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Hardware Implementation of LCD Message Display Based on Cellular Communication

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ABSTRACT: *In this paper hardware implementation has been done for SMS display on a liquid crystal display (LCD) using microcontroller through global system for mobile communications (GSM) technology. This is one of the fastest systems to display any message on notice board almost immediately without any delay just by sending a SMS which is consistently good in quality than conventional way of pasting message on notice board. This proposed system can be used for consciousness in public place for any emergency conditions to avoid the possibility of suffering harm or injury. The results shows that only authenticated user can only display message on the notice board which proves the reliability of the proposed systems.*

Keywords: *Electronic Notice, GSM, Liquid Crystal Display, Microcontroller, Mobile Communication, SMS*

I. INTRODUCTION

An electronic notice display system based on GSM technology offers flexibility to display news and announcements faster than the programmable system. This type of GSM based electronic notice board also called wireless display system (WDS). This WDS can be used at public places like schools, college, university, hospitals, railway stations etc. The WDS consists of a GSM receiver and a LCD unit which can be programmed by microcontroller for a specific mobile phone. It displays the message after receiving the SMS only from the authorized mobile using necessary code conversion. Also it has easy access for the user to add more display units at any time and at any location depending on the requirement. Many works have used GSM base WDS such as mobile operated robot, SMS voting system, SMS based teaching system, SMS based security system etc. Several researches have been done on GSN based wireless display by many researchers [1], [2], [3], [4], [5], [6], [7], [8] to improve overall performance of the system.

Fauzal Naim (2007) has developed a wireless electronic notice board at University Malaysia Pahang by using liquid crystal display (LCD), a receiver, decoder, microcontroller, and dot matrix. That project was based on MC68HC11A1 microcontroller [1]. Rahul and Preeti (2013) designed and developed a multiple LED display boards using AT89S52 microcontroller, GSM module, LCD and several moving LED displays. However, with few limitations, this work proved to be cost-effective and efficient as compared to previous works [2]. Venkatesh, Arjun and Aditya (2013) have developed a GSM based e-notice board as an application of public addressing system [3]. Jagan and Venkareshwarlu (2013) have made wireless electronic display board using GSM technology, using various AT commands to display the message onto the display board. GSM technology was used to control the display board and for conveying the information through a message sent from authenticated user [4]. Payal , Pinki and Shivani (2013) also developed a SMS based wireless notice board display using GSM mobile [5]. Adamu, Gbenga, Ochi and Taidi (2014) have implemented a GSM-based scrolling message display board using 7X96 Light Emitting Diode (LED) and dot matrix [6]. Bhumi, Rohit and Ruby (2015) developed a smart notice board using GSM communication of displaying message on notice board from user mobile phone [7]. Sara, Raja, Anjali, Indhumathi, and Sathiya (2016) have proposed a system which will enable people to wirelessly transmit notices on a notice board using Arduino [8]. From this literature review it is clear that WDS is not a new topic, many works already have been done on it. However still there have a lot of opportunities to work on it to make a cost effective and faster message display system.

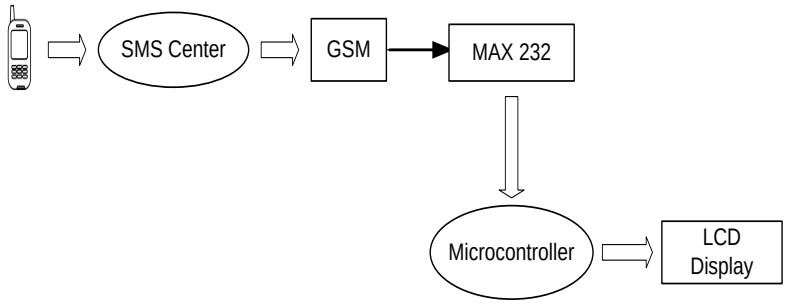

Figure 1: Basic diagram of a SMS display system on LCD via GSM communication

This work aims to make a reliable and low cost message display system. Therefore, a basic diagram of the proposed system is shown in figure 1. There are some interfacing networks, microcontroller with MAX-232, microcontroller with LCD and GSM modem with MAX-232. However, in the conventional work normal personal computer (PC) used with GSM modem to easily display message by using AT command but it is too expensive. Therefore, in this work PC interfacing is avoided. The rest of the paper is organized as follows. Section 2 describes the proposed work. In Section 3, the construction and testing process is discussed. We present the implementation process in Section 4. Section 5 gave the results obtained from the testing. We conclude the paper in Section 6.

