EGR 262

Fundamental Circuits Lab

File: N262L2

**Lab # 2**

**Introduction to the Arduino UNO**

A. **Objectives**

The objectives of this laboratory are to introduce the student to:

1. Arduino UNO hardware
2. Arduino software (version 1.05 or newer)
3. Writing, compiling, downloading, and testing programs to control LEDs using digital outputs on the Arduino UNO

B. **Materials**

Breadboard with Arduino UNO

Adaptor (120V AC to 12 VDC, 1000 mA)

Agilent 33401A Digital Multimeter

220 Ω resistors

LEDs

C. **Introduction**

The two circuits below will be constructed and tested in lab using various programs written for the Arduino UNO. See the ***Presentation for Lab #2*** for more detailed background information.

**Arduino**

**UNO**

**N+2**

**220 Ω**

**Circuit 2**

**N+1**

**N**

**LED**

**Arduino**

**UNO**

**N**

**220 Ω**

**LED**

**Circuit 1**

D. **Pre-Lab Tasks**

1. For all parts of this lab, digital output N on the Arduino UNO will be based on your StudentID as follows: N = last digit of StudentID +2. Examples:
   1. StudentID is 5671234: Use N = 4+2=6
   2. StudentID is 3456789: Use N = 9+2=11

List your StudentID and your value of N for this lab.

1. Use Fritzing to draw a breadboard layout and schematic for Circuit 1.
   1. Reference: See the file ***FritzingEGR262*** on the course website.
   2. Follow the **Basic Rules for Breadboards Produced for EGR 262 labs** listed in reference above.
   3. Begin with the standard EGR 262 breadboard layout in the file ***EGR262Breadboard.fzz*** (available on the course website).
   4. Be sure to use the value of N assigned above.
   5. Save your breadboard layout and schematic for Lab 2 (.fzz file)
   6. Export the breadboard as a jpg image to insert in your lab report.
   7. Export the schematic as a jpg image to insert in your lab report.
2. Repeat step 2 for Circuit 2
3. Write three programs for the Arduino as described below. Be sure to include an initial block of comments at the start of each program as well as comments throughout. Compile each program before lab and correct any errors that occur. Include a copy of each program in the Pre-Lab section of the report (if changes are made during lab, the final version will be included in the Post-Lab section).
   1. Program L2A: Write a program to blink an LED on pin N as shown in Circuit 1. The LED should blink 1 time per second (0.5 s on and 0.5 s off) indefinitely.
   2. Program L2B: Write a program to the three LEDs shown in Circuit 2 in sequence. Spefically:
      * Turn on LED N for 1 second (with the others off)
      * Then turn on LED N+1 for 1 second (with the others off)
      * Then turn on LED N+2 for 1 second (with the others off)
      * Repeat this exactly 10 times (30 s total)
   3. Program L2C: Write a program that uses a function Blink(K,M) to make an LED on pin K exactly M times (0.5s on and 0.5s off). For example, the command Blink(5,7) should make an LED on pin 5 blink 7 times. The program should call Blink 3 times (from setup( )) to do the following:
      * Make the LED on pin N blink 4 times
      * Then make the LED on pin N+1 blink 6 times
      * Then make the LED on pin N+2 blink 3 times

E. **In-Lab Tasks**

1. **Testing Arduino voltages**
   * Connect the Arduino UNO to the computer with the USB cable provided. Also power the Arduino using the AC/DC adaptor. A green light should turn on.
   * Use a voltmeter to measure the voltage on the 5V power rail (with respect to ground) and record the results:
     1. With only the USB connected
     2. With only the AC/DC adaptor connected
     3. With both the USB and the AC/DC adaptor connected
2. **Testing Program L2A**
   * Construct Circuit 1.
   * Download and run Program L2A.
   * Demonstrate the program to the instructor once it is working correctly and also record the results. If any changes were made to the program, save the program under a different name (L2Av2, perhaps) and include a copy in the Post-Lab section.
   * Does pressing the Reset button on the Arduino re-run the program?
   * Use a stopwatch to measure and record the amount of time needed for 60 blinks.
   * Record comments for any problems encountered or lessons learned.
3. **Testing Program L2C**
   * Construct Circuit 2.
   * Download and run Program L2B.
   * Demonstrate the program to the instructor once it is working correctly and also record the results. If an changes were made to the program, save the program under a different name and include a copy in the Post-Lab section.
   * Record comments for any problems encountered or lessons learned.
4. **Testing Program L2C**
   * Download and run Program L2C.
   * Demonstrate the program to the instructor once it is working correctly and also record the results. If an changes were made to the program, save the program under a different name and include a copy in the Post-Lab section.
   * Record comments for any problems encountered or lessons learned.

F. **Post-Lab Tasks**

1. Discuss the results of measuring the voltages in step 1. If both the USB and the AC/DC adaptor are connected, which voltage is used? Is there a disadvantage to using USB power only when testing circuits on the breadboard?
2. Discuss the performance of Program L2A. If any changes were made to the program during lab, include a copy of the modified program with all changes highlighted and discussed. Did the LED blink accurately at 1 blink per second?
3. Discuss the performance of Program L2B. If any changes were made to the program during lab, include a copy of the modified program with all changes highlighted and discussed.
4. Discuss the performance of Program L2C. If any changes were made to the program during lab, include a copy of the modified program with all changes highlighted and discussed.
5. Discuss the purpose of the 220 Ω resistor used in series with each LED.

G. **Report**

A lab report is due 1 week after the date of the experiment.

* The lab report must be your own work. Copying data, tables, graphs, circuits, etc., from other students is not allowed and will result in grades of 0 on the lab.
* Be sure to follow good practices for presenting all tables and graphs. See the Presentation for Lab #1 for examples.
* The lab report should consist of the following sections:

1. Title Page (include course number & title, lab number & title, date, and your name)
2. Pre-Lab Tasks
   * Include instructions or headings for all items to make the report easy to follow.
3. In-Lab Tasks

* Include instructions or headings for all items to make the report easy to follow.
* Be sure to include comments from lab as well as measured data.

1. Post-Lab Tasks

* Include instructions or headings for all items to make the report easy to follow.