Healthy Chair

ECE 445 Presentation

5/2/22

Team 5

Ryan Chen, Alan Tokarsky, Wang Qiuyu

Agenda

- Problem/Objective
- Block Diagram
- Demo
- On-Chair System
- UI System
- Conclusion/Future Work
- Questions

Introduction

Problem

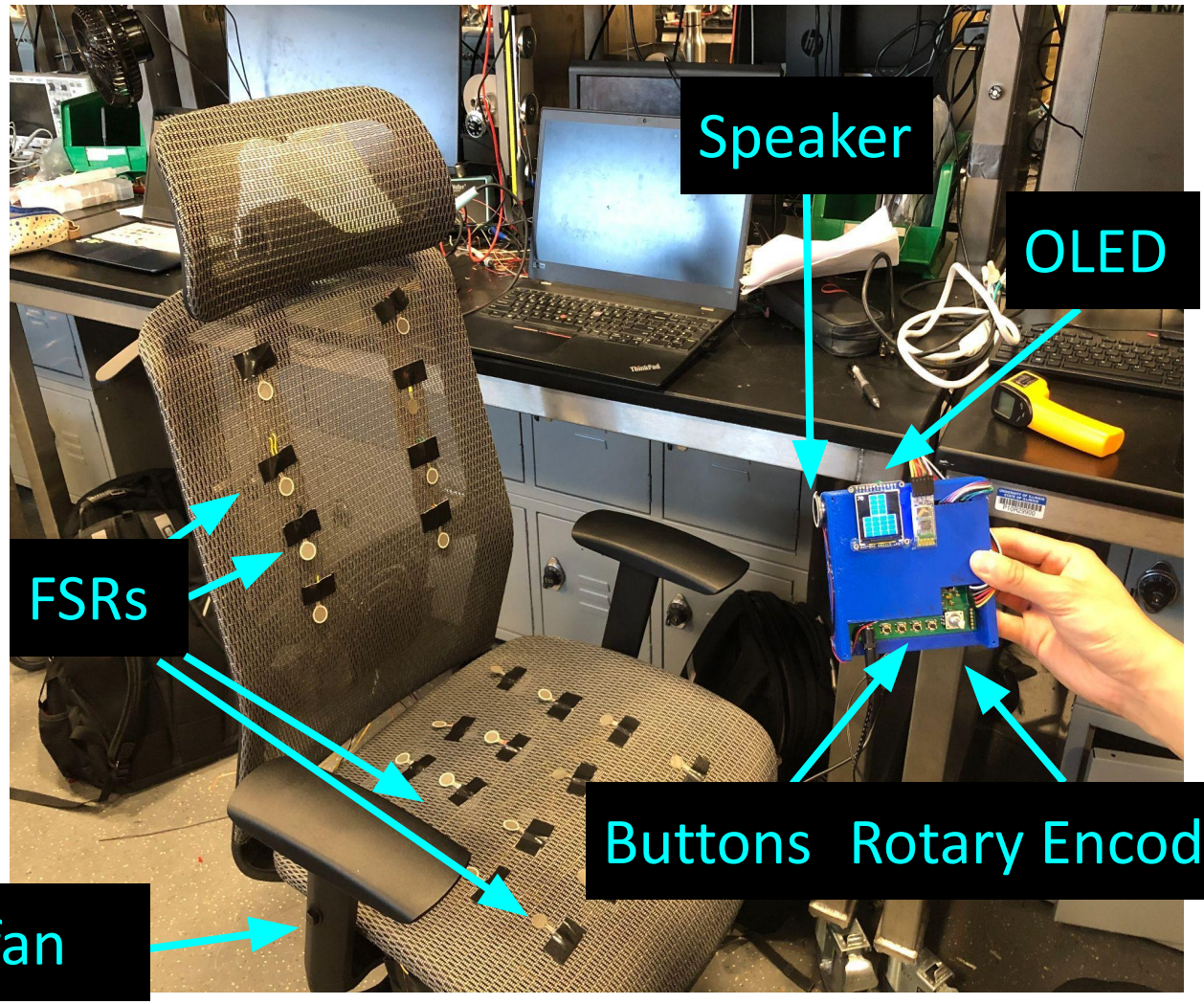
- Sitting too long results in various health hazards
- Sitting improperly is also detrimental to one’s health

Solution

- A Healthy Chair that reminds users to get up and stretch
- UI display screen shows user’s sitting posture
- User-friendly system

High Level Requirements

- Alert user to stand up through speech module
- Display temperature and triggered pressure sensors
- Switch between 3.7V Li-ion battery and 120V AC wall power



