

GSM BASED LED DOT-MATRIX MESSAGE DISPLAY

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ABSTRACT

The information sharing aspect of Information Technology is playing a prominent role in all kind of business either it's a NPO or Profit organization. All kind of business requires and adopts the facility of advertisement to promote their services and products. Information technology makes the advertisement methods more technical and effective as it is easy to transmit and share information. Digital Advertisement is the current requirement of the modern business & Information world. Scrolling LED dot-matrix display boards are used at International Airports, Stock Exchanges, Metro rail stations, shopping complex etc., LED display is an effective mode of displaying information but the complicated task is to make the messages dynamic as the user have to change the message content according to the specific requirements. In case of changing the message content the user have to connect the LED board with the computer, so that the display board cannot be placed anywhere because of dedicated & complex wiring pattern.

GSM based LED dot-matrix display makes the wireless connection between user mobile and LED display. It provides the facility of real-time message displaying means user can change the message content that is to be display according to his/her will. A mobile is used to send the message to the GSM based LED display and the microcontroller does all processing of displaying the message content on the LED display in scrolling pattern.

The aim of the project is to develop a wireless scrolling message board that facilitate the user to change the message content without connecting the Display board with the computer or laptop. The user can update the message content from the remote location. The flash memory of the SIM is cleared after reading the update message to make space available for next message.

I. INTRODUCTION

This project is based on the idea of designing a system for wireless communication between mobile phone and LED display board. With the combination of GSM modem controlled by microcontroller using AT command set for an effective wireless communication system function. It provides the certain level of accuracy [1].

The user having GSM mobile handset can send message to the display board to flash or to display message content in scrolling pattern. GSM modem is used to receive the message at the receiver circuit. The message content sent by the user is stored into the SIM attached to the GSM modem. AT commands are used to communicate with the GSM modem by the microcontroller, AT is the abbreviation of Attention [2].

For the hardware simplification and current required for the module, the Multiplexing of LED is implemented according to the requirement, as only 30 LED's are glowing at one time resulting in reduction of power supply for module.

The led dot-matrix display board accommodates 6x8 led with a distance between the rows of pins of 10mm. A preprogrammed microcontroller is user to supply with the standard format of character set containing character & alphabets with the possibility of generating and displaying punctuation marks, numbers, and special characters, simple graphics. Each character is display in the pattern based on HEX values that are stored in the microcontroller that is termed as look up or match table. The microcontroller looks or matches from pattern and sends out the data bits serially and clock signal. Shift register is used to shift data between the pins connected to each LED. Persistence of vision is the base of the fast scanning of data that is sent on rows and column, which allows the pattern to be displayed because of persistence of vision. Decade counter is used to control the rows on the bases of pulses that is connected to the clock input of the microcontroller [3].

This wireless system of communication requires the following hardware and components

- GSM modem-simcom(SIM900)
- Microcontroller- ATMEL-ATmega328p.
- 6X24 LED dot matrix .
- 74HC595 shift register.
- 4017 decade counter.
- Current limiting Resistors- 220 ohm, 560ohm, 1kohm
- Crystal 16.00 mhz.
- 2N3904 transistors
- Max232 circuit

II. BLOCK DIAGRAM OF SYSTEM

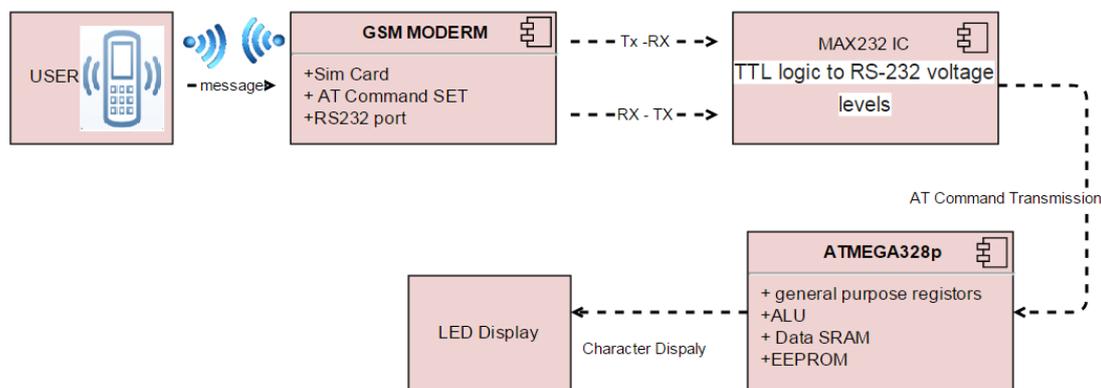


Figure 1: Block Diagram of System

III. CIRCUIT DIAGRAM

There are three interfacing circuit:

