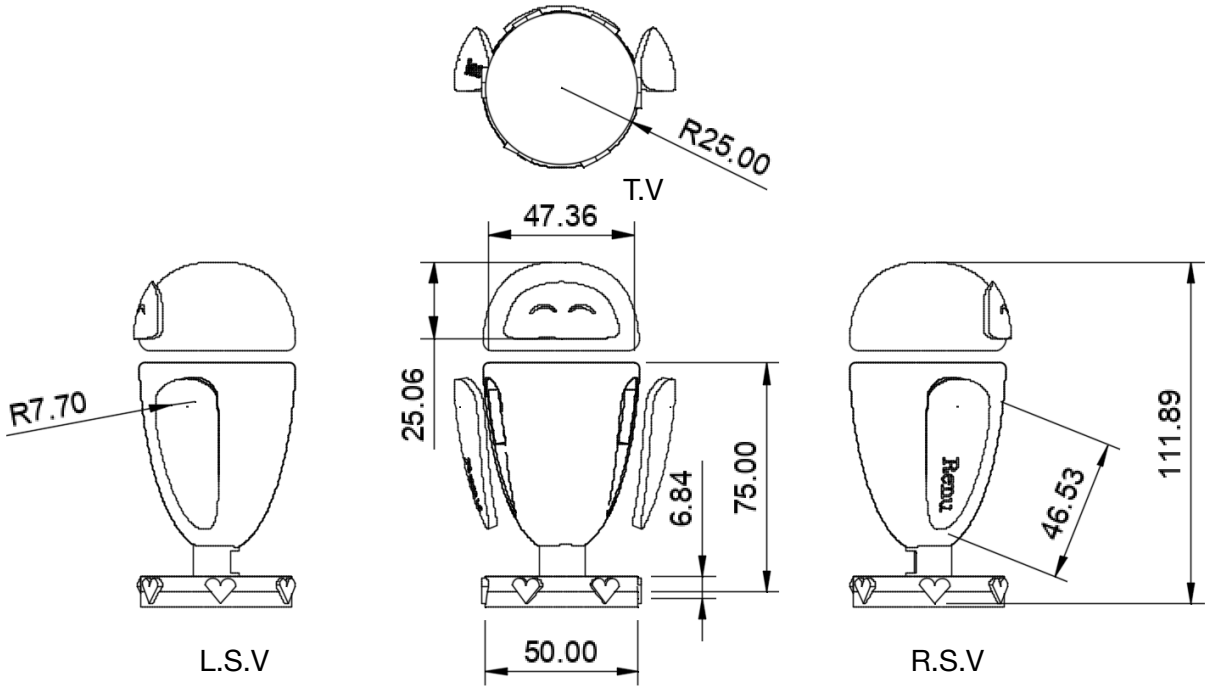
Submitted a little late due to fever (Extension request approved by Prof. Mark Yim)

3.2.1 Finalised hardware design

Design update: To make the design more fun, I redesigned the output side to be wall-e. Also 3d printed the input side again with hearts on the base rim, larger holes for wiring, heavier base and slots to accommodate 3 potentiometers.

