



SIE 370 Lab

Morse Code

1. Objectives

In this lab, you will learn how to use the Arduino Uno Micro-processor. You will learn to control I/O, build a program using the Arduino Integrated Development Environment (IDE), and upload your program to the Arduino.

2. Lab Reading Assignment

Reading Assignment:

Textbook: Exploring Arduino, Jeremy Blum, Chapter 2 (previously assigned)

Topics include:

- Digital Outputs
- Wiring an LED and Using Breadboards
- Using For Loops
- Pulse-Width Modulation and `analogWrite()`

Reference Arduino.cc <https://www.arduino.cc/reference/en/>

3. Task Prototyping

3.1. Task 1: Morse Code Circuit

Re-create the Lab Task Experiment for the Morse Code Circuit and software on Tinkercad using the instructions for the Lab below but adapt the instructions for Tinkercad. Test your wiring and code here in preparation for the Lab and to think of the answer any questions you may be asked during Lab. When you have finished troubleshooting and fixing your code, check to make sure it passes the Acceptance Test.

3.2. Task 2: Introduction to Pulse Width Modulation (PWM)

Re-create the Lab Task Experiment for the PWM Two LED Circuit and software on Tinkercad using the instructions for the Lab below but adapt the instructions for Tinkercad. Test your wiring and code here in preparation for Lab and to think of the answer any questions you may be asked during Lab. When you have finished troubleshooting and fixing your code, check to make sure it passes the Acceptance Test.

4. Instructions for Lab Task Experiment

In this experiment, you will need to perform several related tasks. Please do them in order. After each successful completion of a task, have the lab instructor check your work so you can get credit and move on to the next task.

4.1. Component List

In addition to your Arduino and a breadboard you will need the components in the list below.

Component	Quantity
Red LED	2
220 Ω Resistor	2

Figure 1 Lab Component List

4.2. Task 1 Arduino IDE

If you have not done so already, download the Arduino IDE from <http://www.arduino.cc/>.

4.3. Task 2 Arduino Project: Blink

The Arduino has an on-board LED on pin 13 (see image below). Use the tutorial code Blink on arduino.cc. Make sure you read the tutorial to learn how each part of the sketch works. Write the Blink sketch code into the IDE, upload the sketch to your Arduino, and run the program on the Arduino.



Figure 2 Arduino On-Board LED connected to Pin 13

4.4. Task 3 Morse Code Circuit

In your previous Lab Task, you should have already tested your Morse Code sketch using the on-board LED. If it worked, this task should just be creating the circuit for an external LED (see image below) and testing both the circuit and the new code.

4.4.1. Component Wiring

In addition to your Arduino and a breadboard you will need the components in the list below.

Component	Quantity	Wiring (If Applicable)
Red LED	1	Pin 13
220 Ω Resistor	1	

Figure 3 Lab Task 3 Morse Code Component List

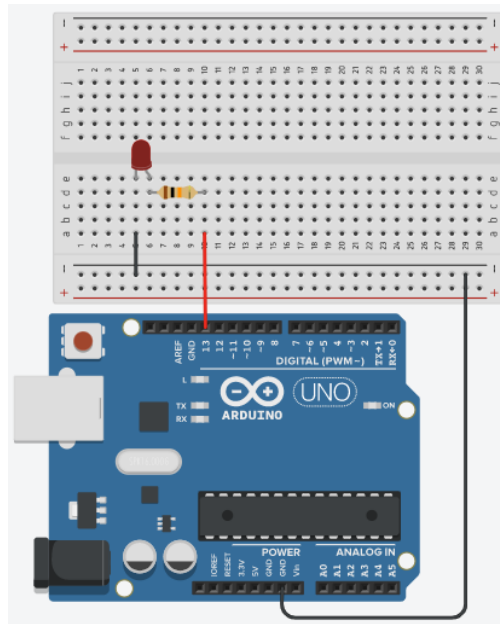


Figure 4 Morse Code Circuit

Connections for this task as shown in the image above:

- The Breadboard Ground Rail is connected to the Arduino GND,
- The LED anode is connected to the Resistor that is connected to the Power Rail, and
- The LED cathode is connected to the Ground Rail.

Using the rules and values in the Morse Code Chart below, write out the international distress message SOS (letter S, letter O, letter S from the chart below) with the following rules:

- (a) A Unit is 100 ms, so
- (b) Dot gets 100 ms
- (c) Dash gets 300 ms
- (d) Between each part of the same letter is 100 ms
- (e) Between each letter is 300 ms
- (f) Between each SOS is 700 ms

