**SY202 – Cyber Systems Engineering**

**Intro**

**CSE**

**Due Date: 05 March 2019**

**LABORATORY INVESTIGATION #05: mbed Programming Introduction**

**Objectives:**

1. To learn how to program an mbed NXP LPC1768 microcontroller to perform a basic output function.
2. To develop familiarity with the mbed Compiler and online resources.
3. To demonstrate serial communications between a PC and the microcontroller, allowing user input to alter mbed output.
4. To demonstrate ‘C’ programming fluency to include use of ‘while’, ‘for’, ‘if’, and/or ‘switch’.

**Introduction**:

This lab assumes that the student has successfully completed the SY202 In-Class Exercise Tutorial: mbed Microcontroller. Internet access is required to use the online compiler found at <https://developer.mbed.org>. Additionally, a serial terminal emulator such as TeraTerm is required on the PC to allow for user interaction with the mbed.

**Procedure**:

Develop and test an mbed program that requests the user to select one of the following messages to transmit in Morse code using LED1 on the mbed. The program should continue to run after transmitting the coded message until the user enters ‘Q’ or ‘q’.

Messages:

a) “USNA”

b) “2021”

c) “CyberOps”

Ensure that your program follows the conventions for light signaling detailed in NIMA Pub 102, International Code of Signals, Chapter 1, Section 3 and Section 6. These conventions state that the rate of 40 letters per minute is used for flashing light transmission of Morse code (approximately 200 milliseconds per “dot” or “unit”). Additionally, the space between any two elements of a symbol, between letters, and between words should follow the requirements of these sections. Write pseudocode prior to attempting to write the actual mbed code.

Solutions to this problem are readily available on the Internet. While I encourage you to use available sources of information, you will not achieve the lab objectives if you directly copy someone else’s code. **Do not submit someone else’s code as your own** and be certain to cite any source of code that you may adapt for this assignment. Ensure that your code is well commented so that I can understand your approach to solving this problem.

**Deliverables:**

1. Pseudocode that details the desired program functionality.
2. Demonstrate program operation to the instructor. This may be accomplished in person or by providing your functioning program (ie a compiled “.bin” file) that can be directly loaded onto the instructors mbed to verify functionality.
3. Follow the lab report template and the general lab guidelines for SY202 lab reports. Refer to the lab rubric for the grading of the lab.

**Extra Credit (12 Points):**

Develop and test an mbed program that transmits messages in Morse code between two stations using the LED lights on the mbed. Station 1 will signal using LED1; station 2 will signal using LED4. Station 1 and station 2 should alternate transmissions.

Your code should consist of at least 3 functions:

A. main function that:

1. Provides some initial instructions for the user: maximum message length, acceptable characters (ASCII characters that represent the alphabet, both upper and lower case, space, and numerals), and end of message signal.
2. Requests the user type Station 1’s message at a prompt and stores all entered characters in a string. The user should signal the end of the message by pressing the enter key (Hint: maintain loop while char != ‘\n’ && char != ‘\r’).
3. Verify that input is valid. If it contains invalid characters, request another message.
4. Call a function to translate the message into Morse code.
5. Call a function to transmit the Morse code message using LED1.
6. Request the user type Station 2’s reply and store all entered characters in a string.
7. Verify that input is valid. If it contains invalid characters, request another message.
8. Call a function to translate the message into Morse code.
9. Call a function to transmit the Morse code message using LED4.
10. Repeat the sequence.

B. morse function that:

1. Takes in a string up to 50 characters in length.
2. Converts the user’s string into a string consisting of only ‘0’ or ‘1’, where ‘0’ represents the LED off and ‘1’ represents the LED on. Ensure that the final string character is ‘0’ to make sure that the LED is off at the end of the message transmission. Be sure to follow the conventions of NIMA Pub 102.
3. Returns a string containing the encoded message.

C. transmit function that:

1. Takes in the string containing the encoded message and transmits the message using the specified LED.

**Deliverables:**

1. Demonstrate program operation to the instructor. This may be accomplished in person or by providing your functioning program (ie a compiled “.bin” file) that can be directly loaded onto the instructors mbed to verify functionality.
2. Ensure that your code is well documented and provided as Enclosure (3) of your report along with the pseudocode written for each function. Provide an estimate of the average additional time necessary for your group to complete the extra credit (ie if one partner worked on the extra credit for an additional 1 hours and the other partner placed an additional 4 hours, report an average additional time of 2.5 hours in your lab report conclusions). No additional information is required (or desired) in the lab report.
3. Partial credit will be given for any working portion (A, B, or C) of the extra credit code.