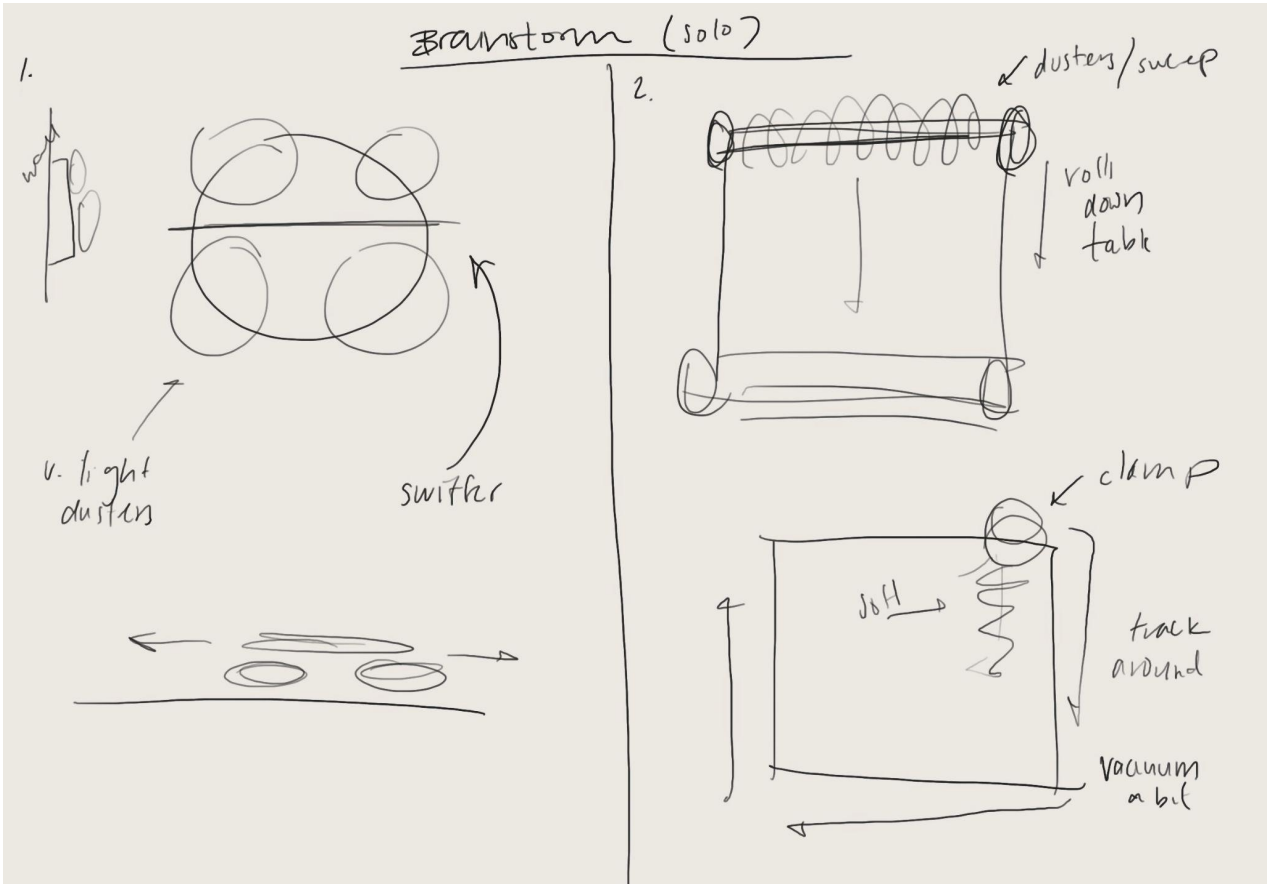
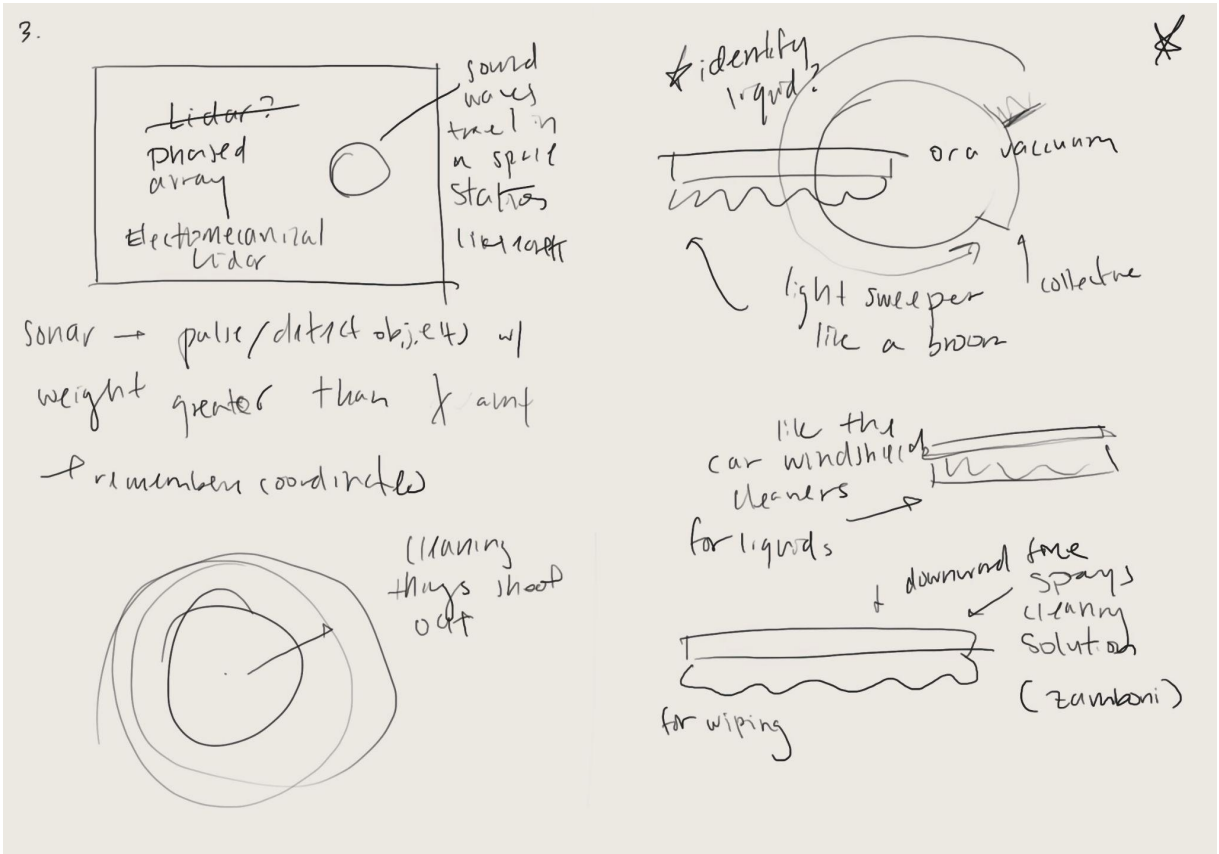
Team: Cookie Jar Robotics