- Microcontroller interfacing MAX-232 TTL convertor for interfacing with GSM modem(fig 3)
- Microcontroller interfacing with decade counter and shift-registers(fig 4)
- Shift-registers and decade-counter interfacing with LED Matrix(fig 5)



IV. HARDWARE PROFILE

4.1 GSM Modem Sim900

GSM modem is used to communicate between user and the display board, it consist of slots for holding SIM card and RS-232 port for connection with computer and other devices, works on frequencies 850/ 900/ 1800/ 1900 MHz. The baud rate is configurable from 9600-115200 through AT command, It is suitable for SMS, Voice as well as DATA transfer application in M2M interface, and used for sending SMS and receiving SMS by controlling it through AT command set from microcontroller and computer[4].

Modem Features:

- **Quad-Band GSM/GPRS 850/ 900/ 1800/ 1900 MHz**
- **RS232 interface for direct communication**
- **Configurable baud rate**
- **SIM Card holder.**
- **Built in Network Status LED**
- **Inbuilt Powerful TCP/IP protocol stack for internet data transfer over GPRS.**
- **SMS**
 1. **Point to point MO and MT**
 2. **SMS cell broadcast**
 3. **Text and PDU mode**
- **Input Voltage: 5V-12V DC**

4.2 Max-232 TTL Convertor

MAX-232 driver provides RS-232 voltage level output used for communication between various electronic devices. It has two drivers that converts TTL logic to RS-232 voltage level and two receivers that converts from RS-232 to TTL voltage levels during the communication for RX and TX requirements between the devices. The signals can be converted in each direction. It receives TTL level to convert then it changes a TTL logic 0 to between +3 and + 15V and change TTL logic 1 to between -3 to -15V for converting from RS232 to TTL [4].

4.3 Atmega328p Microcontroller

In this current project the ATMEL 8-BIT MICROCONTROLLER is used to control all input output peripherals of LED Display and GSM Modem. It creates the interface between GSM modem and LED Dot matrix display. It is 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts [5].

Atmega328p Features

- High Performance, Low Power Atmel®AVR® 8-Bit Microcontroller Family
- High Endurance Non-volatile Memory Segments
- Advanced RISC Architecture
 1. 131 Powerful Instructions – Most Single Clock Cycle Execution
 2. 32 x 8 General Purpose Working Registers



3. Fully Static Operation
4. Up to 20 MIPS Throughput at 20MHz
5. On-chip 2-cycle Multiplier
 - Operating Voltage: 1.8 - 5.5V
 - Temperature Range: -40°C to 85°C

AT commands will be transmitted by the microcontroller for receiving SMS from GSM modem and provides with the data signal and clock signal for scrolling the message.

4.4 6X24 LED Dot Matrix Display

LED Matrix is based on dot matrix pattern that are two-dimensional patterned array that are used to represent characters, symbols and images. It consists of two-dimension matrix where cathodes and anodes are joined together respectively representing the rows and column. The information is flashed on the display by controlling and directing the flow of electricity through columns and rows. A 6 row and 24 column led matrix requires 144 leds all are connected together with common anodes and common cathodes. In this pattern all 144 led are connected to form a matrix of 6*24, all anodes are representing the columns and all cathodes are representing rows. With the combination of row and column each individual LED can be controlled by multiplexing [6].

4.5 Shift Register

Shift registers are a type of sequential logic circuit, mainly for storage of digital data. They are a group of flip-flops connected in a chain so that the output from one flip-flop becomes the input of the next flip-flop. Most of the registers possess no characteristic internal sequence of states. All the flip-flops are driven by a common clock, and all are set or reset simultaneously

In this project 74HC595 shift register are used to control the flow of current in the column of the display. It has an 8 bit storage register and an 8 bit shift register. Data is written to the shift register serially, then latched onto the storage register. The storage register then controls 8 output lines [7].

4.6 Decade Counter

Decade counter stores the stage that has count ten states; it can count through decade or 10 states per stage. Rather than binary code decimal, decade counter counts in decimal digits, decade counter is also a binary counter designed to count decimal 10(1010b). Decade counter counts from 0 to 9 and resets to zero. To set the counter output zero needs to pulse reset line low, then each clock pulse increment is counted until it reaches decimal 9 or 1001. Both NAND gate inputs are high when there is an increment to decimal 10 or to 1010. After the increment to decimal 10 NAND output goes low, and counter resets to zero. 4017 is 5 stage decade counter (one stage consist of ten state count), with 10 decoded outputs Q0 to Q9, Q5 to Q9 are most significant flip-flop output provider, CP0 and CP1 are two clock inputs and MR is an overriding master reset input [8].

