Electronic Security Systems

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Abstract

In recent years use of microprocessor-based electronic security systems have become more popular in business offices, residential homes, private clubs, and industrial plants. This is due to a dramatic rise in property crime, and industrial espionage. There are two types of sensors employed in electronic security systems; passive sensors, and active sensors. Passive sensors do not emit any signal in order to make measurement. They simply report a change from the normal condition. A vibration detector on a window, or a proximity sensor switch on a door are examples of passive sensors. Active sensors generate electrical signals, electromagnetic waves, or optical signals. The response to the generated signal determines the change from the normal condition. Infrared sensors that generate an infrared light beam, and check the reflected beam off an opposing wall or ceiling are examples of active sensors. Electronic graduates could be employed by manufacturers of electronic security systems, or would be responsible for installation and maintenance of these systems. In this paper we will describe and build a computer controlled electronic lock with "Entry Code Switch" and password-protection. We will describe the design, construction, and computer interface technique of the system hardware, and write the system software. This lab project would familiarize electronic students with the steps required in design and manufacturing of typical electronic systems.

Introduction

In the United States, most residential housing units on university campuses are equipped with electronic security systems. These include card-access security locks for main entrance doors, and passive electronic sensors and security cameras for monitoring the side exit doors. Placed in the lobby are television monitors / video recorders for the security cameras, and a Personal Computer (PC) that has the software to control the security system. Personal computers (PCs) for several residence halls can be connected to a larger PC located in a more secure area such as the campus Public Safety and Security Office. The larger PC would not only collect annual data, but also help the campus police to quickly find a security breakdown.

Industrial and manufacturing plants will usually have more sophisticated security systems. In these plants, electronic security systems may have different types of active sensors, and passive sensors. In addition to the sensors, the security systems may include mesh wires embedded into the walls, ceilings, and floors of highly secured warehouses. Embedded mesh wires detect an illegal penetration into the building. Currently, several catalogs that extensively describe commercially available security systems are on the market [1].

The electronic security lock system described in this paper was a student laboratory project. The project was designed to familiarize students with microprocessor interfacing topics. Figure 1 shows the schematic block diagram of the system. The four-position dip-switch is used for setting the "entry-code", and the key pad is used for entering the "password-code".

System Hardware

Figure 2 displays the simulation circuit for the decoder logic. We have simulated the decoder circuit using the Electronic Workbench for Windows 95 software[2]. The flexibility, and user friendly characteristics of this software has been discussed in a previous published paper [3].

The decoder circuit will decode a range of 0300H to 03FFH. Also, as indicated in the address decoder map on figure 3, the dip switch setting must be 0101.

The PC interface card used for connecting the decoder circuit to the computer has been described in a previously published paper [4]. This card can be purchased from the Electronic Industry Association (EIA) office [5].

Figure 4 shows the pinout diagram of the interface card. The interface card is placed in an Industry Standard Adapter (ISA) port of a PC computer.

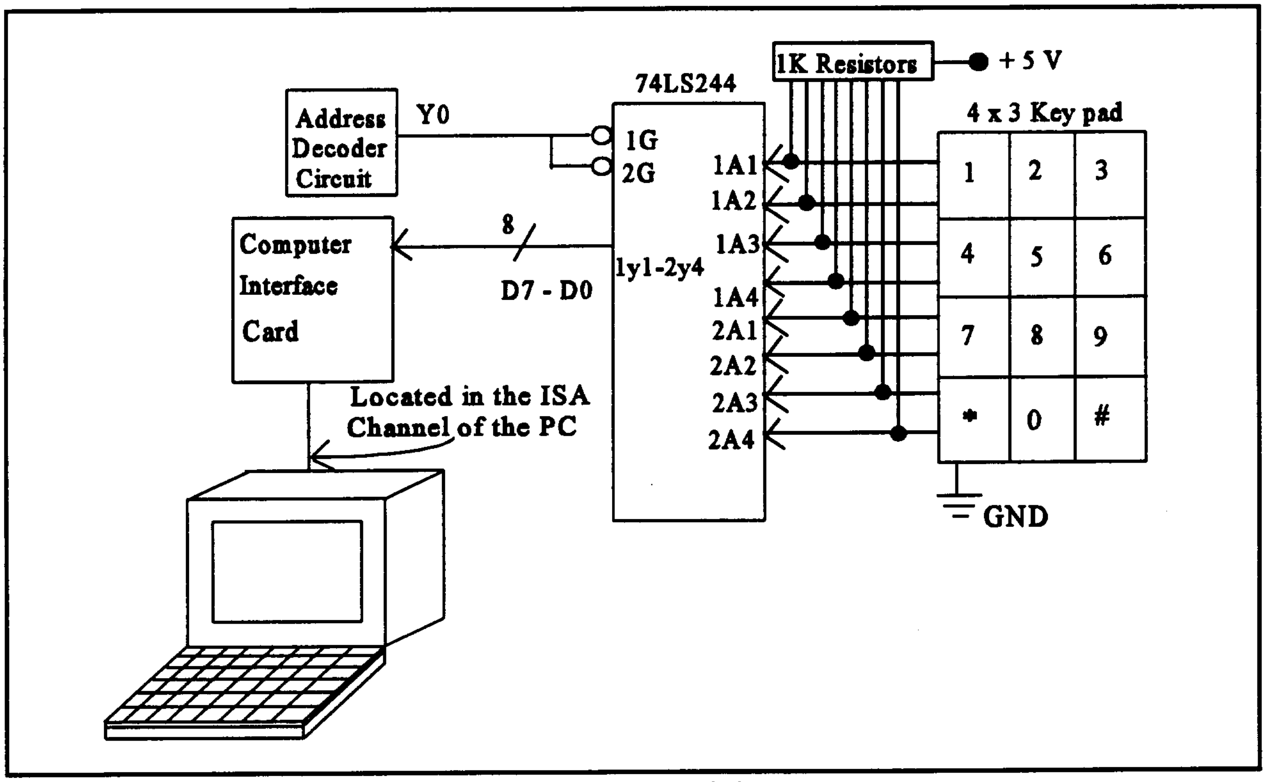

Figure 1 The Security System Block Diagram

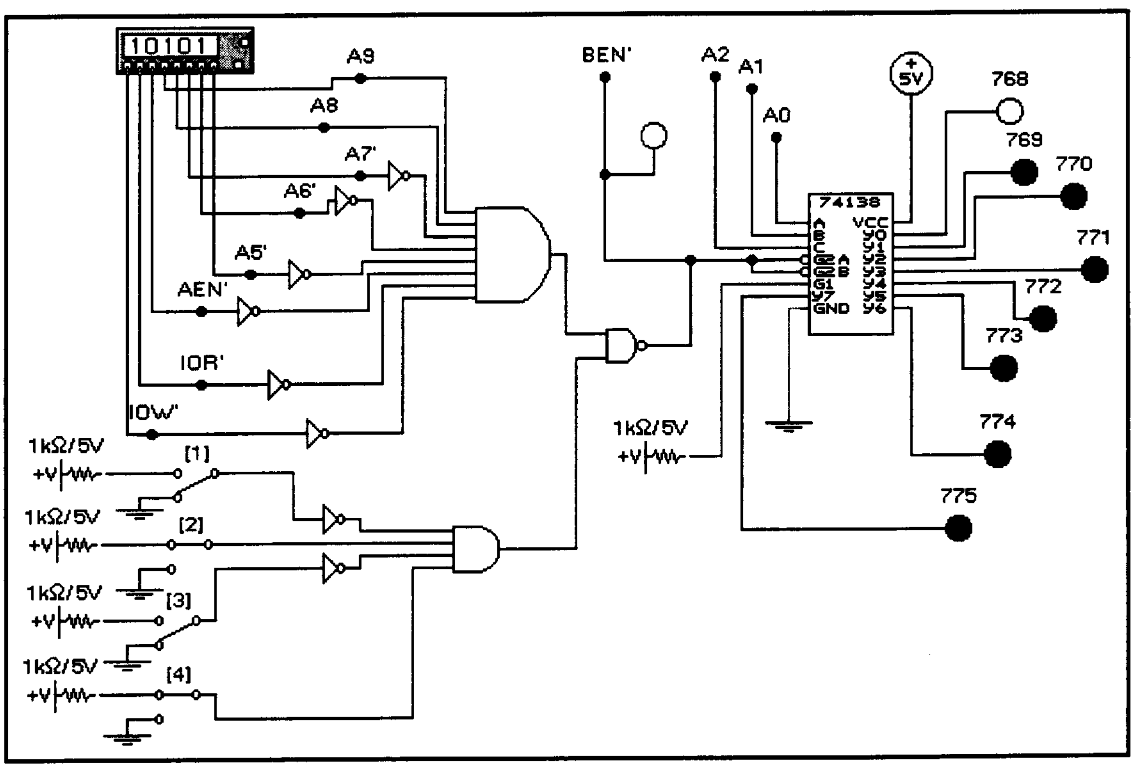

Figure 2 The Address / Switch Decoder Simulation Cicuit

A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0	SW4	SW3	SW2	SW1
0	0	0	0	0	0	1	1	0	0	0	X	X	↕	↕	↕	1	0	1	0