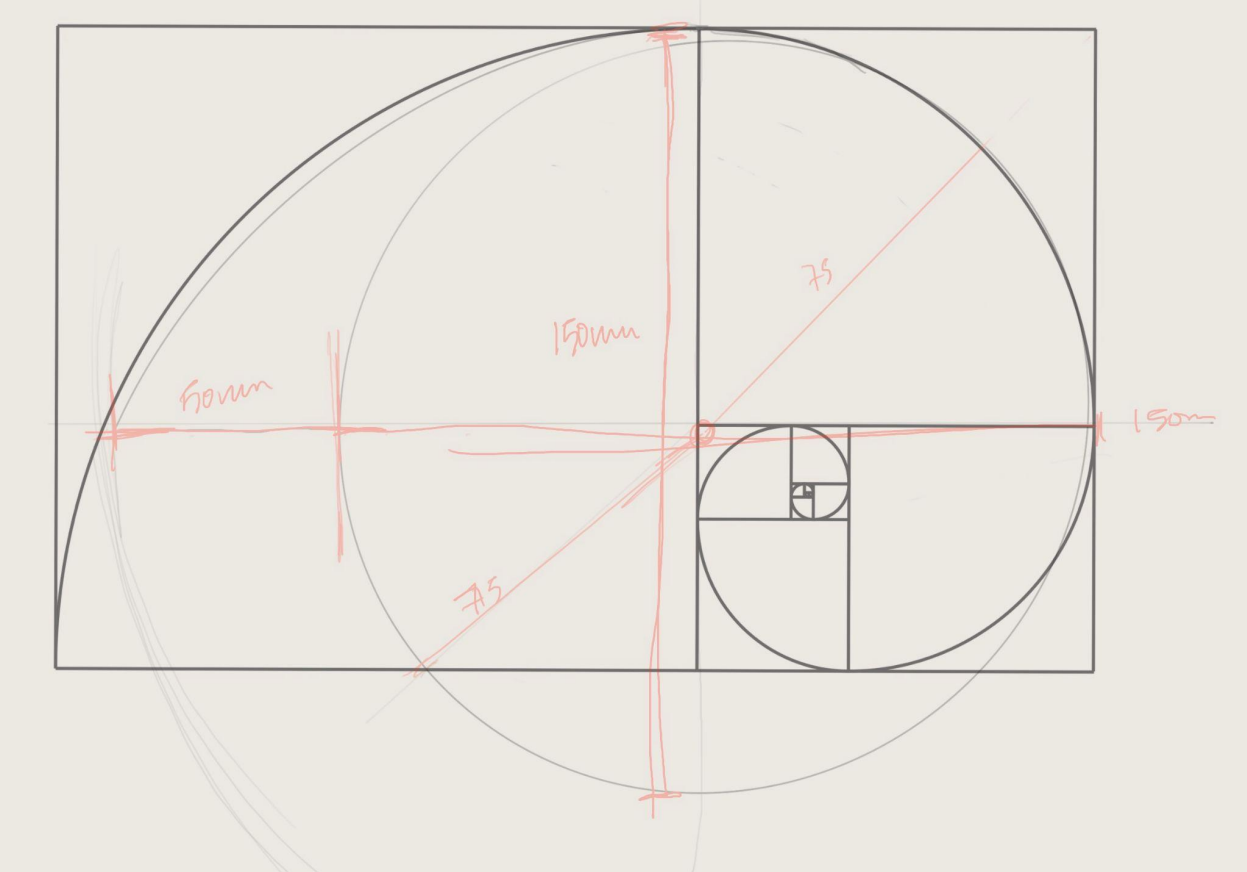
Design Process

Initial brainstorming:





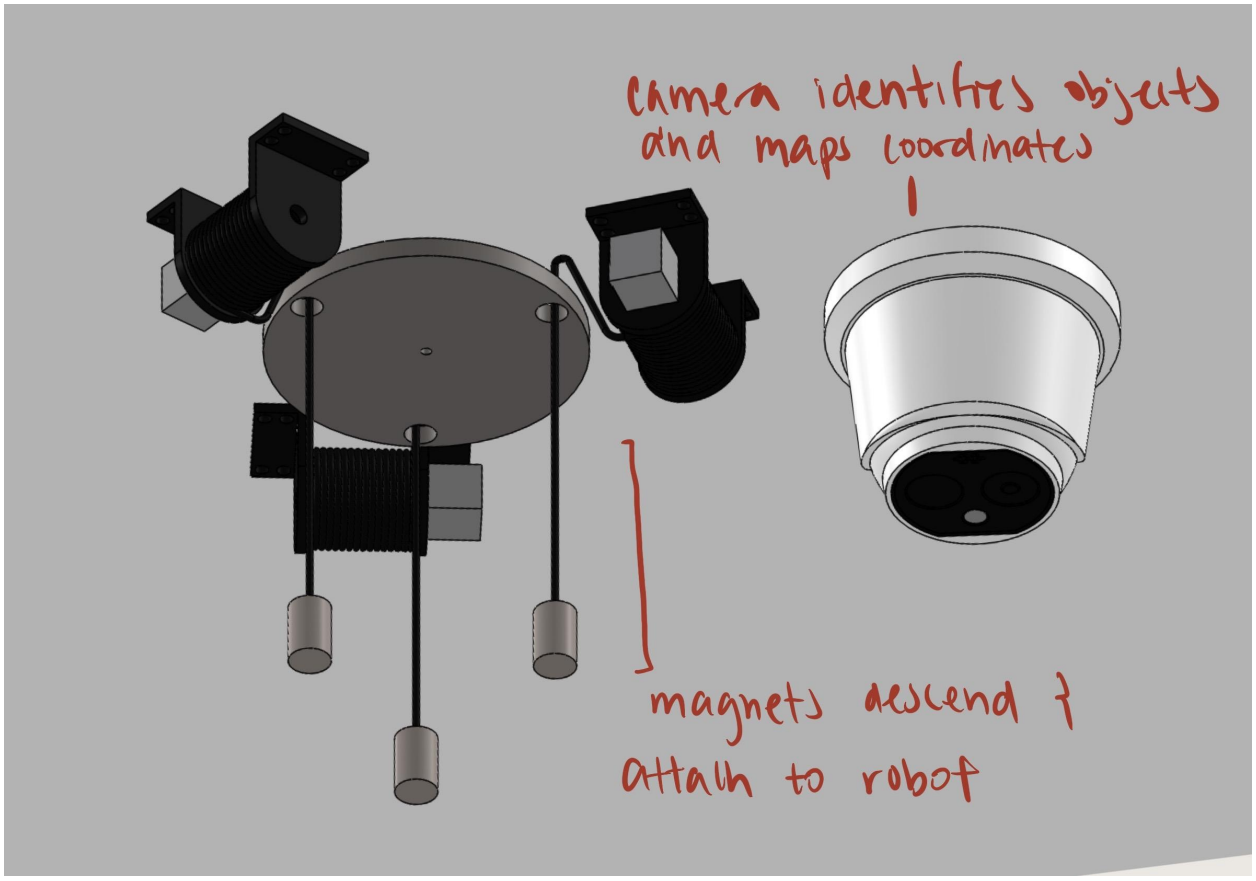
Multiple different designs were considered for the project, including ones that would clamp on the side or attach to the wall. Ultimately, it was decided that a rotating disk that descended from the ceiling would be best.