Block Diagram

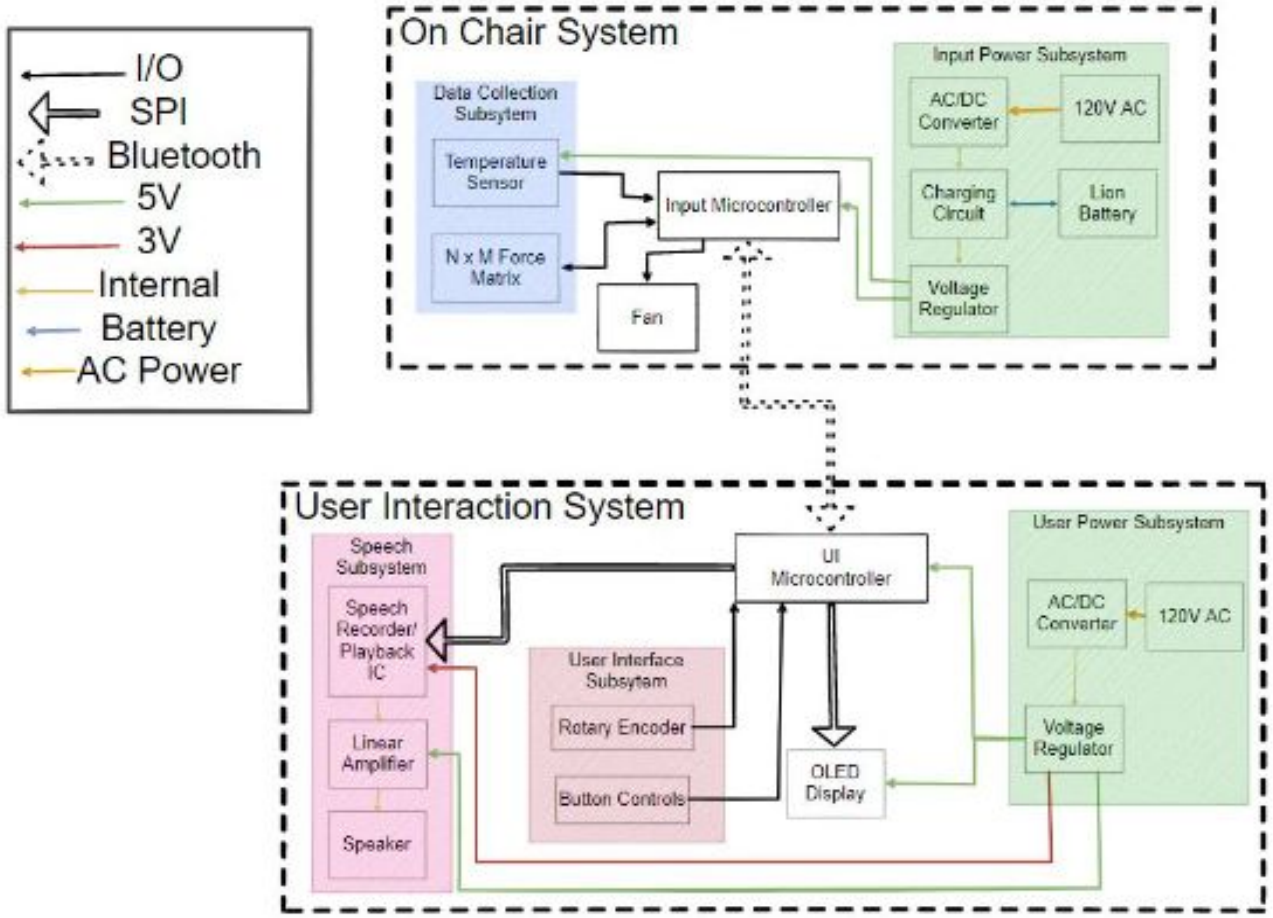
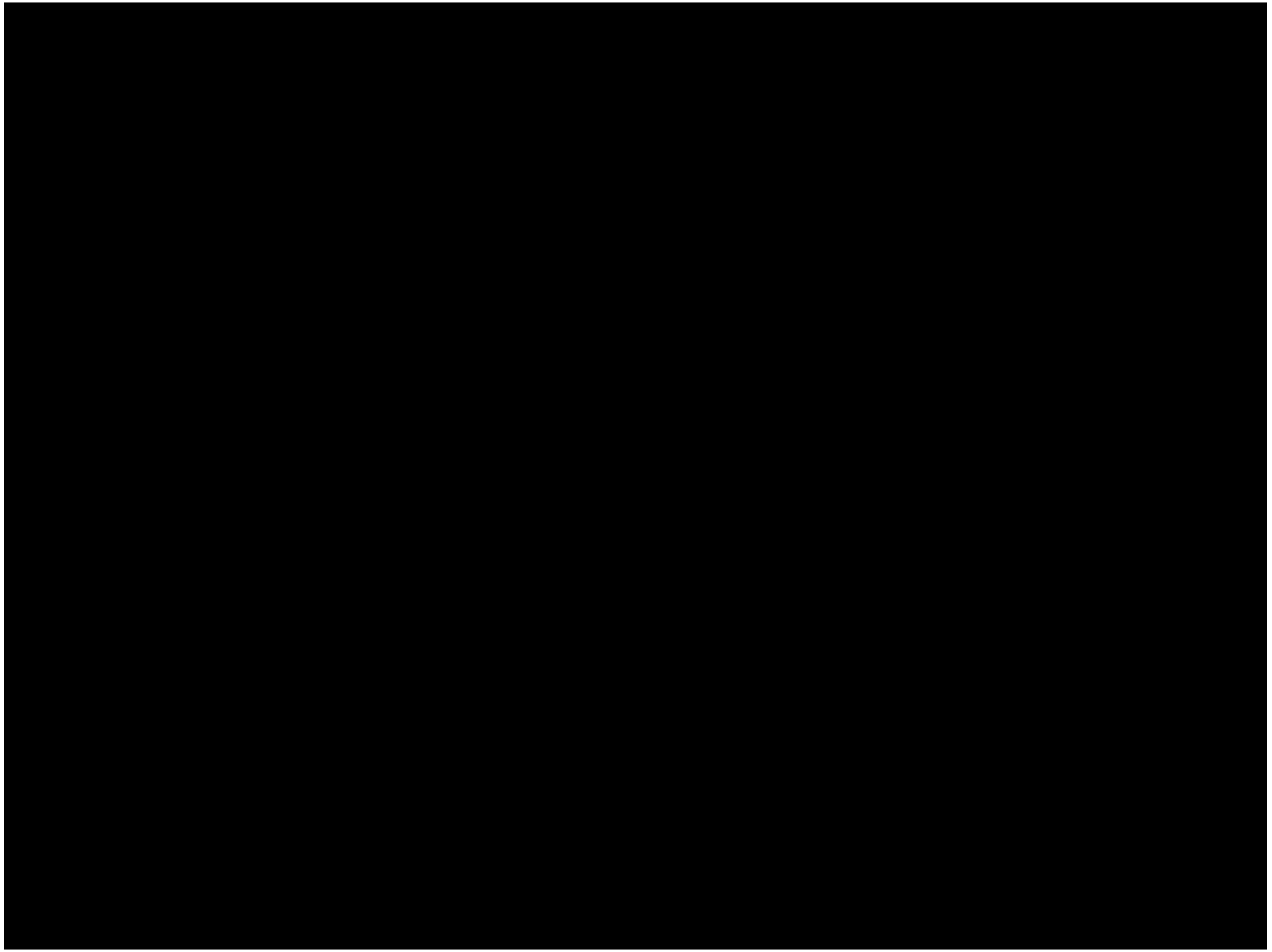
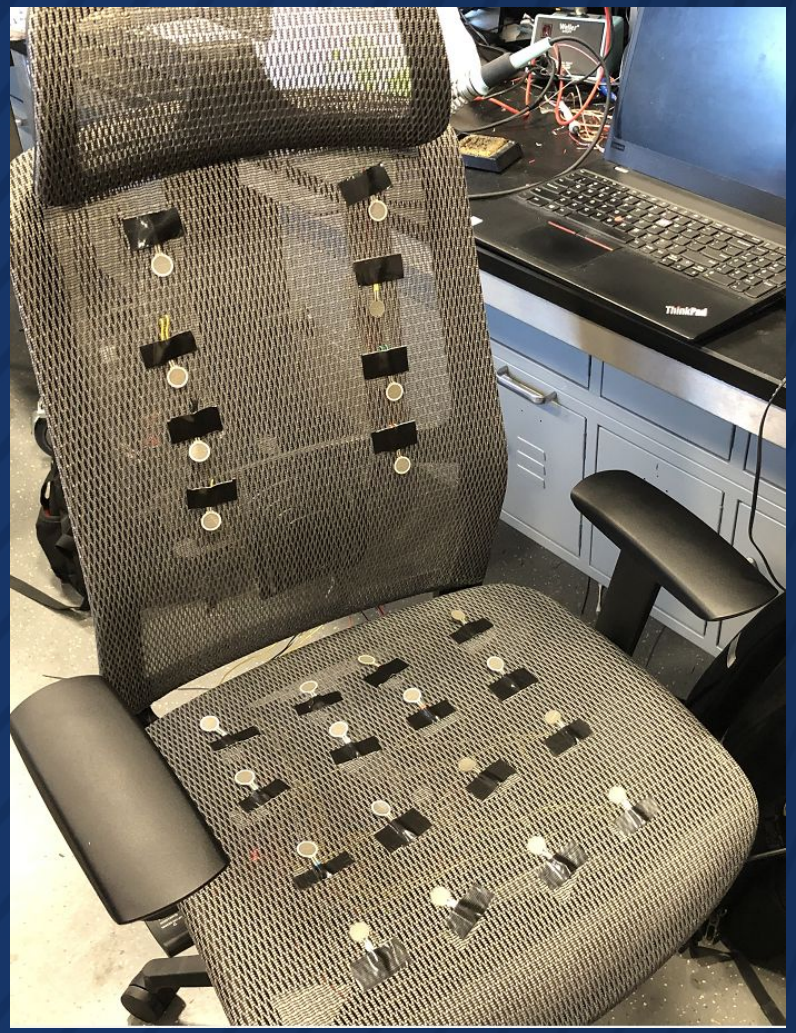


