Lab – 2 Instruction

- Refer to the lab manual on the following pages.

- Design, implement and test the embedded system prototype(s) described in the lab assignment at your convenience.
- Demonstrate your working design to TA in the lab (Rhodes 806) during the week of Sept. 16 per your lab schedule. You may be asked to explain your design during your demo.
- After the demo in the lab, write and submit a report per the format described in "Embedded Systems Design Lab report format" on Blackboard. If the demo didn't show the expected results then you should correct the problem and test the corrected design at home and describe both the problem and the correction in your report.
- Report will be due via blackboard by 11:59 pm on the Thursday next week from the lab week. Late reports will not be accepted.
- Labs will be graded with 50% weight for the demo and 50% weight for the report.
- This lab may be done by group of at most two students. Please submit your lab report to Backboard, one report per group.

EECE 4038C Embedded Systems Design
Lab 2
Servo Positioning Control

Instructor: Fred Chiou

Preparation

Go through Chapters 4 & 5 in "What's a Microcontroller?" (version 3.0) and perform all the activities described in these chapters on the Basic Stamp 2 HomeWork Board.
Using the knowledge you have gained from these activities, develop the following embedded systems using the Basic Stamp 2:

Assignment

1. Calibration of the Potentiometer

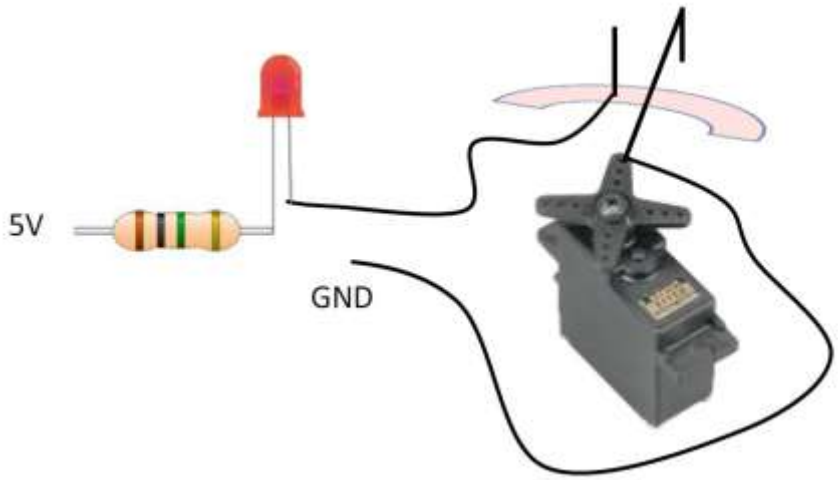
Using your Parallax Basic Stamp HomeWork Board and kit, determine the highest and lowest RCTIME values corresponding to the two extreme positions of the potentiometer knob as discussed on page 153 of "What's a Microcontroller?" book. Report these values and use them in the rest of this assignment when needed.

2. Positioning of a Servo-Controlled Arm Using a Rotary Knob

This experiment is an invitation to develop mechanical arrangement and positioning skills.

Use a potentiometer to control the position of the servo horn between 100 and 1700. Turning the potentiometer to one end should position the horn at the 100 position and turning it to the other end should position the horn at 1700. In between, the pot position should linearly corresponds to the horn position.

Now, consider the circuit diagram in the picture. The position of one end of a wire is controlled by the servo horn which is extended by an arm of suitable length. By rotating the horn, the arm can be moved and the wire can be positioned anywhere along an arc (of an imaginary circle centered on the shaft of the servo).



Another wire is positioned along the arc as shown. When the arm is positioned such that the wires touch each other, the two wires close a LED circuit as shown. When the arm is incorrectly positioned, the circuit remains open.
Build and demonstrate this manual positioning system. Test your system for various positions of the stationary wire along the arc. For each position, move the arm using the potentiometer and close the circuit to light the LED.

3. Automated Positioning of the Servo-Controlled Arm

Continue to use the same mechanical set up as above, but instead of using the potentiometer, write a program to move the arm to seek the stationary wire and complete the circuit. Given a random stationary wire position and a random initial position of the arm, your program will move the arm along the 10-700 arc and lock in position when/where the circuit is completed and LED begins to glow. If the stationary wire is now moved, the program should recognize that the circuit is open and reposition the arm to close the circuit again. If the stationary wire is completely moved away from the arc area, then the arm simple keeps moving back and forth along the arc. You can make suitable modifications to the circuit but retain the LED indicator.

4. Exercise:

Research and discuss two interesting applications of servo motors in two different application domains (healthcare, traffic control, robotics etc.**).** Do these applications involve manual or automated horn positioning as in the previous experiments?

Remember all the precautions discussed in the class and the current source/sink limitations of the microcontroller.

Include photographs of your circuit setups in your report. Include (copy-and-paste) the PBASE programs in your report.

In addition, note that,

1. Your report must include a flow chart for your solution.
2. You must draw the circuit diagram and include a photograph of your circuit setup. You must describe the design decisions made during the circuit design process and any other alternative designs you have considered.
3. Your code must be well documented and must correspond to your flow chart.
4. You must use macros and subroutines wherever appropriate to improve modularity and maintainability of the code.
5. You must use a good template design for your program, following the coding practices you have noticed in your reading assignments.
6. You must discuss the algorithmic, circuit design and programming choices you have made while developing this solution