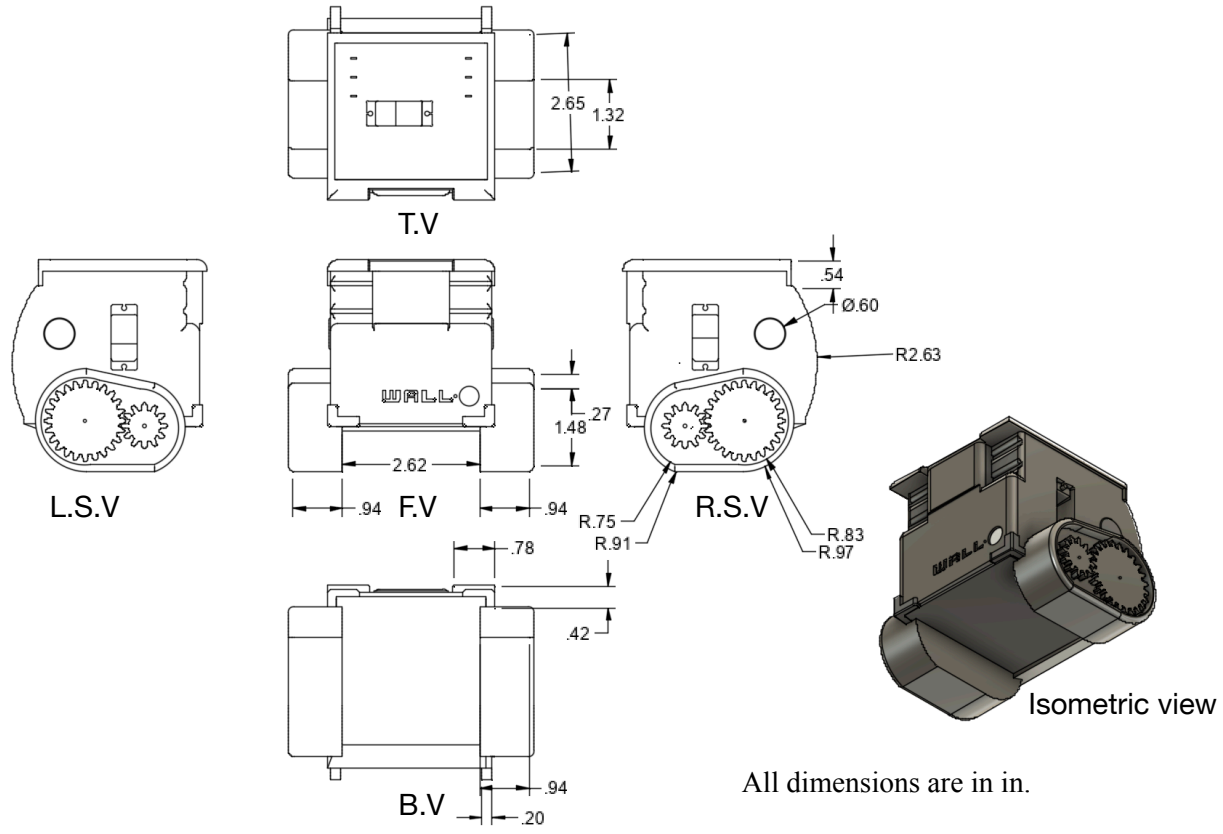
Final Design - Input side: Eve:



Isometric view

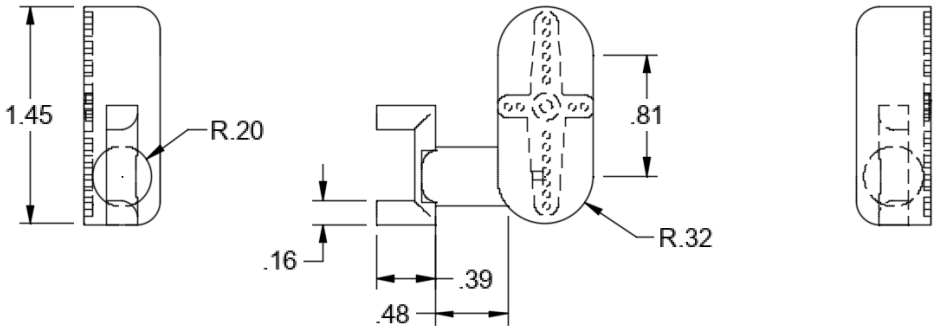
All dimensions are in mm.

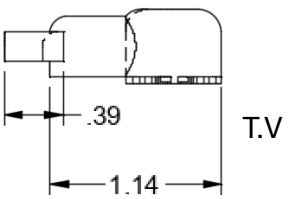
Final Design - Output side: WALL-E: Main body:

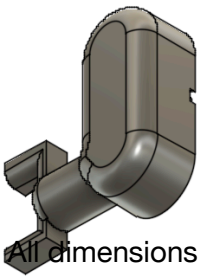


All dimensions are in in.