Design considerations:
We began by clearly writing what we wanted our robot to do:

- Clean table of: stains, spills, dust, crumbs, wrappers
- Ignore: notebooks, laptops, water bottle, pens
- Store: securely to wall/floor for takeoff/landing
- Table: 1m x 5m, 1m tall

Before beginning the robot, we divided its necessary functions into a sequence of steps. The first step was to determine how the robot would identify and avoid objects on the table that we didn't want to be disturbed. This information would be translated onto a coordinate system plotted out over the surface of the table, which would also dictate the path of the robot while it cleaned. The robot could then adjust its position, path, or arm extension accordingly.



Next, the cleaning processes themselves were divided into three steps. First, the robot would travel to specific coordinates identified by the camera as containing trash such as wrappers or scrap paper. After, it would travel to a "reset" point and begin traveling across the surface of the table while vacuuming up crumbs and dust. Next, a wiping arm would extend and any spills or liquids could be soaked up. Finally, the wiping arm would retract and a wiping and sanitizing sequence would begin with the final arm.

The robot was designed primarily with these functions in mind, though inspiration was taken from the Fibonnaci spiral for the aesthetic development of the outer shell.

Decisions made:

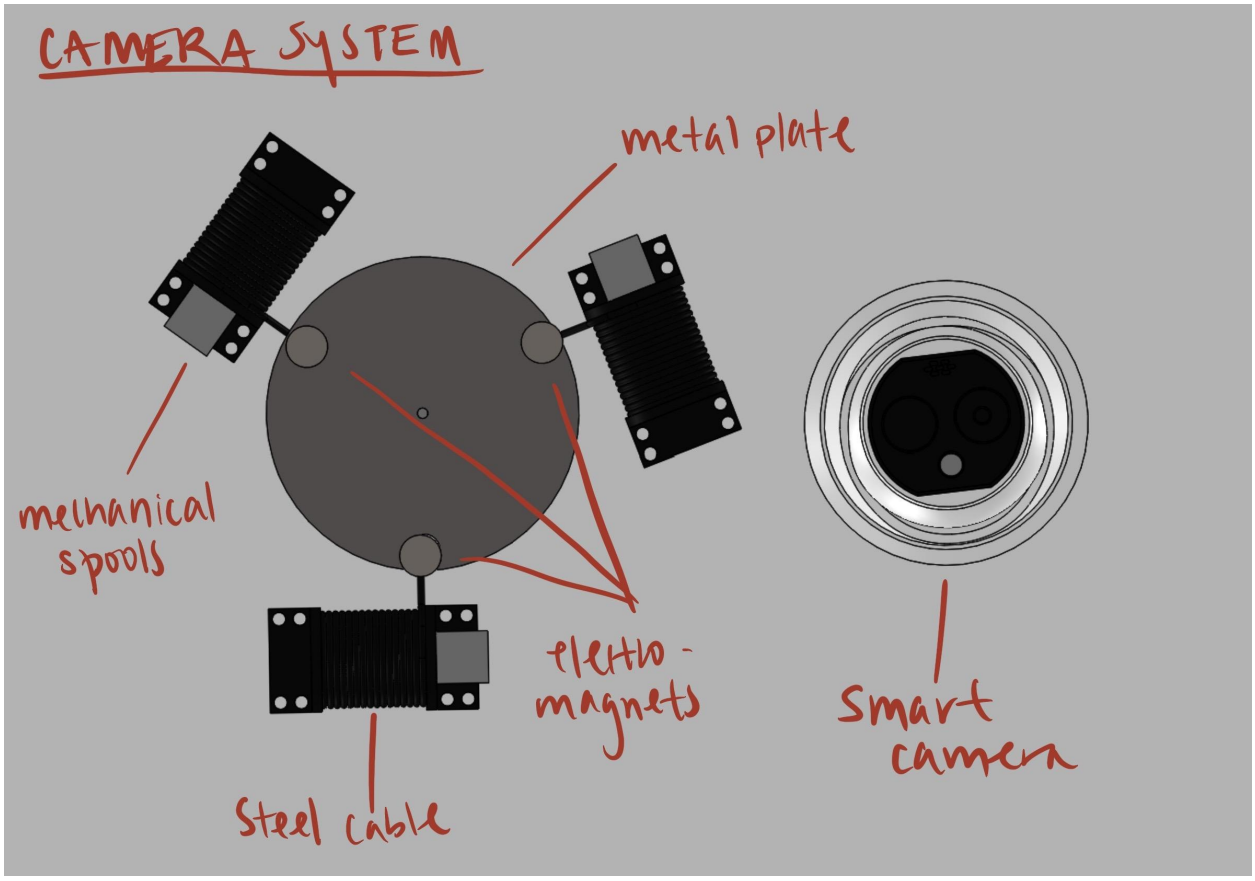
At first, sonar and phased arrays were considered as a way for the robot itself to emit a pulse that would inform it of nearby objects, but as neither could properly gauge weight those ideas were discarded. Ultimately, we decided on a camera attached to the ceiling that would use artificial intelligence and an object recognition sequence to identify the locations of both unwanted trash and objects to avoid. We also explored different ways to secure the robot when not in use, such as attachments to the wall or rising out of the floors. In the end we decided that the robot should be stored on the ceiling. This would not only keep it out of the way while the room was in use, but would solve the problem of getting the robot on top of a 1m tall table without the need for human aid. The vacuum was also rotated 90 degrees so that it would be