Figure 3: Block Diagram

Short Demo Video



On-Chair System



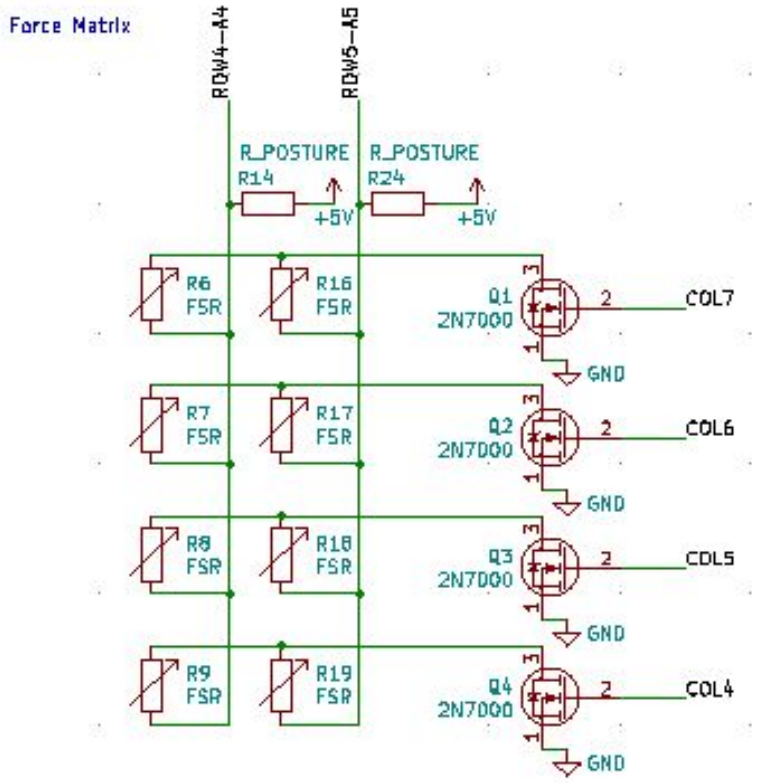
Design: Data Collection

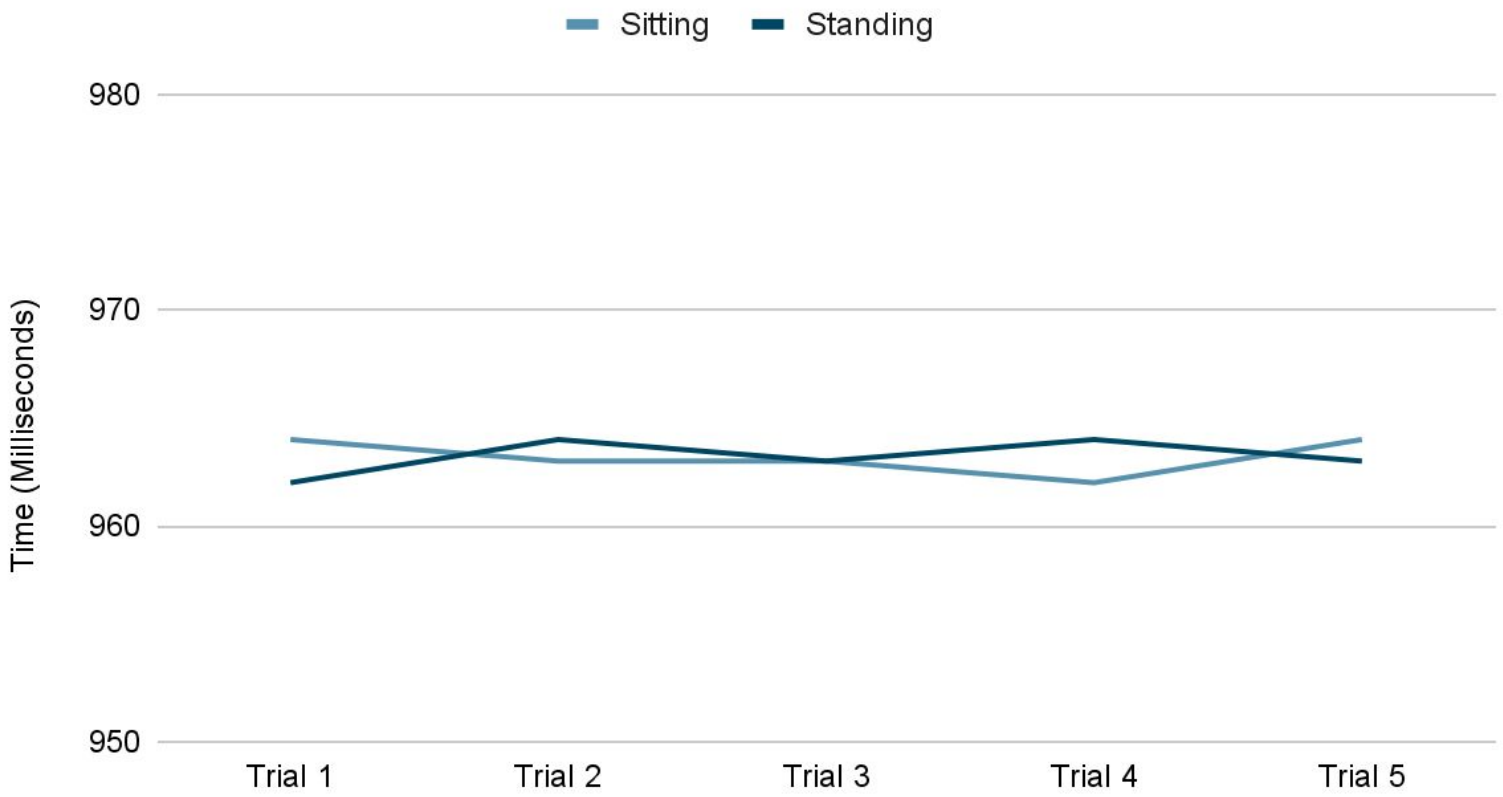
R&V Table

Requirements	Verifications
1. At least 5 different pressure sensing zones	1. Apply 5 different colors on OLED to represent the varying pressure sensing regions
2. Pressure sensors must respond within 10 ms	2. Use Arduino to track response time
3. IR temperature sensor with ±0.5°C of accuracy	3. Use an infrared thermometer to measure temperature of chair seat

Design: Data Collection

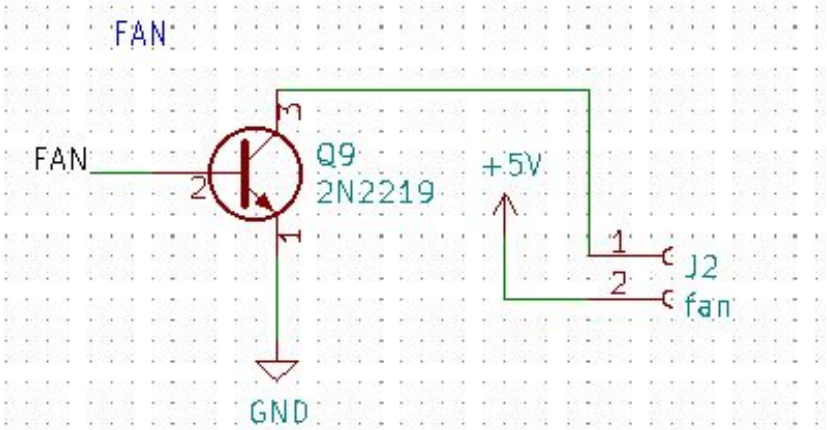
Schematic and Results





- FSR Delay Hardcoded constant 960 Milliseconds
- No speed change based on amount of pressure sensors activated

Design: Fan



R&V Table

Requirements	Verifications	Results
1. Noise output of less than or equal to 25dB	1. Use decibel meter app	1. Noise output of 20.3dB
2. Cools off the chair by 1± 0.5 °C within 10 minutes	2. Use an infrared thermometer	2. Cools off the chair by 1°F for 4 minutes

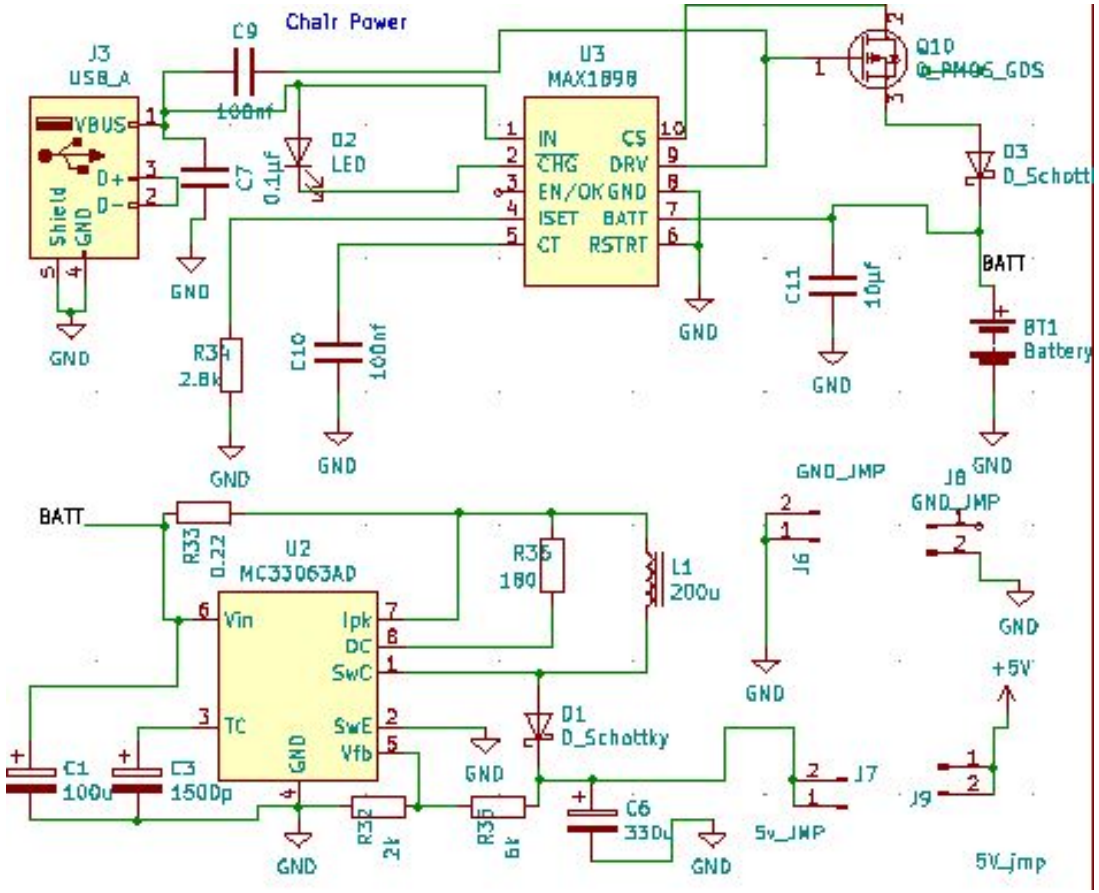
Design: On-Chair Power

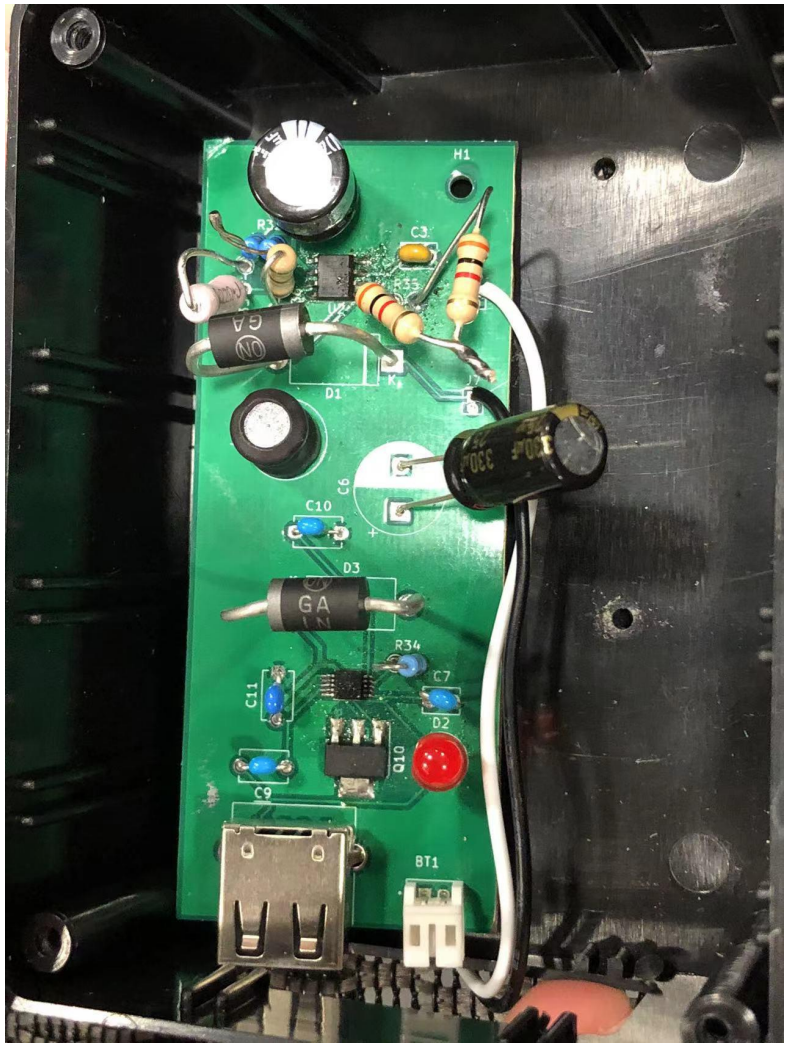
R&V Table

Requirements	Verifications
1. Power drawn from wall when battery is charging	1. Ensure the battery is placed in parallel with the charging circuit output. On-chair components can operate with or without wall power.
2. Battery discharging voltage being greater than 3V	2. When the system is running, record the voltage of the battery and monitor that it does not fall below 3 V.

