

Wireless Load Control Device using GSM Module

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Abstract. This paper presents Wireless Load Control Device (WLCD) using GSM module. The WLCD consists of PIC18F4550, GSM Module, relay circuit, keypad, and LCD. PIC18F4550 is used as a microcontroller to process the received data and then the output signal is sent for on/off relay switch. The users can on/off load in two ways, either keypad or short message service (SMS). The WLCD can control three loads and the current status of each load is displayed on the LCD. A working prototype of WLCD was built to demonstrate the effectiveness and efficiency of on/off load control through the GSM network.

Keywords: wireless load control device, PIC microcontroller, 18F4550, GSM module, SIM900B

1. Introduction

Nowadays, the innovative technologies have become an integral part of human life. Various load control method and technology such as power line carrier (PLC), telephone modem, internet, WIFI, Bluetooth, and ZigBee were established and developed to facilitate comfortable for humans. There are many researches about load control method and technology until now. For example, in 2000, R. C. Luo et al. [1] presented intelligent autonomous mobile robot control through the Internet. In 2010, X. Liu and W. Wang [2] introduced a control system of indoor intelligent Lighting which is based on power line carrier communication. The power line is used to transmit the analogue or digital signals with high speed. Not only power line technology but also wireless remote control and GSM network are used to combine for remote the indoor intelligent lighting and controlling the sensing. Architecture for power monitoring system using the wireless sensor network technology is proposed in 2011 [3]. In 2013, V. Bhatia and P. Whig [4] presents the modelling and simulation of electrical load control system using RF technology. Moreover, V. Bhatia and P. Whig [5] designed and simulated the smart elevator control system with Security based on Dual Tone Multi Frequency. R. Makwana et al. [6] tried to study the comparative of different wireless protocol between ZigBee (over IEEE 802.15.4) and Bluetooth (over IEEE 802.15.1).

In addition, the microcontrollers are playing a very important role in the development of the smart systems [2-5]. The microcontroller is basically a single chip microprocessor suited for machine controlling and system processing because it carries out autonomous operations and takes smart decisions. Moreover, the devices such as air conditioners, power tools, toys, office machines employ microcontrollers for its operation.

This paper designs and develops the control of electrical loads using GSM module. PIC18F4550 is used for processing and controlling of the WLCD. By pressing the keypad on the WLCD, the controllability of the electrical load can be achieved. Moreover, the users can send the command to remote control the electrical load and receive the current status of the load by GSM module.

2. Material and Method

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The complete system of WLCD can be shown in Fig. 1, consists of four major parts: (1) input command, (2) microcontroller, (3) output display, and (4) electrical load driver.

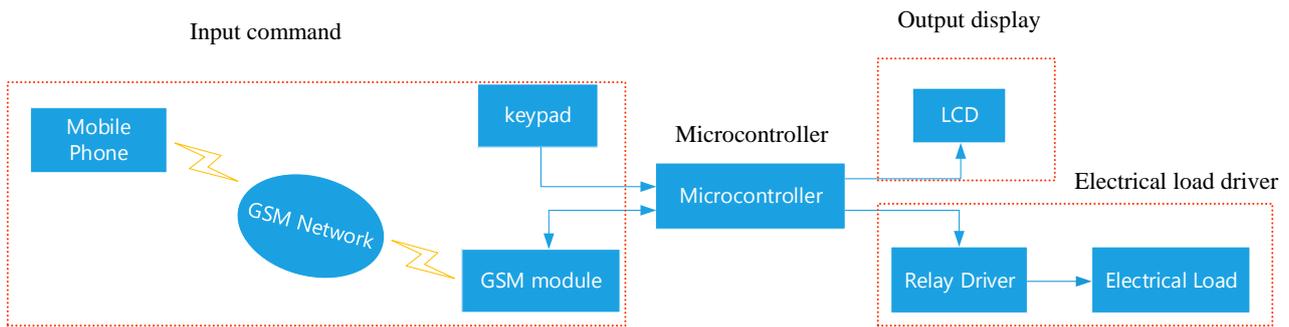


Fig. 1: Block diagram of the WLCD

2.1.1. Hardware Implement

2.1.2. Input Command

WLCD can receive the input command in two ways (i.e. keypad or SMS). 3x4 keypad switches are connected to the microcontroller for sending the input command to control each electrical load. In the other way, the user can interface with the WLCD by sending the SMS from the mobile phone to its. The GSM module (SIM900B) is used to receive that SMS from the user via GSM network and send the data to the microcontroller via RS232 serial port.

2.1.3. Microcontroller

A microcontroller (PIC18F4550) is used as an interface device (input command, LCD and the electrical load driver). It is a 40-pin dip, low power consumption and high speed FLASH/EEPROM technology. It consists of 256 bytes EEPROM memory, 35 Input/output, two external clock modes (up to 48MHz), 13 channels of 10-bit analog to digital converter, and a capture/compare/PWM functions. 7805 voltage regulators are used to convert 12Vdc to 5Vdc and the output is then given to the microcontroller and GSM module. The electrical load driver, keypad and LCD are connected with microcontroller at port A, B and D, respectively.

2.1.4. Output of the WLCD

16X2 LCD is used in the system to display the current status of the WLCD. Besides the LCD, the user can receive the current status of electrical load by sending SMS to the WLCD.