Left hand:



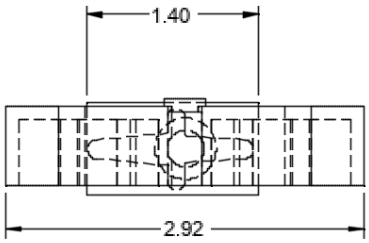




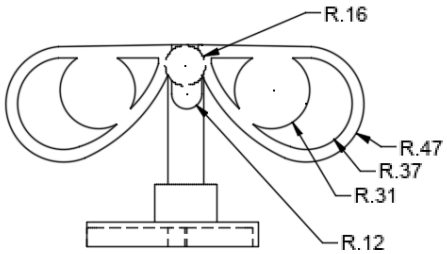
All dimensions are in in.

Right hand has the same dimensions as the left hand but it is mirrored in shape.

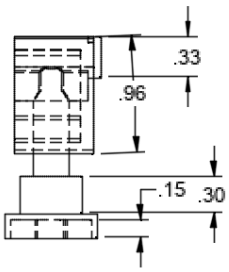
Head:



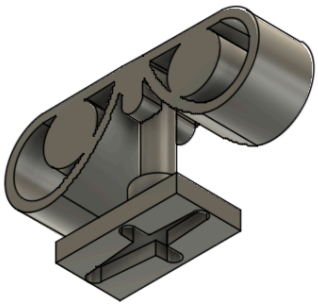
T.V



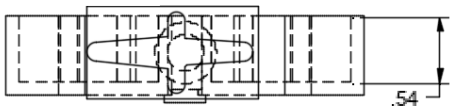
F.V



S.V



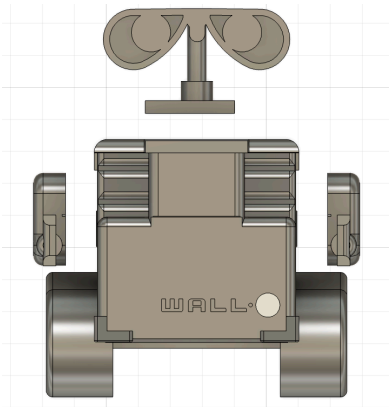
Isometric view



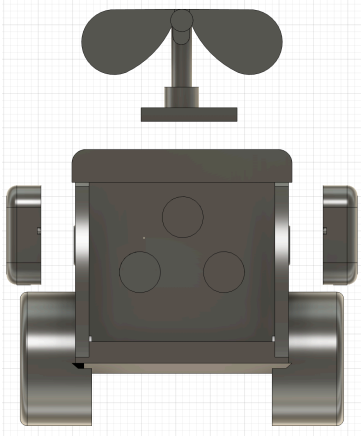
B.V

All dimensions are in in.

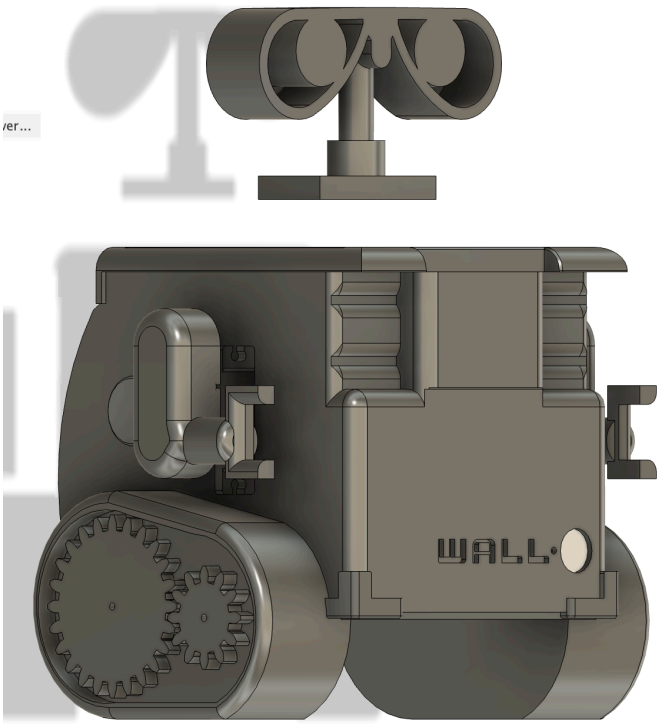
Overall:



