

Lab session week 2 and 3: IoT Programming with Arduino – Basic circuits and programs

Aim

The aim of this tutorial is for students to be able to confidently program the Arduino board and wire small circuits with the breadboard.

Important Information

- Please do not power the sensor nodes (Arduino) before getting the confirmation from your tutor.
- Please use your own laptop.
- If your laptop does not have a USB type A socket, you will need to bring an adaptor.
- Be gentle with the hardware.

Tools

For IoT programming lab sessions, you will be using Arduino Uno boards. These can either be borrowed from us for the semester OR purchased by you. To borrow an Arduino kit from us for the semester:

- Collect the kit from your tutor in your designated Week-1 lab tutorials
- Check that the kit has all the required components for the task: Arduino board, USB cable, breadboard, LEDs, wires, resistors, buzzer, etc.
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Next, you will need to install Arduino IDE on your computer/laptop using the following links.

- **Windows:** <https://www.arduino.cc/en/Guide/Windows>
- **MacOSX:** <https://www.arduino.cc/en/Guide/MacOSX>
- **GNU/Linux:** <http://playground.arduino.cc/Learning/Linux>

Please note that installing Arduino from the repository is not recommended because it might install an outdated version.

Task 1: LED Blink

1. Connect an LED to the Arduino board. Please refer to Figure 1 to connect an LED using a resistor (220 Ω or 1 k Ω).
2. Note that the +ve end of the LED is connected to PIN 2 of the Arduino board. The -ve end is connected to ground (GND) via the resistor. *Refer to Figure 1.1 to understand the +ve and -ve polarity of an LED.*
3. Make sure your circuit is correct. Pay attention to the wires, PIN connections, resistor, polarity of the LED, etc. Ask your tutor for help if required. **Please DO NOT power ON the Arduino board yet.**

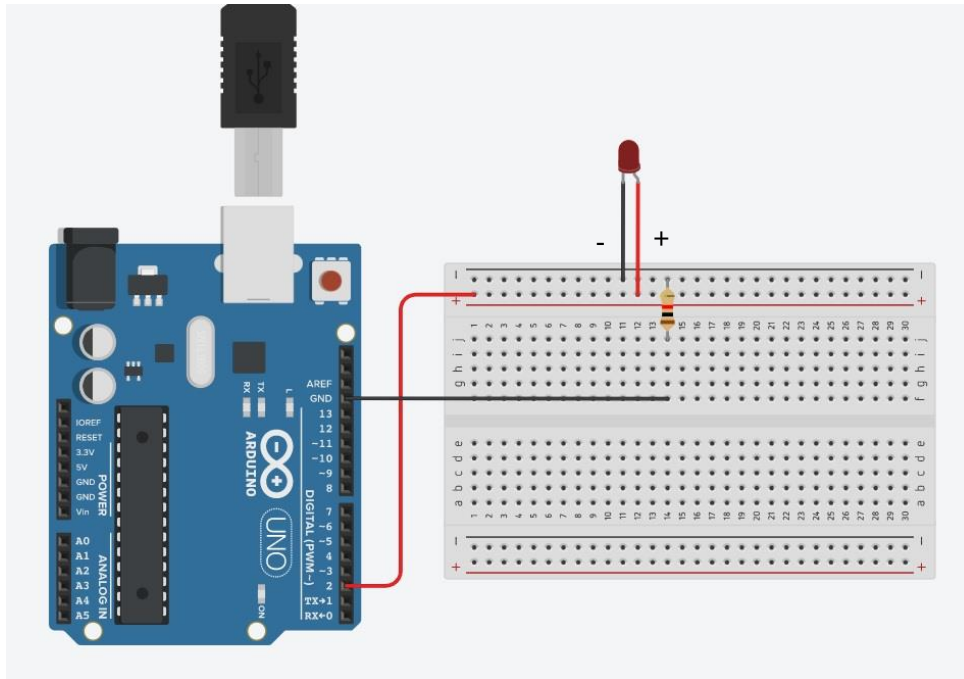


Figure 1: Task 1

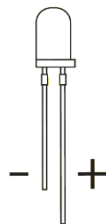


Figure 1.1: LED Polarity

4. Next, open Arduino IDE (installed in your computer).
5. Download the "Week 2& 3 Resources" folder from canvas Modules. Open the folder named "Task 1". From your Arduino IDE, open the file "Task1.ino" saved in your recently opened "Task 1" Folder.
6. Now, connect the Arduino board using the USB cable to your computer which is running Arduino IDE.
7. Before you compile and run, follow the below steps to select the board and port:
 - Select board: Go to Tools menu on your Arduino IDE -> Board-> Select "Arduino Uno"
 - Select port: Go to Tools menu on your Arduino IDE -> Port-> Select the port to which your Arduino Uno is connected.

