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Design and Implementation of a Real-Time Short Message Service –Based Wireless Control System for Automating Home Appliances

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Abstract
Nowadays, technologies present a wide range of possible solutions for automating home appliances and security. The most important part embedded in this solution is the communication system. This system provides the mechanism for sending command and receiving status information. In this paper, a system is developed to monitor all activity occurred at home and alert user using Global System for Mobile communication (GSM) technology. A text message is generated and sent to a preconfigured telephone number. On receipt of short message service (SMS), the owner performs specified task to protect his possessions. Solutions that we have considered in this paper will detect any change in the functioning state of the home appliances and will alert the owner by a short text message. We present the hardware and software design architectures which then is implemented as a real-time application. Our experimental results indicate that the system allows user to efficiently monitor and control home appliances.

Keywords: Global System for Mobile communication (GSM), microcontroller, Short Message Service (SMS), AT commands;

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1. Introduction

Today, wireless technologies allow users to access home appliances from all places without the constraints of a wired connection. The availability of this technology has created the opportunity to have smart houses. Smart houses are supposed to be houses whose electric appliances and security devices can be remotely controlled in the absence of their owners [1].

Mobile phones are the most popular technology mainly used today as a communication tool; it can play a significant role in smart houses [2], [3]. The use of this technology has grown exponentially over the last five years. One of the most applications that are being used with mobile phones is the text messages. Using text messaging in the home security offers an effective way to alert owners about any activity and let them to act immediately [4], [5].

The introduction of mobile phones and particularly the use of text messaging are based on a GSM technology [6]. A GSM is a wireless device that has a SIM card and operates as mobile phone. Moreover, It can be easily interfaced to microcontrollers via a serial port. A GSM Modem also can send and receive messages using AT commands. These commands control the operation of the modem and simplify data acquisition and processing. The ease of deploying the GSM modem provides the benefit of making the system location independent and the user can get alerts anywhere. The modem is also cost-effective compared with the previously existing modems and provides reliable solution for monitoring unmanned sites [7].

On the other hand, theft is increasing nowadays and everyone wants to take a propiate action to prevent intrusion, so the best solution is to develop home security system using wireless technology to keep homeowners, and their possessions, safe from intruders. Mobile phones are suitable to become a controller for home appliances and security. It is sperating rabidly and almost everyone capable to use them anywhere and where the GSM network is available [8]. The system has the ability to make life easier and more convenient [9]. The system allows anyone to switch electrical appliances on and off [10], and monitor houses against smoke. The system also shows which window or door is open, and provides an easy, convenient way to control lights so that you can create the impression that someone is at home.

Therefore, the main goal of this paper is to design and implement a real-time SMS based wireless control system for automating home appliances. The system will combine a GSM communication module and a microcontroller by a serial communication port. Using this technology, the system will send a short message to a concerned phone. The phone can then control the system by sending AT commands. The remainder of this paper is organized as follows. The next section will explain the related work. In section III, we explain the system architecture. In section IV, we explain and present the hardware and software design. Section V gives the experimental results and potential applications. Finally, we conclude and discuss future work in section VI.

2. Related Work

Recently, a large number of systems have been proposed for automating home appliances and security. In general, most schemes that discussed this issue involve remote controlling of appliances and intrusion detection. The authors in [11] proposed a remote monitoring system through the use of spoken commands. A text message is generated and sent to the system. On receipt of SMS, the system will perform the specified task. Meanwhile, the system will alert the user if unusal work happend. In [12], the authors present their system that uses speech to interact with devices installed in a real home. The system combines the beam forming techniques, speech recognition and is used to facilitate the life for those people with disability.

The authors in [13] proposed a system that is used to check the status of appliances and control them through the use of mobile phone. Controlling home appliances such as AC, lights and alarms was

proposed in [4]. The system was implemented by a GSM technology. As the author [13] did, the author in [4] has been used the short mesage in their system to get the status of home appliances. Moreover, they designed the system so that it sends SMS to the authorized user in case a specific event occurs.

Other technologies were considered for controlling home appliances. The authors in [14] have been considered the problem by implementing various network technologies. Monitoring and controlling home appliance via the World Wide Web was proposed in [15]. Their design was based on an embedded card integrated into a server. Using Bluetooth technology was also proposed for controlling home appliance in [16], the authors proposed a controller and client modules, the modules communicate with the host controller through bluetooth technology. Another approach using Bluetooth technology to control home appliances from PC was discussed in [17].

