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Construction of an SMS Operable LED Display Panel

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ABSTRACT

Development of a standalone, matrix type Light Emitting Diode (LED) display panel capable of controlling using short messaging service (SMS) is discussed in this publication. English uppercase letters, numbers and few other symbols are allowed to display in this panel. The size of the panel permits to display thirteen characters at once, but with the help of scrolling character display mode, virtually unlimited number of characters can be displayed as a message. The panel always displays the message body of the SMS which is received to the global system for mobile communication (GSM) modem (Ericsson T10) interfaced to the display panel, if the SMS generated is in the form that the system specified. Two PIC16F877A microcontrollers are utilized in master and slave mode to perform parallel processing of reading SMS from the GSM modem and decoding. An external electronically erasable programmable read only memory (EEPROM) 24LC04B is used as an interactive memory module which can be accessed from the both of the microcontrollers. With further developments, device can be utilized as a commercial SMS based news displaying panel.

1. INTRODUCTION

More precisely it is true to say that the world has become even smaller than we thought for the past few decades, mainly through the telecommunication, due to the rapid development of the mobile phone technology. Global System for Mobile communications (GSM) is the Frequency Division Multiple Access (FDMA) alternative to former Time Division Multiple Access (TDMA) and it has become the most popular standard for mobile phones by owning about 80 % of the global mobile phone market and 100 % in Sri Lankan mobile phone market [1]. GSM also pioneered an economical alternative to voice calls, the Short Message Service (SMS), which is now supported on other mobile standards such as Code Division Multiple Access (CDMA) [2].

Due to the fact that extreme fastness and easiness of SMS, many controlling systems can be found in all around the world based on this. “Tiny Planet” is a small device [3] connected to a GSM modem. When the modem receives a predefined SMS (text message), like "*Activate burglar alarm*" or "*Start backup pump*", the circuit automatically recognizes it as a command, and switches the output port accordingly. Besides switching the port on or off, the user can pulse it for a short period (e.g. “*Switch Motor ON*”). There is again another system which can switch four relays depending on the messages reach to the mobile phone [4]. With this, one can switch ON, OFF or restart some Linux servers, ADSL modems, Printers, Door with electric lock, Garage door, House lights, Water pumps, electric sunshade and much more. In addition to that from amongst variety of similar sort of systems [5, 6] provide very good controlling of house hold appliances and good security systems such as activate the roof windows of the commercial green house, activate the gates to your home or factory, or pull the rolling shutters up or down. In fact there is no limit to the operations that can be managed. A GSM based server room monitoring and alarming system which employs

SMS and ring signal has also developed [7]. Another system which uses the microcontroller and mobile phone gives a call to the owner and also to the Police station (119) under the control of microcontroller and starts a call conference between the owner and the Police station. These all are under the same category of "SMS based device switching" [8]. In Sri Lanka the famous news feeds and voting systems this technique is very much employed.

SMS Operable LED Display panel is based on the concept as mentioned earlier and a hybrid of a GSM modem and a considerably large LED display panel and the panel can simply display the SMS text message reached to it. Considering about the panel, it is simply constructed using the normal biasing phenomenon of LEDs and it is not so complex and costly compared to the frequently used LCD (Liquid Crystal Display) or projection message boards. It is in fact the precise thing to have such a panel so that it is so compatible with interfacing with microcontrollers compared to the other complex panels mentioned. Also its simplicity, field programmability and portability it is more prompted to use for public applications deviating from the normal household appliances.

2. METHODOLOGY

According to the system requirements, hardware construction and software programming is needed. Intended system functionalities are disclosed by the total system design.

2.1 System Design

The system mainly consists of a mobile phone (Ericsson T10), two PIC microcontrollers (PIC 16F877A), external EEPROM (24LC04B) and an LED display panel (8×80) which have discrete functionalities to fulfill the major requirement of the system as Figure 1.

