Detailed Design Assignment

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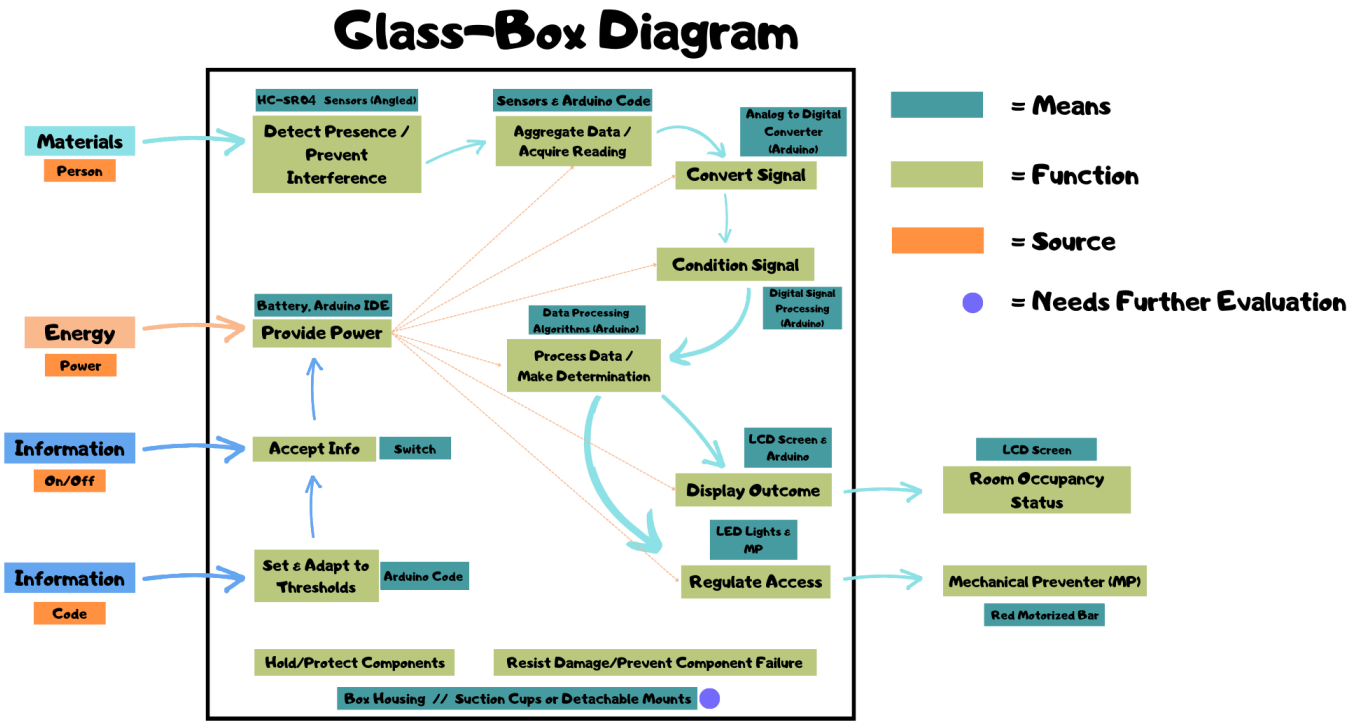
Room Occupancy Monitor