3. System Architecture

As shown in Fig. 1, the architecture of the system consists of five parts: controller circuit, GSM modem, input devices, output devices and power supply. The controller circuit consists mainly from three components; PIC16F876A microcontroller, MAX232 Level converter, and a regulator circuit. PIC16F876A microcontroller is used to send AT commands to GSM modem and checks for new messages from the GSM modem. In case of any change in the state of the home appliances, the PIC16F876A will receive signals from the input devices and respond according to the number of the input devices by sending short message to a preconfigured telephone number. Meanwhile, the user can send SMS message or activate the mic and the audio amplifier at the remote sit. MAX232 is used to convert RS232 signal to TTL voltage level while the regulator circuit maintains five volt. Another circuit has been designed that includes switches as input devices and LEDs as an output devices.

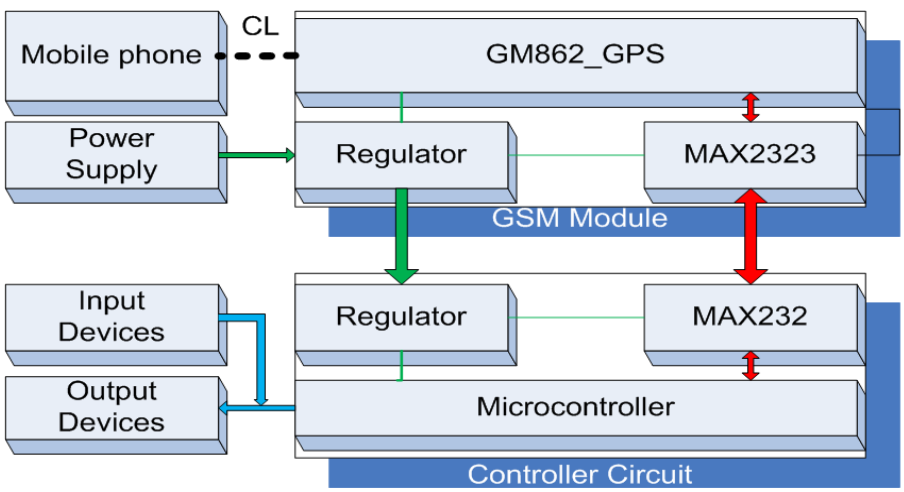

Figure 1. Block diagram of system

Since the serial port of the modem is not compatible with that one on the microcontroller, the microcontroller is integrated with the GSM modem through the MAX232 and MAX2323 chips. Both chips convert the signal from RS232 voltage level to TTL voltage level. The modem was connected to microcontroller board through a serial cable. In the proposed system, we have used Telit GM862-GPS modem that has a SIM card, and works just like phone; the modem is a Quad-band engine that works on frequencies 850MHz, 900MHz, 1800MHz, and 1900MHz. The modem decodes the received message and sends commands to the microcontroller. The microcontroller then sends the command

to the electrical appliances. On the other hand, if the system equips with any kind of intrusion sensors, it sends short message to the user telling him the location of the intrusion. The input devices, output devices used in our system are simple and replaceable. We designed the hardware interfaces so that it can fit almost all the requirement of the owners in their applications.

4. Hardware and Software Design

As shown in Fig. 2, GM862 modem is connected to the PIC16F876 microcontroller through RS232 data link cable. RxD and TxD pins of the GM862 modem are connected to the MAX 2323 chip for signal translation. The output from the MAX 2323 is connected to a 9-pin RS232 female connector. RC6 and RC7 pins of the PIC16F876 microcontroller are connected to the MAX 232 chip. The output from the MAX 232 is connected to a 9-pin RS232 female connector. RB0, RB1, RB2, and RB3 pins are connected to push-button switches to simulate the doors and windows of the home. RA0, RA1, RA2, and RA3 are connected to light emitting diode to simulate the appliances that are being controlled. The crystal of 20 MHz is used for generating 9600 kbps baud rate for serial communication with mobile.