Design: On-Chair Power

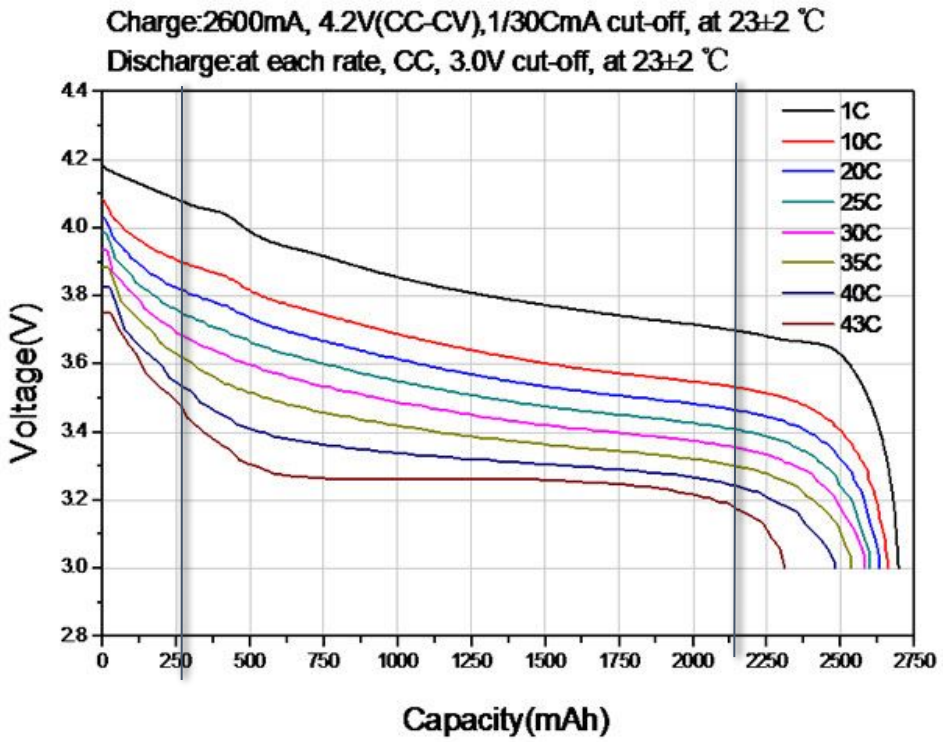
Schematic and PCB



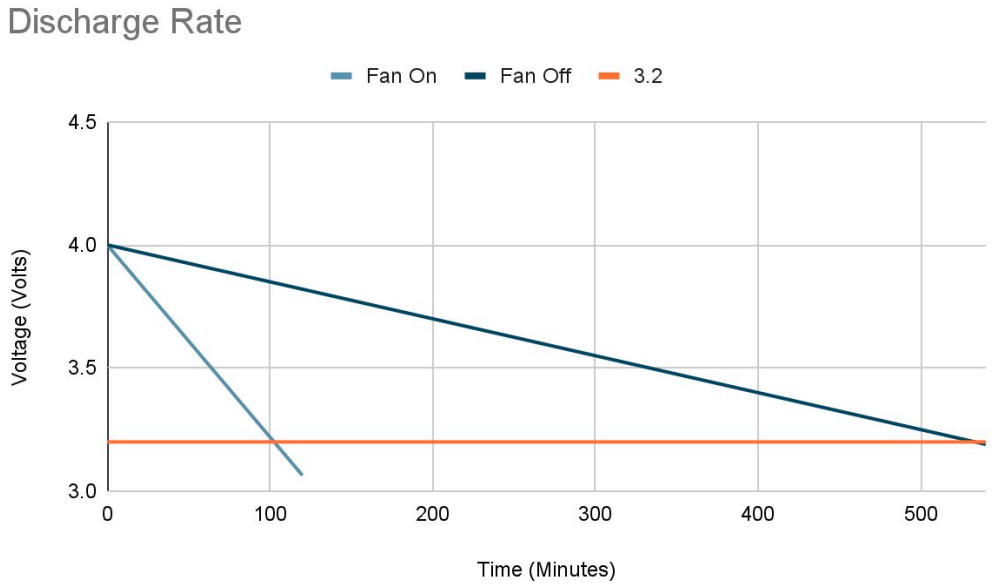


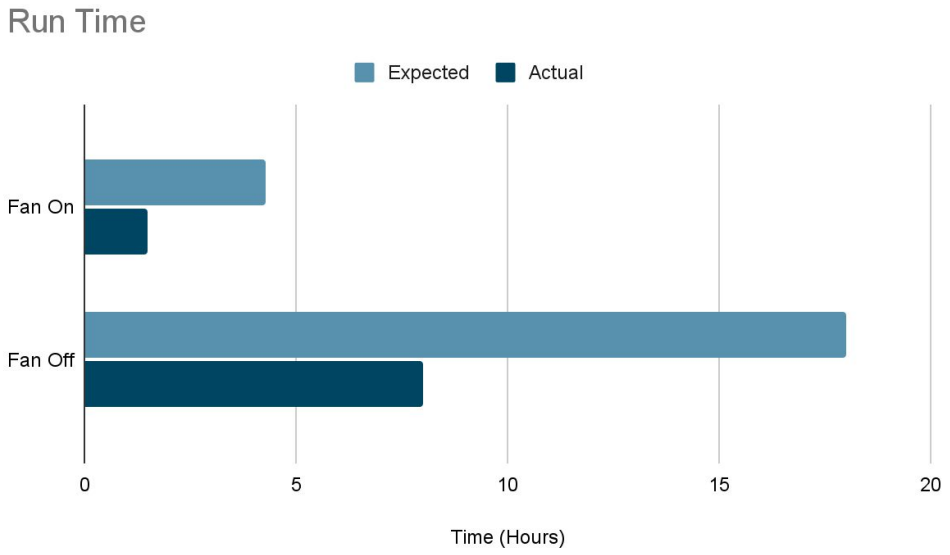
Design: On-Chair Power

Battery Discharging Results

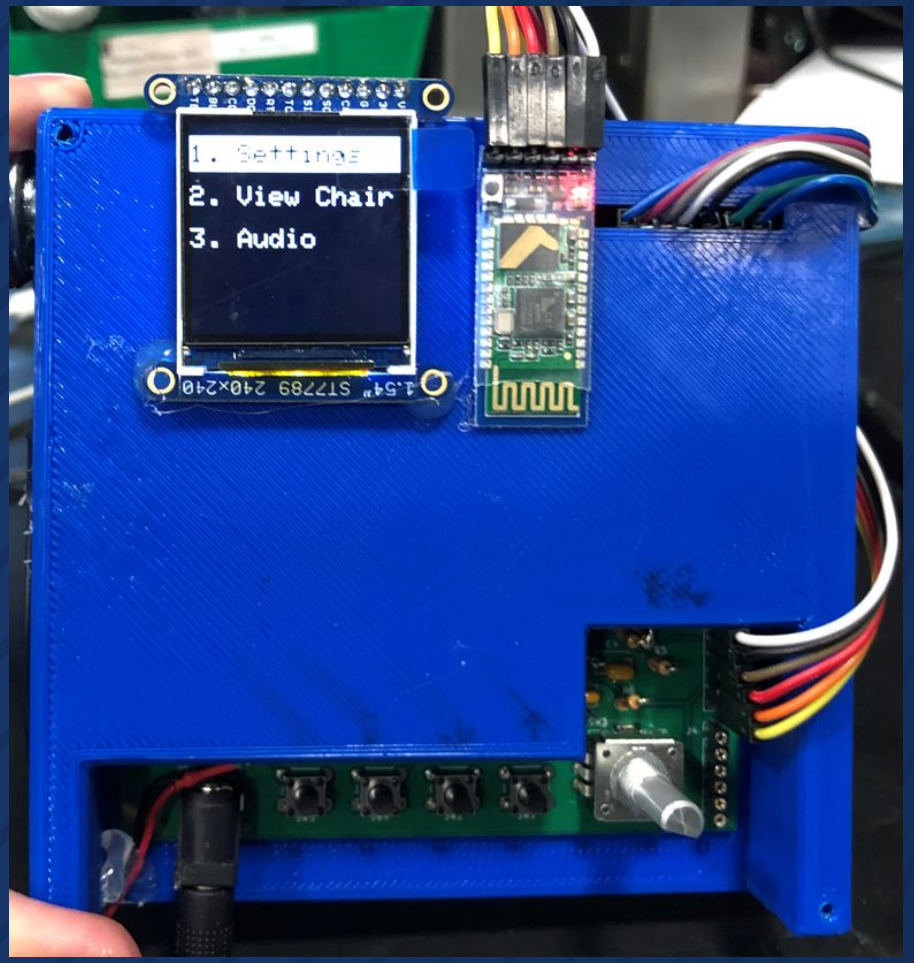


[e-Bike Battery Discharge Rate 4C vs. 3C | LaBatteria]

