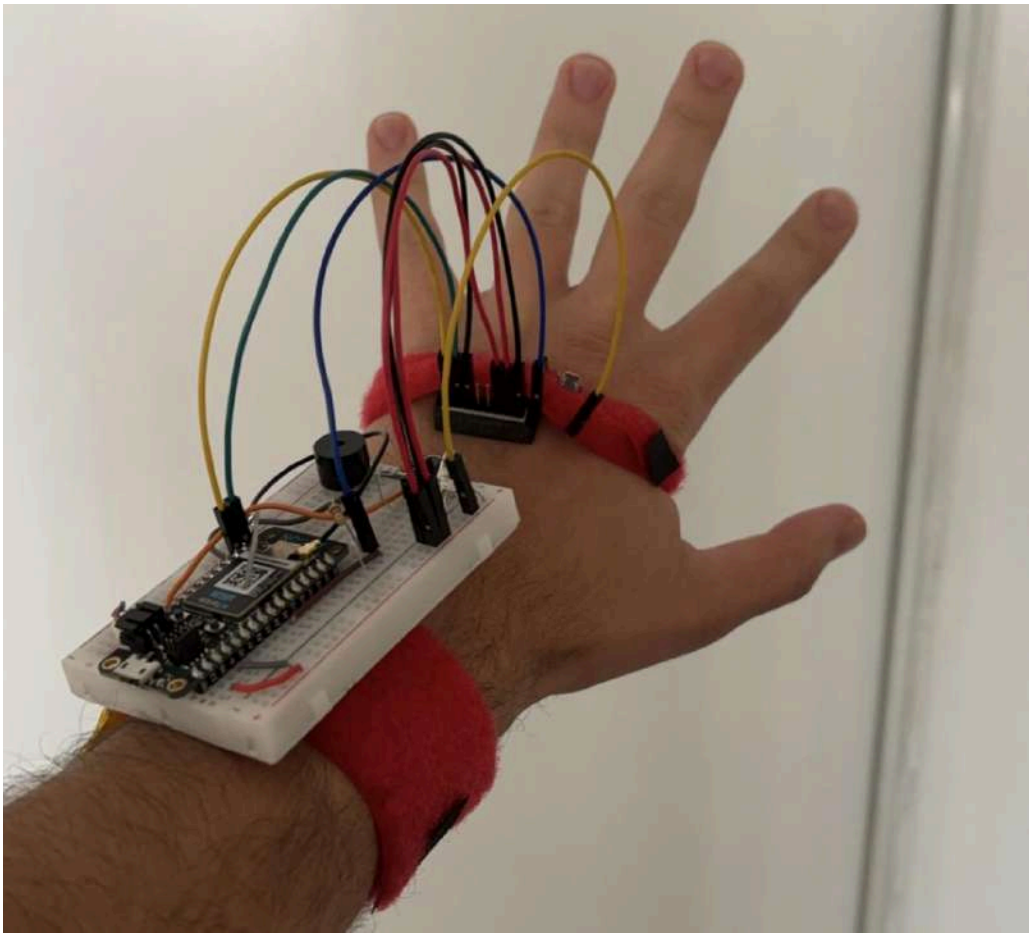
University of Southern California

ITP-348: Making Smart Devices: Introduction to Electronics/Wearables

Fall 2023

Final Project: User Documentation



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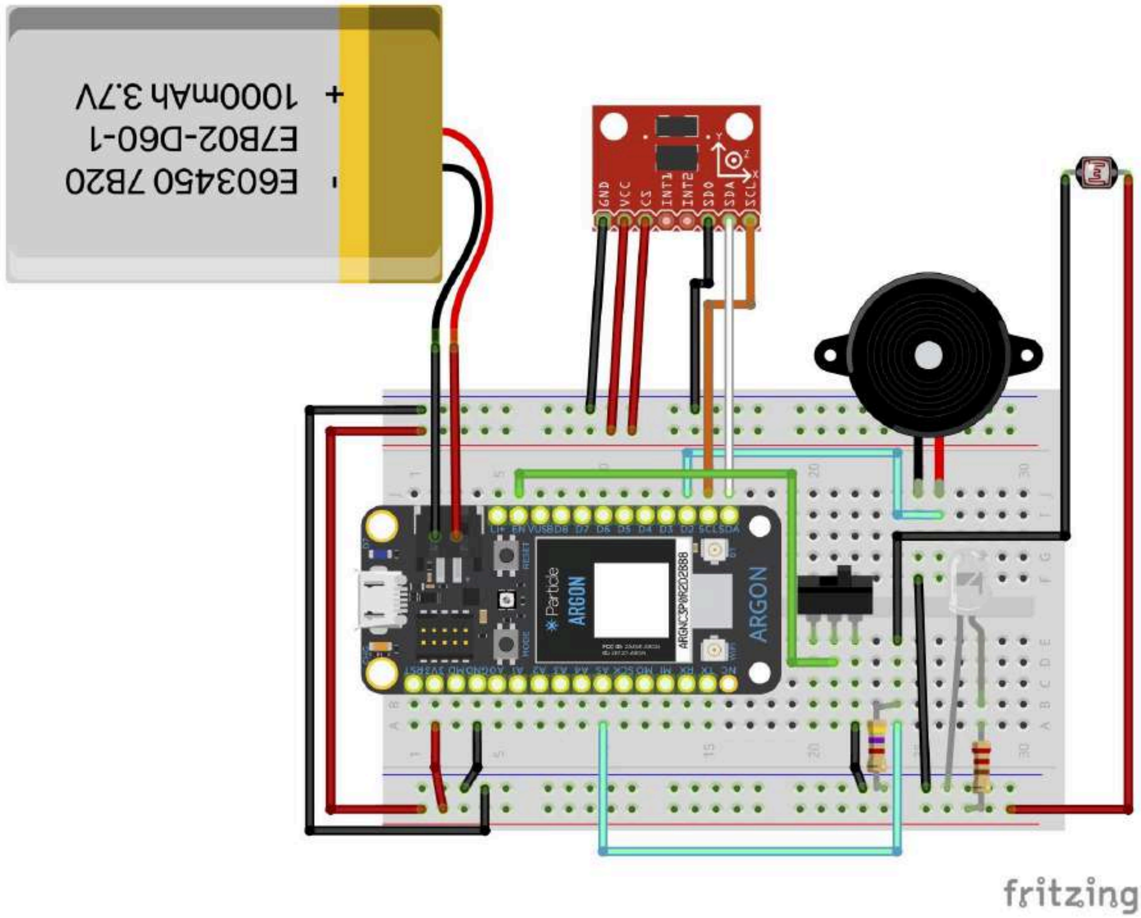
Overview