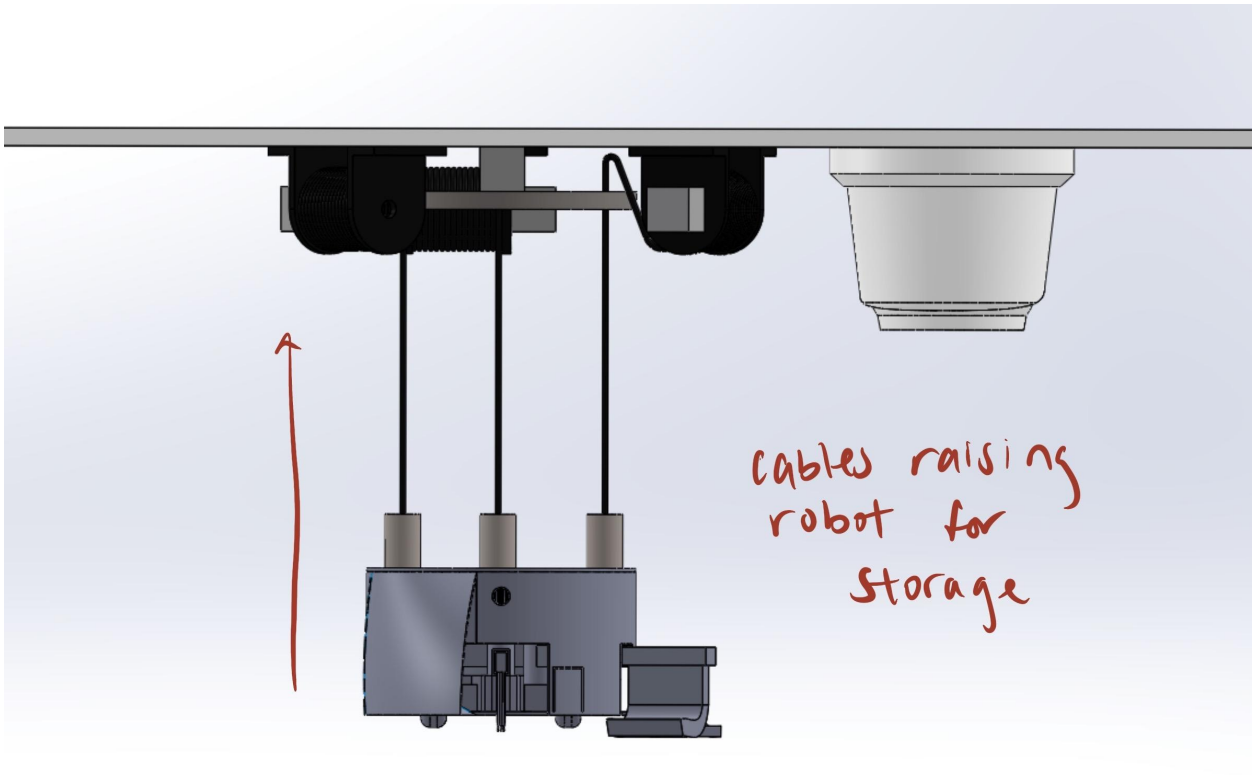
perpendicular to the tangent edge of the device, so that the edges of the table could be vacuumed without half of the device falling off the edge.

Final Design

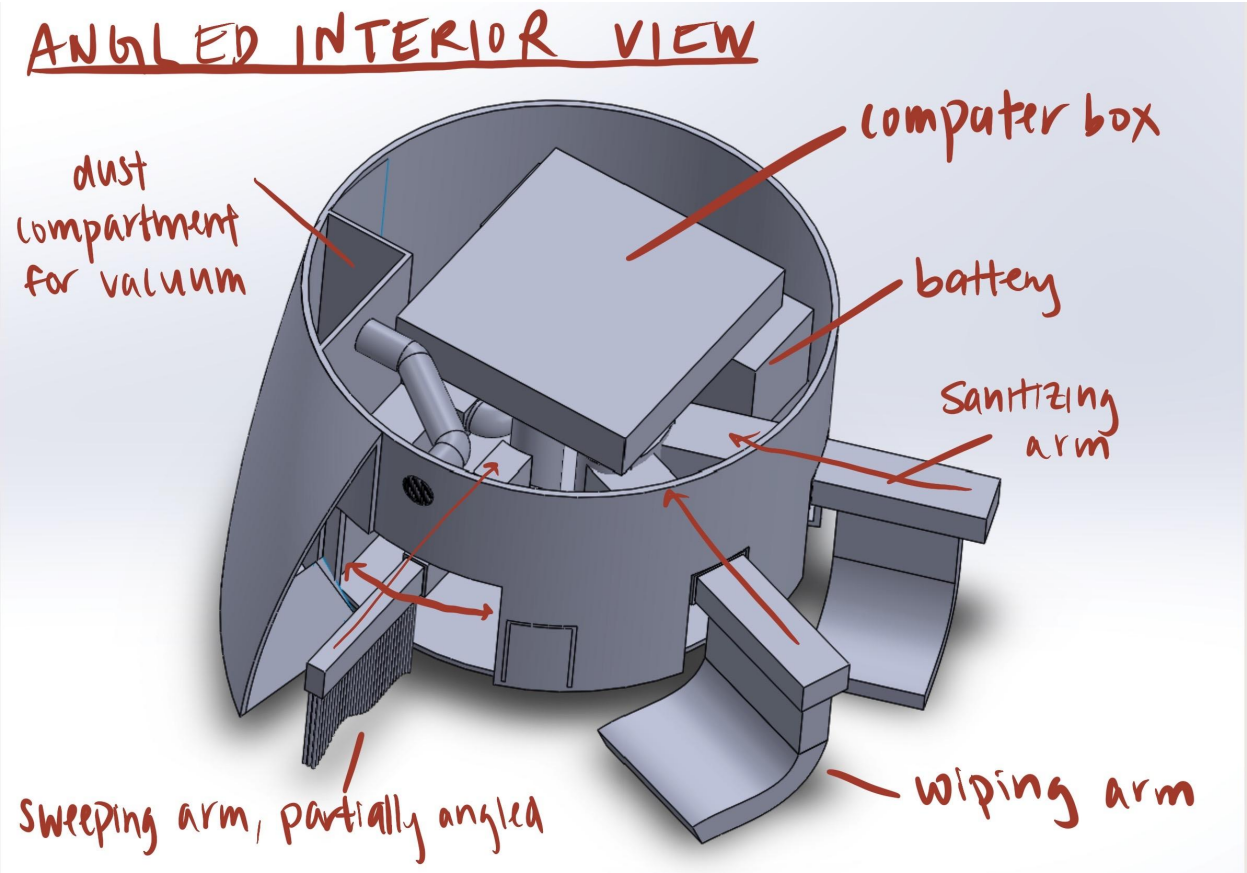
How does it work?

