LAB #3: Vending Machine

Lab writeup is due to your TA at the beginning of your next scheduled lab. Don’t put this off to the last minute! There is pre-lab work to complete before the start of the next lab. NO LATE LAB REPORTS WILL BE ACCEPTED.

1 Objectives

- Use the parallel I/O functions of the 68HC11.
- Learn about usage of FSM abstraction in assembly.
- Design a vending machine.

2 Reading

- Read section 2.4 about FSM abstraction
- Read section 3.4.2 about accurate time delays.

3 Background

In this lab, you will use the parallel I/O ports on the 68HC11 to design a vending machine. In this lab, you are going to design a simple vending machine that accepts nickels and dimes only. It vends candy when the total amount of change received is 15 cents. If it receives too much money, it will vend the candy plus change. There are two inputs switches. One indicates that a nickel is detected and another indicates that a dime is detected. Their precise meanings are as follows:

S1 ON A nickel is detected
OFF No nickel is detected
S2 ON A dime is detected
OFF No dime is detected

A coin is detected when the appropriate switch is detected to be ON and then detected to be OFF. In other words, you can think of the coin passing through a sensor, and the amount of money collected should not be changed until the sensor has gone back to off. In each state, assume only one switch can change at a time. In no switches change, you should stay in the same state. There are three LED outputs with the following meanings:

LED1 Candy has been vended
LED2 A nickel of change has been released
LED3 A coin jam has been detected

The states of your state machine should record how much money has been received since the last vend. Once 15 cents or greater has been received, it should vend a candy by light LED1 for 10 seconds. If more than 15 is received, it should light both LED1 for 10 seconds followed by LED2 for 10 seconds. In either case, it should then return to the initial state to prepare to accept more money. S1 and S2 should never be ON at the same time. If so, a coin jam has been detected and LED3 should light until both S1 and S2 have returned to the OFF position.
4 Tasks

Note: In order to use lab time efficiently, you should complete the first 3 tasks before your lab section.

1. Design the FSM for your vending machine.

2. Prepare a schematic for your design including all chips, switches, LEDs, resistors, capacitors, etc.

3. Design the assembly language program for your vending machine. Do not use loop delays, but instead use the TCNT timer to implement the time delays in your FSM. Be sure that it is designed using the software issues discussed in class. For example, it should consist of separate modules (ex., subroutine for waiting, another for reading the switches, another for setting the LEDs, etc.). It should also be well documented.

4. Connect your circuit and debug your software.

5 Writeup

Include the following items. In this lab, only one writeup per team is required.

1. Your FSM diagram.

2. Your hardware schematic.

3. A printout of your assembly code.