II. PROPOSED WORK

Wireless communication is doing vast technological improvement in the modern era without controlling physical movement of the device. This will happen by designing the embedded system to merge with communication in such a way to make human life comfortable. The main goal of our work is to design a SMS driven automatic display board that can replace the currently used programmable display. The receiver as well as the display board can be programmed from an authorized mobile phone. The message that displayed in the board is sent through an SMS from an authorized transmitter. After that microcontroller will receive the SMS and then verify the sending Mobile Identification Number. By completing the verification, the desired message will display in the board. In the work, reprogramming is not required unlike the electronics display. The display board programs itself with the help of incoming SMS with proper validation. Such a system is helpful for immediate information transfer. Section 2.1 and 2.2 show the circuit component and software requirements that is used in our work respectively.

Circuit Component

Different circuit component is necessary to successfully complete the overall work. Table 1 shows the circuit component lists that are uses in the work.

Table 1: Circuit components list for the work

Serial No.	Components	Rating/Model
1.	Microcontroller	AT89C52
2.	LCD Display Module	20x4 Character
3.	Level Converter	MAX232
4.	GSM Module	SIM900
5.	DC Battery	12V,1A
6.	Ceramic Capacitor	0.1µF
7.	Capacitor	33pF
8.	Electrolytic capacitor	10µF
9.	Crystal Oscillator	11.0592MHz
10.	Resistor	10kΩ
11.	USB converter cable	USB to RS-232

Software Requirements

The overall work is running with the help of both hardware implementation and software simulation. To do the software simulation; there need software which are mentioned one by one. Keil Compiler is used to solve the complex problems related to embedded system. Universal Program Loader is used to burn program in the microcontroller. Hyper terminal is a terminal emulator which is capable of connecting the system. Proteus is doing necessary simulation for the work. Putty is a kind of open source software that will help to get the remote access.

Circuit Diagram

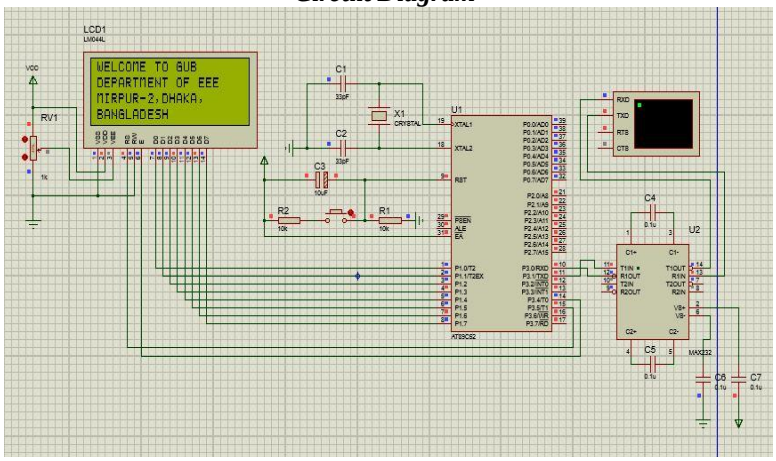

Figure 2: Wireless Electronic Notice Board (WENB) circuit diagram implemented in proteus

Figure 2 shows the overall circuit diagram of the work using proteus. Microcontroller is the main hardware that controls the overall work. First of all MAX232 is an important interfacing unit which connect the GSM to the microcontroller. The MAX232 is helping to pass the information to the Microcontroller AT89C52. Then the microcontroller will check the information that the message is valid or not. If the message is valid then it will pass the message to the display board. Display board will display its message depending on the size of the message.

