Lab 1 – Building a Burglar Alarm System
Assigned: February 7th 2002, Demonstration Date: February 27th 2002

Microcontrollers are elements that fall between electronic hardware and software. They are computers in that they are programmed using algorithmic languages, but they are hardware in that they are installed by being wired into the system with all of the other electronic components. In the first project, we take our first step into the hardware domain by interfacing our first few electronic components: LED's, pushbuttons, seven-segment displays, LCD display, etc., and initiating interaction with our microcontroller. By completing these exercises, we can then integrate these devices to build a burglar alarm system

Objectives
1. Gain familiarity with BS2 programming environment
2. Implement digital inputs from pushbuttons
3. Perform digital outputs to a seven-segment display
4. Interface a LCD display
5. Integrating these elements into a useful system

Please read the corresponding experiments thoroughly before you begin connecting the various pieces:

A. Relevant StampWorks Experiments:
   a. LEDs – Experiments 1, 2, 3, 4
   b. Pushbuttons – Experiment 6, 9
   c. Seven-Segment Displays – Experiments 8, 9,10, 29
   d. LCD Display – Experiment 11
   e. Piezo Beeper – Experiment 6, 20

Implementation
Write a PBASIC program and implement the following in hardware using the Stamp Works Board. You will be required to demonstrate only Part e. (Parts a, b, c, and d are intended to help you break down the task into manageable portions – however, while doing so please keep in mind the final outcome desired and optimize your I/O pins).

a) Turn a LED on and off in response to pushbutton inputs
Interface the pushbutton switches D1-D3 with LED 0 to the Stamp.
The initial state LED 0 is off and pressing a given switch alters the mode of operation of the LED. Pressing Switch D1 starts the flashing of LED0 (once every second) and pressing Switch D2 turns the flashing off. Pressing Switch D3 keeps the LED0 permanently on.
Note:
- Review the discussions of the class with respect to (i) adding a resistance in series with the LED and (ii) ensuring the polarity of the LED before implementation.
- The "button" command could prove useful.

b) Interfacing a Seven Segment display
To part (a), we would like to add a feature that permits us to keep track of the last button pressed. Also, we would like to implement MAX7219 to reduce the number of I/O pins required. Using the pin diagram from the datasheet, connect the pins of one of the seven-segment display directly to the digital I/O lines of the Basic Stamp and set it up to display the last key pressed on the pushbutton keypad.
Note:
- These displays are common cathode displays with built-in current limiting resistors.
- The display needs to be explicitly enabled.

c) Interfacing the LCD Screen
Interface the Basic Stamp to LCD Screen so that you can keep track of the number of the last button (S1-S3) pressed display the button that has been pressed.

d) Interfacing a Piezo Beeper
Interface the Basic Stamp to with the Piezo Beeper built in the Stamp Work Board using the FREQOUT or DTMFOUT commands so that it will create different sound effect.

e) Implement a burglar alarm system
Create a burglar alarm system based on the simple sets of sub-parts that you have tried from parts a to d. As discussed in class, please ensure that the device has the following features:

- It can be engaged/activated and turned off by some sequence of actions.
- It has a password checking mechanism – as the passwords input device you could use multiple pushbuttons, one pushbutton keying in Morse code.
- It should have a time-keeping function that ensures that a user inputs the password within a given period before sounding the alarm.
- Displays relevant information using some combination of seven-segment displays and LCD screens. For example, you could use the seven-segment display to show the input passwords, and the LCD display to show messages to the user – however, we will leave it up to you to optimize a suitable configuration for your system.

Reporting:

Each group should send in a weekly e-mail to the TA, Mr. Chin-Pei Tang (chintang@buffalo.edu) briefly outlining their progress for the week and outlining a schedule for proposed completion of the rest of your lab assignment by the group (these will be due on the Thursday of each week).

For the lab report, please provide a self-standing document, which describes and explains the complete system and would enable someone else to replicate your work easily.

- Please follow the guidelines provided at http://www.eng.buffalo.edu/Courses/mae576/ReportFormat.htm.
- For sample reports see http://www.eng.buffalo.edu/Courses/mae576/SampleReport.pdf and http://www.eng.buffalo.edu/Courses/mae576/Spring2002/LAB_REPORTS/.

Specifically in your report:

- Describe the implementation and operation of your system. How secured is your alarm system? How could you improve its features?
- Document your system with a circuit diagram, and a list of components.
- Include a listing of your program with ***thorough*** comments.