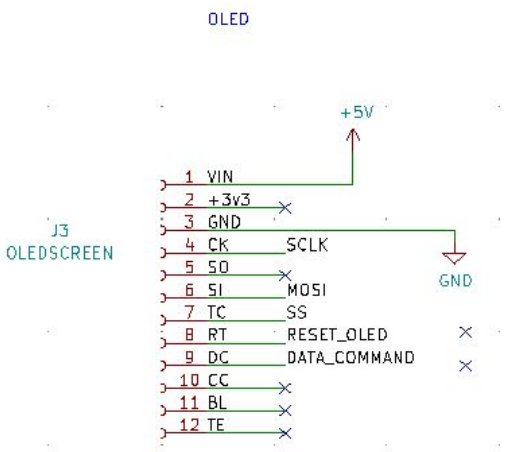


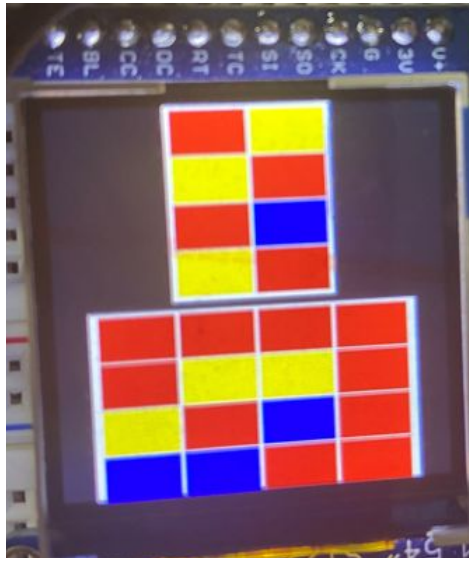


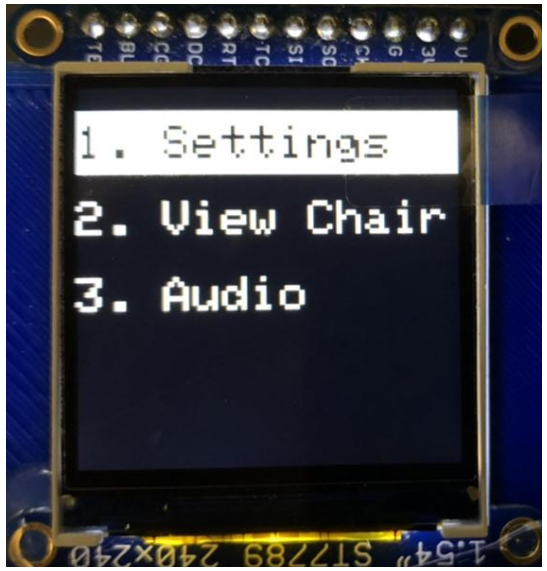
UI System



Design: OLED



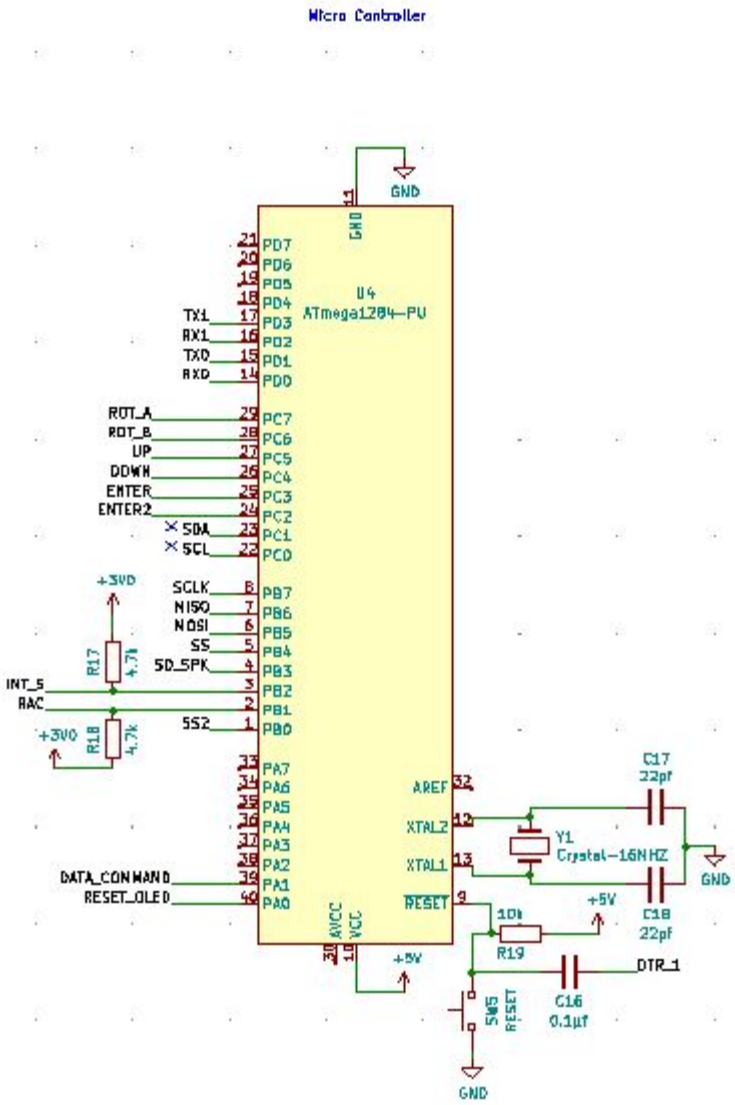




R&V Table

Requirements	Verifications
1. Display all pertinent information	1. Watch and test display
2. Response time within one second from input	2. Use timer to record response time