Please note: The port number might vary for each computer. So select the one that is applicable to you.
8. Next, verify (compile) the code using sketch drop-down menu (or verify button tick symbol). Upload the code to your Arduino board using the "Upload" option from the "Sketch" drop-down menu or using the right arrow icon on the Arduino IDE.
9. You should now see the LED blinking if your circuit is wired correctly and your code is correct.

Please ask your tutor for help if this doesn't work.

For you to do!!

Task 1.1: LED Blink (PIN 3)

1. Keeping the rest of your circuit as is, this time, connect the +ve of the LED to PIN3 on the Arduino board and modify the "Task1.ino" file to make the blinking LED program to work for PIN3.

Task 2: Buzzer:

1. Connect the buzzer to the Arduino board and rig up the circuit as shown in Figure 2.
2. Refer to Figure 2.1 to understand the +ve and -ve PIN connections of the buzzer in your kit. The buzzer in Figure 2 has 2 pins while the one in the kit has 3 pins. All connections will remain same. You will only need to connect the middle +5V pin on your buzzer from the kit to a +5V pin on the Arduino Uno.
3. Make sure your circuit is correct. Pay attention to the wires, PIN connections, resistor, polarity of the LED and buzzer, etc. Ask your tutor for help if required. **Please DO NOT power ON the Arduino board yet.**

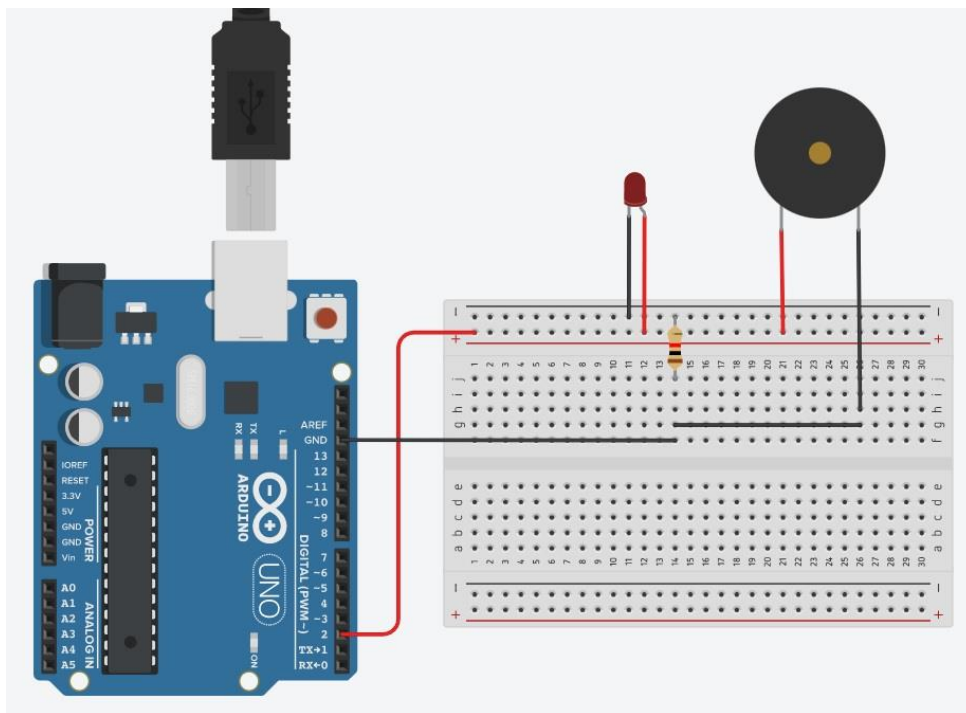


Figure 2: Task 2

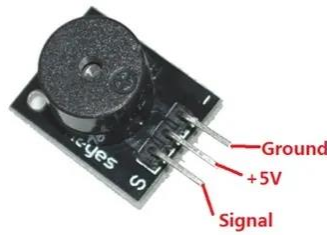


Figure 2.1: Buzzer pin configuration.

