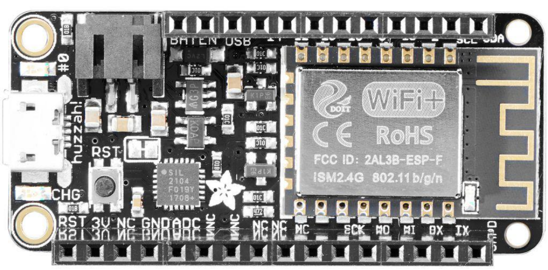
Internet of Things – Intelligent and Connected Systems

EECS E4764



Introduction

The structure behind almost any system is that they take in inputs, process the inputs, and finally create some sort of output based off of the results from the processing. Especially interesting is the data we can extract from the real-world to process on computers, machines, the cloud, etc. To be able to process data digitally, we require the use of sensors to detect the changes that are occurring in the world and to produce an output that can be read in by a controller, computer, etc. In this lab, we will be setting up the ESP8266 board to take in various sensor inputs from the physical world and to generate a response from the board or other components based on our inputs.

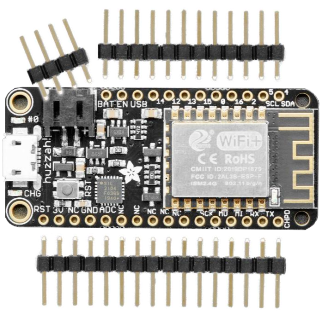
The overview of the system we will be building is as follows. The system is turned on when a user pushes a button, generating an interrupt, that is fed into one of the board's GPIO pins. While the system is turned on the ADC will begin sampling from the sensor attached to the board's only ADC pin. Based on the values read from the ADC, the system will turn on an LED and begin operating a piezo/vibration motor; the brightness of the LED and the pitch of the vibration motor will change based on the readings from the sensor and are controlled through PWM, a common method for controlling actuators. The sensor that we will be using in this lab is an analog light sensor.

Obtaining and processing sensor data is a vital part of IoT and human-machine interaction; every key pushed on your keyboard or button pressed on your mouse or phone is processed by your computer or laptop to produce an output on your device that people can control and use. The concepts and processes used in this lab will subsequently be incorporated into the final smartwatch to allow for human-machine interaction.

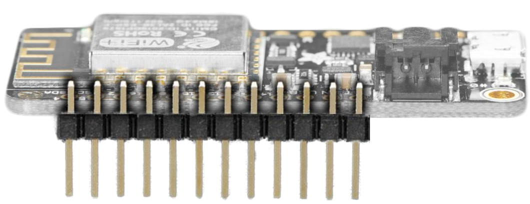
Part 1: Getting ready

Task 1

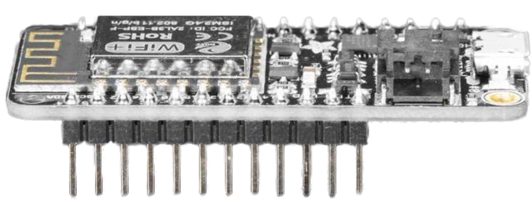
Solder the header pins onto Feather HUZZAH as shown below.



Find the header pins in and bend / cut them to match exactly the number of holes on the board.



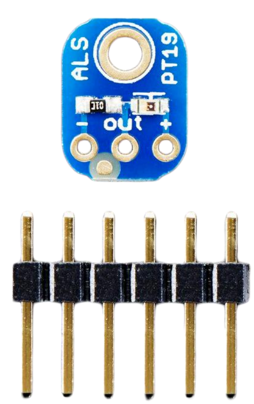
Put the short side upward through the holes on the HUZZAH board.



Use a soldering iron to solder the header pins onto both sides of HUZZAH.

Task 2

Solder the light sensor using the same method.



Part 2: Reading in Sensor Data

Task 1

Wire up an LED with an appropriate circuit to a GPIO pin on the ESP8266 and control the brightness of the LED with PWM.

Task 2

Do the same with the piezo/vibration motor; The LED and piezo brightness and pitch are what we will vary based on our sensor input.

Task 3

Connect the analog light sensor to the ADC input to the HUZZAH board and sample at 1 Hz (1 sample per second). You will see that values you read out will be an integer number. Try varying the readings from the light sensor by placing your finger on the sensor and removing it. You can see what values you are getting by printing to the serial port.

Task 4

Next, we will combine what we have done so far; Start reading in light sensor values at a rate of at least 10 Hz and based on the readings you get from the sensor, adjust the pitch of the piezo/vibration motor and brightness of the LED accordingly (e.g. increase in light levels to an increase in LED brightness or piezo frequency).

Checkpoint 1

Change the brightness of an LED and the pitch of a piezo in accordance to readings from the light sensor.For example, the more light that reaches the sensor, the brighter the LED shines and the higher the pitch from the piezo will be.

Part 3: Interrupts and Debouncing

Task 1

Next we will work with interrupts by adding an on-off switch. Connect a button to one of the GPIO pins. Use proper hardware and software debouncing so that you can generate stable interrupts with a button press; at most your button should interrupt once when you press the button and once when you release. If it interrupts any more than that, then the debouncing software and circuit is not adequate.

Checkpoint 2

Debounce a button press. At most, an interrupt should be generated once when the button is pushed and once when the button is let go.

Task 2

Incorporate the button press with the light sensor/LED/piezo system created in part one. When you press and hold the button, your system should generate an interrupt to start sampling the light sensor, changing the brightness of the LED, and changing the pitch of the piezo. When you let go of the button, the system should turn off.

Checkpoint 3

Create the combined system; the system is activated when the button is pressed and deactivated when released. While activated, the LED and piezo changes brightness and pitch depending on the light sensor readings.

Lab 2 Checkpoints:

1. Change the brightness of an LED and the pitch of a piezo in accordance to readings from the light sensor. For example, the more light that reaches the sensor, the brighter the LED shines and the higher the pitch from the piezo will be.

2. Debounce a button press. At most, an interrupt should be generated once when the button is pushed and once when the button is let go.

3. Create the combined system; the system is activated when the button is pressed and deactivated when released. While activated, the LED and piezo changes brightness and pitch depending on the light sensor readings.

Submission:

Submit the file for each checkpoint onto courseworks → Assignments → Lab2

The submitted files should be named like

`labx_{member1_uni}_{member2_uni}_{member3_uni}_check{X}.py`

- There should be 3 files for this lab.

e.g.

- lab2_jw4173_mz2878_zx2366_check1.py
- lab2_jw4173_mz2878_zx2366_check2.py
- lab2_jw4173_mz2878_zx2366_check3.py
-

Due Time

September 28st, 2022, 3:00pm (checkpoint confirmation & codes submission)