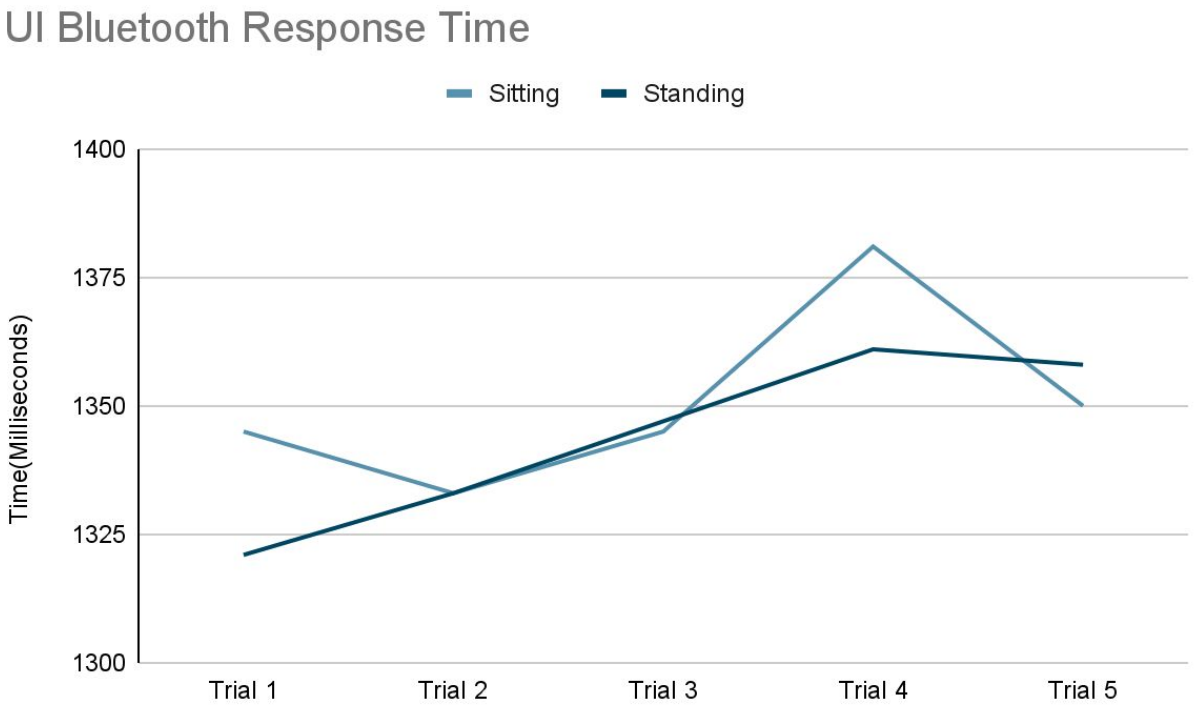
Design: Microcontrollers

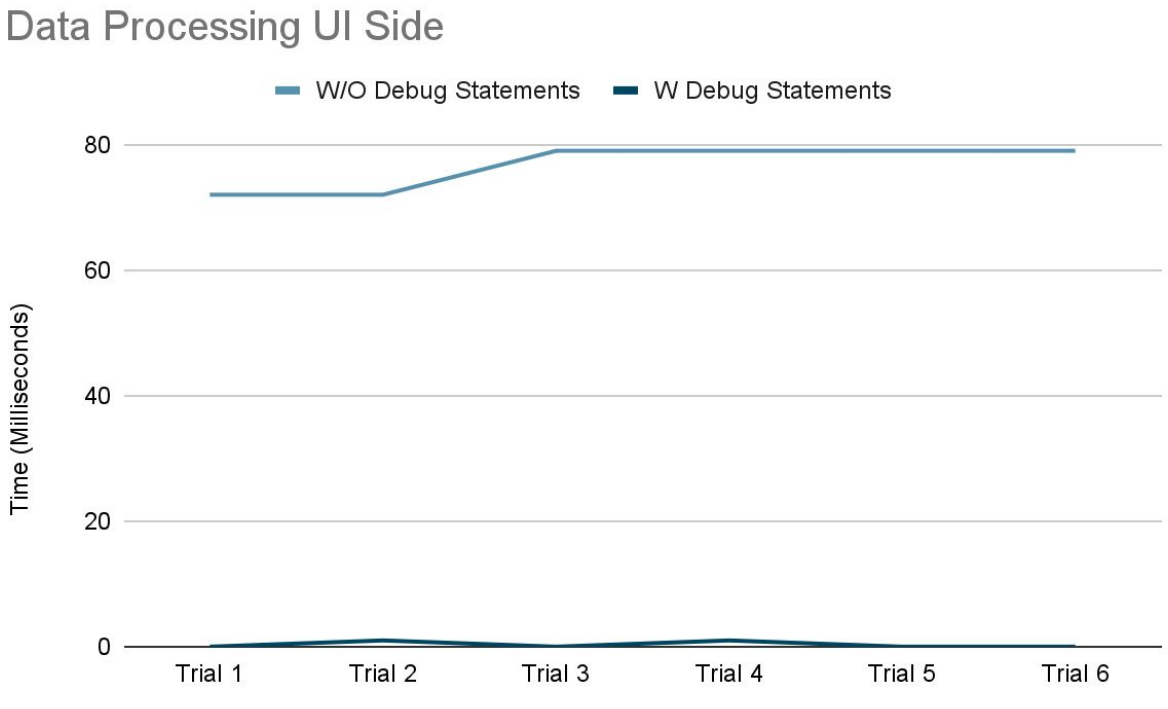


R&V Table

Requirements	Verifications
1. Communicate via bluetooth	1. Data received from the other microcontroller within 2 seconds of asking
2. User parameters can be changed from the user interface.	2. User Interface changes the parameters on the display quickly and accurately
3. Parameters are remembered between power cycles.	3. Parameters should stay constant after we plug and unplug the UI system

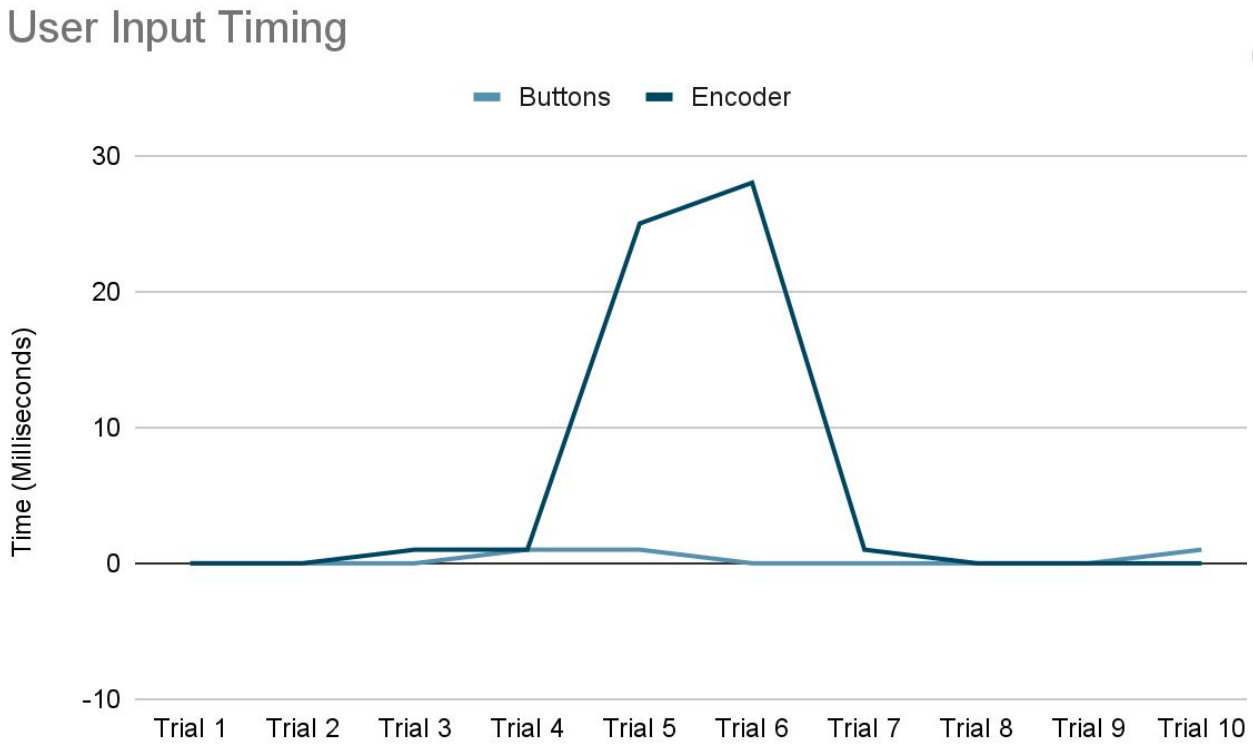
Design: UI System Timing Results

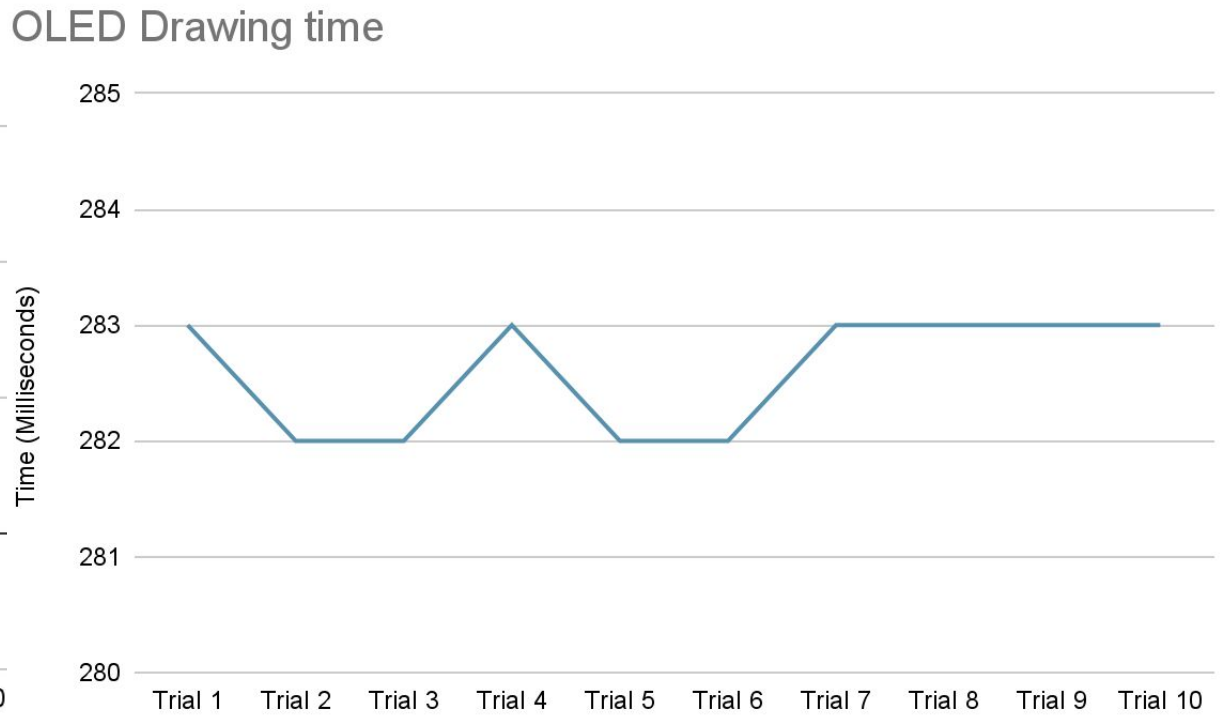




- Bluetooth response time encapsulates sending, receiving, and processing data
- Bluetooth response time is limited by sending and receiving
- Data processing was demonstrated with debug statements

