Design and Fabrication of Security and Home Automation System

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Abstract. Home automation system was designed and fabricated for controlling of home appliances, gas detection and home security. The fabricated system could detect the intruder using infrared sensor and monitor the room or office in real time by web camera. The password was needed to enter the house or office and the operation of home appliances could be remotely controlled by network, too. This fabricated system was small and had an advantage to supplement additional function easily.

1 Introduction

Nowadays the increasing developments of home automation and security system have been driven primarily by the need to promote the benefit of our lives. Home automation is needed to maintain safety, convenience, and comfortableness at home as controlling the home appliances, detection of gas leakage, fire alarm, controlling the light, and monitoring the visitors. Some conditions, however, are necessary for security and home automation system. First, the power consumption of home automation system should be low and the size must be small because it could be used in house. Second, the installation and maintenance of the system should be easy. Finally, it is easy to operate the system and could be controlled remotely through the Internet. The concern about security system has been increasing to protect the human beings and valuable things. A sensor is important in security system. Infrared sensor, thermo sensor, optical sensor, and biometrics such as finger print recognition and iris recognition are usually used in security system[1-6]. In this paper, security and home automation system are designed by VHDL and fabricated using CPLD[7]. The fabricated system was small and showed good performance. In addition to, we could add other functions easily.

2 System Design and Fabrication

The flowchart of security and home automation system is shown in Fig. 1. Architecture was made by VHDL and we verified the model with VHDL simulator.

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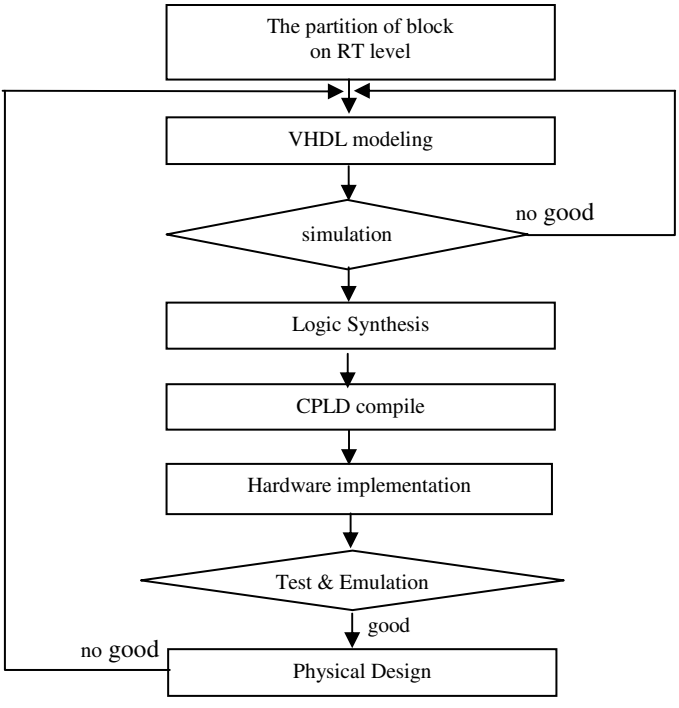


Fig. 1. Flowchart of the security and home automation

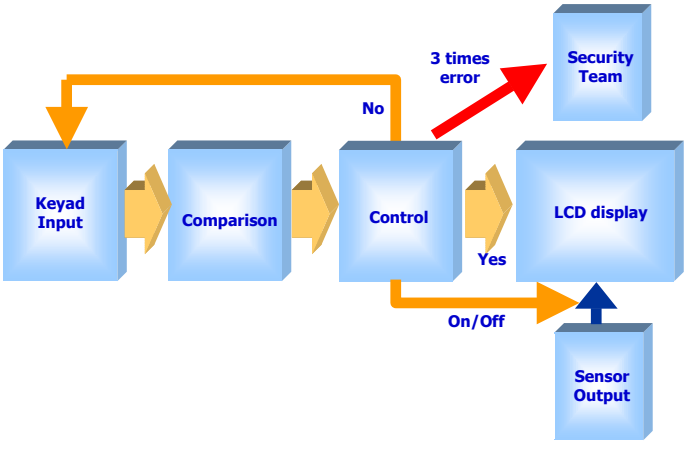


Fig. 2. Block diagram of door control in security system

For security system, we used two infrared sensors to detect an intruder and the keypad to permit a visitor to enter a house or office. The block diagram of door control in security system is shown in Fig. 2. Keypad input is used as an input signal. If a

