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Design and implementation of security and control system for home electronic appliances

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Abstract

We have been designed and developed a security system including home automation with control of electronic appliances. The system can detect intruders using infrared sensors and monitor rooms or offices in real time by web camera. The password was needed to enter a house or office. The operation of home electronic appliances also can be easy and remotely controlled by Internet. The system was designed by VHDL. The size of the fabricated system is small and it showed good performance.

Key Words : security system, home automation, sensor, Internet, VHDL

1. Introduction

Recently the developments of security system and home automation system have been driven intensively for promoting the benefit of our lives. The security system has been used to prevent intruders. Home automation that controls the electronic appliances such as fire alarm, turning the lights, detects gas leakage, and monitors the visitors is needed to maintain convenience and comfortableness in house. Some requirements, however, are needed for home automation system. First, the power consumption of home automation system is low and the size must be small because it would be installed in house or office. Second, the installation and maintenance of the system should be easy. Finally, the operation method of the system is easy and could be controlled remotely by network. The interesting of security system has been increased as the needs of protecting the human beings or valuable things are increasing. Infrared sensors, thermo sensors, and biometric sensors are usually used in security system[1-4]. Researches on the home security systems are mostly concentrated on detecting intruders and gas leakage, etc. So the necessity of studies on home automation that control the home electronic appliances is demanded in conventional security system. In this paper, we have developed a security system including control functions for home electronic appliances which can be remotely controlled through the Internet. The security and home automation system are designed by VHDL and fabricated using CPLD. The system is small and its performance is good. And it is easy to add other functions and apply to other home electronic appliances.

2. System Design

Fig. 1 shows a block diagram of the system. The flowchart of security system including home automation is shown in Fig. 2. The suggested architecture was made by VHDL and we verified the model with VHDL simulator[5,6]. For security system, we used two infrared sensors to detect intruders and a keypad to permit a visitor to enter a house or office.

We added the functions to control the home electronic

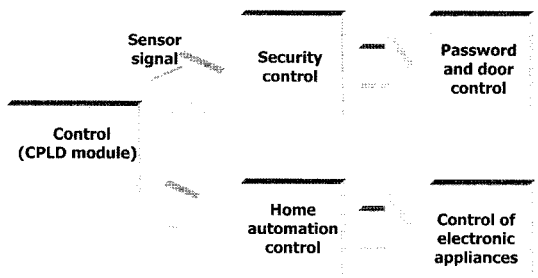

Fig. 1. Block diagram of the system.

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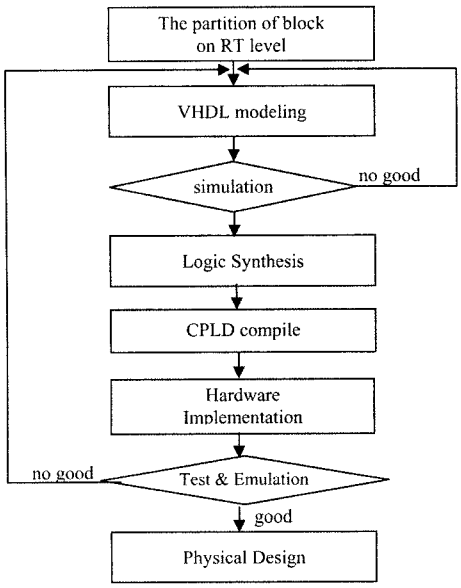


Fig. 2. Flowchart of the home security system.

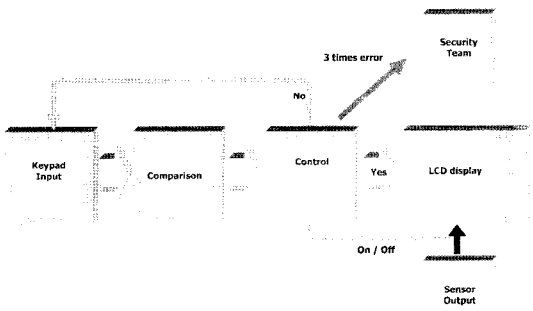


Fig. 3. Block diagram of door control in home automation system.

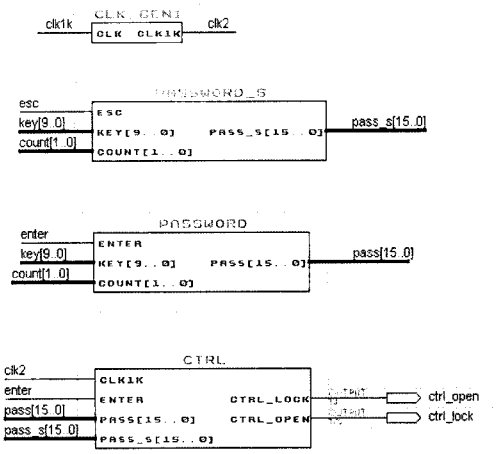


Fig. 4. The input part of the keypad.