Note- "Signal" pin is next to the "S" mark on the buzzer and the "ground" pin is next to the "-" mark on the buzzer, the middle pin on the buzzer is +5V

Signal pin goes to one of the PINs (e.g., PIN2) on the Arduino board, +5V goes to +5v pin on the Arduino board, Ground goes to GND on the Arduino board.

4. Next, open Arduino IDE (installed in your computer).
5. Download the "Week 2& 3 Resources" folder from canvas Modules. Open the folder "Task 2 folder". From your Arduino IDE, open the file "Task2.ino" saved in your recently opened "Task 2 Folder".
6. Now, connect the Arduino board using the USB cable to your computer which is running Arduino IDE.
7. Before you compile and run, follow the below steps to select the board and port:
 - Select board: Go to Tools menu on your Arduino IDE -> Board-> Arduino Uno
 - Select port: Go to Tools menu on your Arduino IDE -> Port-> Select the port to which Arduino Uno is connected.

Please note: This might vary for each computer. So select the one that is applicable to you.

8. Next, verify (compile) the code using sketch drop-down menu (or verify button tick symbol). Upload the code to your Arduino board using the "Upload" option from the "Sketch" drop-down menu or using the right arrow icon on the Arduino IDE.
9. You should now hear the buzzer beeping on and off if your circuit is wired correctly and your code is correct.

Please ask your tutor for help if this doesn't work.

For you to do!!

Task 2.1: Buzzer (PIN 3)

1. Keeping the rest of your circuit as is, connect the +ve/signal pin of the buzzer to PIN3 on the Arduino board and modify the "Task3.ino" file to make the buzzer program to work for PIN3.

Task 3: Push Button (with LED)

In this task you will learn to use a push button to turn an LED ON when the button is pressed, and turn it OFF when the button is pressed again.

1. Connect a Push Button and an LED to the Arduino board. Please refer to Figure 3 for the circuit diagram.
2. Make sure your circuit is correct. Pay attention to the wires, PIN connections, resistor, polarity of the LED, etc. Ask your tutor for help if required. **Please DO NOT power ON the Arduino board yet.**

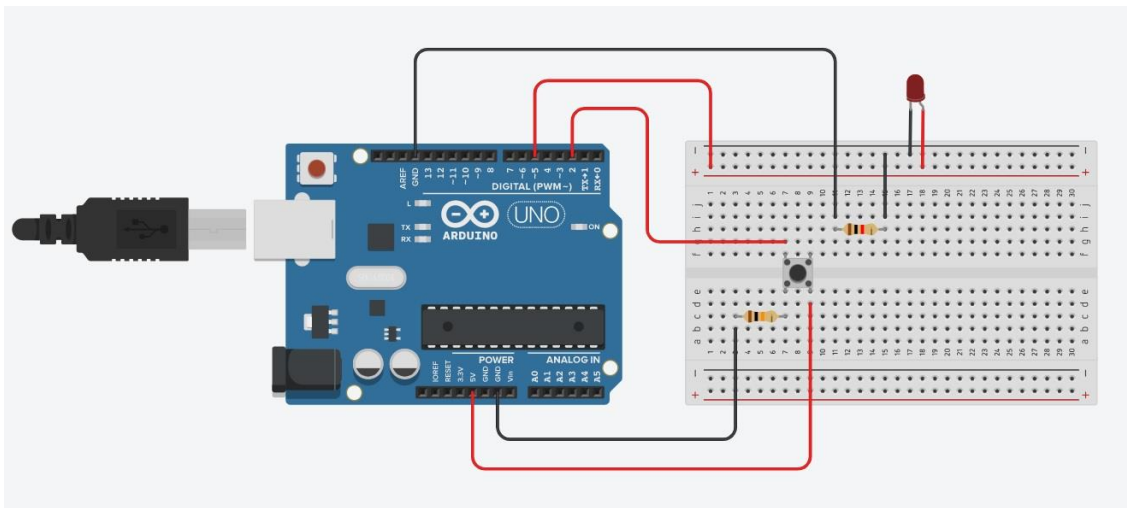


Figure 3: Task 3

3. Next, open Arduino IDE (installed in your computer).
4. Download the "Week 2& 3 Resources" folder from canvas Modules. Open the folder "Task 3" folder. From your Arduino IDE, open the file "Task3.ino" saved in your recently opened "Task 3" folder.
5. Now, connect the Arduino board using the USB cable to your computer which is running the Arduino IDE.
6. Before you compile and run, follow the below steps to select the board and port:

- Select board: Go to Tools menu on your Arduino IDE -> Board-> Arduino Uno
- Select port: Go to Tools menu on your Arduino IDE -> Port-> Select the port to which Arduino Uno is connected.