4.7 Crystal 16.00 Mhz Oscillator

It works on the mechanism of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is commonly used to keep track of time. Crystal is used

In order to have a baud rate of 9600 for serial communication with modem. Also a higher value of crystal is of prime importance in this project which has the effect of reducing the flicker seen in the LEDs.

The user will send message that will be received by the GSM modem, and the GSM modem communicate with microcontroller using serial communication port RS232 with baud rate 9600. Microcontroller transmits AT commands to read the message from the GSM modem SIM.

- AT{ to initialize the modem }
- ATE0.....{to turn echo off }
- AT+CMGF=1.....{to set the message format to TEXT }
- AT+CNMI=2,1,0,0,0..... {notification of new message }
- AT+CMGR=1.....{to read the stored message }
- AT+CMGD=1.....{to delete the message }

First three commands, GSM modem responds to the microcontroller with the message 'OK'. This message is ignored by the microcontroller. After the execution of the final AT command, the GSM modem responds with the following long message.

+CMGR:"REC UNREAD", " sender's number", "Date and time"

Message part here

OK

The microcontroller only keeps the message part and discards the remaining message. This message is stored in the buffer array which is later used to display the message on the dot matrix led module.6. Message Display on LED Matrix process

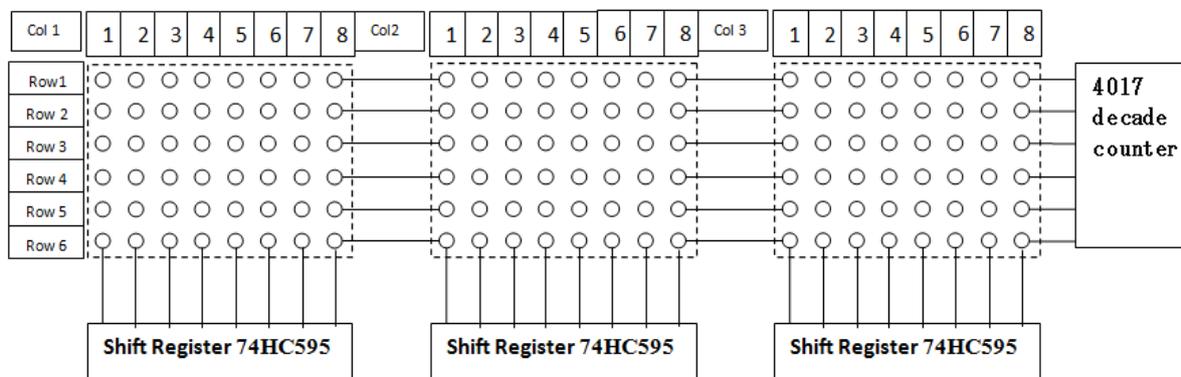


Figure 2 LED Matrix 6X24

According to the figure 1 three shift registers are used (one shift register for each 6X8 block of LED set) for the input signal of LED column and a decade counter is used for the row input signal control. The six display matrix row using the output of the atmega328p, that is controlling 4017 decade counter as well as 74HC595 shift register for column. A current limiting register is connected with each LED of the column. The shift register can resist current up to 8mA. The binary code of 0 and 1 is used for blinking the LEDs in the sequence to display character. Microcontroller use the ASCII code of the character to be display stored in the internal memory that matches the pattern in character generation. Controller send the series of display pattern to the shift register. Any bit pattern that is '1' means turn on the LED, and any bit pattern that is '0' means off LED. The clock transfer of serial data into shift register is done by the controller and the process is repeated for first line of

other 2 matrix display column segment now decade counter first pin control the first row of the matrix. All high LED display the character pattern. This process is repeated for all rows and columns.

Following is the pattern for display character on LED matrix

BA {B01110000,B10001000,B10001000,B11111000,B10001000,B10001000}

BB {B11110000,B10001000,B10001000,B11110000,B10001000,B11111000}

BC {B11111000,B10000000,B10000000,B10000000,B10000000,B11111000}

BD {B11110000,B10001000,B10001000,B10001000,B10001000,B11110000} etc.

The 16 bit display buffers are used for scrolling effect in 3 display matrix and the message scroll from right to left direction.

VI. CONCLUSION

GSM plays vital role in wireless technology, this project describes how a person can develop a LED matrix that can display scrolling message with support of GSM modem and other specified hardware. The multiplexing technique is used for displaying character on the matrix and the scrolling speed can be controlled by the microcontroller. This project can be used anywhere as it is based on wireless communication. Its dynamic messaging display nature makes it feasible for use in every field where the content keeps of changing like stock exchange, railways, airports, restaurants etc. the major advantage of this project is advertising as the display board can be placed at any height either in air or on earth there is no requirement of wires to communicate.

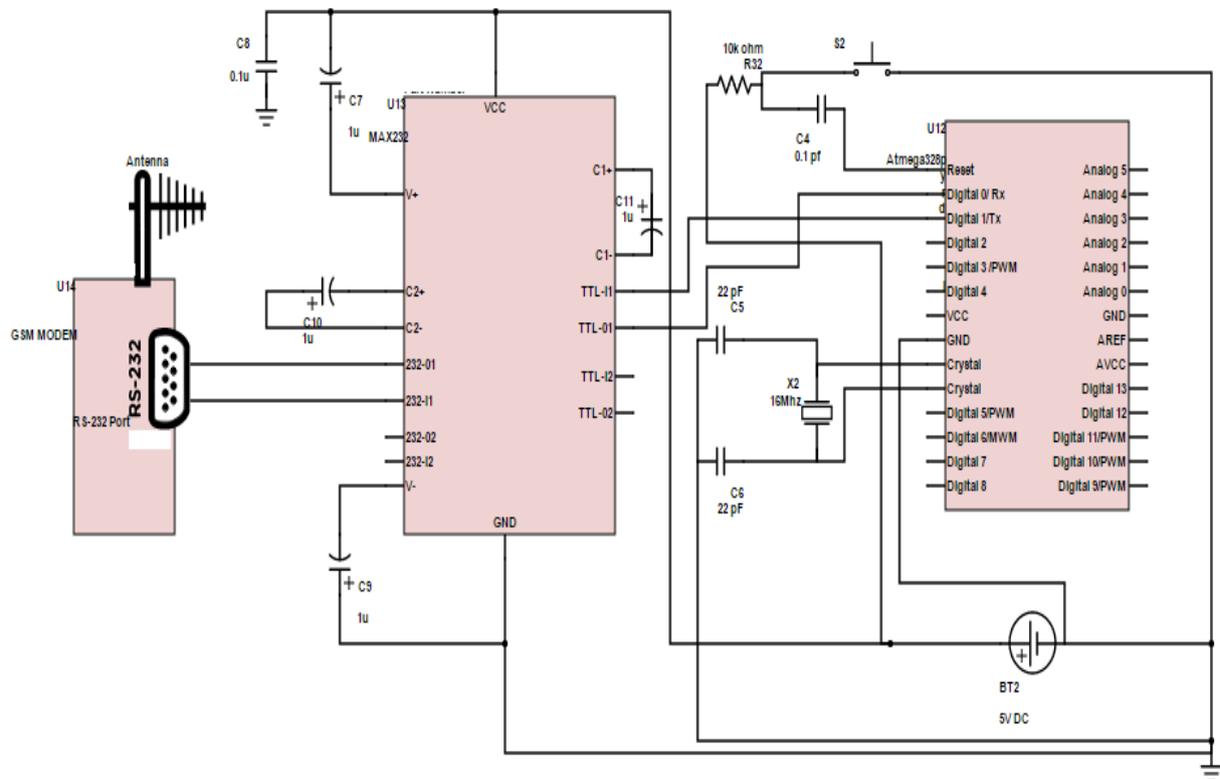


Figure 3 Microcontroller Interfacing MAX-232 TTL Converter for Interfacing with GSM Modem

