacitor value of 2,200µF was used as the filter capacitor.

IMPLEMENTATION

The implementation of this work was done on the breadboard. The power supply was first derived from a bench power supply in the school electronics laboratory. The implementation of the work on bread board was successful and it met the desired design aims with each stage performing as designed.

CONCLUSION

This technical paper has discussed "GSM based Alphanumeric Scrolling Display System" which can be widely used for displaying notices in colleges, advertisement in stock market, by sending messages in form of SMS. The hardware board contains PIC 16F877A microcontroller at the heart of the system. The microcontroller is interfaced with GSM Modem. It is used to convert RS232 voltage levels to TTL voltage levels and vice versa. Microcontroller coding was done using embedded C programming. Multiple users are authorized to update notices on the digital notice board provided the user has the pass code

The digital scrolling light advert display was implemented using light emitting diodes (LED) matrix array. The LED matrix array was driven by a microcontroller programmed to handle the character/ message display. The choice of the LED matrix array and the use of a microcontroller were made to ensure that the display unit does not consume much power. A GSM module which serves as the receiver of the transmitted pulses from the mobile phone was also incorporated.

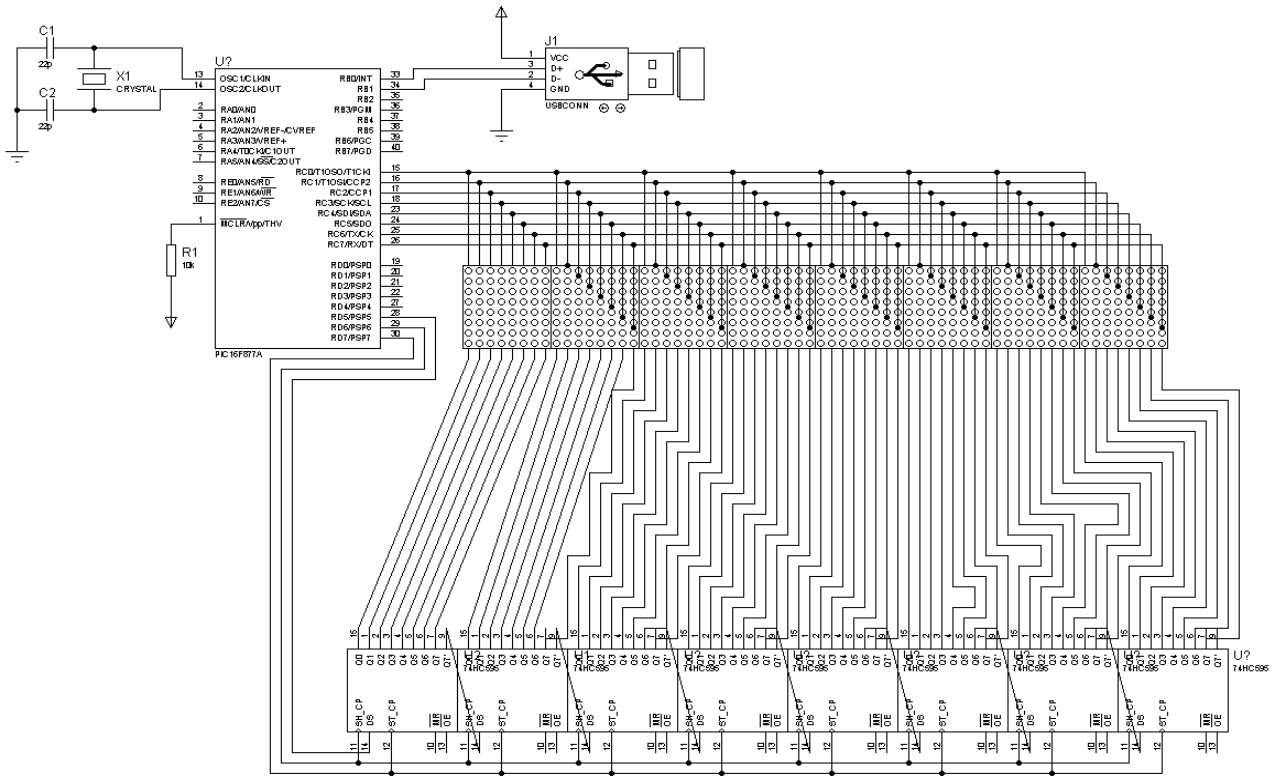

Figure 5: Circuit Diagram for A GSM Based Scrolling LED Display System

Conflict of interest: None

REFERENCES

1. Brachee U, Kunalp.T, Akash P and Kulkarni R.T (2014):"GSM Based Alphanumeric Scrolling Display System'', International Journal of Advanced Research in Computer Engineering & Technology (IJARCET). 3(2): 149-155.

2. Caj H **(**2014): ''Applications of GSM Based Scrolling Display System'', International Journal of Advanced Research in Computer Engineering (IJARCT). 8(7): 419- 422.

3. Dahul K and Preeti A(2013): "Design and development of GSM- based multiple LED display boards",International Journal of Computer Applications. 7(8): 40-46.

4. FanasK.Pi, Banasree D and Gautam D (2013): "An overview of microcontroller based-system'' International Journal of Soft Computing and Engineering (IJSCE). 2(6): 228-231.

5. Frachee U.K, Kunal P.T, Akash P, Kulkarni R, Rajkishor M and Tugnayat J(2013): "GSM mobile phone based LED scrolling message display system'', International Journal of Scientific Engineering and Technology. 2(3):149-155.

6. Gaj H (2014):"GSM based alphanumeric Scrolling Display System",International Journal of Advanced Research in Computer Engineering & Technology (IJARCET).3(2): 419-422.

7. Hehta V.K (2013): "Principles of Electronics", Second Edition, S.Chand& Company Ltd, India. 23-65.

8. Jijay G, Sedra Y and SmithR(2014): "Microelectronic: principles and applications of GSM" International Journal of Engineering and Technology.4(8):34-61.

9. Kobert L,Boylestad R and Louis N (2002): "Electronics devices and circuit theory", Eighth Edition, Prince-Hall, United Kingdom. 23-71.

10. Leo L(1984): "A GSM scrolling display", International Journal of Engineering Research. 6(2): 12-41.

11. SedhaR.S(2002) "A text book of applied electronics", S. Chand and Company Ltd., New Delhi, 23-46.