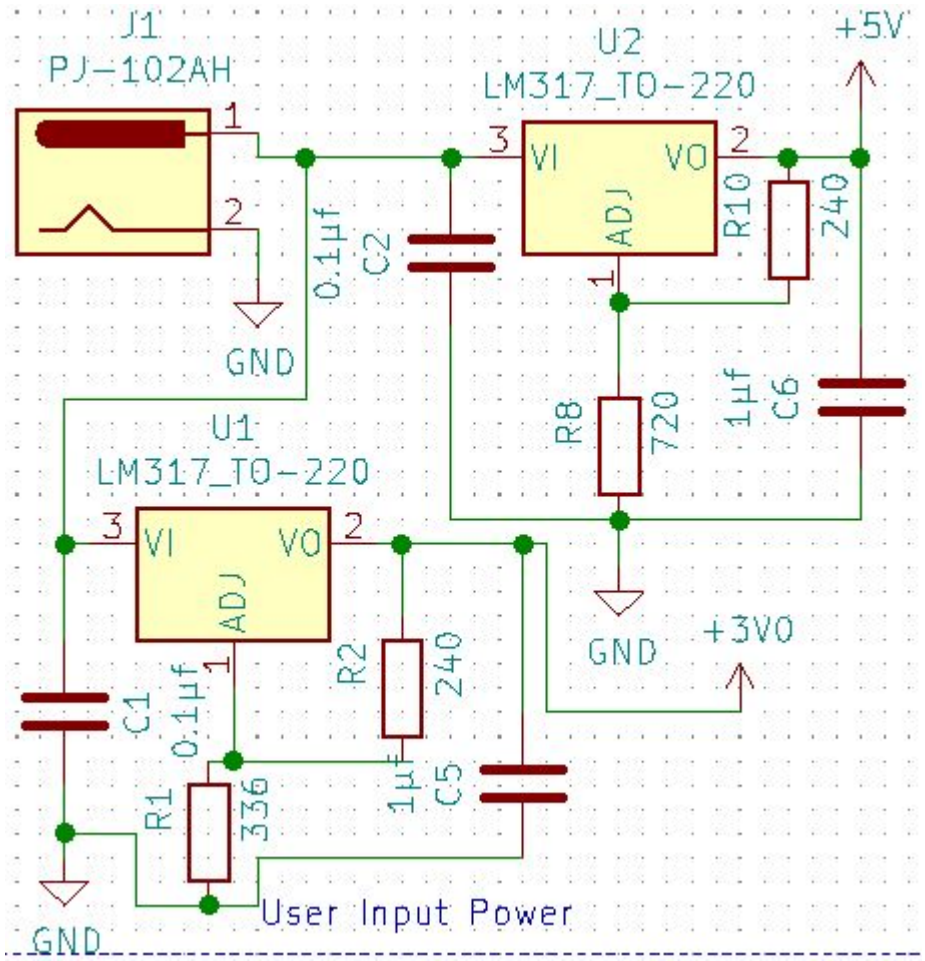
Design: User Interface Subsystem Timing Results





- User buttons add almost no time to interrupts
- OLED drawing time based on updated chair mapping

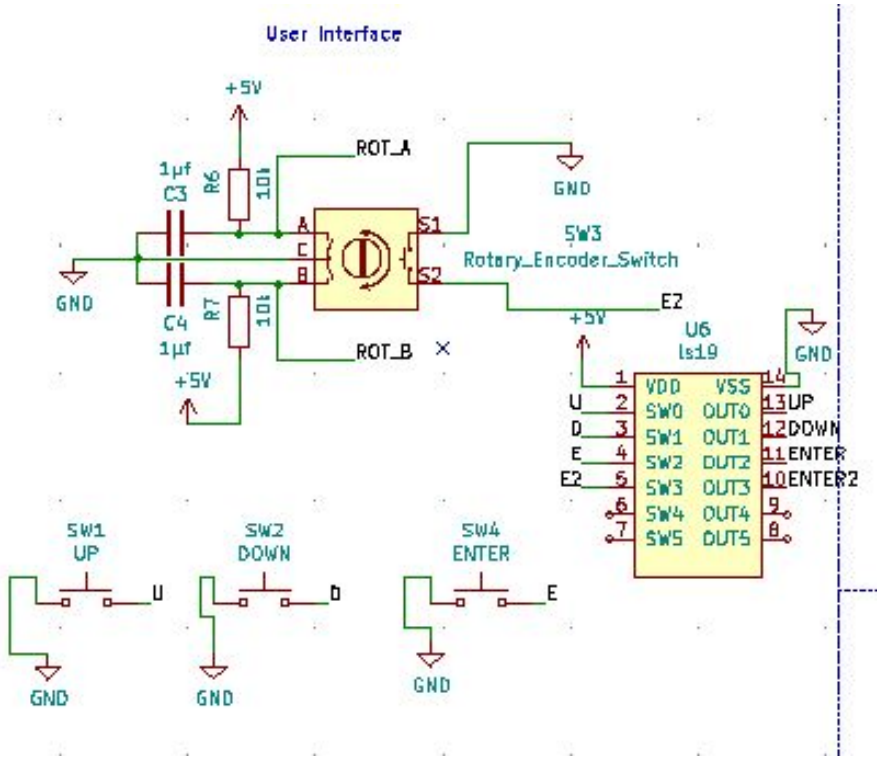
Design: User Power



R&V Table

Requirements	Verifications
1. Both linear voltage regulators must provide 5 ± 0.5 V and 3 ± 0.3 V	1. With the load(s) connected to either 3 V or 5 V regulator, the output voltage is measured within 10% of 3 V and 5 V

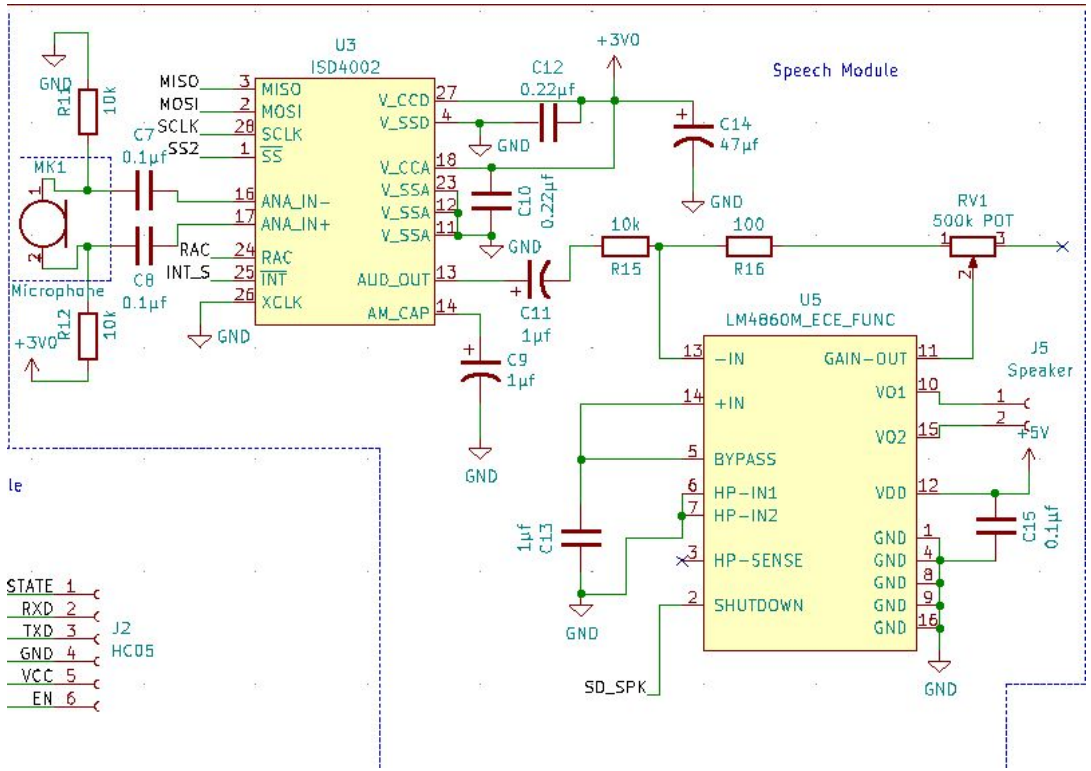
Design: User Interface



R&V Table

Requirements	Verifications
1. All buttons and rotary encoder react to user input	1. Clicking the buttons and twisting the encoder should change menus and settings on the OLED display.