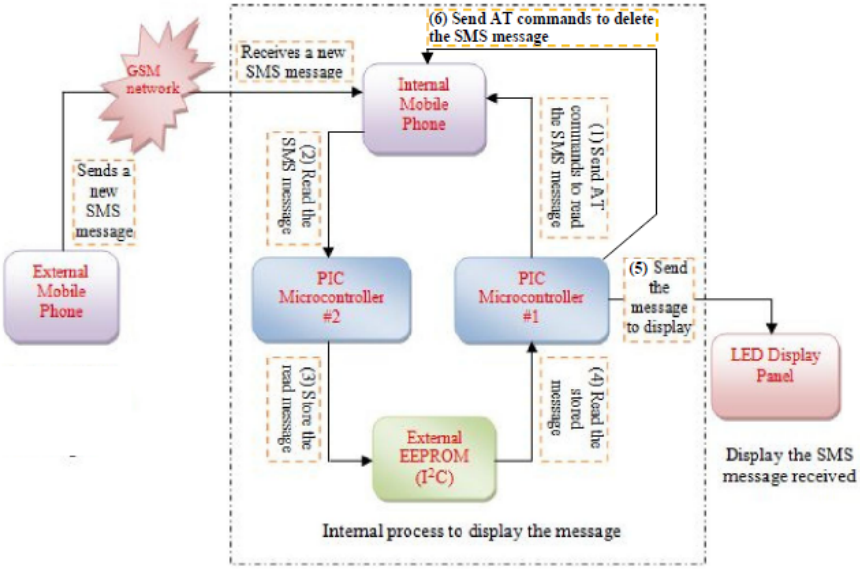

Figure 1 System Design

Above diagram gives a brief description about the system from a reception of a new valid message till its displaying and it is the outline of the system. It is assumed that there is no message stored in the memory location 1 of the preferred memory "ME – phone memory". New message that is stored in this location will only be displayed.

2.2 Construction

The system contains several hardware units or in other words several circuitries. But here, only the circuits that are relevant to the panel Figure 2 and Figure 4 are considered and the way of displaying characters is also illustrated.

2.2.1 LED panel (8×80 dot matrix)

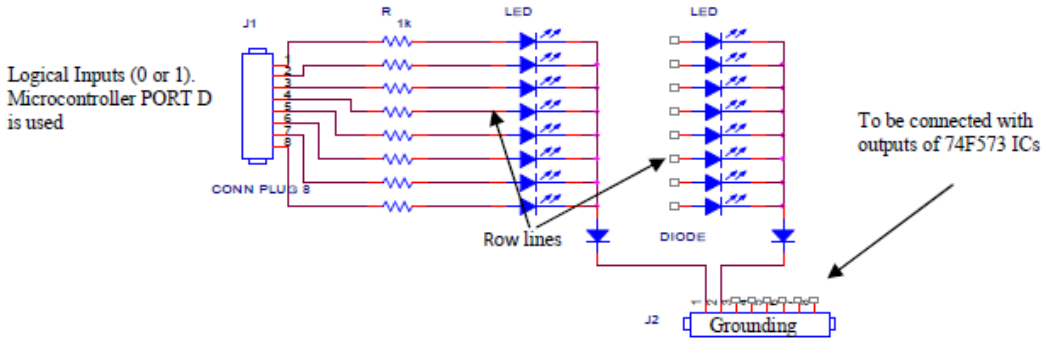

Figure 2 Part of the schematic of the LED panel

Each and every character that is allowed in the system is encoded in such a way that each character needs five columns of the panel. According to the encoding letter "A" is displayed as Figure **3**.