2.1.5. Electrical load driver

The electrical load driver includes the opto-isolator and the relay circuit. The opto-isolator has the function to transmit the output signal from the microcontroller to the relay circuit. The relay circuit is an interrupting device designed for shutting on/off the power supply. The relay switch is designed for the electrical load at 220Vac and 10A. When the WLCD receives the command, the microcontroller will control the relay switch to on/off the electric power supply via the opto-isolator. The prototype of hardware implementation was done as shown in Fig.2.



Fig. 2: the WLCD prototype

2.1.6. Software Implement

According to the hardware circuit design features, WLCD controlling program flowchart is introduced as shown in Fig. 3. First, the system initializes each module, and then turns off all electrical loads. Then, WLCD started already, the microcontroller sends the command of AT + CMGD = 2 for clearing the second data storage space in the SIM card of GSM module. When the user sends the short messages to WLCD, GSM module will send that command to the microcontroller. After that the microcontroller will turn on/off load according to the received command and show the current status on the LCD. The microcontroller sends a command (such as AT+CMGS="+66868273639" and "SW1-ON SW2-ON SW3-OFF") to the GSM module for informing the current status to the user. In the other way, when the received command is sent from the keypad, the WLCD will operate to on/off the electrical load and show the current status of each electrical load on the LCD module.

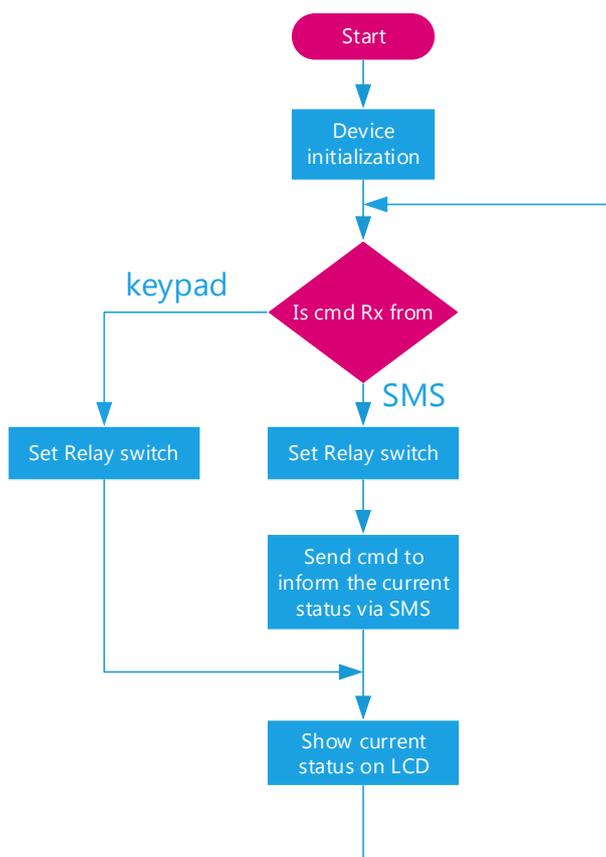


Fig. 3: Flow diagram of WLCD controlling program

Table 1 shows the control command to control the electrical loads of WLCD. For example, when the user need to on only SW2, the command is “*010#”.

Table 1: WLCD control commands

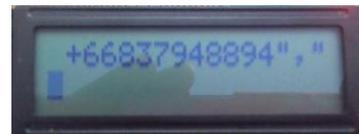
Command	SW1	SW2	SW3
*000#	OFF	OFF	OFF
*001#	OFF	OFF	ON
*010#	OFF	ON	OFF
*011#	OFF	ON	ON
*100#	ON	OFF	OFF
*101#	ON	OFF	ON
*110#	ON	ON	OFF
*111#	ON	ON	ON

3. Results

Electrical loads such as fans, bulbs, and computer etc. are tested and controlled wirelessly by the WLCD. When starting up the program, the LCD will show as Fig. 4(a). Then, three electrical loads can be controlled at a time in the present system. For example, when the user enters “*000#” to the WLCD using keypad, all of electrical loads will turn off and the LCD will show the current status as shown in Fig. 4 (b). Next, the user sends the SMS command (“*111#”) to the WLCD, the LCD will show the phone number of a user as shown in Fig. 4 (c). Then, all loads are switched on and the LCD will show the current status of electrical load as shown in Fig. 4 (d). After that, the microcontroller will send the current status to the user via SMS as shown in Fig. 4 (e).



(a) Start up the program



(c) the number of user who send the command to the WLCD



(b) Off all electrical load



(d) On all electrical load



(e) SMS send and receive from WLCD

Fig. 4: the result of WLCD

4. Conclusion

To control the electrical load by wireless communication using GSM module, the WLCD was constructed. The WLCD is designed to provide three loads (rated of each load at 220Vac 10A). The electrical loads can be turned on/off by keypad on WLCD or SMS via GSM network as the command shown in Table 1. The user can know the current load status by LCD on WLCD or the SMS from WLCD.

The advantage of WLCD can be stated as follows:

- wireless control from remote places,
- ease of operation by using any mobile possible to on/off electrical load,
- the users will get a convenient, and
- time saving.

In addition, this WLCD can be applied to the other systems such as controlling the pump, motor, etc. In the future work, we will add the electrical measuring system which can read and send the electrical measuring value such as power and energy to the user. The system will be designed to increase the current load more than 10A by using the higher size of the relay. Moreover, the WLCD can be extended to the desired number of loads by adding the relay circuits and changing the control commands.

5. References

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