Please note: Port number might vary for each computer. So select the one that is applicable to you.

7. Next, verify (compile) the code using sketch drop-down menu (or verify button tick symbol). Upload the code to your Arduino board using the "Upload" option from the "Sketch" drop-down menu or using the

right arrow icon on the Arduino IDE.

8. You should now be able to turn the LED ON with the push of the button and turn it OFF when the button is pushed again, if your circuit is wired correctly and your code is correct.

Please ask your tutor for help if this doesn't work.

Task 3.1: Push Button (with Buzzer)

Modify Task 3 to work with a Buzzer instead of an LED.

Please ask your tutor for help if needed.

Task 4: Traffic Lights (Extension task (optional but important!))

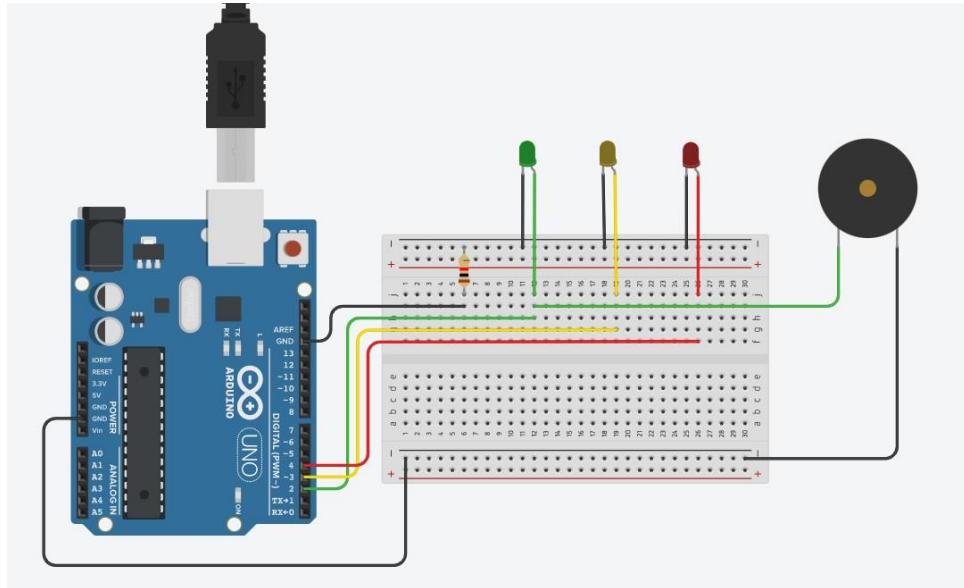


Figure 4: Task

Now that you have learnt how to blink the LED and beep the buzzer, we want you to build a traffic light (our own simplified version!!). Your traffic light will have a 3 LEDs (red (PIN2), yellow (PIN3), and green (PIN4)) and a buzzer (PIN5). The sequence of how the traffic light works is as below:

- i. Red LED turns ON for 10s;
- ii. Red LED turns OFF, Yellow LED turns ON for 10s;
- iii. Yellow LED turns OFF, Green LED and Buzzer turns ON for 10s;
- iv. Repeat steps i, ii, iii, iv for 5 times.

The circuit connection diagram for this task is given in Figure 3. Using this as a reference, write the Arduino code to make the traffic lights as described above.

Resources

- IoT Programming (SWE30011) week 2 lecture
- Week 2& 3 Resources folder from Canvas -> Modules-> Week 2/Tutorials
- Arduino Language Reference: <https://www.arduino.cc/reference/en/>
- Arduino Foundations: <https://www.arduino.cc/en/Tutorial/Foundations>
- Arduino Built-In Examples: <https://www.arduino.cc/en/Tutorial/BuiltInExamples>