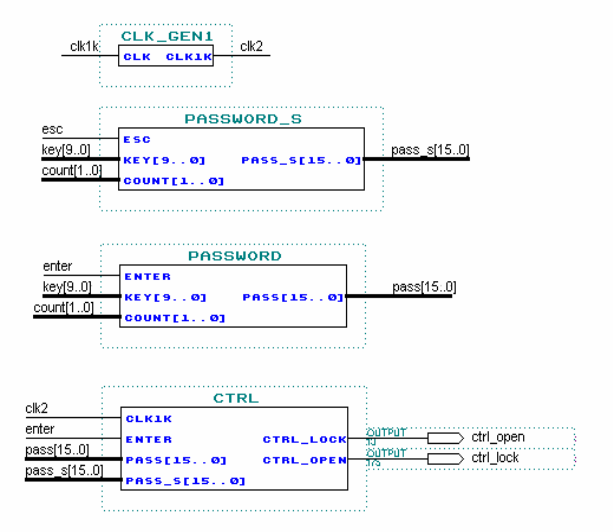


Fig. 3. The part of keypad input

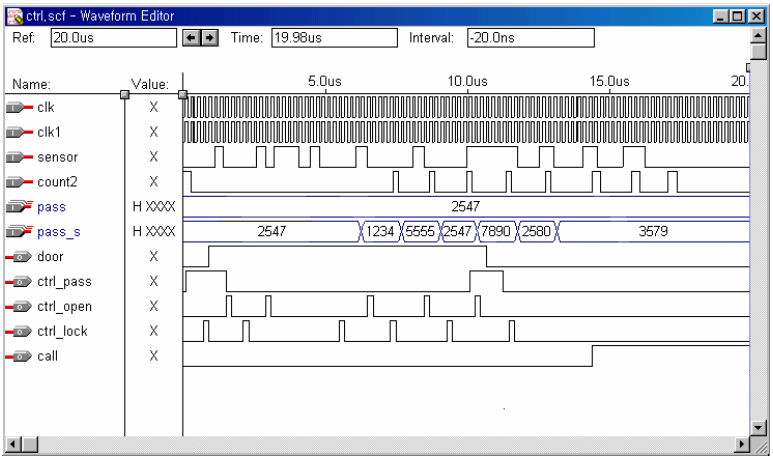


Fig. 4. The simulation of sensor and door control part

Table 1. The distance between photo detectors

	The distance between the infra-red sensor and the photo detector	The distance between photo detectors
The distance between top and bottom	13.5 cm	5.48 cm
The distance between left and right	7.5 cm	3.6 cm