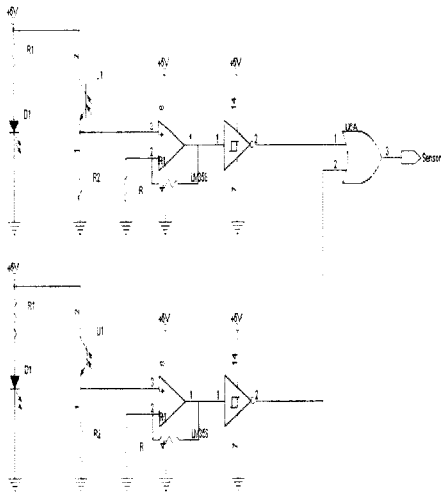


Fig. 5. Sensor circuits.

appliances to the system showed in previous paper[7]. Fig. 3 shows a block diagram of security system. To open the door in seconds, the password entered by a visitor should be the same as the password saved in the system. The visitor should enter a correct password in 3 times. Otherwise, the system informs policeman or the master.

Fig. 4 shows the input part of the keypad. The CTRL compares the saved password with keypad input and synchronizes the clock frequency. We could change the password anytime but in 5 seconds. Two infrared sensors detect intruders at the front of the door by comparing the sensor signals. The sensor circuit is shown in Fig. 5 and the simulation results are shown in Fig. 6.

The home automation system controls electronic appliances such as TV, audio component, air conditioner, lights and web camera in computer and detects gas leakage. In addition, remote control of the electronic appliances by network is possible such that a master can reserve the start and stop time of them. The master can monitor the room or office by the web camera in anytime and at anyplace through the Internet and can move the web camera all directions. This system can easily extend to the additional electronic appliances, too.

The block diagram of the control part of electronic

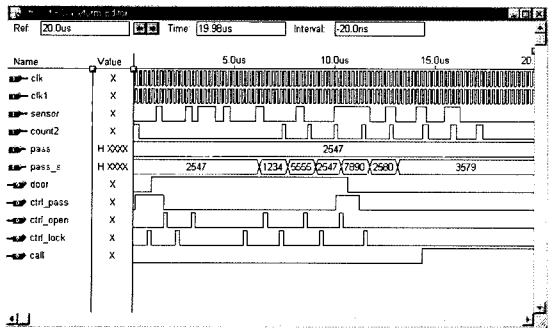


Fig. 6. The simulation of sensor and door control.

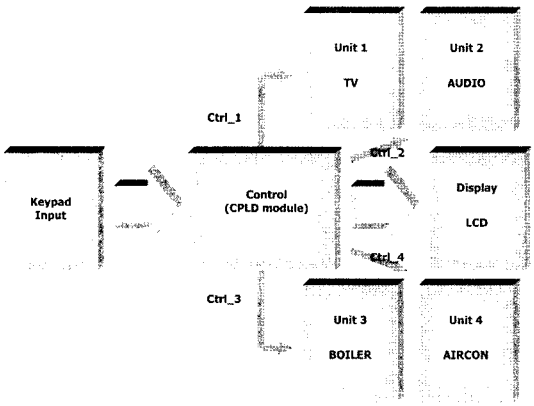
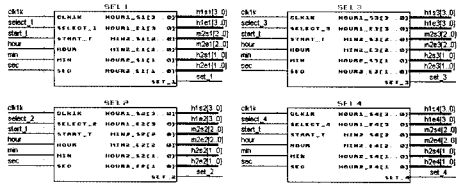
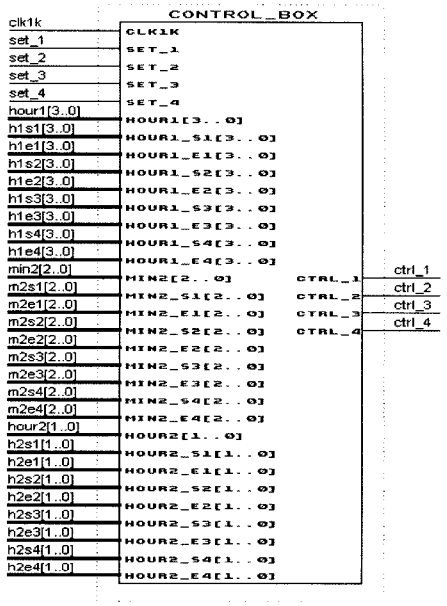


Fig. 7. The control part of electronic appliances in home automation system.