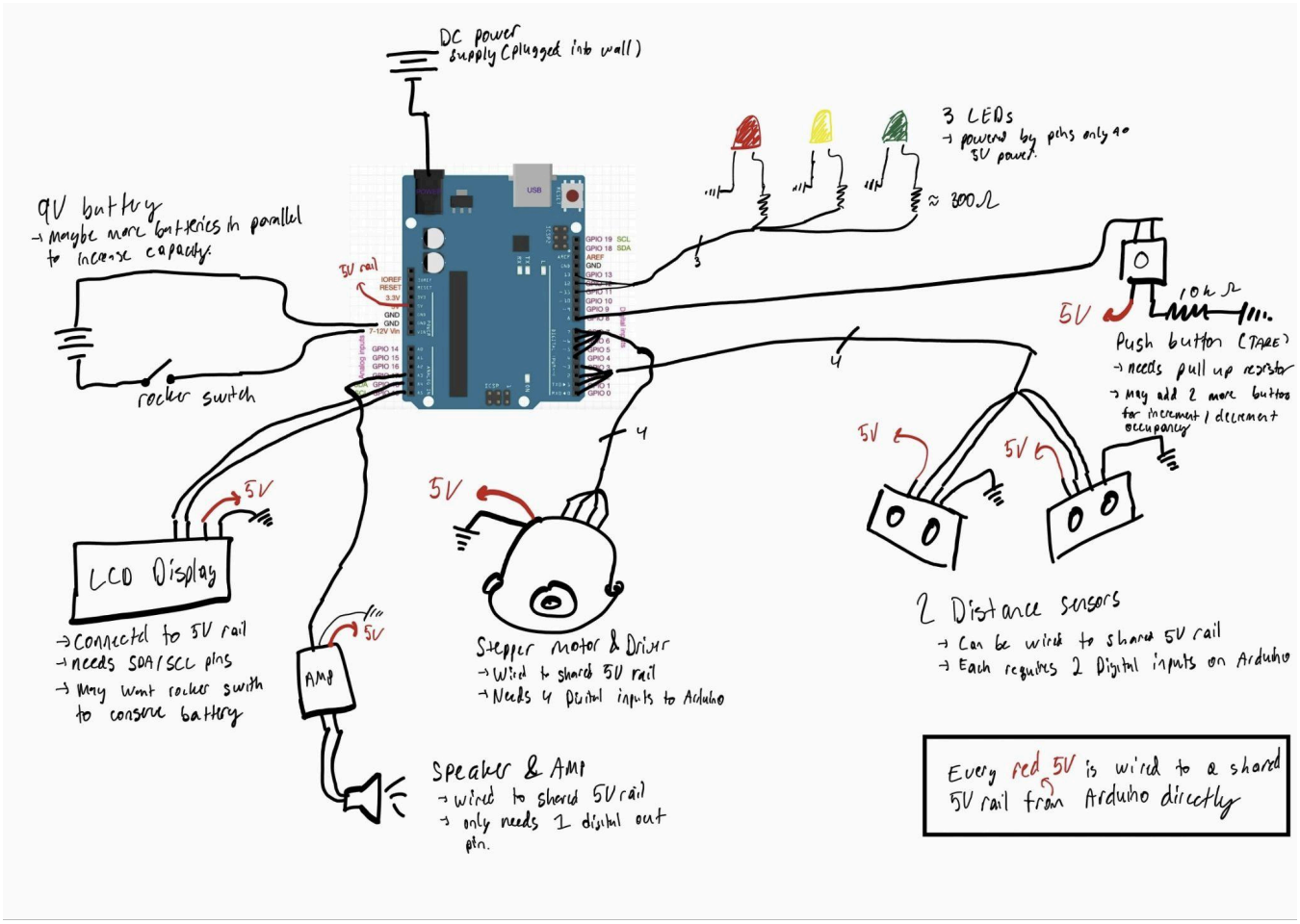
Problem Statement:

Design a device for administrators to monitor and control classroom occupancy, preventing overcrowding for health, safety, and compliance with fire and disease spread regulations.