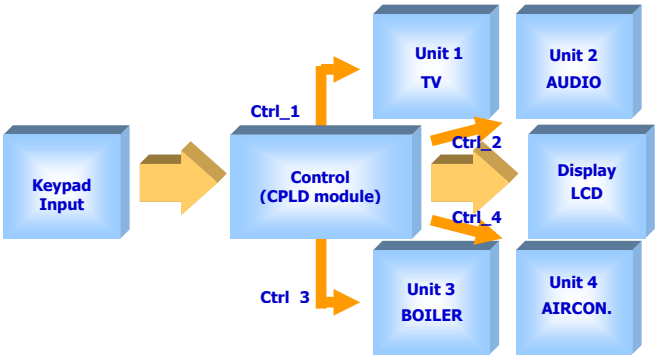
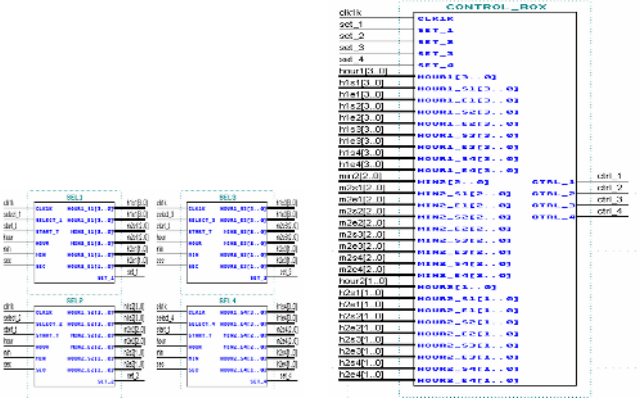


Fig. 5. The control part of the home automation

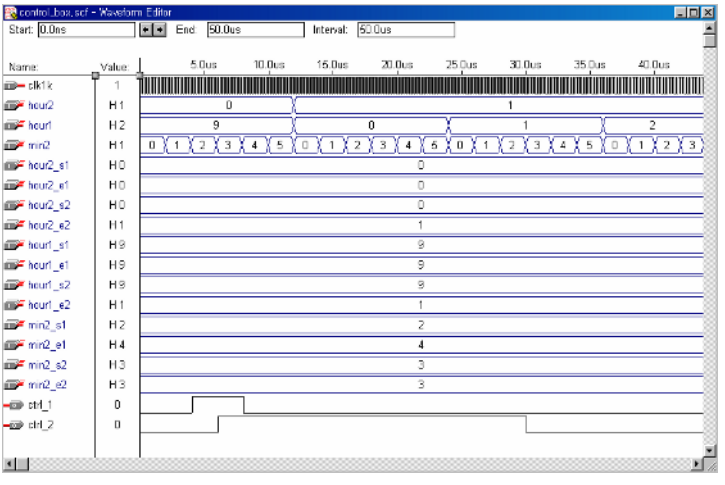


(a) (b)

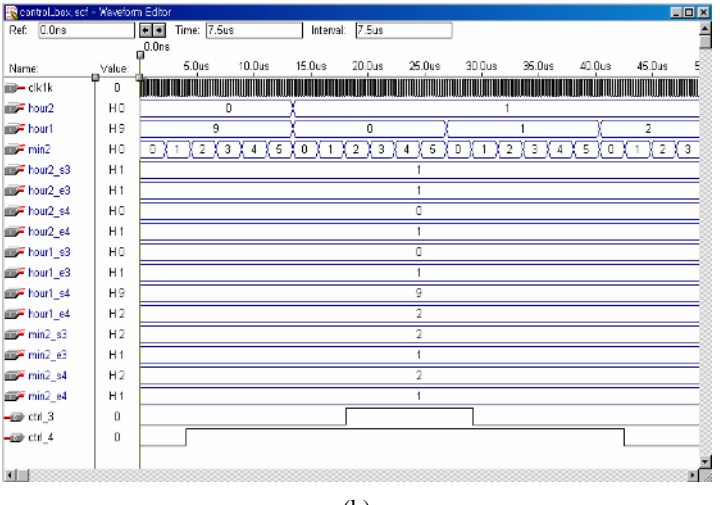
Fig. 6. The input and output signals of CONTROL_BOX

