

C-3PO (Star Wars) Animatronic Figure Personal Project

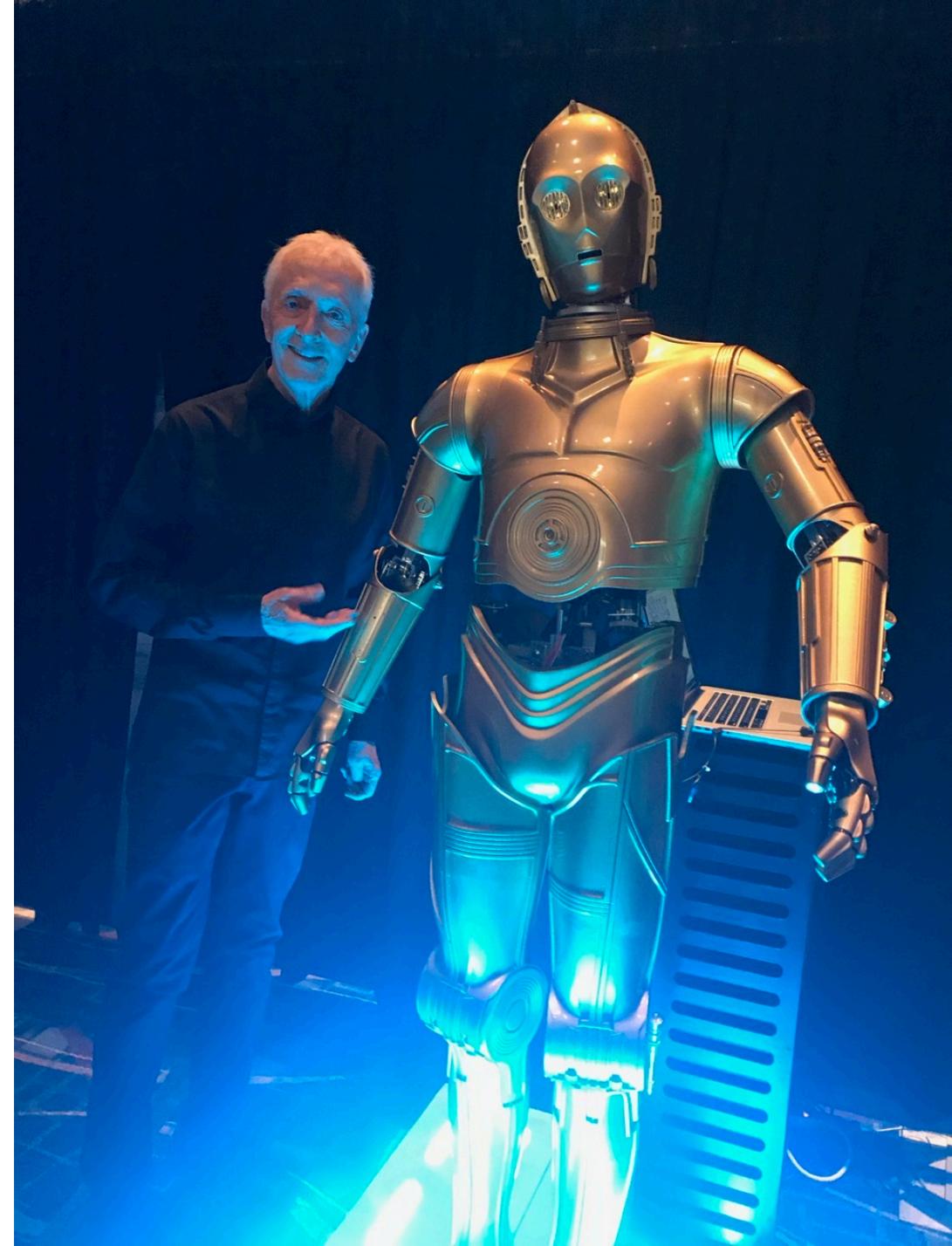
A walkthrough of the project so far...

Presented by Chris Lee

April 15, 2021

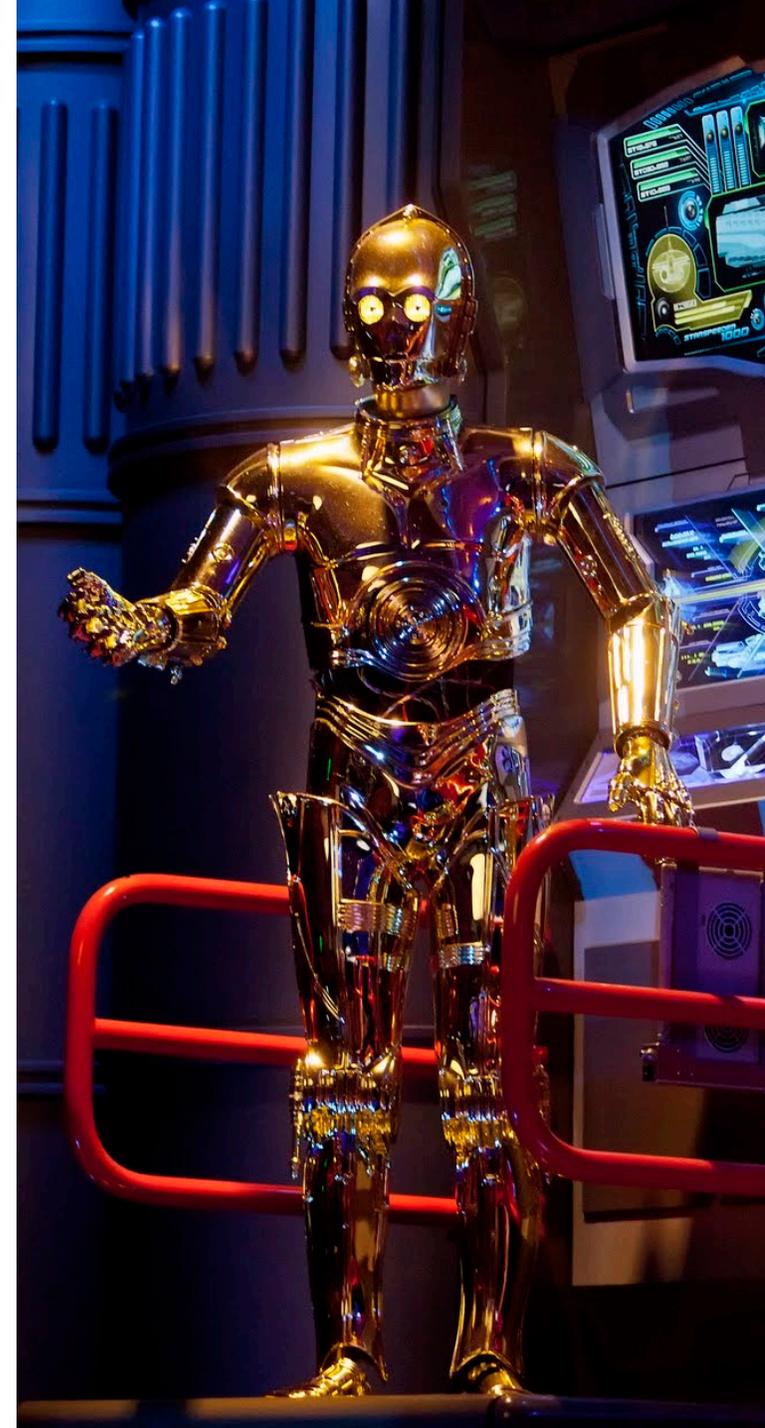
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Project Overview and Goals

- Human scale (1:1) animatronic figure with 16 functions (DOF)
- Separate control cabinet with HMI
- Replicate look and performance as seen in Star Tours queue area in Disney parks
- Emphasis on fast, smooth motion to truly convey the spirit of the character
- Animation through 3D model rigging, real-time joint data from control HMI to PLC/Arduino array out to servos
- Synchronized voice-over, background sound effects, lighted base, possible additional scenic elements



Project Timelines

- **Version 1**
Start: Sept 2018
Deadline: April 2019 (*Star Wars Celebration Chicago*)
- **Version 2** – Upgraded actuators and electrical controls
Start: June 2019
Deadline: April 2020 (*Sci-Fi Convention Nashville COVID*)
- **Version 3** – New animation system and modular shells
Start: Sept 2020
Deadline: August 2022 (*Star Wars Celebration Anaheim*)