(a)



(b)

Fig. 8. The input and output signals of CONTROL_BOX.

appliances is shown in Fig. 7. We could choose each electronic appliance to set the operation time and LCD panel displays the states. The control signals (SEL1, SEL2, SEL3, SEL4) of each appliance are shown in Fig. 8(a). The operating time of each appliance was inputted to the CONTROL_BOX. Then the appliance was operated according to the set time which is output signal from the CONTROL_BOX as shown in Fig. 8(b). Fig. 9 shows the simulation of CONTROL_BOX. The control signals (ctrl_1, ctrl_2, ctrl_3 and ctrl_4) of SEL1, SEL2, SEL3, and SEL4 were generated at set time. The hour2, hour1 and min2 represent present time. The s1 (s2, s3, and s4) and e1 (e2, e3, and e4) are start and stop time of SEL1 (SEL2, SEL3, and SEL4). All electronic appliances are well operated by the set time.

3. Operation of System

Home automation and security system are fabricated using CPLD (Altera Inc.) and tested. Fig. 10 shows the LCD panel and the keypad, where LCD panel indicates the door states, the input password signal with asterisk marks, and a phone number of the master which the system call to when input password was wrong for 3 times. This LCD panel also displays the states and operating time of the electronic appliances. We made a control program to operate functions of the electronic appliances in C++. The operating time of the electronic appliances can set or change in remote computer through the Internet. The monitor of remote computer displays the operating time and states of the electronic appliances as well as room or office in real time by the web camera as shown in Fig. 11. We can choose the electronic appliances, set time to operate the electronic appliances in remote computer, set the temperature of an air conditioner, and move the web camera by click-

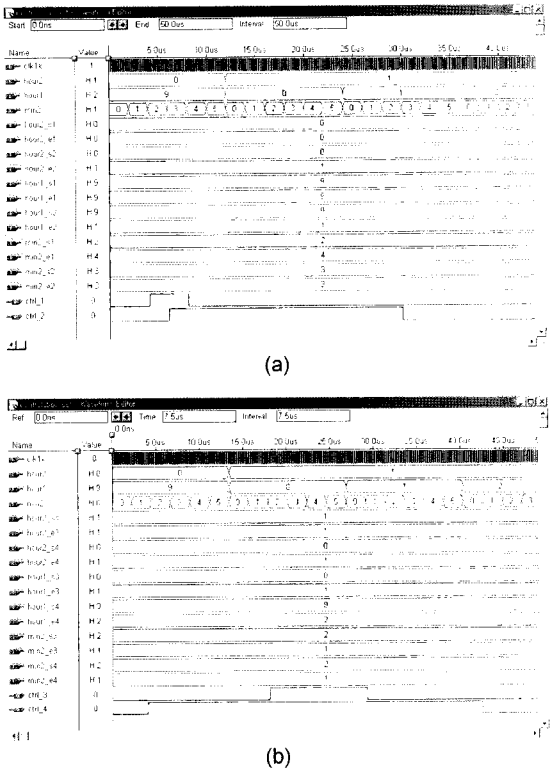


Fig. 9. The simulation of home automation system.

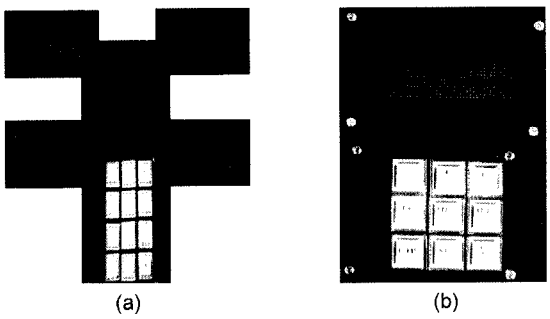


Fig. 10. LCD panel and keypad in security system.

ing the buttons in anytime and at anyplace through the network. The electronic appliances operate fairly well by the set time. After the termination of the control program, the latest data is saved by the computer automatically.

4. Conclusions

The necessity of Home automation and security system has been increasing for convenience and protecting human or properties. We have designed the system by VHDL and fabricated the home automation and security system using CPLD. This fabricated system gives you emergency alarm when it senses intruders or gas leakage to fulfill more robust security. The home automation system remotely controls electronic appliances through network. This system is small and can easily extend to both additional functions and other electronic appliances. Our further study is that we will connect the electronic appliances with polymer optical fiber (POF) to improve the performance of our system in home network.

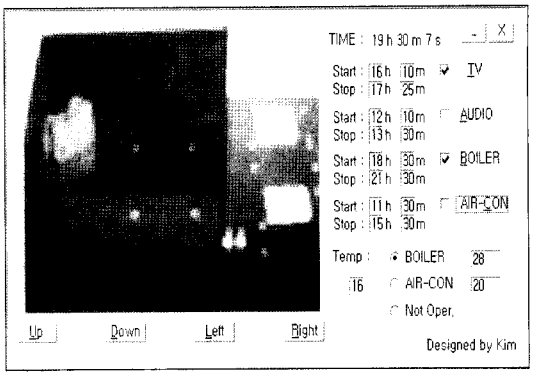


Fig. 11. The remote computer monitor.

Acknowledgements

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