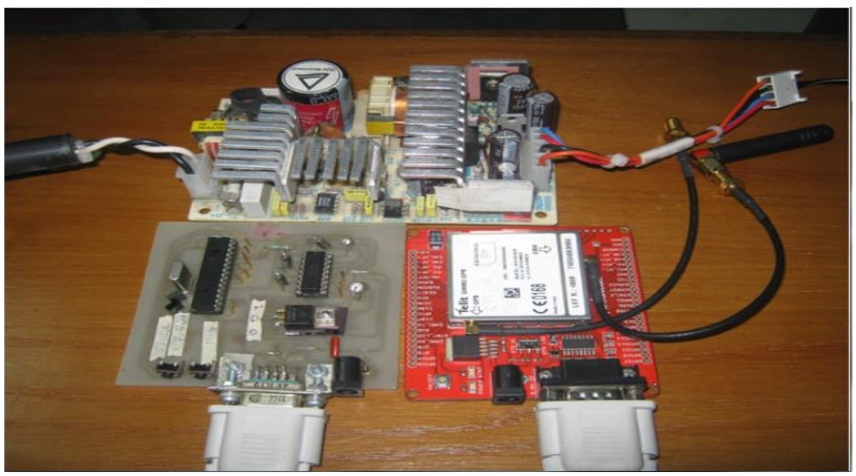

Figure 2. Printed circuit board with GM862 modem

The software has been developed in C language using mikroC compiler for PIC devices. With this compiler, the user gets a powerful and easy-to-use tool. The flowcharts of the system are shown in Fig. 3 and Fig. 4.

As shown in Fig. 3, PIC16F876 microcontroller is initialized to configure port A as an input, port C and port B as an output. UART is initialized for 9600 kbps, 8-bit, no parity and 1 stop bit. For enabling SMS reception using GM862 modem, microcontroller sends AT command until the modem responds with OK, then it will issue another command to check the short measege presence and to test if the module is connected to network or not. If the microcontroller does not receive the correct response, GM862 module will continue checking for network status until it connects to network. As soon as the modem makes sure that module is connected to network, the loop is terminated. After initializing all peripherals, the module will start the subroutine by sending SMS message based on the command coming from the microcontroller.

As shown in Fig. 4, the microcontroller will send “AT+CMGF=1” command to set module in text mode. After receiving the correct response, the microcontroller will send the phone number using the

"AT+CMGS= phone number" command, then it will send the message string that includes a number understood by the owner.

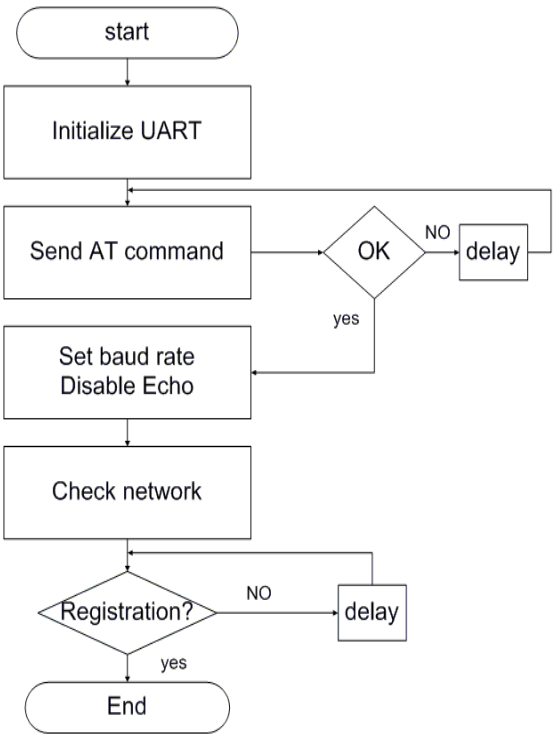

Fig.3. Flow chart for module startup

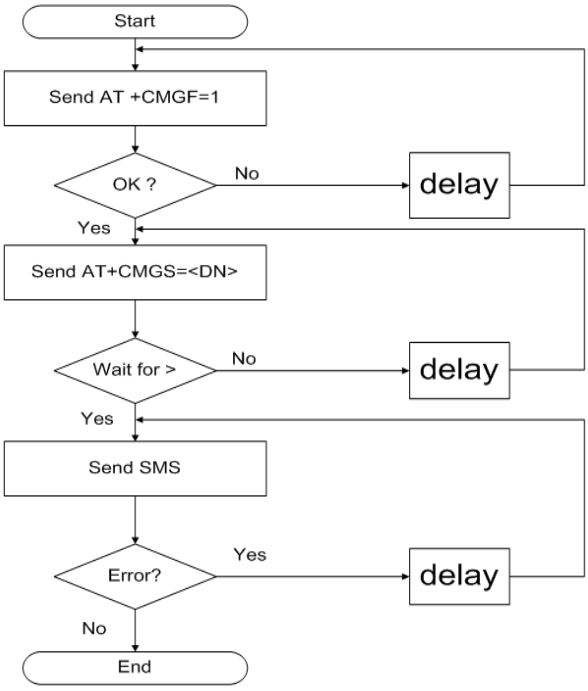

Fig.4. Flow chart for sending SMS

5. Experimental Results

After integrating all the components, the control circuit that consists mainly from three components; PIC16F876A microcontroller, MAX232 Level converter, and a regulator circuit was connected to a COM port and tested using the HyperTerminal program. GM862 module was also connected to a COM port and tested separately. Then the GM862 module and control circuit have been completely implemented with four scenarios: dialing a preconfigured number, sending SMS message, sending SMS message then making a call phone, and finally doing all the previous tasks and toggling led's on port A. All experiments were designed to force the intelligent home to perform the above tasks when an event of intrusion was detected.

