55:036
Embedded Systems and Systems Software
Spring, 2007
Fifth Laboratory Assignment

Due Dates:

   Prelab: Tuesday, March 20
   Lab Report: Thursday, April 5

Objective:

The purpose of this lab is to gain experience with external interrupts, magnetic stripe readers, numeric keypads, EEPROM, and embedded programming in C.

Lab Description:

The software for this lab is to be written in Mocrochip C18 C.   You will build a simple electronic door access system. To be authenticated for entry, a user must first swipe an ID-card that contains a 10-digit user-ID number through a Magtek mag-stripe reader that is interfaced to the PIC. If the system recognizes the user-ID on the card, the user will be prompted (via the QwikFlash LCD display) to enter a 4-digit PIN. The user will enter the PIN on a 4x3 numeric keypad that is interfaced to the PIC.   If the PIN is correct, the user is authenticated. Authentication will be noted by displaying a message on the LCD and lighting a LED on the QwikFlash board for five seconds.

User-IDs and associated PINs for authorized users will be stored in data EEPROM on the PIC so that this information will be retained even if the processor is powered down. Once a user has been authenticated, he/she can request to change their PIN by pressing the SW3 pushbutton on the QwikFlash Board. The system will then prompt them to enter the new PIN twice before changing the PIN stored in the EEPROM.

Here are some usage scenarios:
1. User: swipes card containing a user-ID that is not in the system's list of authorized users
    System: displays on LCD: **Invalid**
                                                    Card

2. User: swipes card containing a valid User-ID
    System: displays on LCD: **Enter**
                                          PIN:
    User: enters an invalid PIN. As PIN is entered, system displays '*'s on the LCD—e.g **Enter**
                          PIN:****
    System: Responds with: **Re-enter**
                                        PIN:

User: re-enters PIN, as above
(This sequence will continue until user enters a valid PIN)

User: Enters a valid PIN in response to "Enter PIN" or "Re-enter PIN" prompt
System: Turns on LED for five seconds and displays on LCD: **Door Is**
Unlocked

3. Authorized User: Presses SW2 pushbutton within 5 seconds of being authorized.
System: Responds with: **Type New**
PIN:
User: Enters a new PIN. As new PIN is entered, system displays '*' on LCD:
Type New
PIN:****
System: Prompts user to reenter new PIN: **Re-enter**
PIN:
User: Re-enters a different PIN:
Re-enter
PIN:****
System: Displays on LCD: **PIN not**
Changed

4. Authorized User: Presses SW2 pushbutton within 5 seconds of being authorized.
System: Responds with: **Type New**
PIN:
User: Enters a new PIN. As new PIN is entered, system displays '*' on LCD:
Type New
PIN:****
System: Prompts user to reenter new PIN: **Re-enter**
PIN:
User: Re-enters the same PIN:
Re-enter
PIN:****
System: Changes the stored PIN and displays on LCD: **PIN**
Changed

Note: You should write a separate, simple program to populate your EEPROM with a set
of user-IDs and associated PINs: Use the following user-IDs **:**

0192837465
2828282828
5503655036
8675309000
5432167890
1029384756

Prelab:

Carefully review the class lecture notes and read Sections 16.2, and 19.3-19.6 in the text to fully understand the basics of interfacing the mag-stripe reader and 4x3 keypad to the PIC. Also review the C18 compiler documentation for the following:

- Interrupts: Section 2.9.2 and 5.3 in the C18 Compiler User's Guide
- Data EEPROM access: Section 5.3 in C18 Compiter User's Guide

Also, review the data sheet for the Magtek magnetic stripe reader.

Carefully design your solution to the lab using flow-charts and/or pseudo-code. Do not start writing C code until you FULLY AND COMPLETELY UNDERSTAND the solution.

To be submitted on Tuesday, March 20: Pre-lab report in the format specified in the Laboratory Guidelines document. The pre-lab report should include a flowchart and/or pseudo-code code description of your algorithm.

Lab Report:

Your lab report (due on Thursday, April 5) should follow the general format described in Laboratory Guidelines document.

Some Important Considerations:

Be systematic. There are really three major new objectives here to be mastered: i) successfully read the User-ID from the mag-stripe reader; ii) read the PIN number from the keypad; and iii) Read and write the PIC's EEPROM. Deal with each of these as a separate problem—e.g. you may first want to develop a program that just reads the mag-stripe and displays the user-ID on the LCD for verification. Then you may want to write a program that just reads a PIN from the keypad and displays the digits on the LCD for verification. When you have the pieces written you can start to put them together to achieve the final objective.