The Smart Posture Aide for Violinists and Violists (SPAVV) is a wearable device connected to the cloud. It has an accelerometer that goes on the back of your left hand, along with a relative light sensor, and a main breadboard that goes on your left forearm (as shown on the title page image). The breadboard has a speaker, power switch, and an always-on LED. The accelerometer is used to detect changes in wrist angle, the LED and light sensor is used to show the relative proximity between the back of the left hand and the left forearm, and the speaker plays a pitch depending on whether the angle threshold, light threshold, or both are exceeded. The SPAVV also graphs the change in angle and the light sensor output on an Initial State dashboard. The dashboard allows the user to set the angle and light thresholds, as well as calibrate the base orientation of the accelerometer.

Initial State Dashboard Link: https://go.init.st/uue3as7

Wiring Diagram and Components



The components in the wiring diagram above may be rearranged as long as it does not affect the connections between them (for example, the accelerometer’s 3V and GND wires could connect to the other +/- strip of the breadboard), and the wire colors are meant to differentiate between different purposes (power, ground, clock, etc.). The lithium-polymer battery allows you to use the SPAVV without being tethered to a computer or outlet by a USB cable.

Component	Location	Purpose
3-Axis Accelerometer	The back of the left hand	Output the direction of gravity relative to the back of the left hand
Relative Light Sensor	The back of the left hand	Determine if the back of the left hand is too close to the LED on the forearm (the left wrist is bent too much)

Power Switch	Main breadboard	Turn the device on and off to prevent unnecessary battery loss and cloud data transfers
LED	Main breadboard	Provide constant light for the relative light sensor
Piezo Buzzer	Main breadboard	Play a note with the pitch depending on if the angle, light, or both thresholds are exceeded

Device Usage Instructions

The following steps assume the accelerometer gains and offsets have been found, and the SPAVV code has been flashed onto the Argon. If this assumption is incorrect, see the Developer Version of the documentation for steps.

1. Use velcro to attach the main breadboard to your left forearm, and the accelerometer and light sensor to the back of your left hand
    a. In the picture on the title page, a 3D-printed piece was used to house the accelerometer
2. Get in proper posture (see Appendix) and then use the switch to turn on the Argon
    a. If the Argon is on, the LED in the middle should be on
        i. If the LED is not on, and both switch orientations were tried, then double-check the wiring
        ii. If the wiring is correct, use the USB cable to connect a computer to the Argon and then try toggling the switch
        iii. If step 2.a.ii worked, then the battery is likely dead and needs to be recharged (leave it plugged in while the USB is also plugged in)
3. Open the Initial State dashboard to view the graphs and set thresholds
    a. The thresholds can be set using the sliders next to the “Calib. Accel.” button.

Key Features

This device, along with its cloud component, will have the following features:

1. Wrist angle tracking, using a 3-axis accelerometer
2. Wrist-forearm proximity tracking, using an LED and relative light sensor

3. Calibration of accelerometer via Initial State
    a. Hold the position you want to set as the baseline, and press the “Calib. Accel.” button on the Initial State dashboard
    b. Once you see the angle drop to around 0º, the calibration is complete
4. User-set angle and light level thresholds via Initial State
    a. It may take a few seconds for the Argon’s thresholds to update after the threshold sliders on the Initial State dashboard are moved
5. Graphs displaying wrist angles and light sensor output on Initial State
6. A switch to turn the device on and off
7. A buzzer to notify the user when an angle and/or brightness threshold is reached

Appendix

Good Wrist Posture	Bad Wrist Posture