III. SYSTEM MODELING

In the proposed work, there are combinations of hardware implementation and software simulation. It is also necessary to design some mechanical parts to perform a specific function. First of all an SMS has been sending to GSM modem from a mobile phone and the SMS is stored through AT commands. Using microcontroller it is possible to retrieve the stored message in GSM and display it on a LCD display using embedded programming languages. Short information can be sent from a mobile phone as SMS and made display until the next one.

Diagram of Functional Decomposition

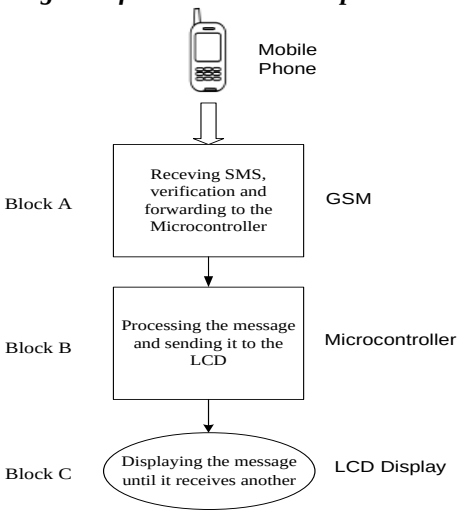

Figure 3: A block diagram of functional decomposition

Figure 3 shows functional decomposition diagram of the overall work. The whole work is divided into 3 blocks. First block is the GSM block which will receive data from the mobile phone and forward the message to the microcontroller. Second block is the microcontroller block which will process the message and sending it to the LCD display. Third block is the LCD display block which will display the desired message until it receives another.