When the ceiling camera and artificial intelligence don't register any movement on the table for an extended period of time, they trigger three motorized spools of steel cable to lower the robot onto the table. When the cables have been lowered within a set height margin, electromagnets on the ends deactivate and the cables retract, allowing the robot to move without interference. AI communicates data input from the camera to the robot in real time, using an object recognition software (such as ObjectNet, ComputerVision, or Viso.ai) to identify objects on the table to avoid; such as laptops, notebooks, water bottle, pens, and pencils, as well as trash such as wrappers and napkins.

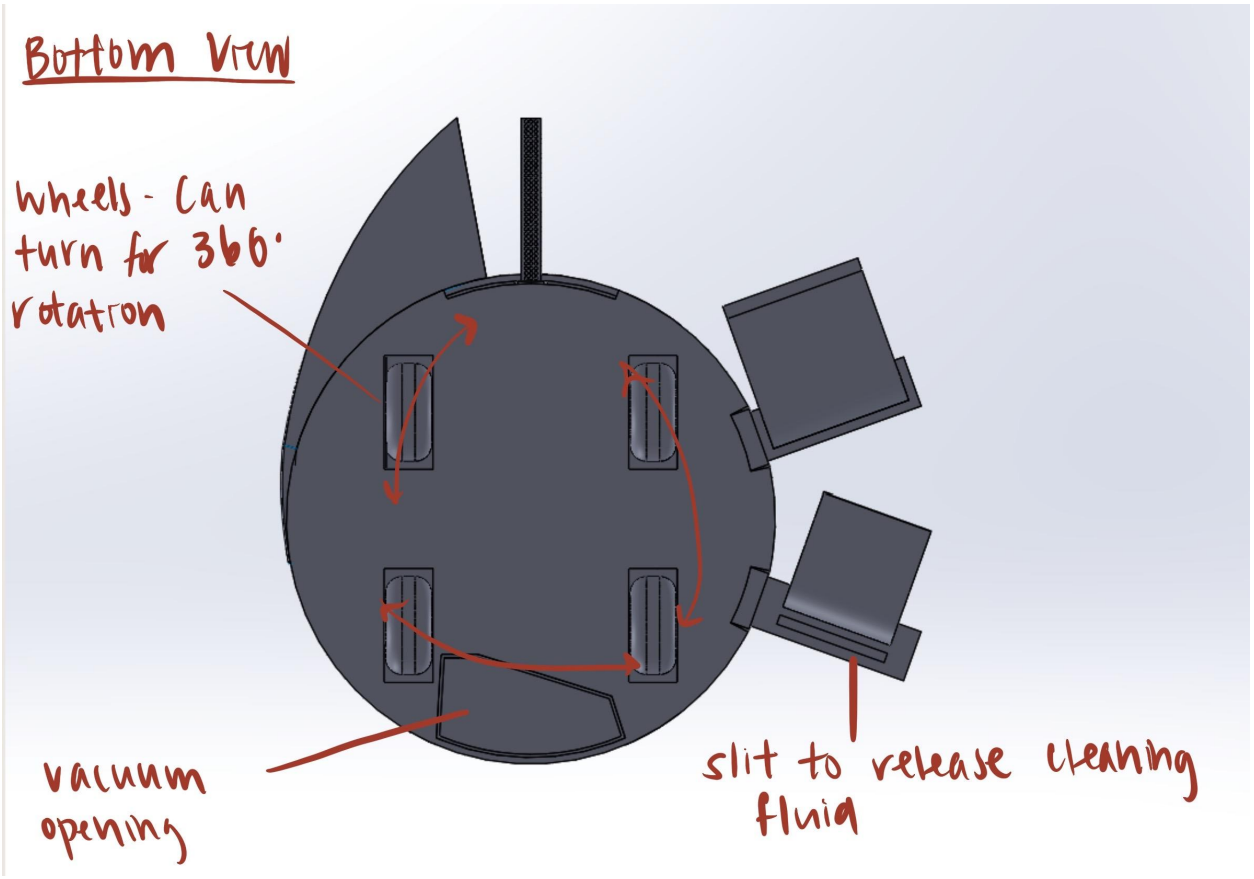

CAMERA SYSTEM
metal plate
mechanical spools
electro - magnets
Smart camera
Steel cable