Design: Speech



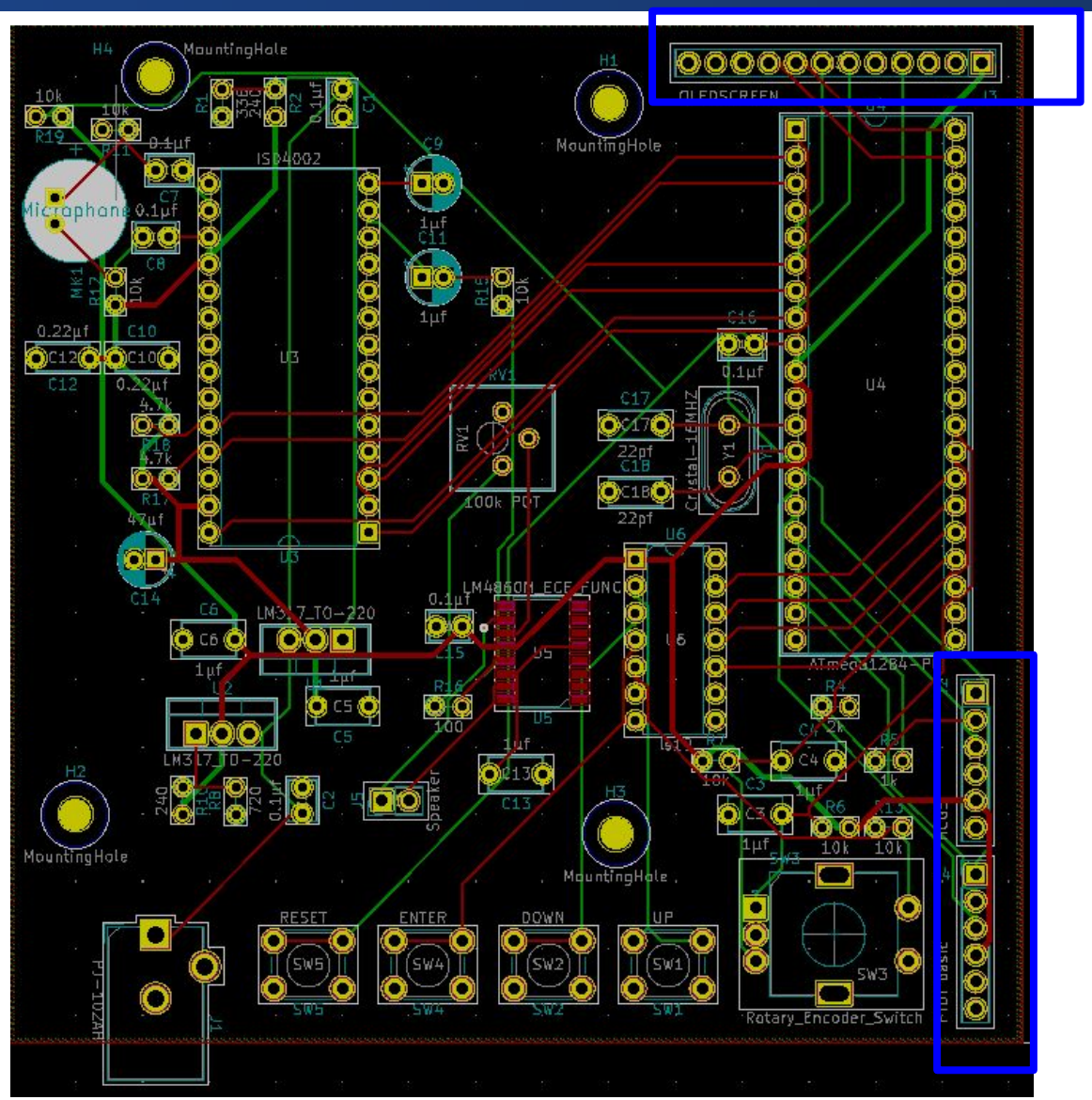
R&V Table

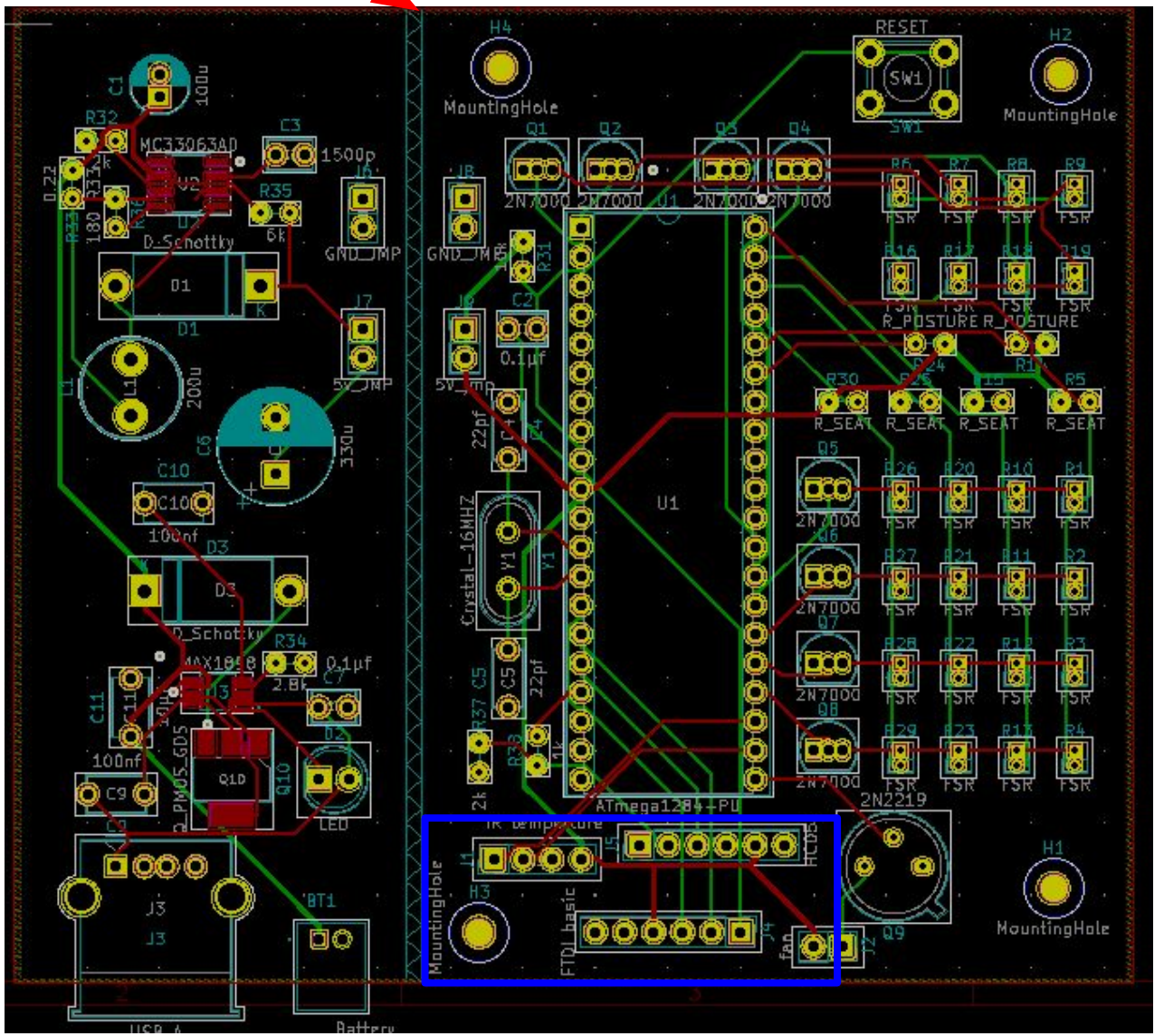
Requirements	Verifications
1. Record and playback our voices for 5-15 seconds	1. Record a 10-second speech of warning into the speech module and make sure it can record and accurately play back the recordings.

Gain = 2* RV1 / R15 = 2* 500k / 10k = 100

Too large gain significantly amplifies environment noise!

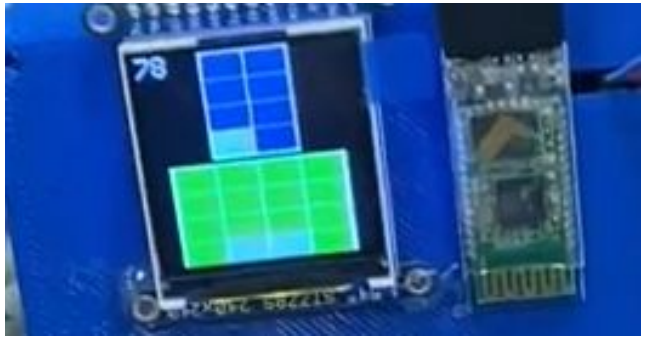
PCB Design and Issues

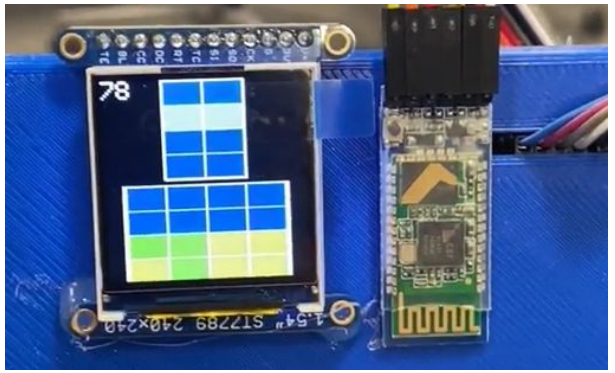




Conclusion

- Sensors on the seat accurately portray how you are sitting
- Fan is responsive to temperature changes
- System obeys user parameters
- Pressure sensors exposed on chair surfaces
- Hard to overcome the force threshold on the sensors on the back
- Wires are messy under the chair





Future Work

- Add a cushion or cover so the sensors are not able to be seen
- Utilize pressure sensors with lower activation ranges on the back of the chair
- Run wires through the sides of the chairs
- Add a battery for UI system to enhance portability
- Low power mode

Thank You

All Questions are Welcome

The Grainger College of Engineering

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN