

# Pinch-free Animatronic Shell

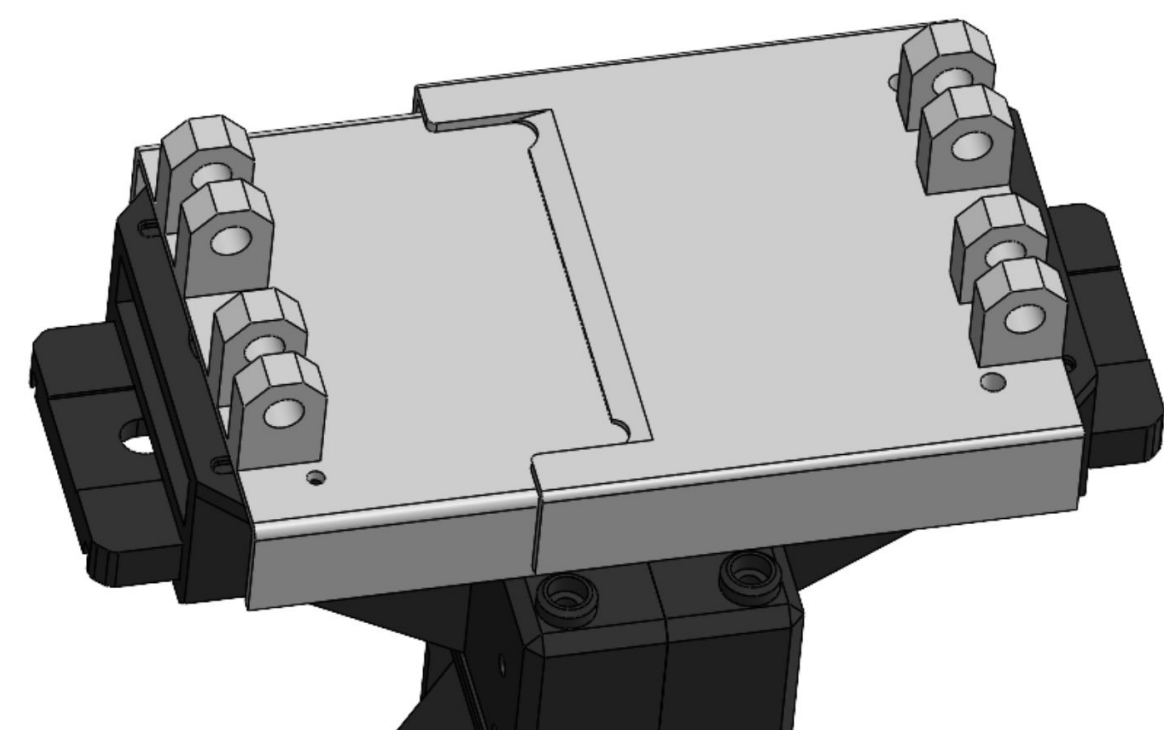
Aaryan Kainth | Jack Carpino | Jennifer Ku | Jenna Handschumacher | Yolanda Lin

## Background

As amusement parks push for more immersive guest experiences, human-animatronic interaction is becoming increasingly common, making safety a critical concern. Our project is a purely mechanical and pinch-free animatronic shell, using modular joint covers to eliminate pinch hazards without sensors or electronics. We narrowed the system down to 6 main pinch points, with 3 innate pinch points along the robot arm itself, and 3 propagated pinch points caused by the geometry of our character.

## Critical Pinch Solutions

### Claw Cover



Sliding covers with a chamfer to push out fingers.

### Soft Teeth



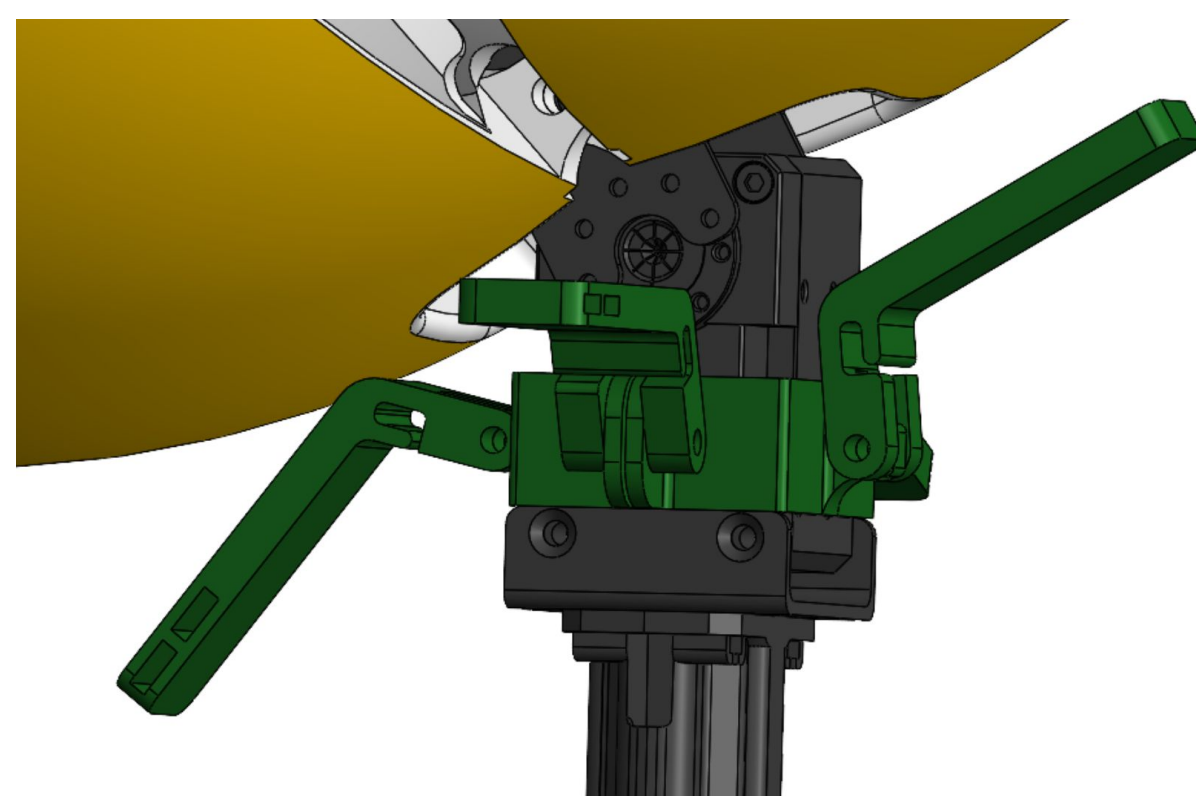
Soft, foam-casted teeth that deflect when pushed on.

### Elbow Sleeve



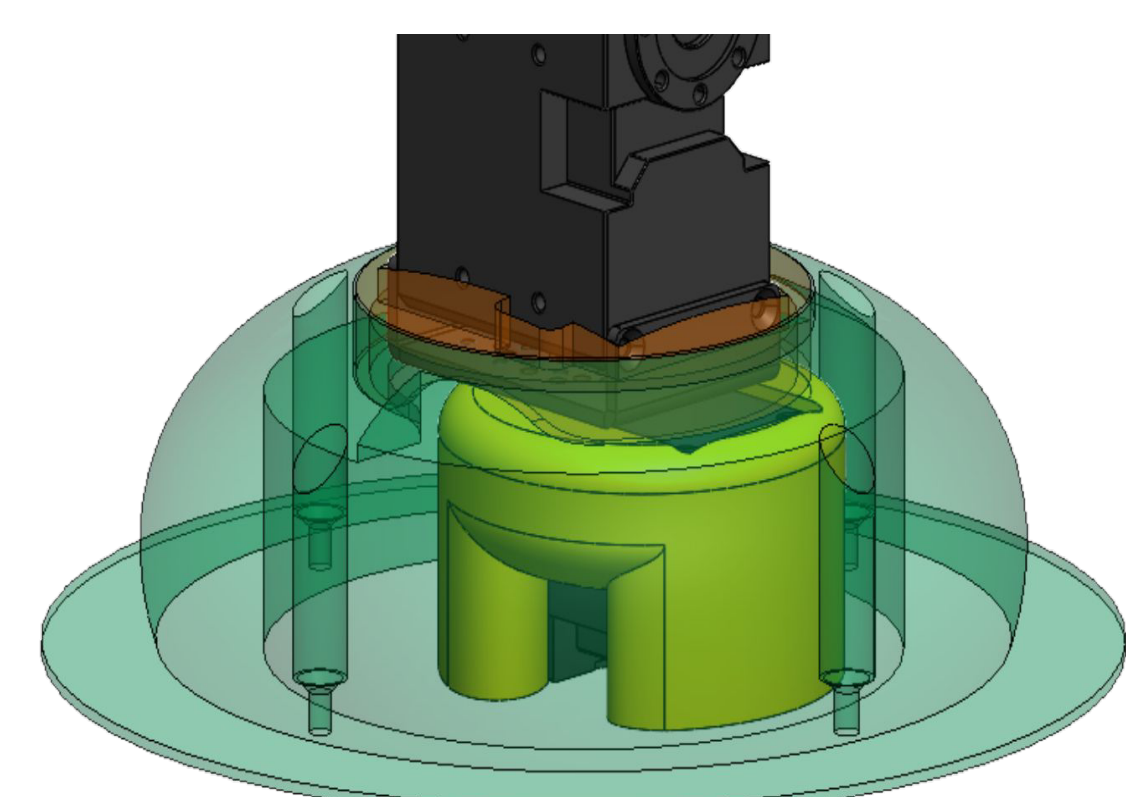
Flexible silicone sleeve that gently stops hands.

### Neck Cover



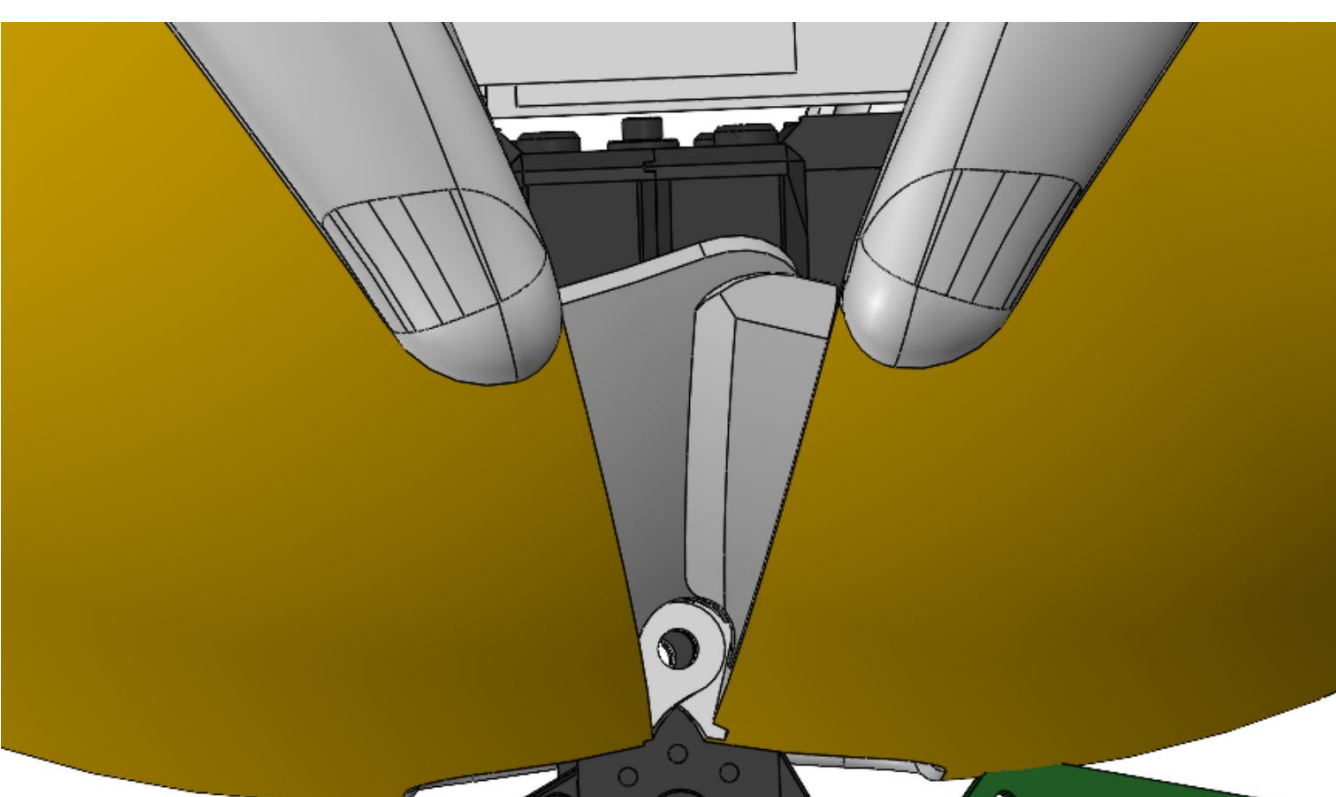
Rubber band-loaded system that covers neck slot.

### Shoulder Bulb



Seamless rounded shape that fully eliminates rotational pinch.

### Jawline Cover

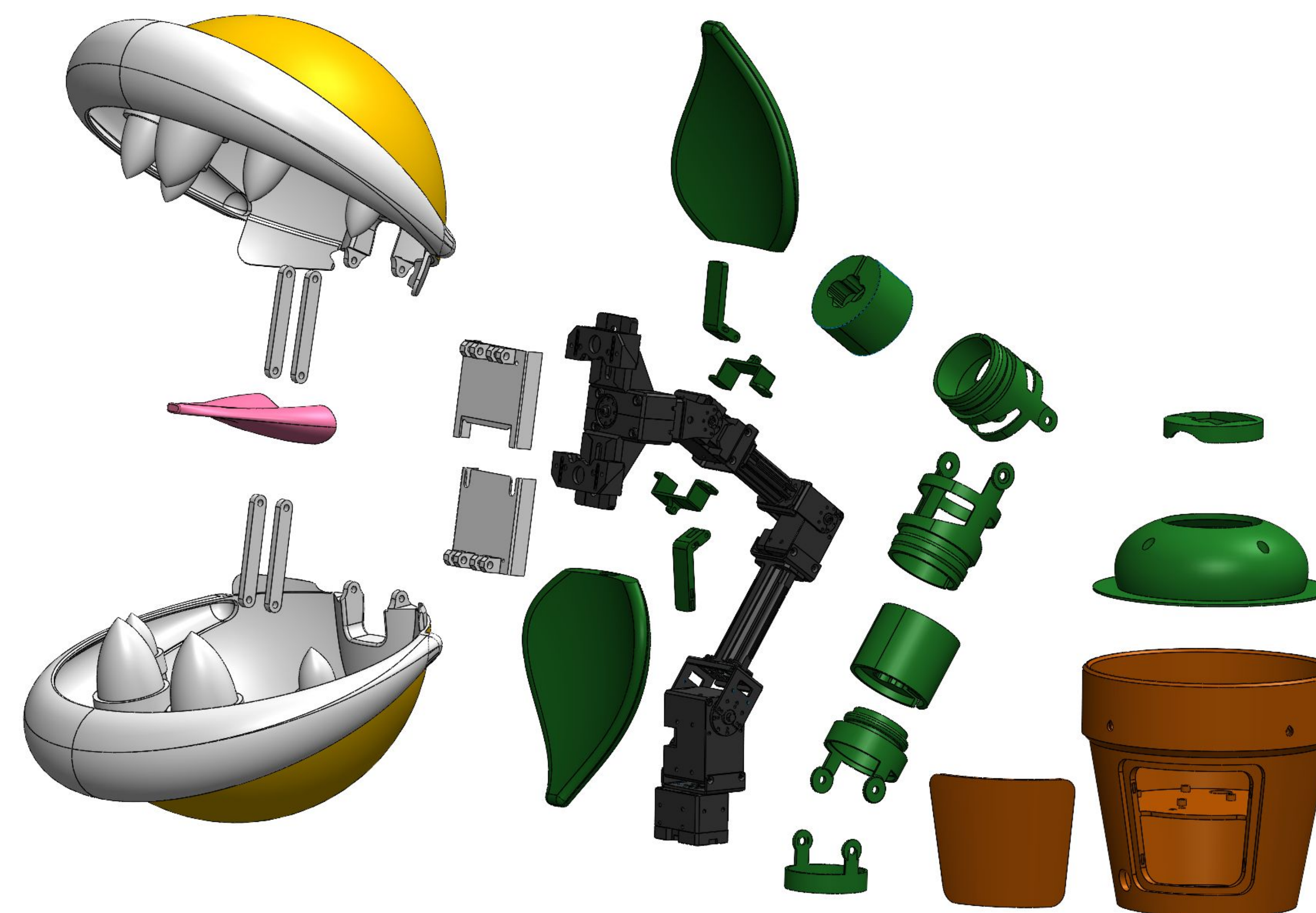


Two sliding covers that prevent fingers from being wedged.



## Design Summary

Our final system integrates a robotic arm, lightweight character shell, soft exterior skin, and custom