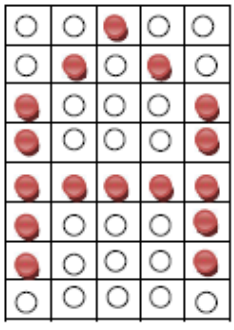

Figure 3 Display of the letter 'A'

2.2.2 Circuitry to drive the columns of the LED panel (Ten 74F573 Buffer ICs used)

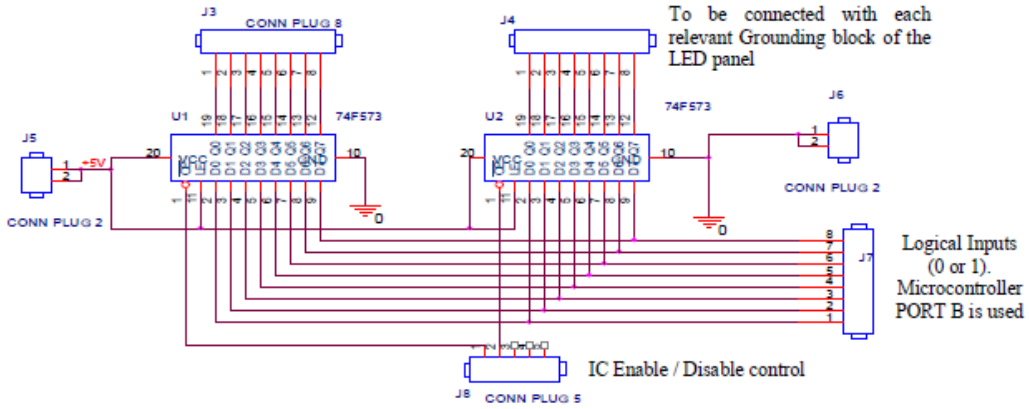

Figure 4 Part of the schematic for the process of column select

2.3 Operating Issues

For the communication between the GSM module and the microcontrollers, AT Command Protocol is used. When the AT commands are sent to the GSM module (ERICSSON T10), what really happens first, is the echoing those commands through its transmission line simultaneously. This reaction cannot be stopped in this GSM module. This makes an environment so that one microcontroller can't be used to read an SMS message, due to the limitations of the microcontroller (i.e. Sequential execution of commands and Reception buffer rules in UART-Universal Asynchronous Receiver Transmitter). In order to overcome this problem, help of the second microcontroller is needed and then one sends AT commands to read the SMS message and the other one can accept the data which transmit through the GSM module simultaneously.

Other main process is the writing to and reading from the EEPROM (24LC04B) through microcontrollers. The microcontroller which has the message inside it writes to the EEPROM and the second one reads the message from the EEPROM and then put it into the LED panel to display it. There must be a clear switching between the writing process and the reading process with the microcontrollers or in other words, one microcontroller must disable the I^2C Master mode while the other one is using that.

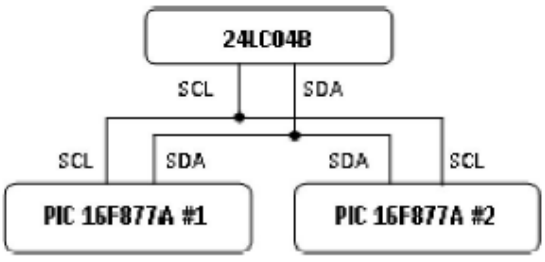

Figure 5 EEPROM's Line Connections with Microcontrollers

There are two modes called “Text” and “PDU” (Protocol Description Unit) in the case of SMS in GSM modules. The GSM module which is used here supports only to the PDU mode and the message received is in accordingly to that mode. Hence, this message string must be converted in to the Text mode if it is to be displayed through the panel which each character represents an ASCII value then. There must be a strong program for this conversion. Figure 5 represents the form of an SMS message received in PDU mode and the Table 1 represents the PDU encoding of a text string respectively.