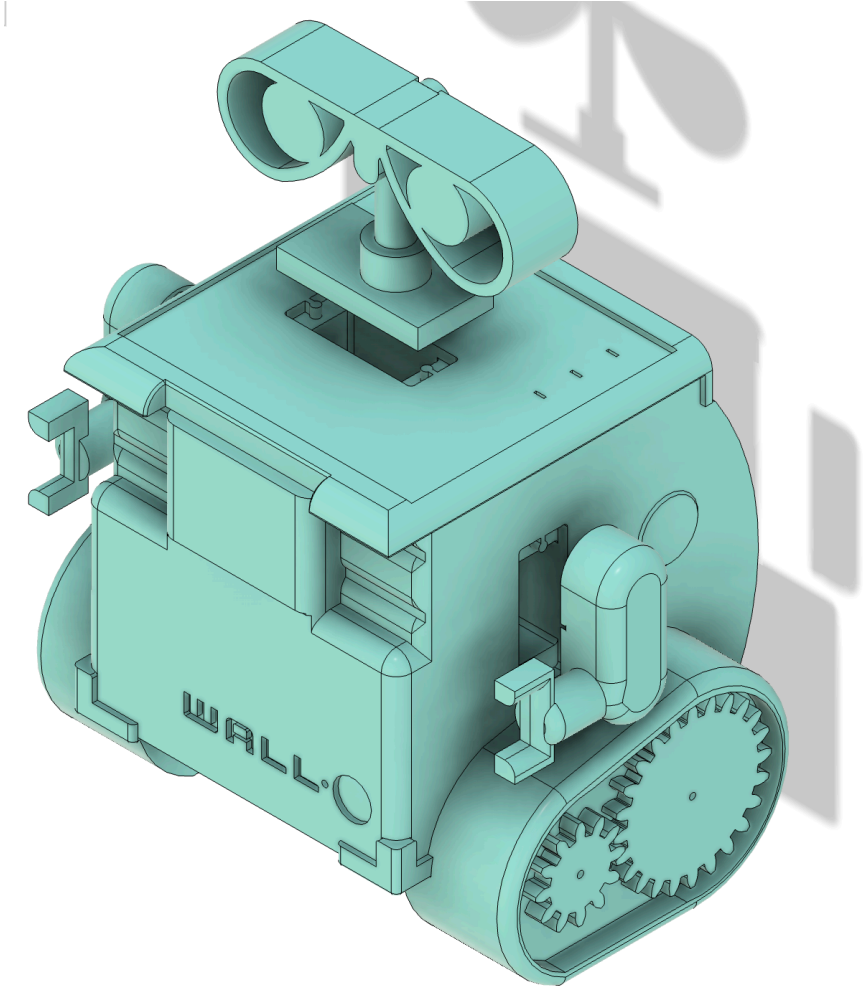
F.V



Backside V

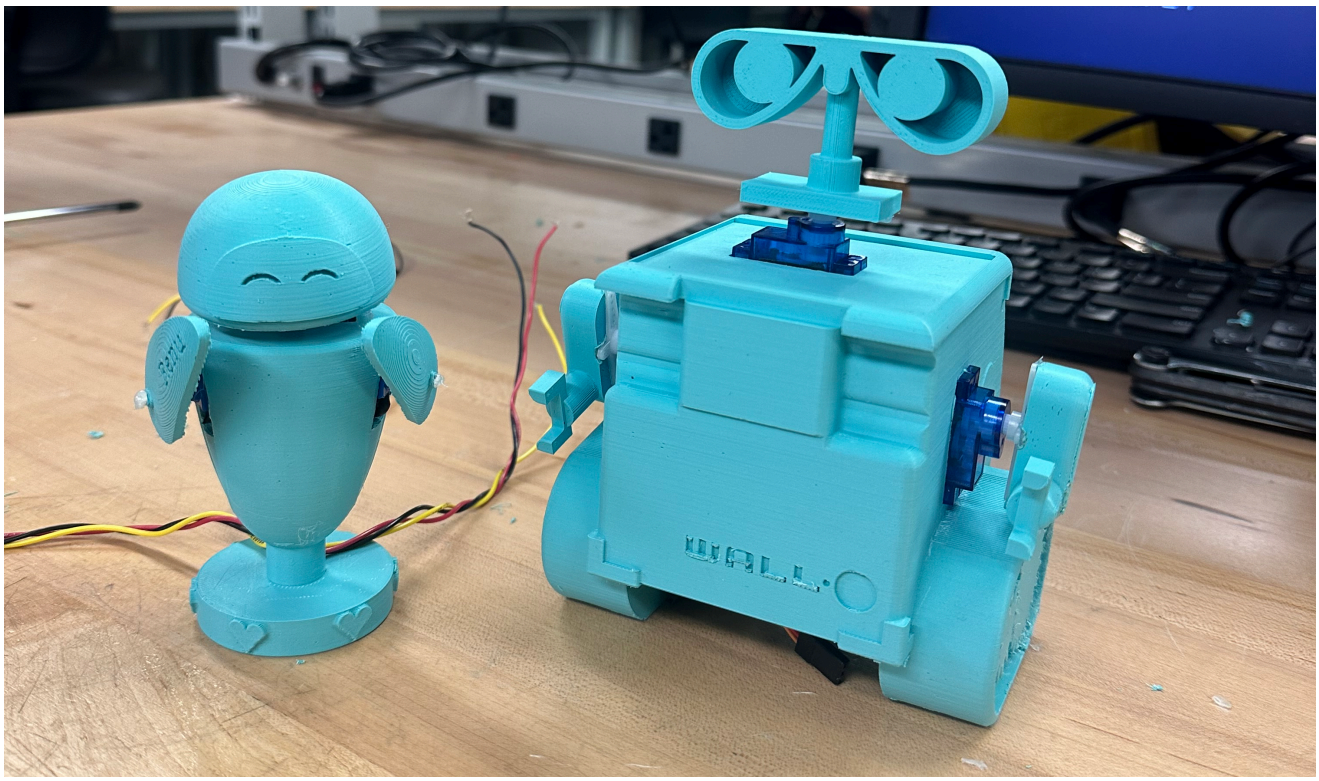


Isometric view



Output side: Final CAD model, isometric view

Input side: Final CAD model, isometric view



Final 3D printed models: Input side and Output side

Short description of mechanical design:The Eve and WALL-E inspired mechanism from WALL-E is designed to demonstrate the operator's control from the input side (Eve) to the output side (WALL-E). Potentiometers are integrated into the input side to capture operator movements, which in turn control servos on the output side. This setup enables the output side to mimic the actions performed on the input side. I designed the input and output using Fusion360.

Key Components:

- Rotating Head: The head of Eve and WALL-E can rotate 180 degrees, providing a wide field of view and expressive movement. This rotation is controlled by a servo motor integrated into the output mechanism.
- Articulating Arm 1: Eve's arm and WALL-E's arm can move with a range of 160 degrees, allowing it to perform a variety of gestures.
- Articulating Arm 2: Eve's arm and WALL-E's arm can move with a range of 160 degrees, allowing it to perform a variety of gestures.

Fabrication: To create this Eve and WALL-E inspired mechanism, the rotating head and the arm components can be fabricated using 3D printing with PLA. 3D printing is particularly suitable for replicating Eve's curved surfaces and WALL-E's intricate details. The lightweight structure ensures that the servo motors can efficiently manage the movements of the head and arms.
The model has 3 degrees of freedom (3-DOF), with head rotation and two arm movement. 3-DOF will introduce more dynamic and expressive movements, in keeping with EVE's and WALL-E's character from WALL-E.

Main challenges: Since I used fillet a lot in my design, the 3d printing time increased. Also due to the false gear design I put on Wall-E's body, removing the support structure became a hassle. Another challenge was to mount the Servos inside the body, for this I had to take into account tolerances for an interference fit. To have distributed weight to balance the structure upright, my models are designed to be bottom heavy.

3.2.2 Hardware fabrication and analysis

Made the output side of my waldo. Used the 3 SG90 RC servos.