pinch-point mitigation features into a fully realized piranha plant character. Throughout development, our team addressed challenges including pinch-point propagation, weight distribution, modular assembly, wire routing, and skin integration.



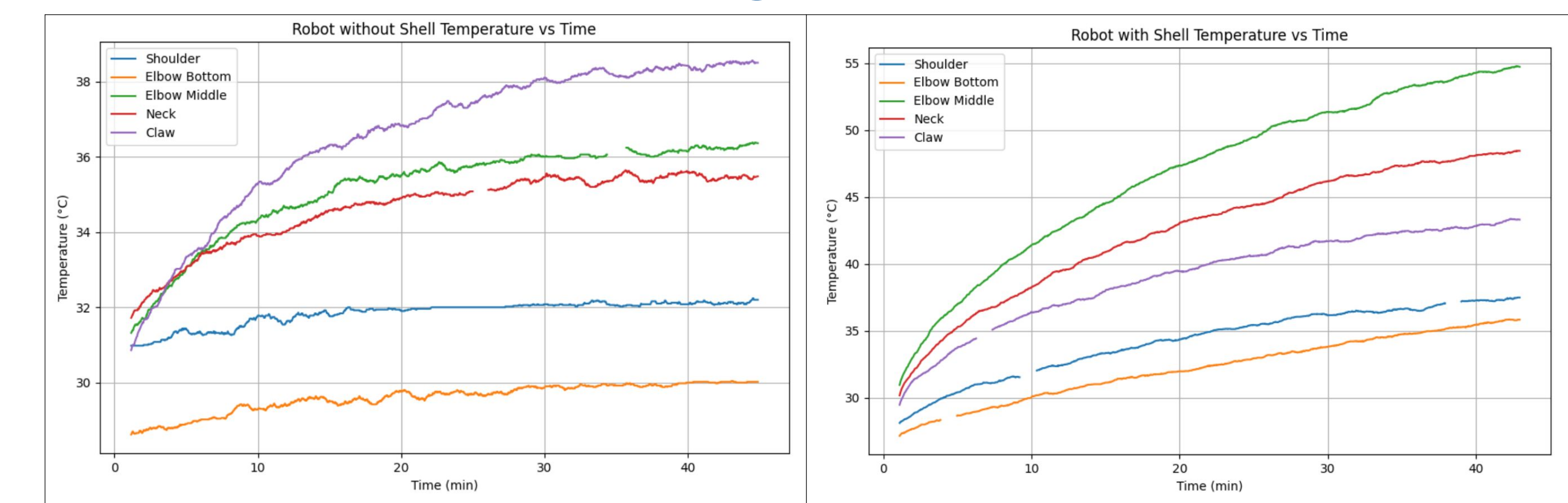
Exploded view of final CAD iteration.