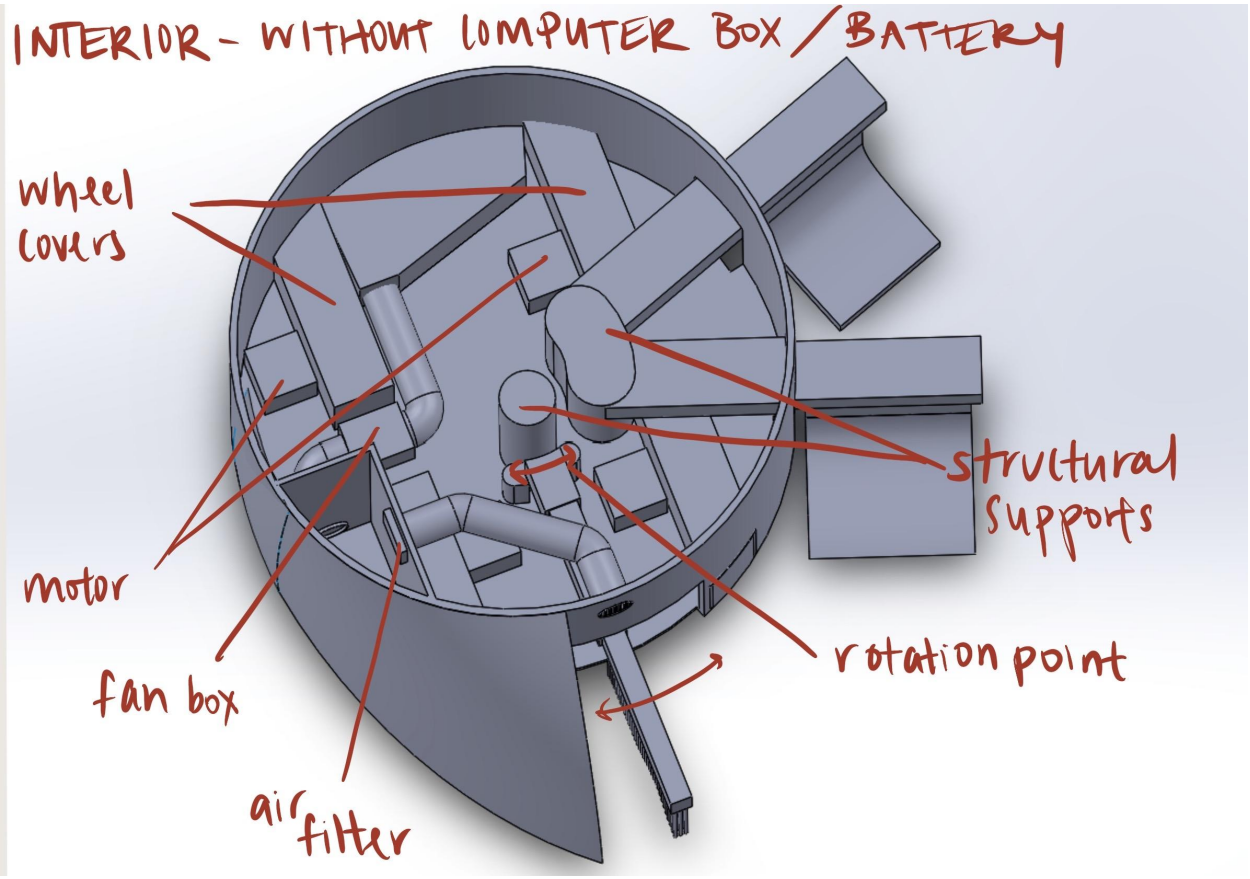
First, trash is swept into the waste bin with a pneumatic brush. The brush is stored inside the body of the robot, and extends out when in use. It sweeps trash up and over the ledge of the dustpan, ensuring nothing falls back out. The brush then retracts into the body and resets to its forward position, ready to extend when needed for the next piece of trash. Once the camera registers that all trash has been picked up, the next cycle, vacuuming, begins.



The vacuum is located under the front end of the body, opposite to the waste bin opening. The robot travels in a linear pattern (without axial rotation) across the table, covering the entire area except those covered by objects that should not be moved. This process picks up all dirt and crumbs, holding them in the dust compartment while the air runs through a filter and out the back of the robot. The compartments that contain both the garbage and dust are detachable for quick and easy disposal.