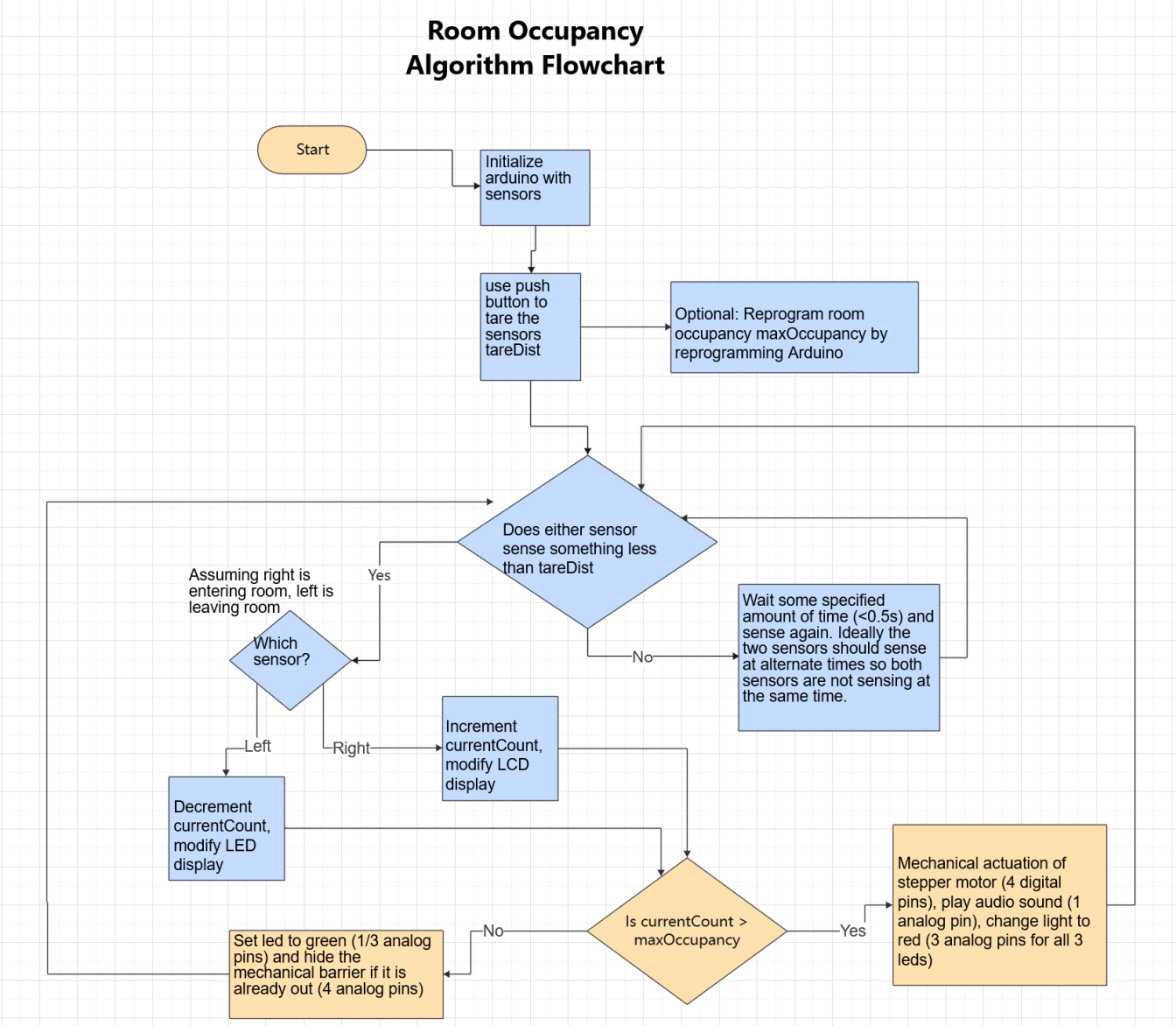
Glass Box:



Circuit Plan:



Code Flow Chart:



Housing Size (estimate):

The components attached to our main housing include the Arduino, a 9V Battery laying in a battery case, and wiring connections from the Arduino to several electronic components such as LED's, Buzzer, Rocker switch, Push button, 2 Ultrasonic Motion Sensors, LCD Screen, and a Stepper Motor along with its module.

In Figure 1, the components inside the housing can be viewed with the sliding lid off. Sitting inside the housing are the Arduino, 9V Battery, and the stepper module.

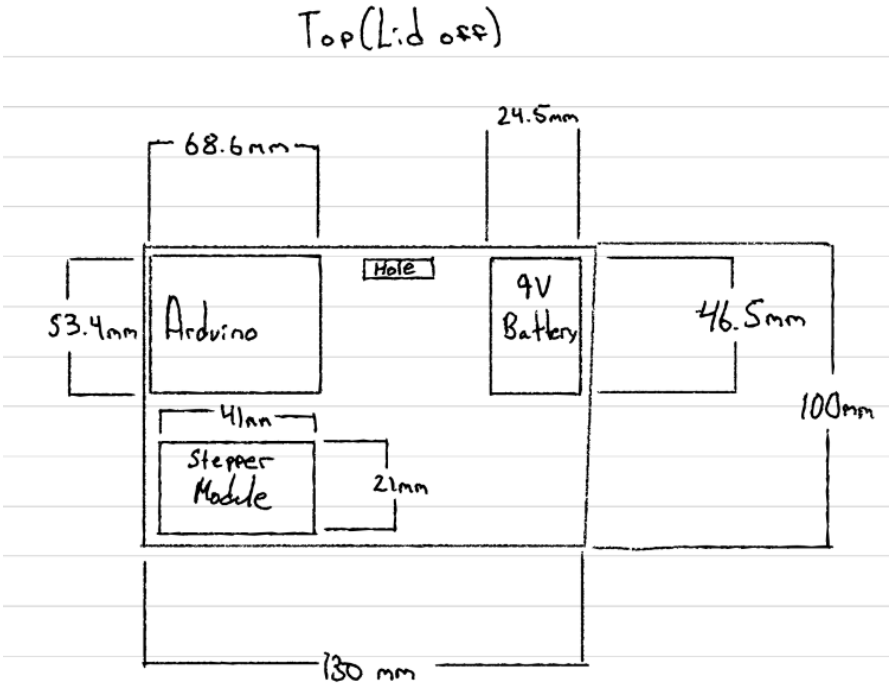


Figure 1: Top view of the housing with lid off. Arduino, Stepper Module, and 9V battery can be seen laying in respective positions. The rectangle marked Hole is a hole for the wiring from the stepper motor to be connected to the module.

The Arduino will be attached via adhesive tape placed under its casing. A plastic case holding the Arduino will be able to provide an easy way to mount the Arduino without damaging the device. The 9V battery will be placed inside a plastic 3D printed case that will be attached via adhesive tape to the housing. This case offers easy replacement of the 9V battery when needed. The Stepper Motor Module will also be placed inside a plastic 3D printed case which will be attached via adhesive tape to the housing. This ensures that all electronic components laying inside the housing are sturdy and cannot move around easily but can be replaced if necessary without damaging the housing.

In Figure 2, the front view of the housing can be seen. Attached to the Front view are the LCD Screen and 3 LED’s.

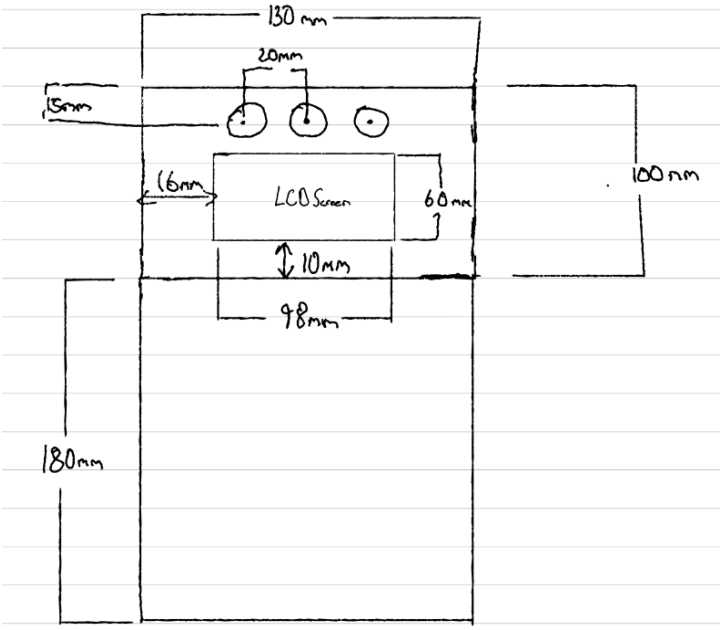


Figure 2: Front view of the housing with the LCD screen and 3 LED's in their respective positions.

The LCD screen will be attached via screw holes inside the LCD module and holes made in the housing. The LED's will be mounted via hot glue and wired to the Arduino from the inside.

In Figure 3, the Back view of the housing module can be seen where the Motor is attached to.

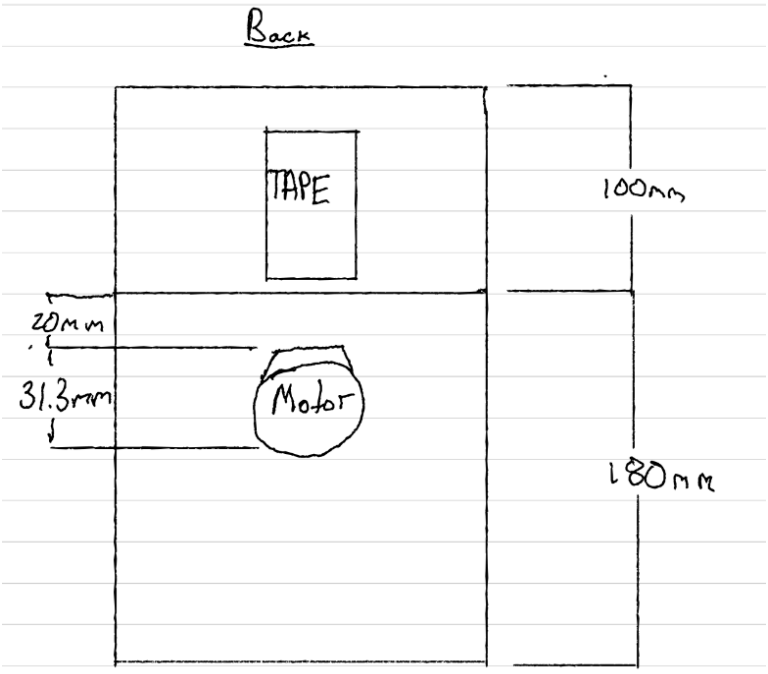


Figure 3: Back view of the housing with the motor attached to the back plate in its respective position.

The Tape box is the adhesive tape that will be placed on the top back face to mount to a wall. The motor will be attached to the back lower plate of the 3D printed housing, wired through the hole that can be seen in Figure 1. The motor will be connected to a plastic 3D printed case and then attached to the housing via screws to ensure stability. The mechanical arm will be press fitted onto the shaft.

In Figure 4, the right side of the housing can be seen with the Rocker Switch and the Button attached.

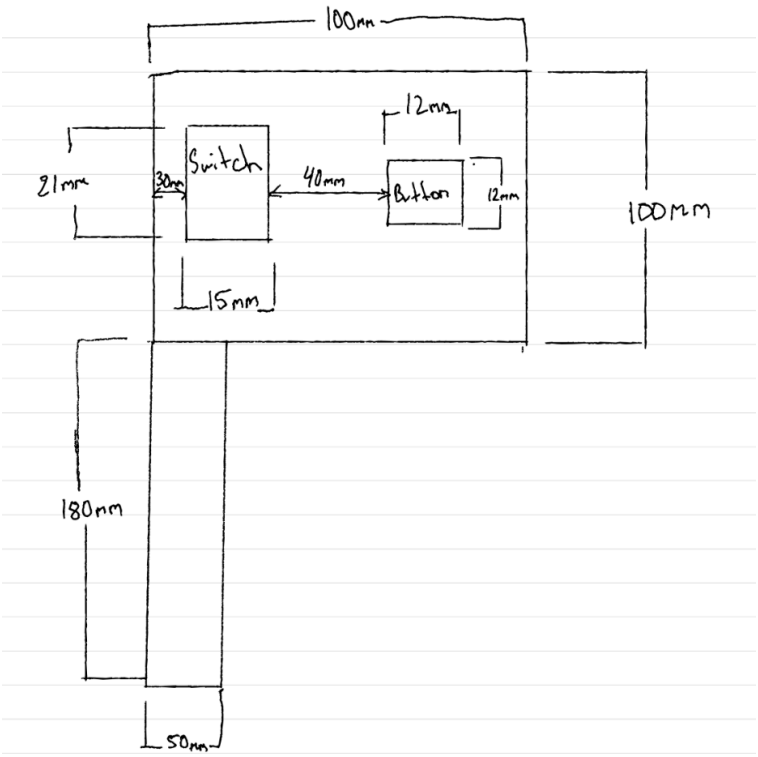


Figure 4: Right view of the housing with the switch attached and button attached in their respective positions.

