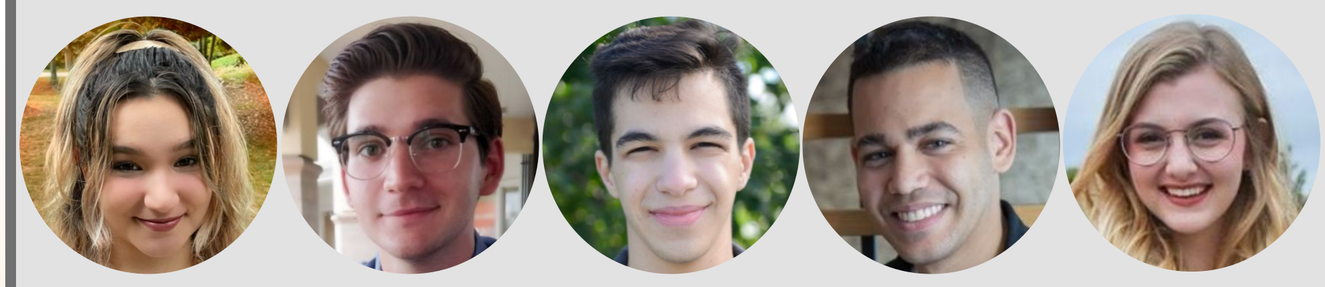
P21009: Pediatric Test Mannequin - Sensing

RIT Kate Gleason College of Engineering Multidisciplinary Senior Design

Introduction

A pediatric stander kit has been developed to modify a manually controlled pediatric stander to enable motorized movement controlled by the child who is secured in the stander. The idea of motorizing a pediatric stander has been pursued by a series of MSD projects at RIT. We are not currently able to collect data that characterizes the performance of the motorized kit and the experience of the human riding on the stander. Although some prior teams definitely did some testing, the data was limited and for limited scenarios. A system (PSPAS) that can be used to measure and record data relevant to the stander and a human subject secured to the stander. A stretch goal is that this system might be easily adaptable to similar projects (e.g., a wheelchair) that involve devices that facilitate mobility of a human subject.

Meet the Team



Rhiannon Jimenez
BME
Project Manager

Chris Abajian
CE
Lead Engineer

Aharon Sebton
EE
Validation and Test Engineer

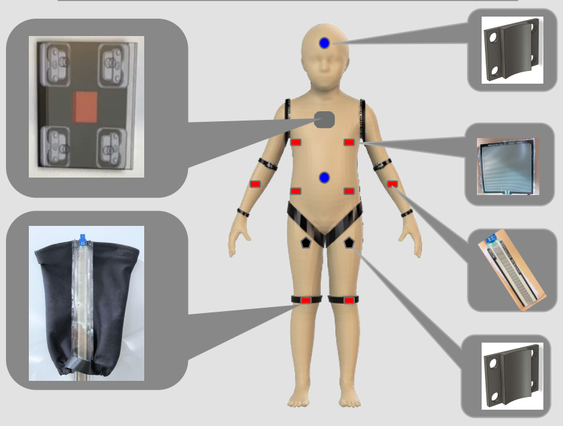
Thomas Sosa
EE
Integration Engineer

Rebecca Reich
CE
Software Developer

Design Process

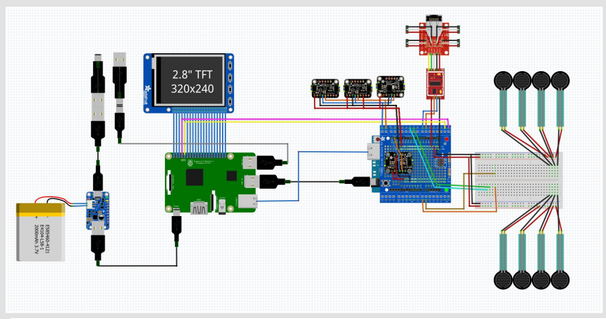
Sensor Placement

Orientation Sensor (OB)	●
Force Sensor Resistor (FSR)	▬
Inertial Measurement Unit (IMU)	⬟
Chest Scale	⬬

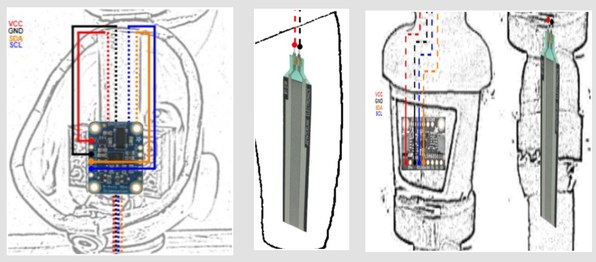


Shown above are the sensors and their placements on the mannequin. The pictures displayed are the mount set-up for each of the sensors. This includes 3-D printed designs for the OB and IMU, industrial strength velcro for the FSRs, a compression sleeve for the FRS, and a 3D printed chest scale design.

