Mechanical Overview

Year: 2023   Semester: Fall   Team: 8 Project: Smart Seat Sensor
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Author: Lee Dongeun   Email: ldongeun@purdue.edu

Assignment Evaluation: See Rubric on Brightspace Assignment

1.1 Commercial Product Packaging

We analyzed two commercial products that like our design. Product 1 is the Varlite Evolution Wheelchair Cushion and Product 2 is Occupant Classification System (OCS) used in car companies.

1.2 Product #1

Varilite Evolution Wheelchair Cushion

Fig1.1: Varilite Wheelchair Cushion

This product features a pressure sensitive design with air filled cells that is able to adjust to the user's body to have a correct body posture. Down are some potential pros and cons associated with the packaging of this wheelchair cushion.

Pros:

1) Product Protection: One of the most important pros of this product is to have a layer of protection to prevent damage to any of the sensors. The evolution foam technology

developed by this company is bonded to four-way-stretch knit fabric for maximum safety and conformity during immersion. The fabric itself is puncture and water resistant.

2) Comfortable and Light: The packaging is made so that the product is comfortable to the users and very light that it does not have to add weight to the wheelchair.

Cons:

1) Pressure Sensitivity: Air is one of the main elements in Varilite Evolution Wheelchair cushion technology because using air the air cushion is readjusted to the user. Air is high maintenance because they tend to leak and if they leak it is very hard for the users to calibrate the correct amount of air pressure.

Our product will look very similar to the product above where it will have the shape of a seat. We will not be using any air pressure in our design as there is no value. One element that could be inspired by this design is cushion safety. Our design should be able to protect all the sensors that will be used to detect human seating.

1.3 Product #2

Figure 1.2: Occupant Classification System

Car Occupant Classification System is a technology that combines pressure sensors, thermal sensors and other data to detect not only the presence of the person seated but also their weight, size and thermal capabilities. This system is used for airbags and seatbelt reminder.

Pros:

1) Packaging safety: The OCS is a square pad that has sensors on the sides, covered externally by rubber for protection, This OCS is also covered by a layer of leather seat for protection of the sensor.

2) Light and uses limited space: The square OCS is small in size compared to the chair and as well as thin so that it does not interfere with other technologies that is set up in the seat such as seat heater.

Cons:

1) Cost: Because this OCS is highly sensitive as well as have many different capabilities, High quality packaging can lead to expensive overall cost of the design. For instance, in order to install this technology into a car passenger seat, the user has to buy a seat cushion pad for comfortability.

2) Difficulty in opening: The Seat sensor technology is made in such a way that it is difficult to open, this issue might give frustration to the user.

Compared to this product, our product will try to use the whole chair as a sensor, the sensors will be spread out throughout the chair, the seat cushion mat will have the PIR sensor and the FSR whereas the thermal sensor will be placed elsewhere to detect thermal activity. The commonality that this product has to our design is the cushioning and the safety.

2.0 Project Packaging Description

As seen from Appendix 1, the packaging will be designed as a seat cushioned mat with a square FSR in the side edges. The Thermal Camera & Human Presence would be enclosed in a small plastic container that will be stuck to the back of the seating and the front. The packaging of these sensors should not interfere with the reading.

One of the many reasons the sensors are in a different packaging is because the Thermal Camera and the Human presence sensor are small hardware sensors that has the capabilities of breaking when the user seats. The protection layer as well as the calibration such that the sensors work properly is a different problem as well as will have expensive cost.

3.0 Sources Cited

**[1] Varilite, "Evolution Seating," [Online]. Available:
https://www.varilite.com/seating/evolution.html. Accessed on: September 21, 2023**

**[2] I-CAR, "Collision Repair News (CRN-1239)," [Online]. Available:
https://rts.i-car.com/collision-repair-news/crn-1239.html. Accessed on: September 21, 2023**

Appendix 1: CAD Model Illustrations

Major Dimension of the pad sensor: Width: 16 inches, Depth: 16 inches, Thickness: 2 inches
Major Dimensions of the plastic container: 4 inches, Depth 4 inches, Thickness: 1 inch
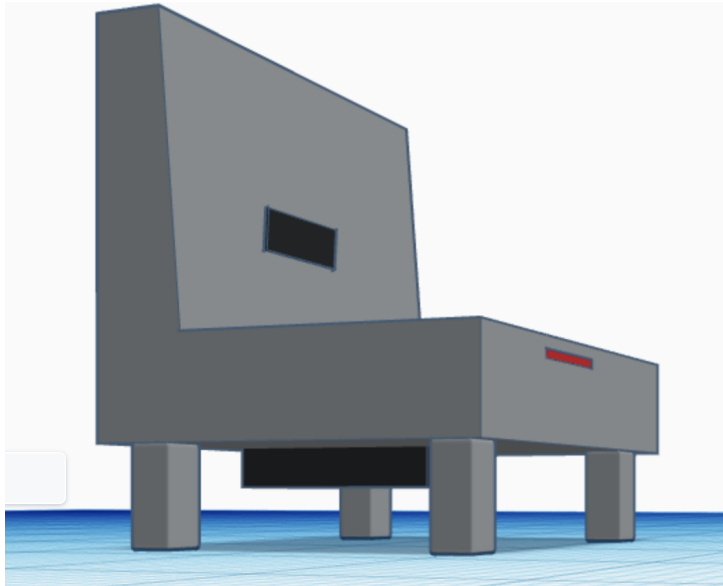
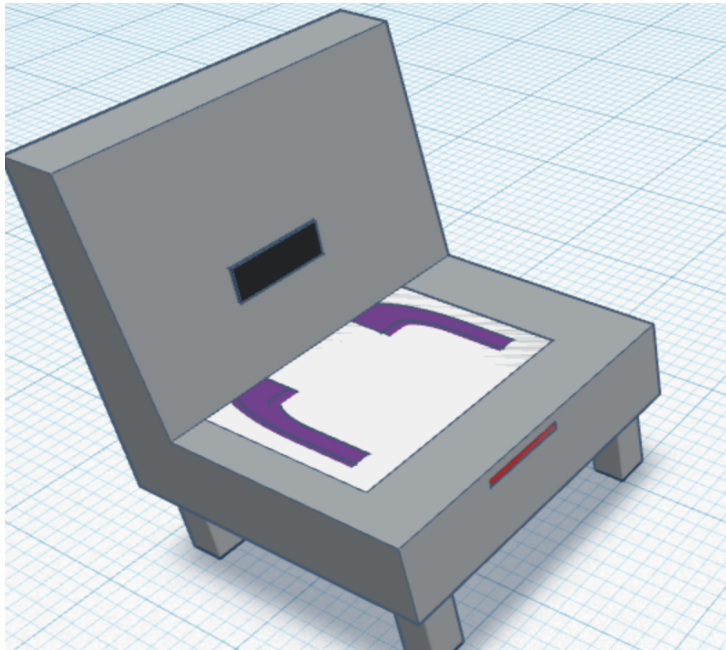Fig 1: Side View of the product, the PIR sensor shown as a red block to detect leg movements