Diagram of Data Flow Chart

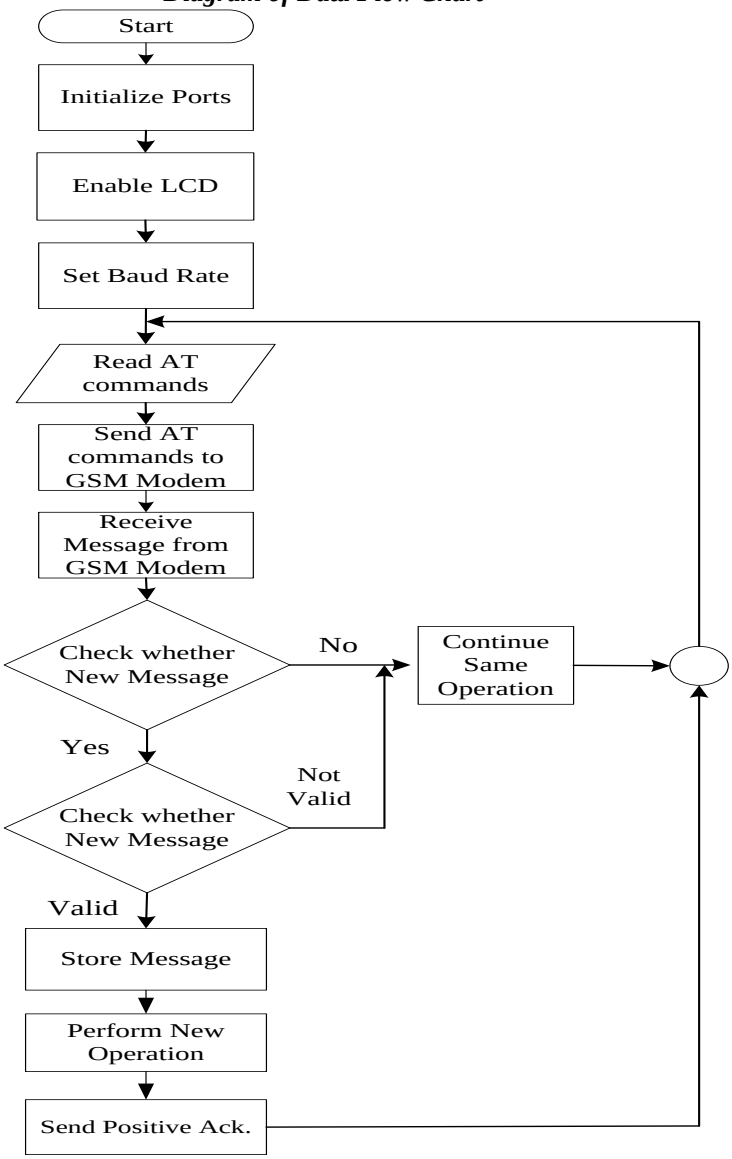

Figure 4: Flow chart of the overall process

Figure 4 explains the data flow diagram of the work. At first the data flow diagram starts with initializing the port and then enabled the LCD display and set the baud rate. After that AT commands has to be executed by the GSM. By finishing the executing command, it is sent to the GSM modem where commands are processed. At this request the messages has been sent to the microcontroller so that it can be displayed in proper way. The sending messages have been checked and if the sender is valid the messages are stored. Any operation pertaining to the present result is performed. Once the operations are performed the acknowledgement is sent. In the worst case scenario if there are no new messages the loop of checking for new messages continues until the new one arrives.

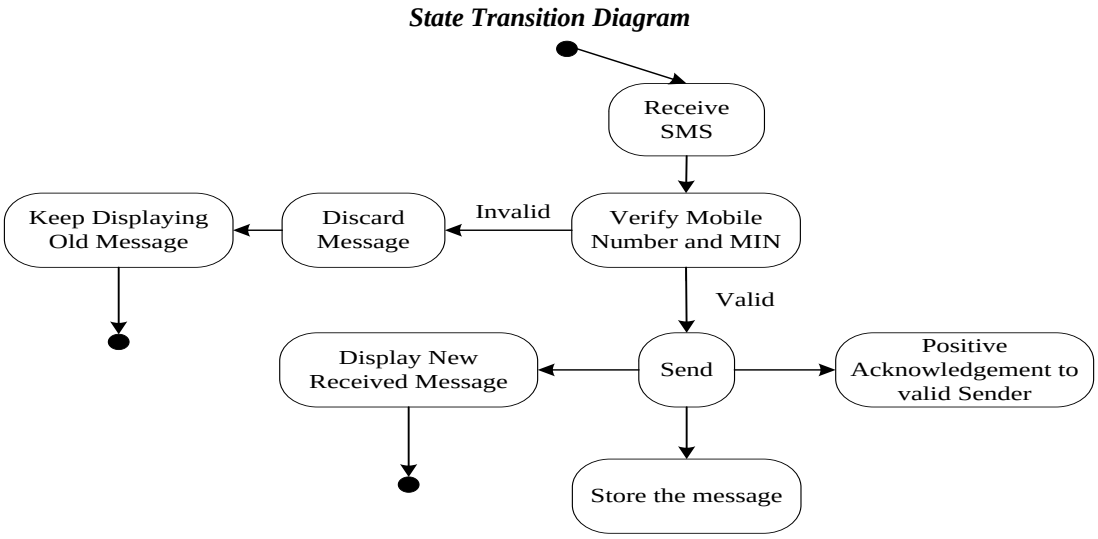

Figure 5: A block diagram of State transition

The state transition refers to all the finite states the system enters during the process, pointing out the behavior of the system when the message is received from the end user. Just as soon as the message is received from the user the message is validated by comparing with the password characters. The message is stored and sent to display. In the other scenario the invalid user message is discarded by the microcontroller and later keeps checking for any new recent messages.