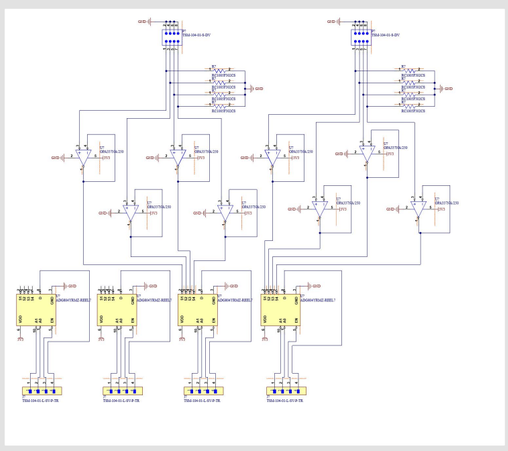
Wiring Diagrams



Torso Content:
Battery, PowerBoost, LCD, NXP, Raspberry Pi, Protoboard, Load Combinator, and Load Cell Amp, Chest Scale, FSR
Head Content:
OB
Arms Content:
FSR
Legs Content:
FSR, IMU



Protoboard Design



We designed schematics for our system on altium. Implemented a protoboard. To simplify the support circuitry needed for the FSRs. This protoboard consisted of eight op-amps going into a multiplexer which funneled into 4-to-1 MUXES. This was needed to switch between limited analog inputs on our microcontroller.

User Interface

The User Interface consists of three selectable options. The first is the configuration menu where components can be calibrated, enabled, or disabled. The next is the collection menu where an operator can control the start, stop, or pause of measurement data. Finally, the export to USB sends a report to a removable disc drive. All menus have an option to return to home.

Requirements

Relevant and Retrievable

- PSPAS must record data that is relevant to stander performance and human experience
- Must measure velocity, acceleration, inclination, and force/pressure
- PSPAS produces interpretable time stamped data

Untethered and Operational

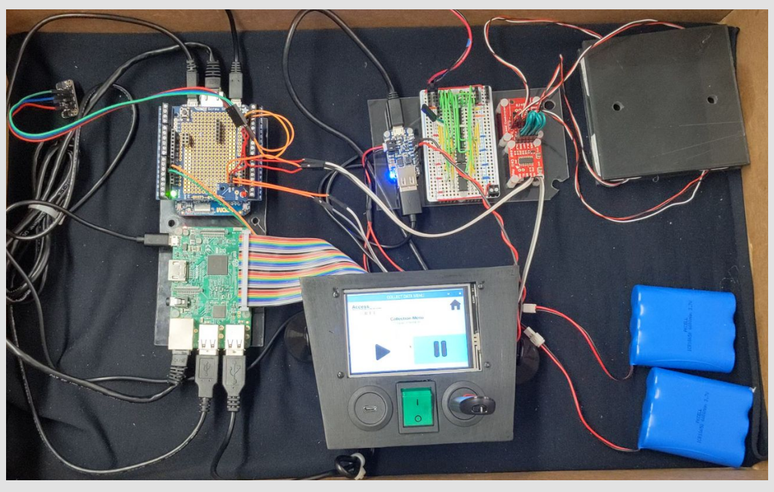
- Must have untethered power, control, and communication
- Batteries must last at least 8 hours and have minimal charging time

Compatible with Stander

- PSPAS interfaces with stander using current stander attachment and support devices

Deliverables

The final deliverable consisted of our sensing system fully operational. The next steps would be to integrate the sensing system into the structure system (to the left). Below is the end result of the sensing system set-up. The control panel containing the user interface is shown attached to the Raspberry Pi and NXP to communicate with the chest scale (upper right).



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- Carlos Barrios
  Nick Marsaw

Facilities:
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- KGCOE Machine Shop

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