\Fig 2: Top View of the product, purple area acts as a pressure sensor and white block is the cushioned mat.
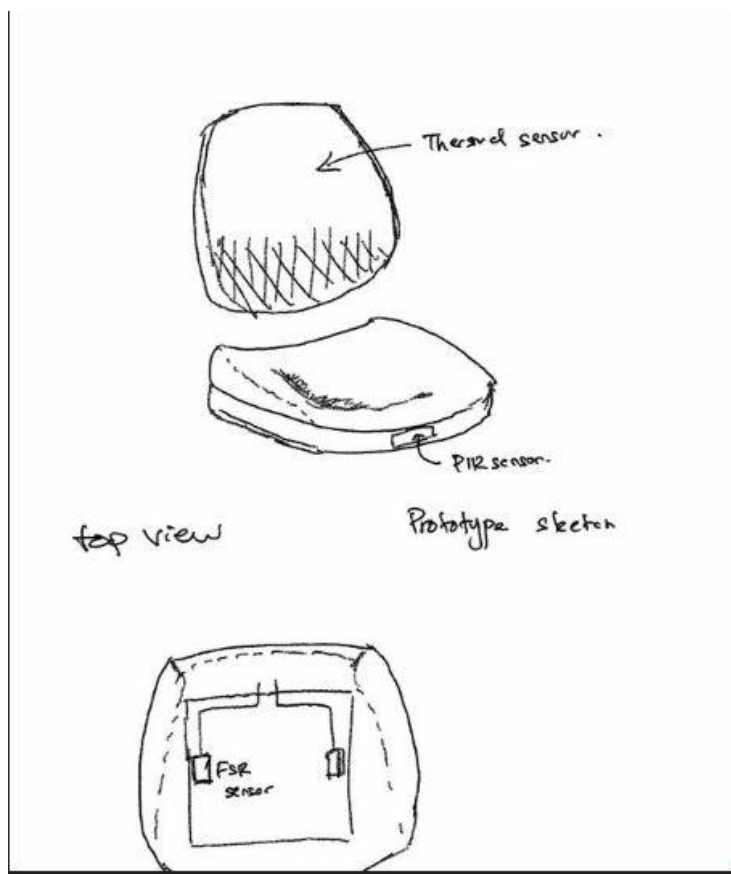
\Fig 3: Prototype sketch of the overall design

Appendix 2: Project Packaging Specifications

Materials	Quantity	Weight	Cost
screws 1/4"-20, .5"	8	40.00g	$2.00
air foam sheet 24" x 24"	2	20.00g	$9.6
Bolts 1/4"-20, 3/4"	2	13.00g	$0.30
Silicone rubber pad sheet	2	200.00g	$13.00