keypad input were the same as password saved in security system, the door would be opened. Otherwise, the door would not be opened. If input password is wrong in 3 times, the system informs policeman or host of alarm signal. Fig. 3 shows the part of keypad input. The CTRL compares the password with keypad input and synchronized the clock frequency. We could change the password anytime in 5 seconds. Two infrared sensors were used to detect an intruder at the front of the door. The sensor signals were compared and controlled the door. The simulation of sensor and door control part is shown in Fig. 4, where pass and pass_s are the password saved by host and password inputted by visitor, respectively. The distance between two photo detectors receiving the infrared signal is investigated to improve the sensitivity of photo detectors when the distance between the infrared source and the photo diode is constant because the radiation angle of the infrared source is 27° at operation current 50mA. The results are shown in Table 1. Home automation system controls home appliances such as TV, audio component, air conditioner, lights and web camera in computer and

detects gas leakage. In addition, remote control of the home appliances by network is possible so that a host can reserve the start time and stop time of them. The host can monitor the room or office in the web camera in anytime and anyplace through the Internet and move the web camera all directions. This fabricated home automation system can easily extend additional home appliances, too. The block diagram of the control part of home automation is shown in Fig. 5. We could choose the each home appliance to set the operation time and LCD panel displays the states of it. The control signals of each appliances are shown in Fig. 6(a), where SEL1, SEL2, SEL3, and SEL4 represent home appliances, respectively. The operating time of each component was inputted in CONTROL_ BOX and they were operated according to setting time



(a)



(b)

Fig. 7. The simulations of CONTROL_BOX

which is output signal from the CONTROL_BOX as shown in Fig. 6(b). Fig. 7 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. In Fig. 7 the hour2, hour1 and min2 represent present time, s1 (s2, s3, and s4) and e1 (e2, e3, and e4) are start time and stop time of SEL1 (SEL2, SEL3, and SEL4). All home appliances are well operated by the set time.

3 Operation of the Systems

Security and home automation system are fabricated using CPLD (Altera Inc.) and tested. 56 % of total cell amount was used. Fig. 8 is LCD panel and keypad, where LCD panel indicates the door states, input password signal with asterisk marks, and phone number of police office or host which the system call to unless the visitor enters correct password in 3 times. This LCD panel also displays the operating time of home appliances. Fig. 9 shows the monitor of remote computer, which displays the states and operating time of home appliances and room or office image by the web camera. We can choose the home appliances, set the operating time of the home appliances, and set the temperature of air conditioner and heater through the network. And we can move the web camera to see the house or office anytime and anyplace by the network as we click the control button displayed in computer monitor. The system showed good operation. When the control program written in C++ was terminated, the computer saved the latest data automatically.

(a) (b)

Fig. 8. LCD panel and keypad of the fabricated system. (a) security states and (b) the state of TV of home automation system.

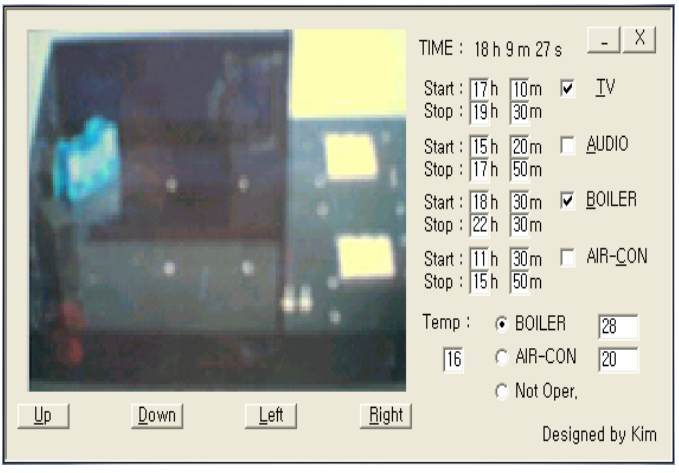


Fig. 9. The room monitored by web camera and the states of home appliances in computer monitor

4 Conclusions

The needs of Home automation and security system have been increasing for comfortableness and protecting human and properties. We have designed the security and home automation system by VHDL and fabricated the system using CPLD. The fabricated system informs you of emergency alarm when it detects intruders. Home automation system remotely controls electronic through network. This system was small and can be extended easily both additional functions and other home appliances.

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