Figure 3 Address / Switch Decoder Map

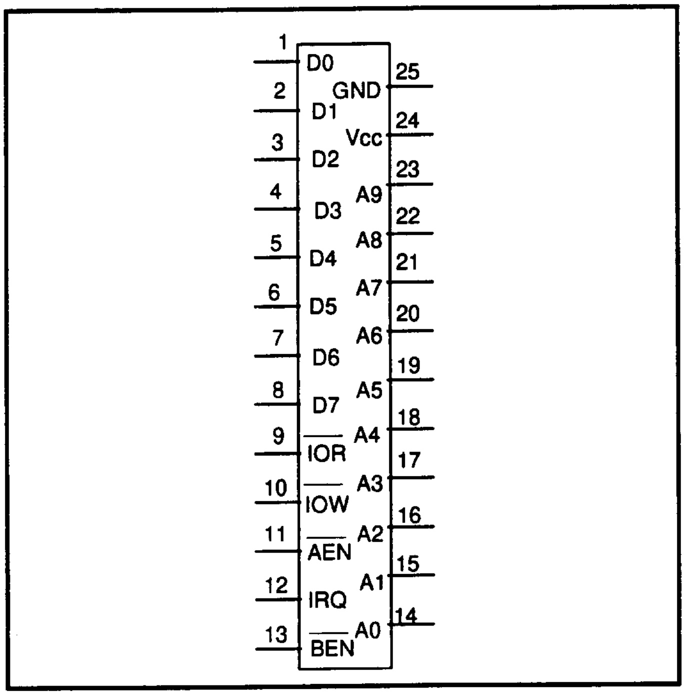

Figure 4 Pinout Diagram for the PC Interface Card

System Software

Figure 5 displays the system software. The system will first request to set the four digit dip-switch. Figure 3 shows that the correct dip-switch setting is 1010. Once the dip-switch is set, the program will ask for a five-digit entry code number from the key pad. The correct code is 12271. If the correct code number is entered, the system will welcome you with the message “Your are in!”. Otherwise, it will request the code again. The program allows you to attempt to enter the code three times prior to sounding the alarm. Appendix A contains the software. The entry code may be altered periodically by the system administrator.

Conclusion

The lab project was intended to familiarize the students with the computer interfacing. Also, the concept of electronic security systems was illustrated. The hardware design and implementation would enhance the students' microprocessor interfacing ability. The software portion of the project is intended to help students be able to program for new security systems, or analyze existing electronic security software.

References:

1. Simplex Time Recorder Co., Dist.: Commercial Security System, Fort Wayne, IN.

2. Electronic Workbench for Windows 95, Interactive Image Technologies Ltd., 700 King Street W, Suite 815, Toronto, Ontario, Canada M5V2Y6.

3. “Simulation of Analog and Digital Circuits with Electronic Workbench”, 1996 American Society for Engineering Education (ASEE) Annual Conference Proceedings, Session # 3548, Paper #1, June 1996.

4. "Computer Interface for Liquid Crystal Display

(LCD)", 1997 American Society for Engineering Education (ASEE) Annual Conference Proceedings, Session #1532, Paper #6, June 1997.