## Costuming



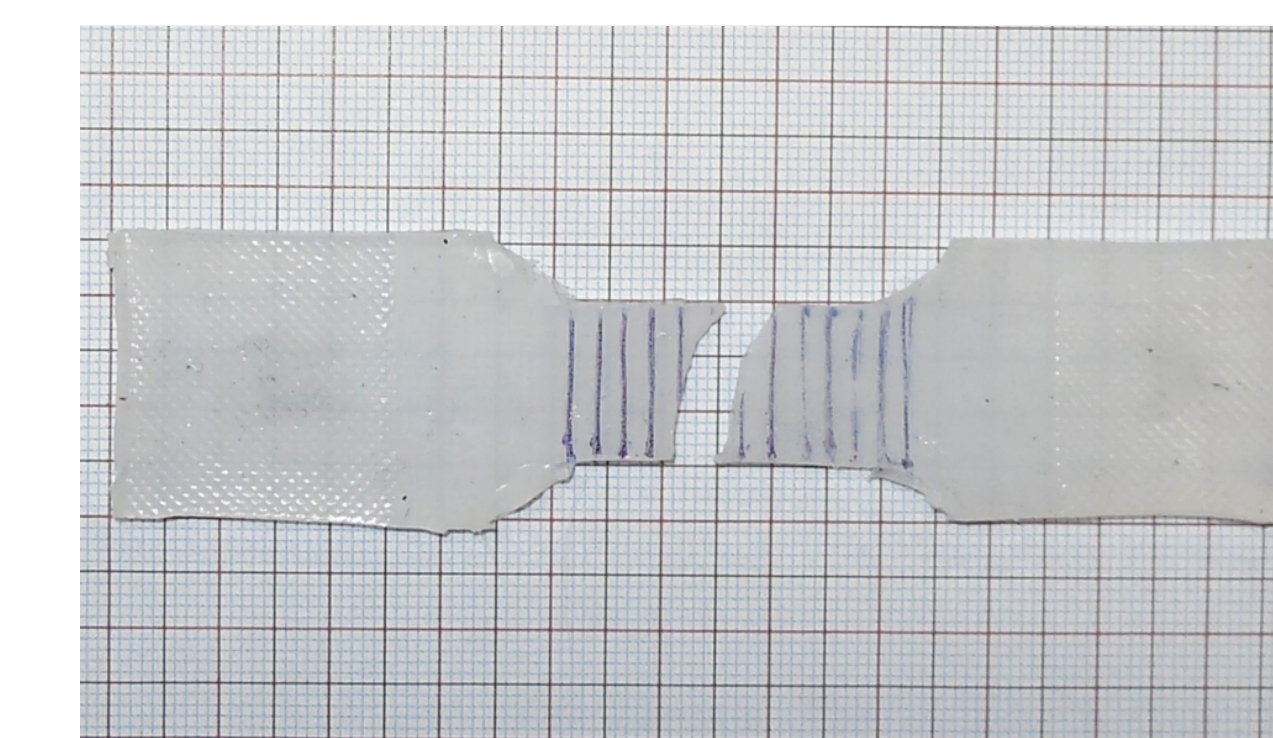
- Smoothed head shell with XTC-3D, painted the head shell and tongue with model paint.
- Sewed and added easily detachable felt sleeves/covers to the leaves, stem, and inner mouth.
- Mounted the base of the pot to a piece of round, turf-covered plywood for stability & aesthetics.

## Testing Results



### Heat Dissipation Test

These plots compare motor temperatures measured over 45 min of continuous motion at room temp between exposed robot arm (left) and robot with fully mounted costuming (right). Max temperature reached with costuming on is 55°C, well below our 77°C threshold



### Soft Material Fatigue Test

ECO-FLEX 50 (elbow solution material) tested on a UTM machine with 0-200% strain at 0.5Hz, we found failure at ~28,000 cycles.



### Pinch Solution Test

To test the viability of our pinch solutions, we took a child-sized wooden hand and held it to the pinch points while the robot is in motion, to prove that it would not experience any pinch.

## With Special Thanks to:

Marcela De Los Rios, Andreane d'Arcy Lepage, Erika Varis Doggett, Krish Kumar, and Professors Tyler Susko, Kirk Fields, and Yon Visell!

