Lab – 1 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 in the lab (Rhodes 806) during next week (the week of Sept. 10) 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 one report per student.

EECE 4038C Embedded Systems Design
Lab 1
Reaction Time Test and Morse Code Receiver

Preparation

Go through Chapters 1-3 in "What's a Microcontroller?" (version 3.0) and perform all the activities described in these chapters on the Basic Stamp 2 HomeWork Board.

Assignment

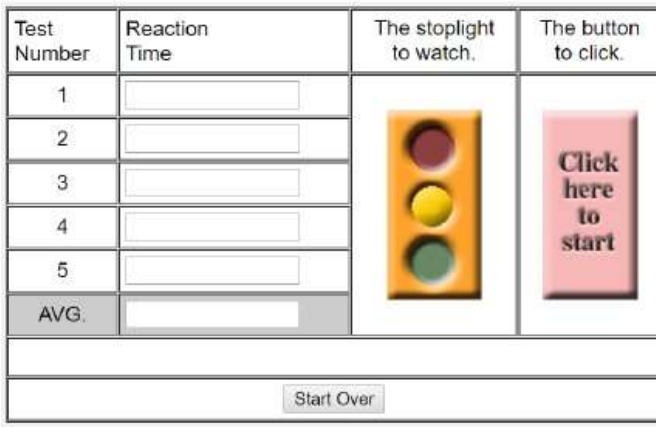
Using the knowledge you have gained from these activities, develop the following embedded systems using the Basic Stamp 2.

1. Reaction Time Test

Medical and diagnostic applications are among the most important class of applications for embedded systems. One such application is Reaction Time[1] (RT) measurement. Reaction time is the time that elapses between a person being presented with a stimulus and the person initiating a motor response to the stimulus. RT is important for the studies of perception and movement, and perceptual decision making and motor planning.

This assignment seeks to develop a simple reaction time meter. Review the "reaction time test" at the following link:
https://faculty.washington.edu/chudler/java/redgreen.html

Your goal is to implement the same test in hardware using the Basic Stamp 2 kit. Use red, yellow and green LEDs for the lights and a push button switch for the button. Five consecutive reaction times in milliseconds and their average should be printed on the screen. Randomize the time of change from red to green.



Design, implement and test the system.
Report sample test results.

A neuroscientist proposed this hypothesis: "One would react more quickly if the button is released rather than pressed." Modify the system to verify this hypothesis.

Again, Design, implement and test the system.
Is this hypothesis correct?
Report relevant test results.

1. https://en.wikipedia.org/wiki/Reaction_time

Another scientist hypothesized that the reaction time depends on which among the ten fingers is used. Verify this hypothesis using your reaction timer and report supporting test results.

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

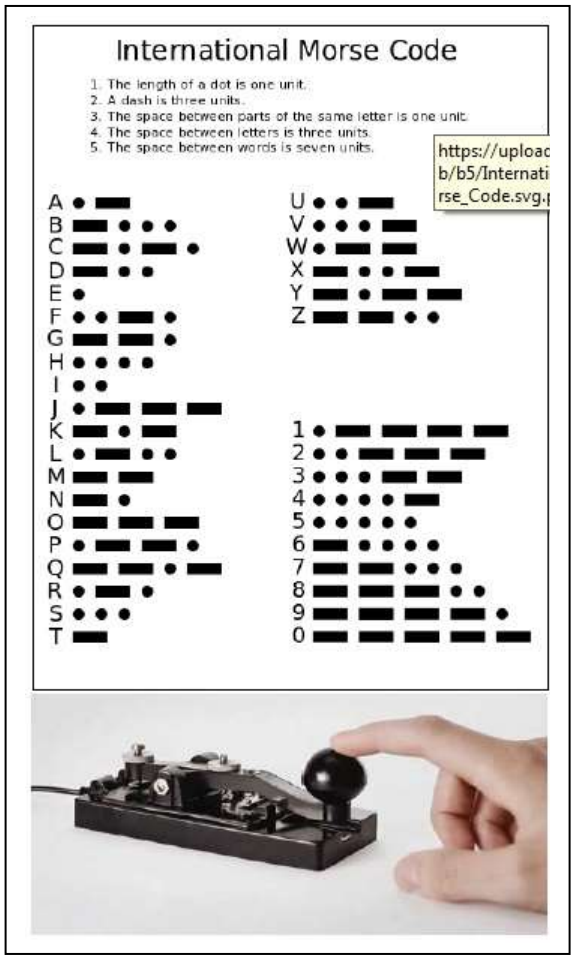
Include a photograph of your circuit setup in your report. Submit the PBASIC programs as separate files.

2. Morse Code Receiver

Embedded systems are widely used in communication applications, especially in encryption and decryption. In this assignment, you will design a decoder for a simple code. While this is not a secure code, this is perhaps the most widely used code for communicating text.

Review the information about Morse Code at https://en.wikipedia.org/wiki/Morse_code.

Your task is to design a Morse Code receiver and decoder using the HomeWork Board.
Use a push button switch to enter the code.
Program the microcontroller to read the code, decode and display the English sentence on the screen.



Tune your system for a suitable unit duration, for example 250 ms, to match the fastest speed at which you comfortably enter the code.
Dot would be one unit long, dash three units long, etc.

To simplify the decoder program, your system can be limited to recognize the following letters and words/sentences made up of those letters:
All letters in the last names of the students in the lab group.

Example: If LoVaglio and Walrath are the last names then your system should recognize the letters L,O,V,A,G,I,W,R,T,H and spaces with letters, between letters and between words.
To test your system, you can create words using a word generator site such as https://www.word-grabber.com/letter-sorting.

Design, implement and test the system for at least 10 different words and 3 different sentences.

Include a photograph of your circuit setup in your report. Submit the PBASIC program as a separate file.

For 20% bonus, design and test a complete Morse Code decoder for the entire alphabet and numbers.

In addition note that,

1. Your report must include a flow chart for your solution for each system.
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.