Tooling requirement

Tooling	Estimated Cost
Drill press	N/A
3D printing	Free
Tapes	N/A

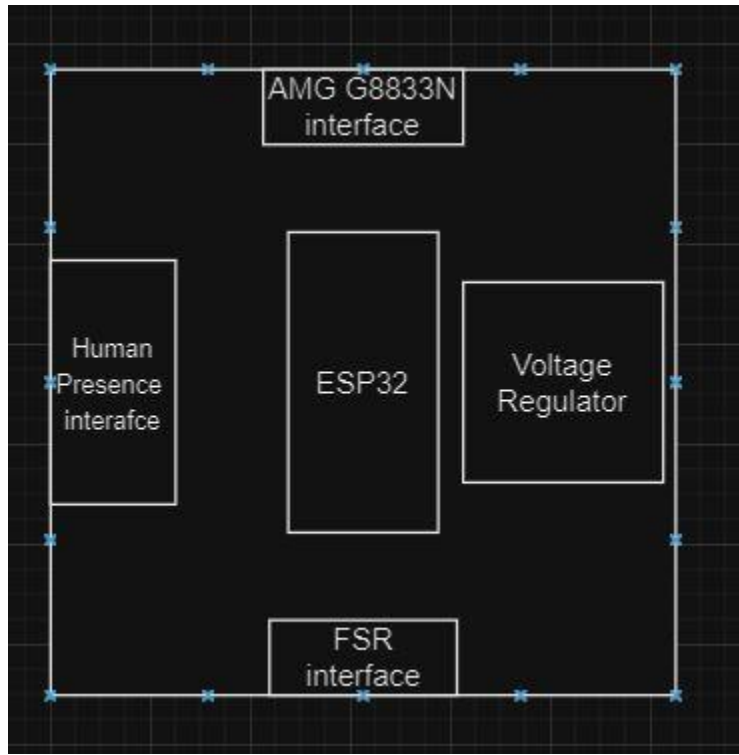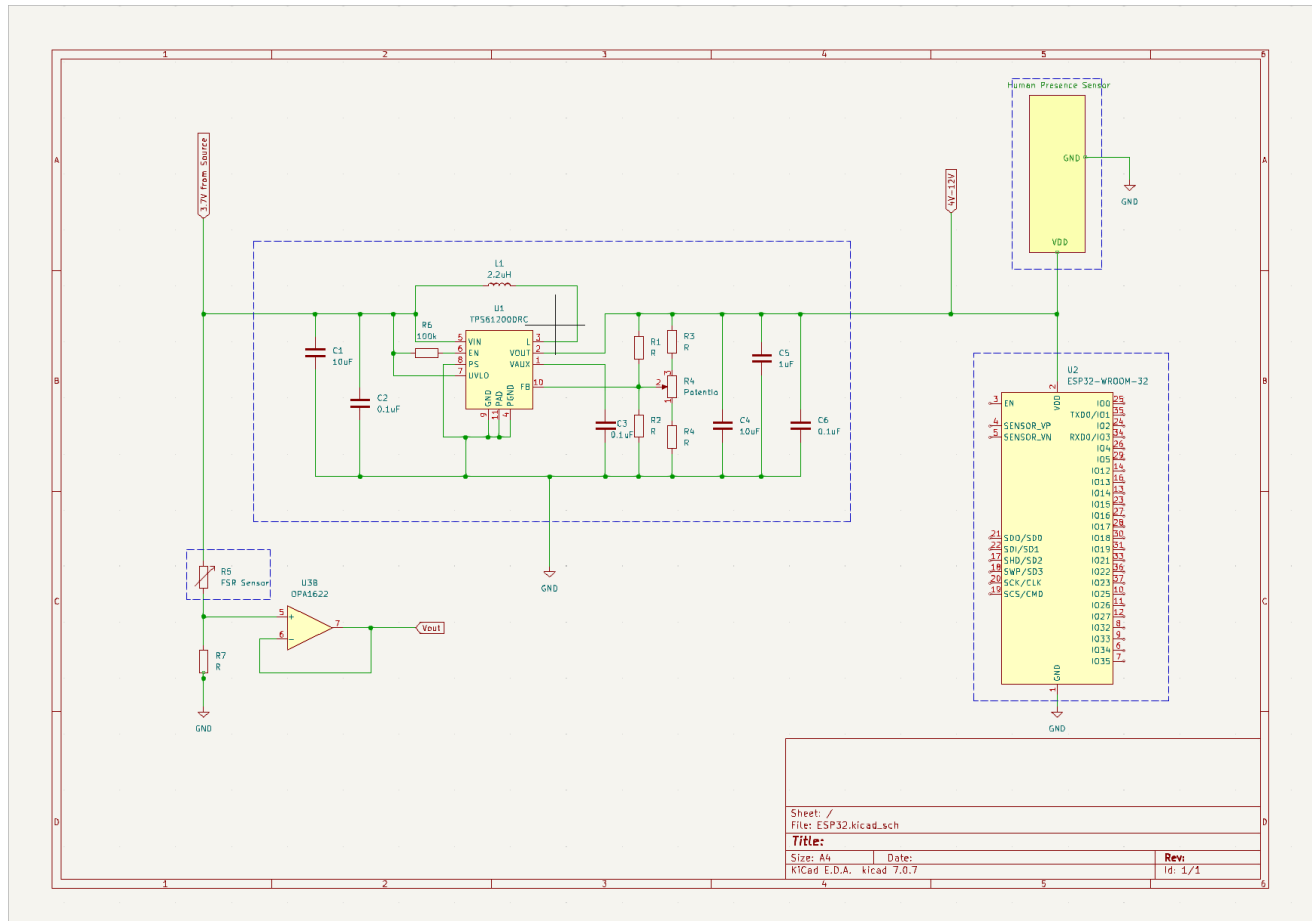**Estimated cost for packaging: $25**

Appendix 3: PCB Footprint Layout

Fig1: PCB layout proposal

Fig2: KiCAD version of the PCB layout