Analysis of the potential current usage by circuit:

Potentiometers (20k shaft pot) = 5/20,000 = 0.5mA

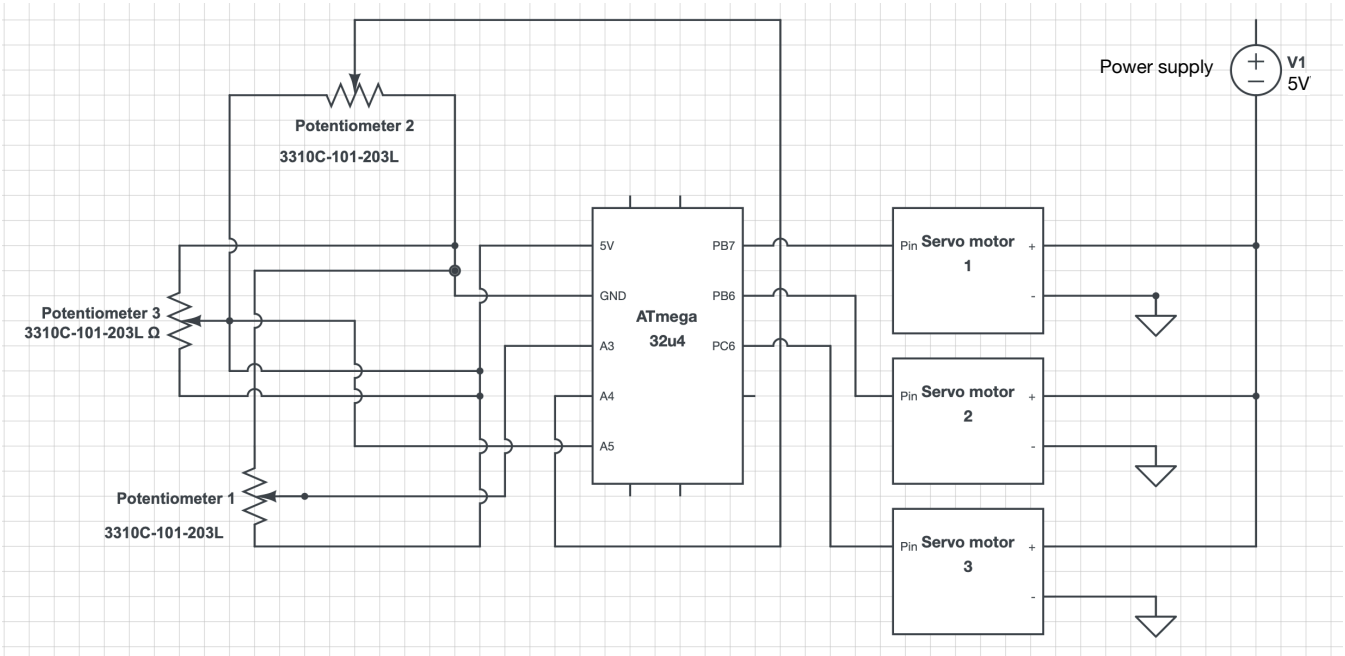
Servo motors (3) = 100mA - 250mA each motor (under load) and 10mA each when idle

Itsybitsy = 10 - 20 mA. Maximum is 500mA.

According to https://opencircuit.shop/product/towerpro-sg90-9g-micro-servo-motor-180, stall current is 650±80mA. Worst servo current is 580mA, i.e., measured at stall torque.

Total current drawn in worst case = (0.5mA*3) + (580*3) + 500mA = 2241.5mA

Current sourcing capabilities of power supply: I limited my power source to deliver 5V and 1A to prevent components from damaging. Used the power source only for the servos. The potentiometers are powered by the Itsybitsy making sure it has the necessary capability to operate continuously.



Schematic circuit diagram of both the input and output sides of Waldo

3.2.3 Software Integration and demonstration

Integrated everything to make a complete waldo input/output system. My output accurately mimic the input with minimal delay.

Code: Separate grade scope submission (main.3.2.c)

Video: https://drive.google.com/file/d/153Zd7CopL19aDFnf2wJH9cCVDH99KItg/view?usp=share_link

3.2.4 Do a dance!

Video: https://drive.google.com/file/d/1vWRgFe2hMiQNUlWEOjfz0Tas3roO82In/view?usp=sharing