6. Conclusion and Future Work

In this paper, we presented a low cost, highly reliable wireless system to automate various home appliances and provide security against intrusion using GSM technology. This system provides a good solution to the threft problem faced by some owners in daily life. The system has been design and implemented using PIC16F876A microcontroller. Telit GM862-GPS module has been used for communicating with the home owners. The system has been experimentally tested for sensing purposes through SMS message transfer with the owners. The solution presented her can be customized to suit any activity occurred at home provided that all sensors are installed and in use.

References

[1] Cho, J.-S., Park, S.-H., Han, Y.-J., & Chung, T.-M. CAISMS: A context-aware integrated security management system for smart home. *9th International Conference on Advanced Communication Technology*, ICACT, 2007.

[2] Wu, B.-F., Peng, H.-Y., & Chen, C.-J. A practical home security system via mobile phones. *Proceedings of the 5th WSEAS International Conference on Telecommunications and Informatics,* Istanbul, Turkey, May 27-29, 2006, pp. 299-304.

[3] Wong, M.-C. A phone-based remote controller for home and office automation. *IEEE Transactions on Consumer Electronics,* 1994, 40 (1), pp. 28-34.

[4] Sikandar, M., Khiyal, H., & Khan, A. SMS based wireless home appliance control system (HACS) for automating appliances and security. *Issues in Informing Science and Information Technology,* 2009, 6.

[5] Azid, S.-I., & Kumar, S. Analysis and performance of a low cost SMS based home security system. *International Journal of Smart Home*, 2011, 5 (3).

[6] Peijiang, C., & Xuehua, J. Design and implementation of remote monitoring system based on GSM. *2008 IEEE Pacific-Asia Workshop on Computational Intelligence and Industrial Application.*

[7] Ramamurthy, B., Bhargavi, S., & ShashiKumar, R. Development of a low-cost GSM SMS-based humidity remote monitoring and controlling system for industrial applications. *International Journal of Advanced Computer Science and Applications,* 2010, 1 (4).

[8] Alheraish, A. Design and implementation of home automation system. *IEEE Transactions on Consumer Electronics,* 2004, 50 (4), pp. 1087-1092.

[9] Soo, E.-K., & Sung, K.-M. Design and fabrication of security and home automation system. *ICCSA 2006, International Conference Computational Science and Its Applications,* Proceedings Part III, 2006, p. 3137.

[10] Lili, Y., ShuangHua, Y., & Fang, Y. Safety and security of remote monitoring and control of intelligent home environments. *Proceedings of IEEE International Conference on Systems, Man and Cybernetics,* 2007, pp. 1149-1153.

[11] Jawarkar, N.-P., Ahmed, V., Ladhake S.-A., & Thakare, R.-D. Micro-controller based remote monitoring using mobile through spoken commands. *Journal of Networks,* 2008, 3 (2).

[12] Potamitis, I., Georgila, K., Fakotakis, N., & Kokkinakis, G. An integrated system for smart-home control of appliances based on remote speech interaction. *8th European Conference on Speech Communication and Technology,* Geneva, Switzerland, Sept. 1-4, 2003, pp. 2197-2200.

[13] Nguyen, T.-V, Lee, D.-G., Seol, Y.-H., Yu, M.-H., & Choi, D. Ubiquitous access to home appliance control system using Infrared ray and power line communication. *3rd IEEE/IFIP International Conference in Central Asia,* vol. 1, Tashkent, Uzbekistan, Sept. 2007, pp. 1-4.

[14] Delgado, A.-R., Picking, R., & Grout, V. Remote-controlled home automation systems with different network technologies. *Proceedings of the 6th International Network Conference (INC 2006),* University of Plymouth, 11-14 July 2006, pp. 357-366.

[15] Ali, A.-R., & Rousan, M. Java-based home automation system. *IEEE Transactions on Consumer Electronics,* May 2004, Issue 2, pp. 498 - 504.

[16] Sriskanthan, N., Tan, F., & Karande, A. Bluetooth based home automation systems. *Journal of Microprocessors and Microsystems,* 2002, 26, pp. 281-289.

[17] Shepherd, R. Bluetooth wireless technology in the home. *Electronics and Communication Engineering Journal,* 2002, 26, pp. 281-289.