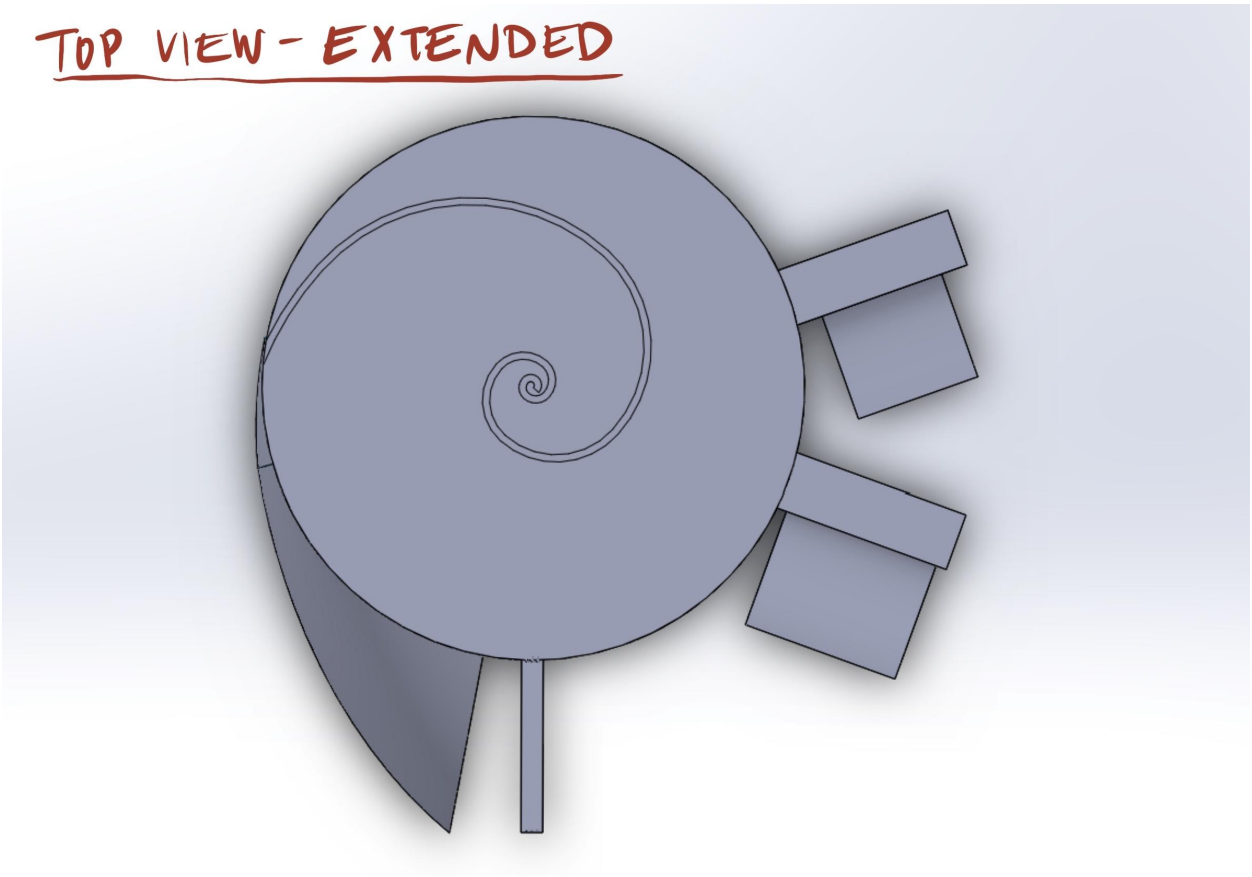


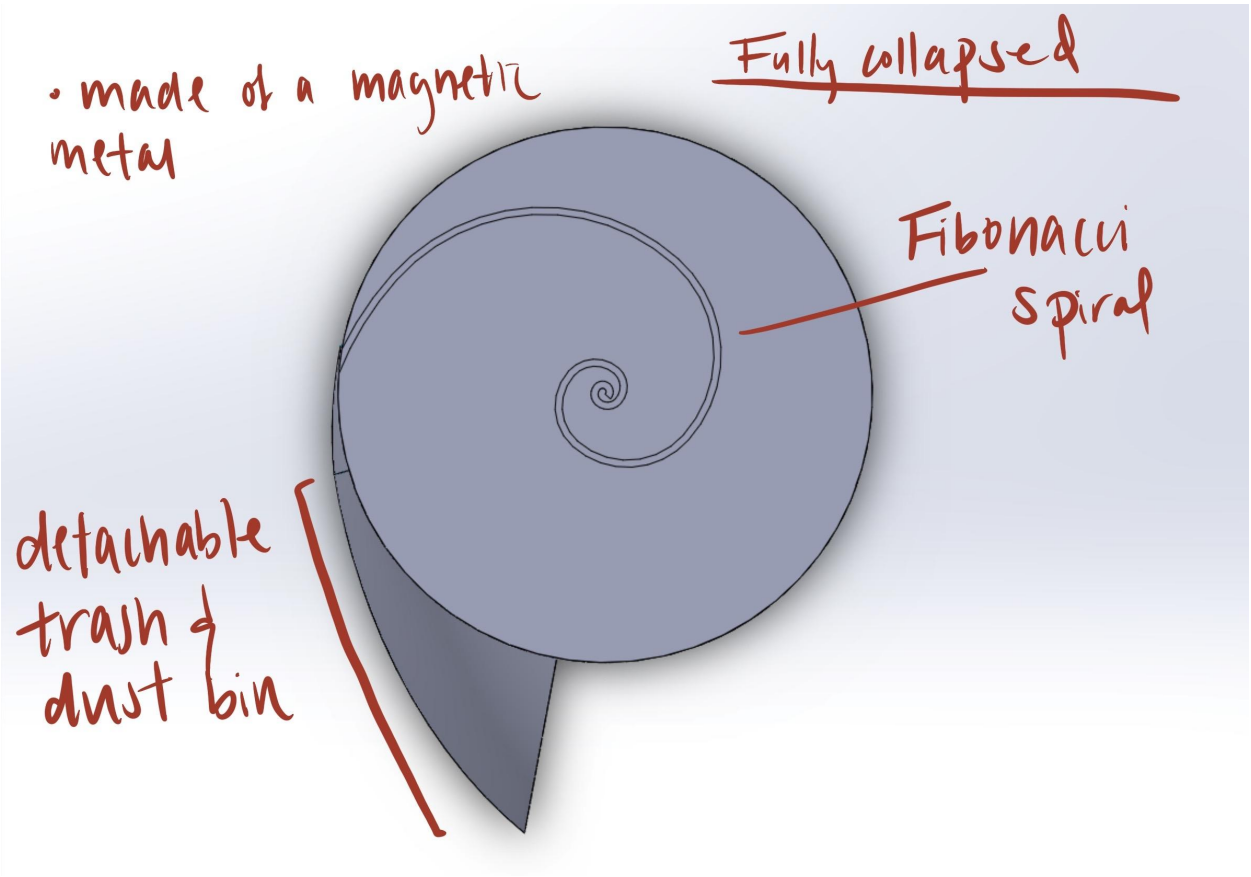
After vacuuming, the robot extends its wiping arm, complete with a super absorbent, removable and washable cloth on the end. The robot spins across the table, moving linearly while rotating about its center,while the cloth soaks up any spilled liquid.