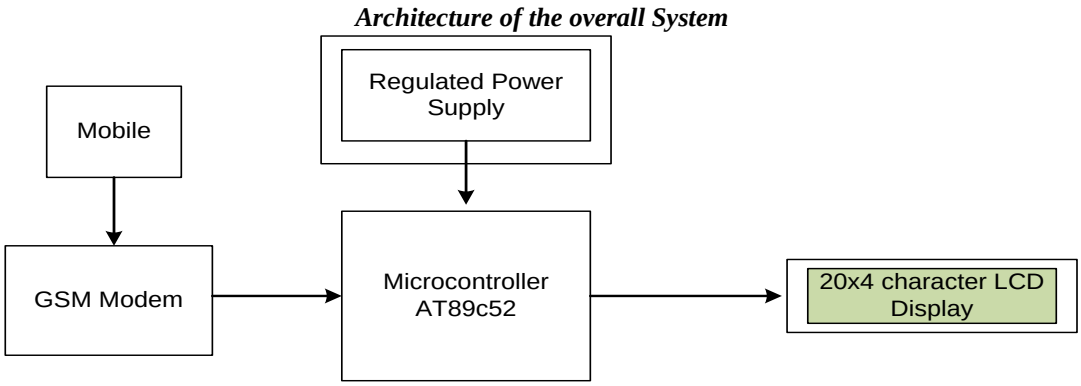

Figure 6: Architecture of the overall system

Architecture of the system consists of Microcontroller which involves in the operation and validation. Regulated supply is to power up the whole circuit components. GSM modem stores any message received by the user, any operation performed by the GSM is due to the AT commands initiated by the microcontroller. Microcontroller forwards the message to the LCD. LCD receives the message and can display only 20*4 characters at a time. Mobile is the end user that starts the interaction with GSM by sending a message.

IV. RESULTS

The condition for the serial transmission is that both the DTE and DCE should have equal operational baud rates. So, using the command AT+IPR = 9600, the modem baud rate was set to be at 9600 bps. ATE/ATE0 command was later used to turn of the ECHO from the modem. Microcontroller baud rate was fixed at 4800bps setting terminal count of Timer 1 at 0FFh (clock frequency = 1.8432). The registers (TCON and SCON) were set accordingly. As the devices are now set for the working process, the setting of TI flag causes the transmission of the data and the data is known to be received by the setting of RI flag. When the TI flag is set the microcontroller sends and AT command to the modem in form of string of characters serially. The SBUF register of the microcontroller receives the data and later it is moved into the physical memory of the microcontroller. The validating process is then started by comparing the senders' number with the pre-stored number in the memory. When the verification of the sender's identity is successfully executed, control flow goes into the LCD module to display the valid message stored in the memory as shown in the figure 8. Though

the display has 80 characters, the character location on the LCD and the DDRAM address does not quite follow the conventional four rows 20 characters display. The LCD device diagram is shown below.

Table 2: LM044L LCD display memory map

Character No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1st Line	80	81	82	83	84	85	86	87	88	89	8A	8B	8C	8D	8E	8F	90	91	92	93
2nd Line	C0	C1	C2	C3	C4	C5	C6	C7	C8	C9	CA	CB	CC	CD	CE	CF	D0	D1	D2	D3
3rd Line	94	95	96	97	98	99	9A	9B	9C	9D	9E	9F	A0	A1	A2	A3	A4	A5	A6	A7
4th Line	D4	D5	D6	D7	D8	D9	DA	DB	DC	DD	DE	DF	E0	E1	E2	E3	E4	E5	E6	E7

The rearrangement of the memory map shows how the memory addresses are related to the character positions on a 20 x 4 LCD display. Although above depiction shows the DDRAM differently than before, the actual DDRAM configuration and operation is exactly the same as described above for the 40 x 2 display. The reason is that there is no way of telling the LCD controller that there are now 4 rows of 20 characters instead of 2 rows of 40 characters. In case of the sequential display of the valid message, the characters will appear in the third row after finishing the first row. Then the normal automatic incrementing from 27h to 40h will cause the display to continue on the second row and after that it will go forward to the fourth row. After that the following characters will appear back on the first row, and so on. So it is needed to estimate for the LCD design while programming the host controller. Mainly the microcontroller can keep track of the DDRAM addresses. When needed, a new starting DDRAM address can be set up.