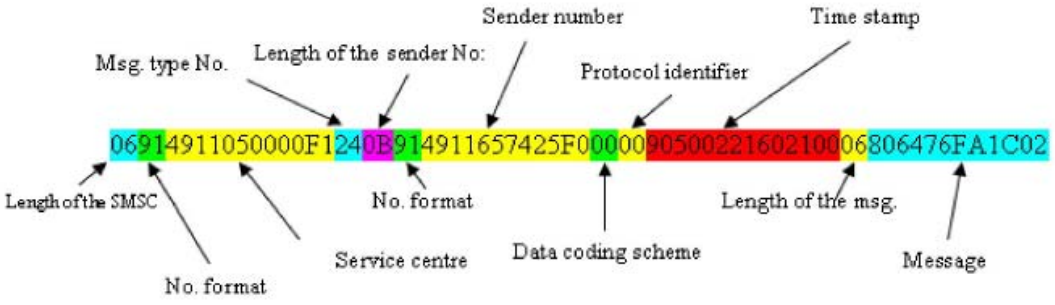

Figure 6 PDU String of a Received SMS message

Table 1: Segment wise description of an SMS message in PDU format

Message Characters	P	H	Y	S	O	C
ASCII Value	80	72	89	83	79	67
Septets (binary)	1010000	1001000	1011001	1010011	1001111	1000011
Octets in PDU mode	01010000	01100100	01110110	11111010	00011100	00000010
	Octet Number					
	01	02	03	04	05	06
PDU value of each octet (hexa-decimal)	80	64	76	FA	1C	02

Message in PDU mode is now “806476FA1C02” and it is not as “PHYSOC” in Text mode.

3. DISCUSSION

The system is straightly capable of displaying thirteen characters at once through the LED panel. English capital letters, Numbers (0-9) and majority of symbols most frequently used are enabled in the system and also there is a default character (space) specified to display on the panel if there is an unspecified character in the message string. Normally a character needs five columns on the panel irrespective of the 'Space'. 'Space' character only needs four columns and each character is separated by a column. Also the character string can be scrolled from Right to Left on the panel in a reiterative manner for a given period of time. Also for the time being system it is set to accept messages which has less than or equal to sixteen characters and only fourth character onwards are used as the relevant message due to the reason that normally the first three characters are get corrupted within the system.

Considering about the final outcome of the system it should be mentioned that prime intention of retrieving a text message from a GSM module through an LED panel was successfully achieved, but under several limitations. Harnessing the full capabilities of the microcontrollers through programming those limitations can be eliminated further and can have more effective results such as increasing the number of characters that can be retrieved. Also by making further developments to make it fully automated would give an opportunity to use the system at any location freely.

4. CONCLUSION

This SMS Operable LED Display Panel was developed mainly using, a GSM module, two microcontrollers and an external EEPROM. The GSM module is used to receive a new message and to indicate and drive the message to the system. According to the GSM module outputs, the complete system is handled by the two microcontrollers. The developed system is more suitable for SMS based news feeds.

REFERENCES

1. *GSM Association*. Retrieved June 2009, from GSM world - Market Data Summary: http://www.gsmworld.com/newsroom/market-data/market_data_summary.htm, 2009
2. F. Trosby, *SMS, the strange duckling of GSM*. Emerging Markets in Telecommunications, (2008) 197-194.
3. A. R. Bitti, *Tiny Planet.* Retrieved 2008, from http://www.riccibitti.com: http://www.riccibitti.com/design.htm, 2002
4. S. Vasilis, *SMS remote control.* Retrieved 2007, from http://www.serasidis.gr: http://www.serasidis.gr/circuits/smscontrol/smscontroller.htm, 2007
5. *Textually*, Retrieved 4 2008, from http://www.textually.org: http://www.textually.org/textually/archives, 2005
6. M. S. Khiyal, *SMS Based Wireless Home Aplliance Control System for Automating Appliances and Securituy.* Rawalpindi,Pakistan, 2006
7. S. C. Wattage, P. D. Ariyadewa and H. H. E. Jayaweera, *Development of serverroom monitoring system based on GSM,* 65th Annual Seesions of SLAAS, 2009
8. K. Calvin, *Patent No. 06, 4904.* United States of America, 2005