Hint: program it so that each pass through the loop() function spells out SOS

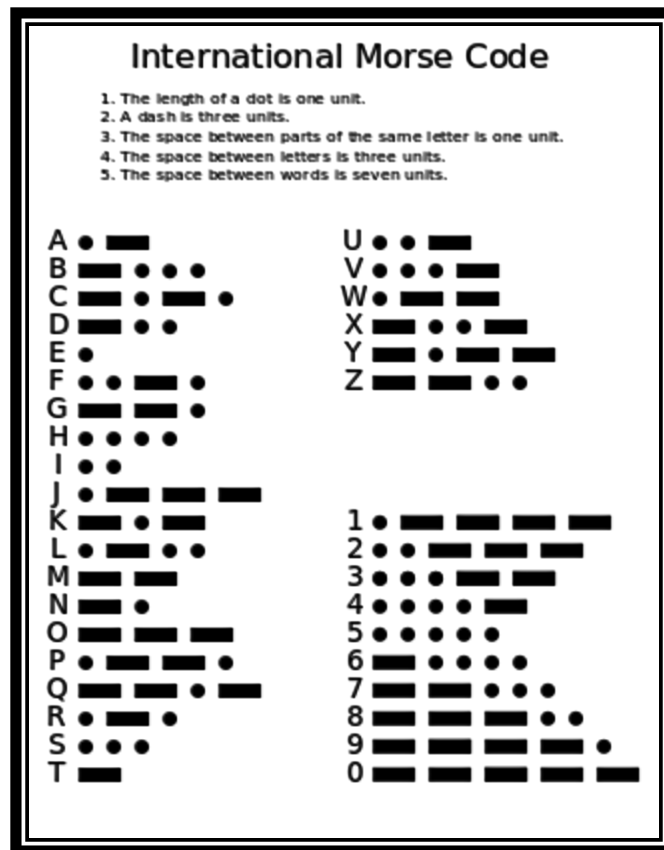


Figure 5 Morse Code Chart
https://en.wikipedia.org/wiki/Morse_code

Let each loop() function write out SOS. Make sure you put the break between the letters and the break between each SOS (loop).

When you have completed this task, show your Lab Instructor your working project running through the Acceptance Test.

Submit your code for this task to your Lab Assignment Folder.

4.5. Task 4: Introduction to Pulse Width Modulation (PWM)

In your Reading Assignment, you learned about PWM. In this task you will test how PWM can be used to control the brightness of an LED.

Build a circuit on your protoboard using two LEDs (don't forget the resistors). The LED voltage source will come from 2 different PWM pins on your Arduino. Your Arduino sketch should be able to control the brightness of the two LEDs simultaneously.

4.5.1. Component Wiring

In addition to your Arduino and a breadboard you will need the components in the list below.

Component	Quantity	Wiring (If Applicable)
Red LED	2	Pin 11 and Pin 3
220 Ω Resistor	2	

Figure 6 Lab Task 4 PWM Two LED Circuit Component List

WARNING This Lab instruction sheet and the Lab solution are not to be shared online or in-person at any time.

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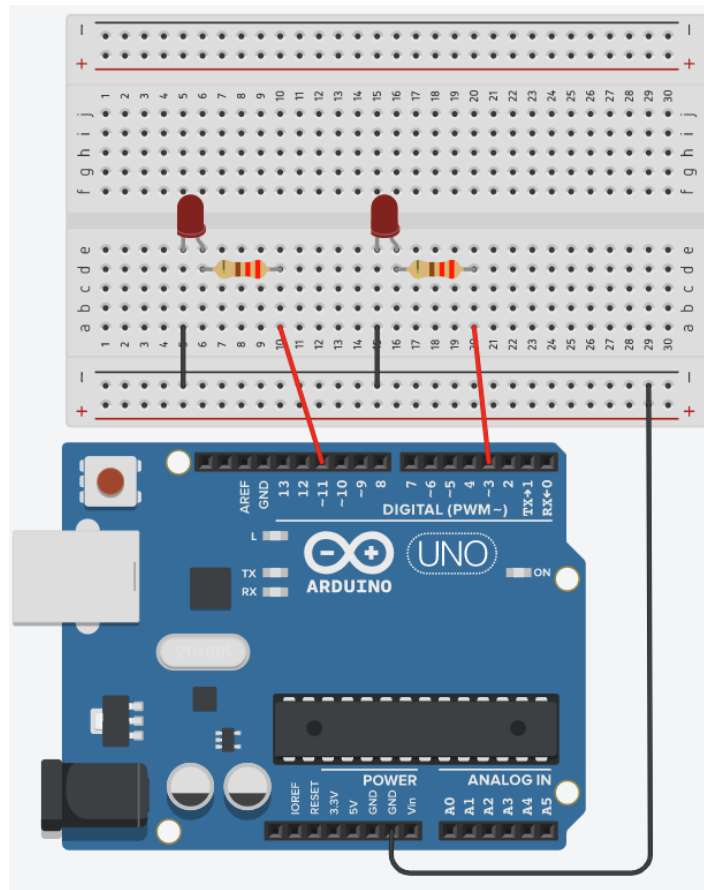


Figure 7 Lab Task 4 PWM Two LED Circuit

Write the code that will control two LEDs such that:

- (a.) LED 1 will slowly increase brightness from 0% to 100%
- (b.) LED 2 will slowly (at the same rate as LED 1), decrease brightness from 100% to 0%

HINT: In the Fade tutorial, we used a For Loop. Here, we will rely on our **loop()** function to set and reset the brightness for LED 1 and LED 2. When we have faded the LEDs from one extreme value to the other, we reset the brightness values for each.

When you have completed this task, show your Lab Instructor your working project running through the Acceptance Test.

Submit your code for this to your Lab Assignment Folder.