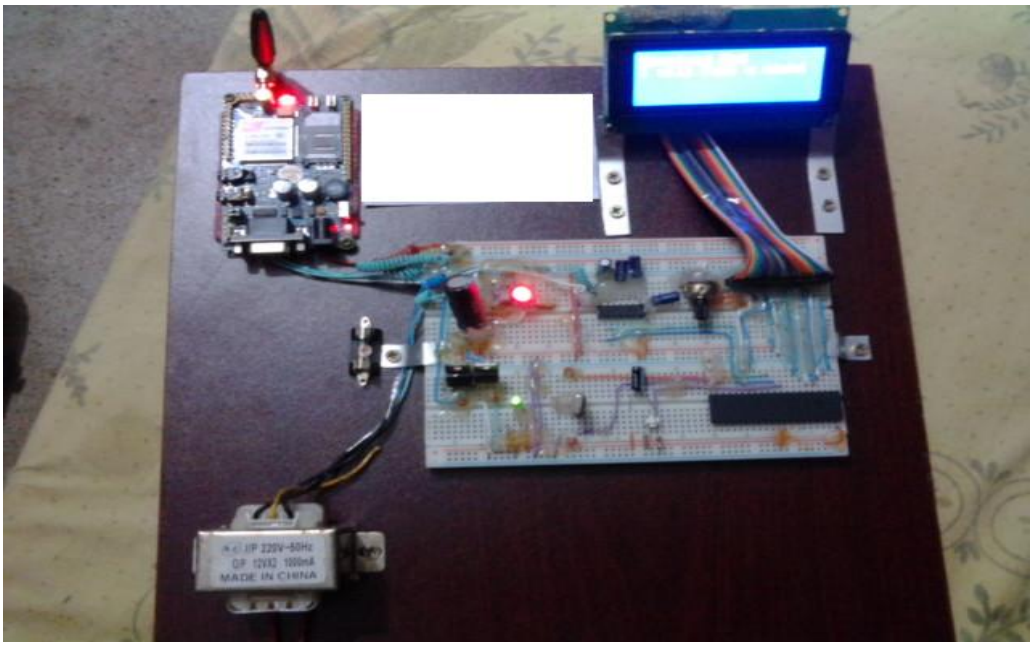

Figure 7: Hardware implementation of WENB

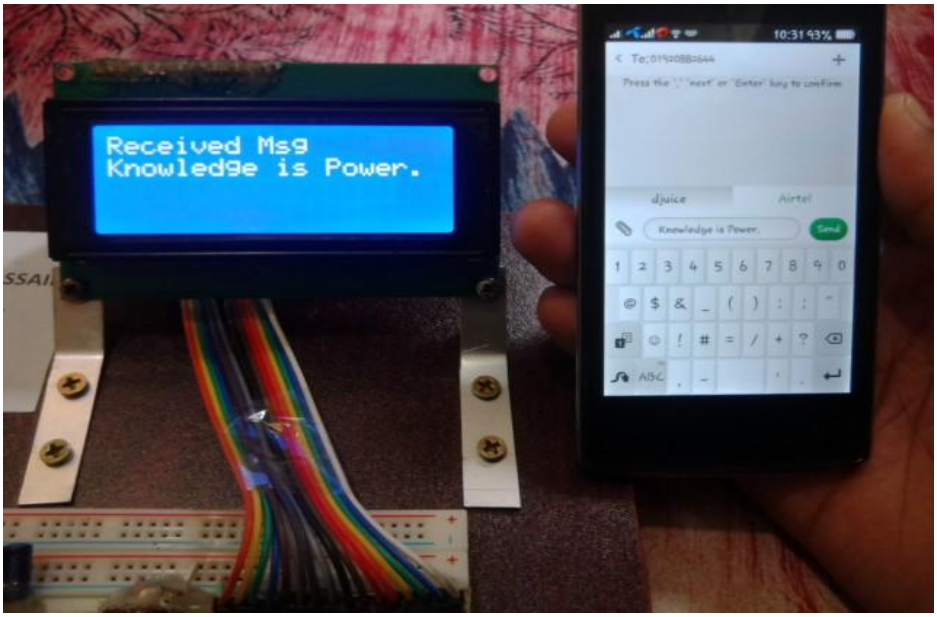

Figure 8: Message display in the board

V. CONCLUSION

The prototype system for SMS display based on GSM technology was efficiently designed and implemented. The experimental result shows that the device is working properly as the desired requirement. Further development of this work can be done with message storage facilities and larger LCD display can also be added according to the user need. Finally, this project has shown a cost effective system for small scale application using cellular communication.

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