5. Electronic Industries Association (EIA), Consumer Electronic Group, Washington, D.C.

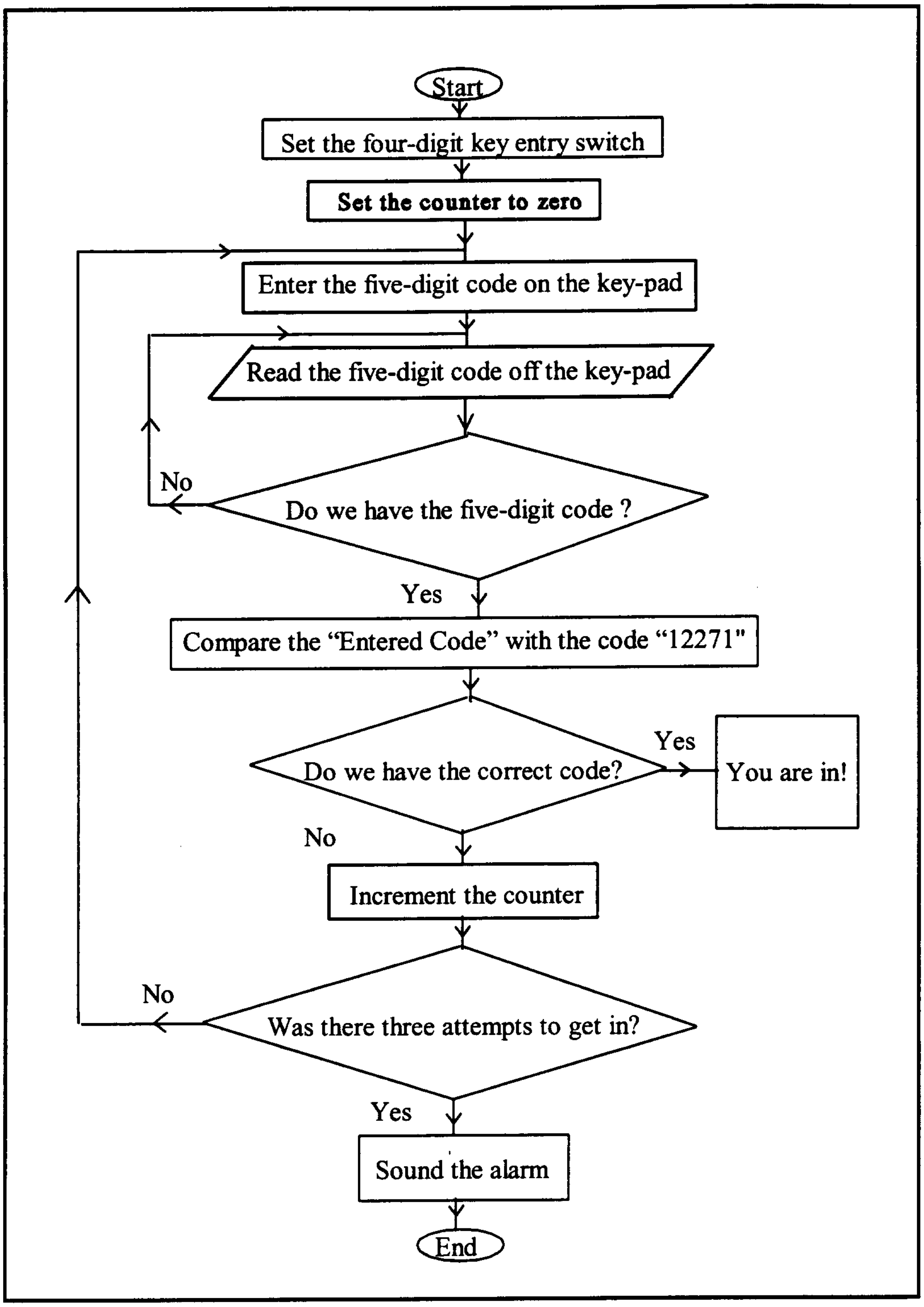

Figure 5 The System Software Flowchart

Appendix A:

```
CLS
SCREEN 1
COLOR 8, 0
Print " Make sure to set the correct four digit key code on the
Switch!"

begin1:
attempts = 0
begin:
CLS


x = 1
start:

REM     Scan the Keypad for a "five digit number".
FOR t = 1 TO 5
d(x) = INP(768)

REM     If no key have been pressed, go to the label "start".
IF d(x) = 255 GOTO start

REM Decode and find the value of the pressed push-button on
the keypad.
IF d(x) = 254 THEN d(x) = 0
IF d(x) = 253 THEN d(x) = 1
IF d(x) = 251 THEN d(x) = 2
IF d(x) = 247 THEN d(x) = 3
IF d(x) = 239 THEN d(x) = 4
IF d(x) = 223 THEN d(x) = 5
IF d(x) = 191 THEN d(x) = 6
IF d(x) = 127 THEN d(x) = 7

REM     Print the value of the pressed push-button on the
        keypad.
PRINT d(x);
FOR p = 1 TO 800: NEXT p
x = x + 1

REM     Do we have a five digit number yet?
IF x > 5 THEN GOTO check
NEXT t

REM     Does the five digit number match the system code?
check:
IF d(1) = 1 AND d(2) = 2 AND d(3) = 2 AND d(4) = 7 AND
d(5) = 1 THEN GOTO ok ELSE GOTO alarm
END

REM     The entered five digit code was correct!
ok:
CLS
LOCATE 5, 10: PRINT "You are in !"
LOCATE 7, 10: PRINT "System off"
DO
LOOP WHILE INKEY$ = ""
GOTO begin1

REM the entered five digit code was not correct!
alarm:
LOCATE 5, 10: PRINT "didn't make it"
SLEEP 1
attempts = attempts + 1

REM Has there been three unsuccessful attempt to get in?
IF attempts = 3 GOTO soundoff
GOTO begin

REM Three unsuccessfull attempt to break into the system!
Sound the alarm, and display flashing colors on the computer
screen.
soundoff:
clr = 1
DO
x1 = 0: x2 = 2: y1 = 0: y2 = 190

q = 537
FOR t = 1 TO 100
LINE (x1, y1)-(x2, y2), clr, BF
SOUND q, .2
q = q + 50
x1 = x1 + 3
x2 = x2 + 3
NEXT t
clr = clr + 1
IF clr > 3 THEN clr = 1
LOOP WHILE INKEY$ = ""
GOTO begin1
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Earned his Ph.D. in electrical engineering, from university of Kentucky, in 1987. He is presently an associate professor at Eastern Kentucky University. Dr. Rabiee is a registered professional engineer in the state of Kentucky, and a member of IEEE, ASEE, and NAIT.