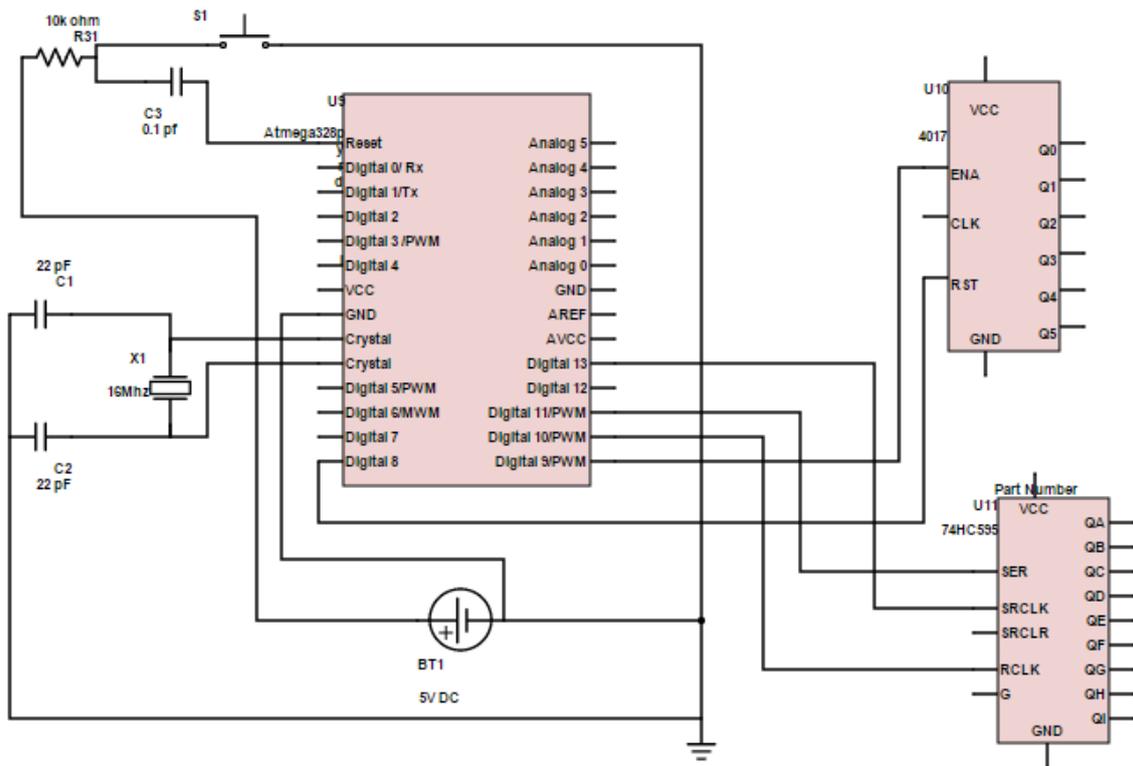


Figure 4 Microcontroller Interfacing with Decade Counter and Shift-Registers

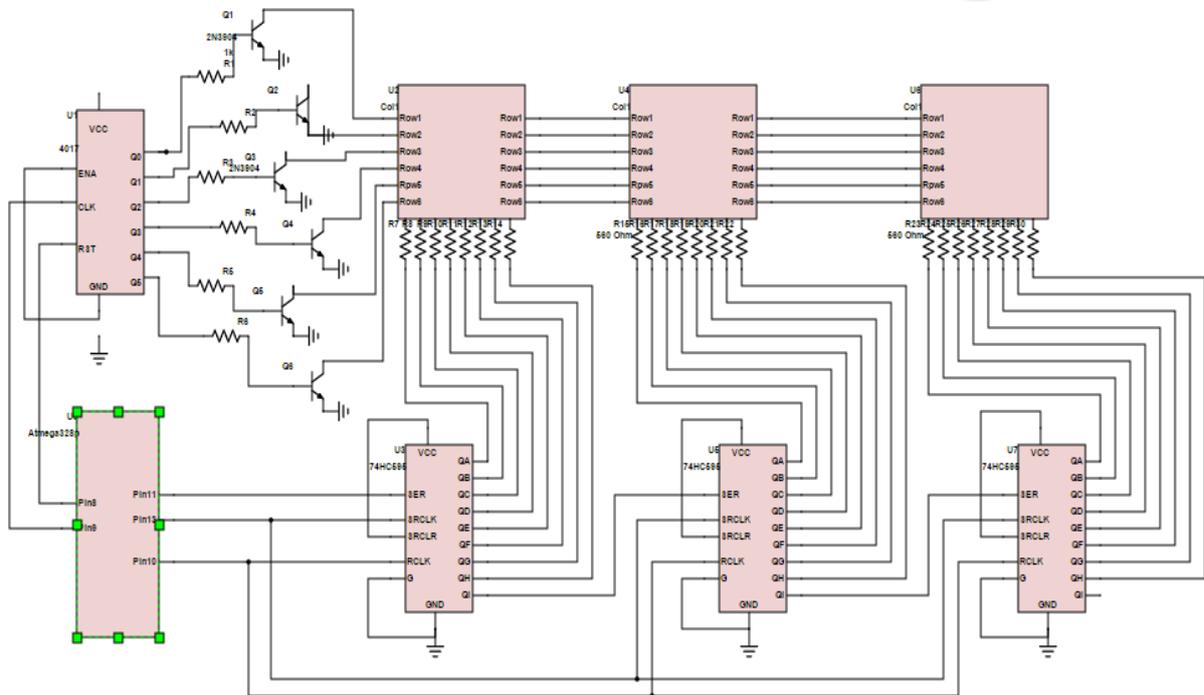


Figure 5 Shift-Registers and Decade-Counter Interfacing with LED Matrix



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