The switch will be attached via press fit into the hole created in the right side of the housing. The button will be soldered on a PCB board which will be attached to the inside of the housing via hot glue. Both will be wired from inside the housing to the Arduino.

The sensors will sit outside of the housing near the door and they will be wired through a hole in the wall of the housing to the arduino. Suction cups will be used to efficiently place and relocate the sensors.

Since our objectives do not include any specific notes about durability (besides being reliable), we maintain that any kind of ABS plastic will work for a prototype of our product. The only risk of damage to the enclosure is if it drops to the ground. We can take preventive measures to ensure that will not happen. If we choose to take extra precautions with material, PLA is stronger than ABS.

USER INTERFACE: The front of the housing enclosure features a 98mm by 60mm LCD screen which will display the maximum occupancy of the room at a given time as well as the number of people in the room currently. Inside the box, the arduino will be directing each component and the battery will power them. Attached to the bottom of the box will be the stepper motor with our mechanical indicator connected to it. When maximum occupancy is not reached, the indicator will be in the “down” position, and hidden from the user behind a ‘wall’ attached to the bottom of the enclosure. When maximum occupancy is reached, the indicator will flip up to the right or left, depending on which side of the door the sensor is on. If it is on the left side, the indicator will flip up and to the right toward the door and vice versa. This device can easily be made for both sides of a door with just a small change in the code that controls the motor’s rotational movement.

The housing and preventive indicator will be mounted on a wall next to the door around chest level. It will contain the arduino, battery, motor, LCD, and indicator. Chest level is optimal for visibility of the LCD screen and the indicator as well as the ability to remove the lid and access the housing components. The infrared sensors will both be on the outside of the door at around chest level. Chest-level was chosen over other heights because of its accuracy in counting bodies (foot-level might count each foot on a person as one body). One sensor will be closer to the door than the other to allow the device to track which direction someone is walking. If the sensor closer to the door gets tripped first, the device will know that someone is walking out of the room, and vice versa.

BOX DIMENSIONS: 130mm x 100mm x 100mm

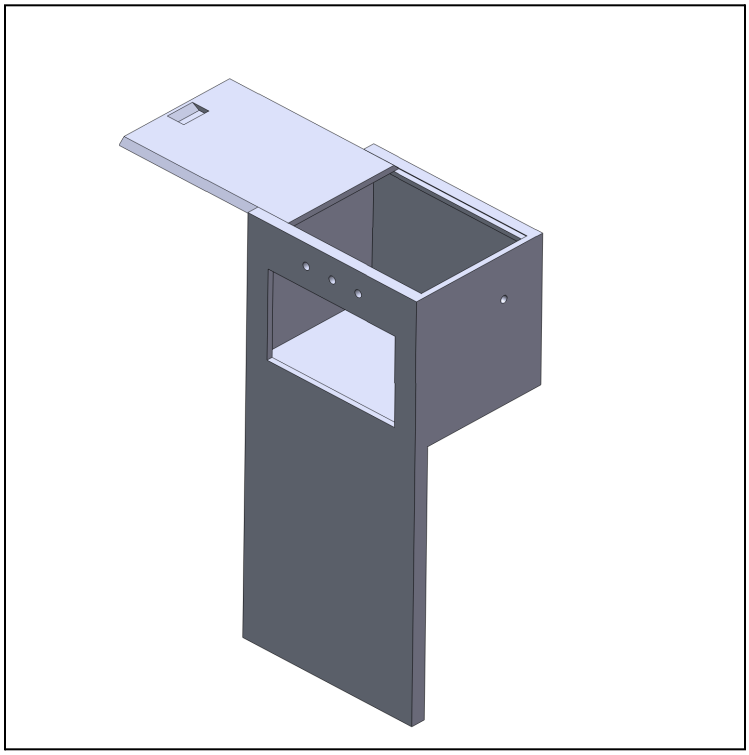


Figure 5: Isometric view of our housing CAD model (SOLIDWORKS). The lid has a notch for easy removal with one finger

Contribution Summary:

Hayden and Allen: Housing size, layout of components
James: Circuit plan and code flow chart
Phyliss: Glass box diagram