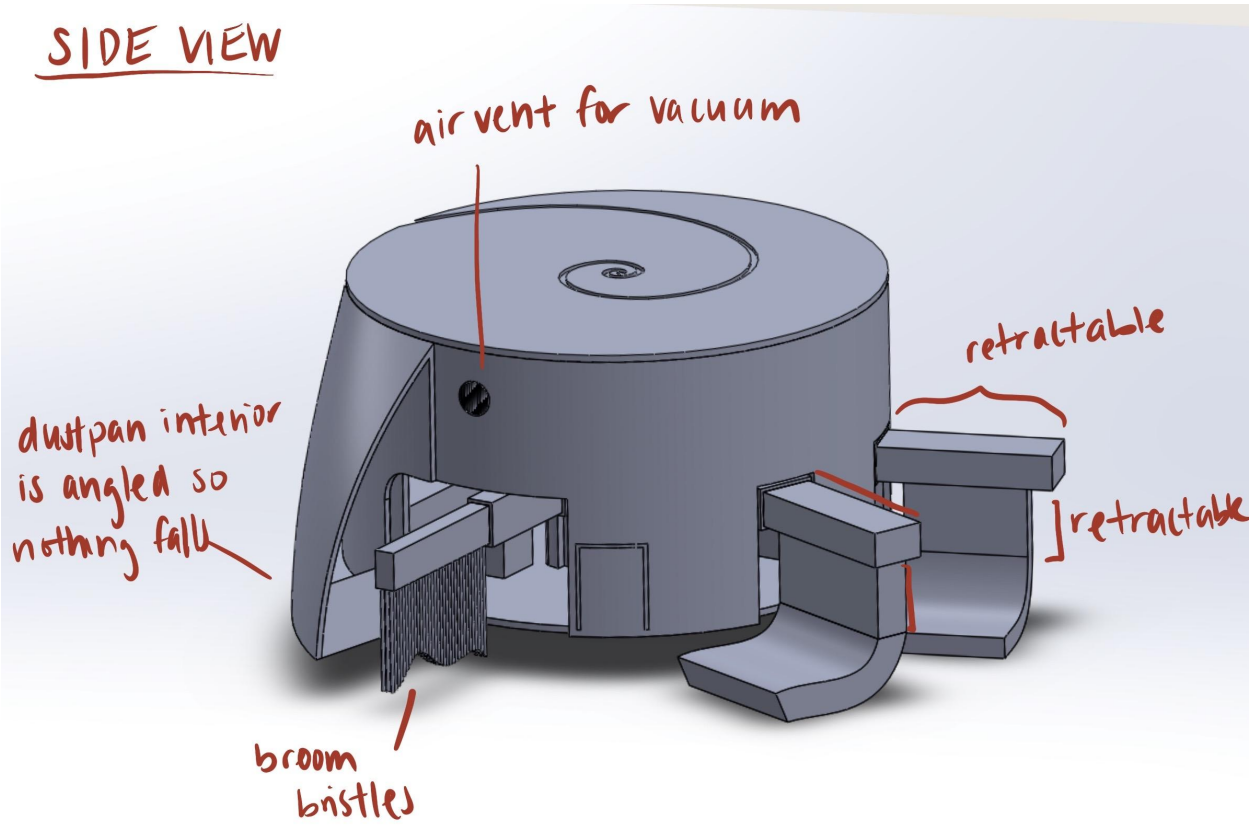
After the table has been cleared of any unwanted materials, wet or dry, the robot retracts the wiping arm and extends the sanitizing arm. A sanitizing solution is dripped onto the table while a cloth follows behind, and the robot moves linearly across the table while rotating around its center. When the entire table has been sanitized, the robot returns to the center coordinates of the table. The motorized spools extend the electromagnet-tipped cables, picking up the robot and returning it to the ceiling for storage.

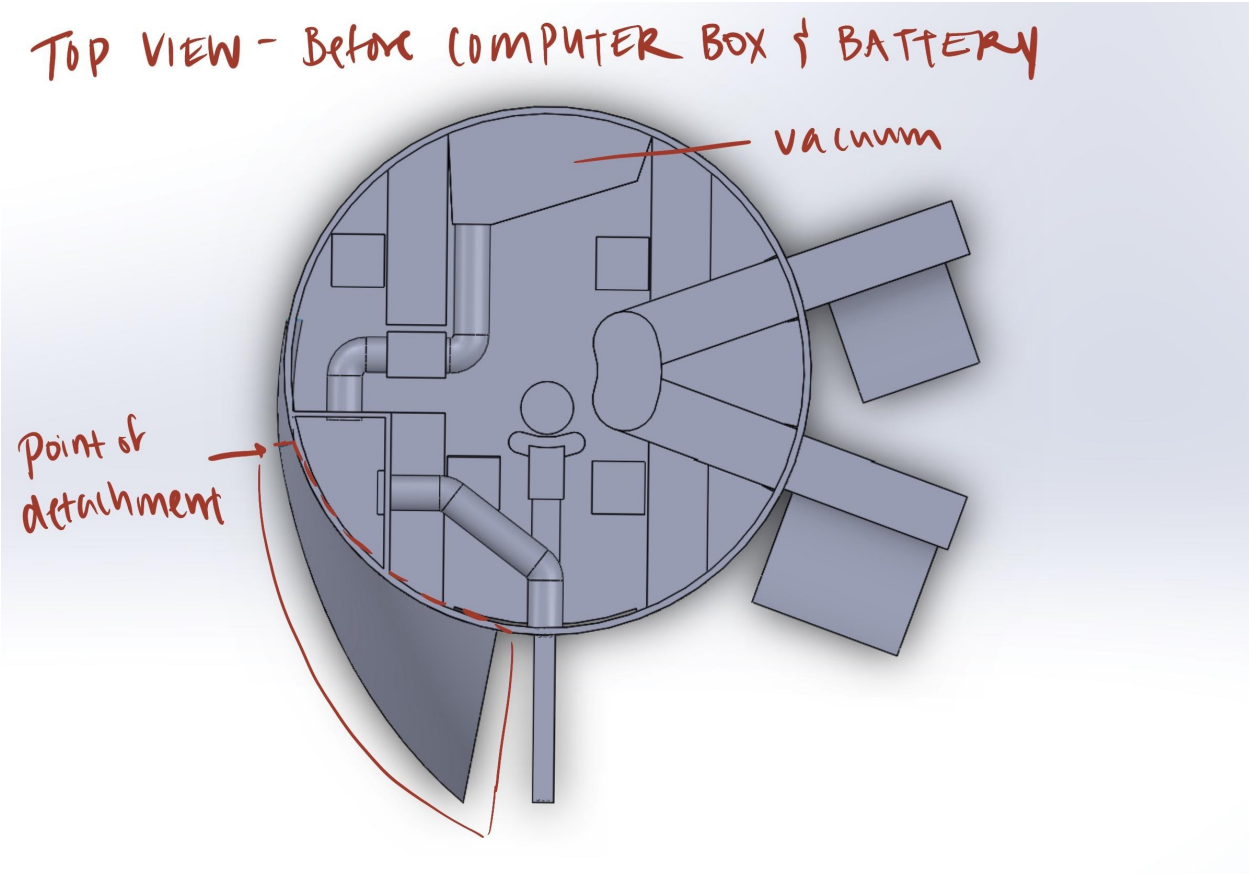
TOP VIEW - EXTENDED




• made of a magnetic metal
Fully collapsed
Fibonacci spiral
detachable trash & dust bin

SIDE VIEW


air vent for vacuum
retractable
dustpan interior is angled so nothing falls
retractable
broom bristles



Advantages:

- Autonomous start/finish
- Avoids objects left on table
- Cleans and sanitizes table
- AI can learn objects left on table and constantly improve decision making
- Real-time feedback on movement

Disadvantages:

- Uncommon items may be mislabeled by AI
- Objects left directly under robot may disturb raising and lowering process
- Requires occasional manual cleaning/emptying