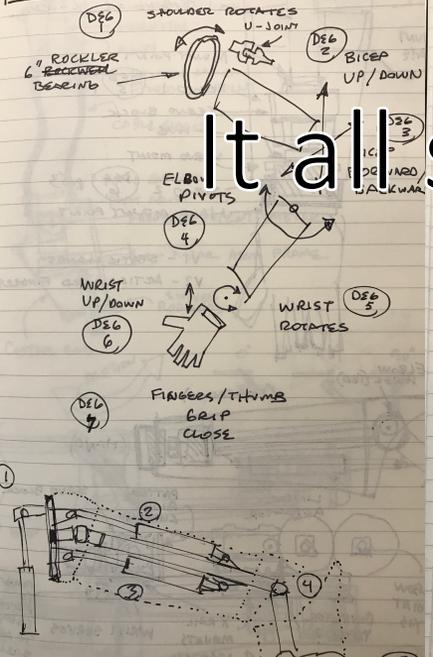


Project Components

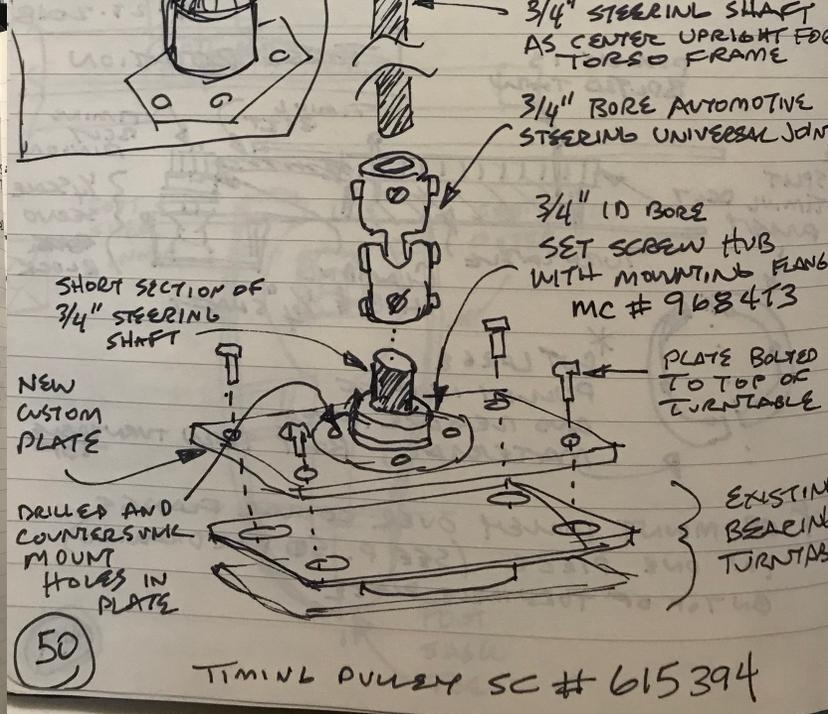
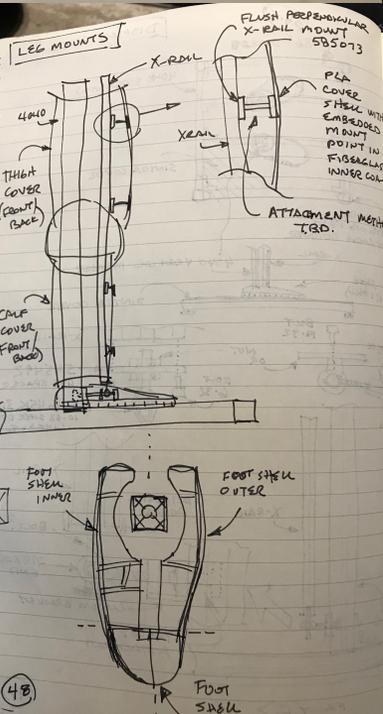
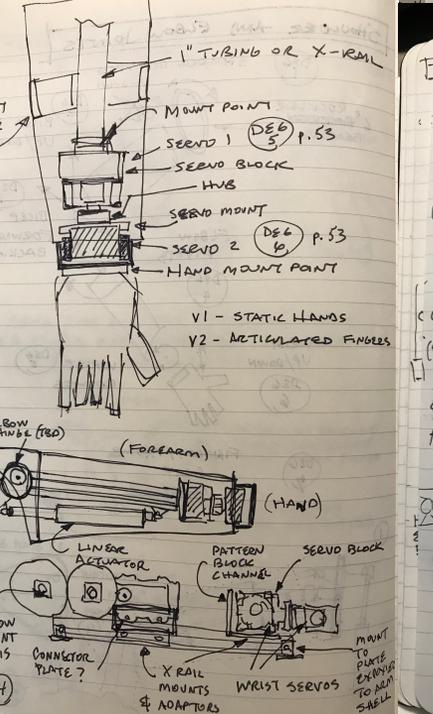
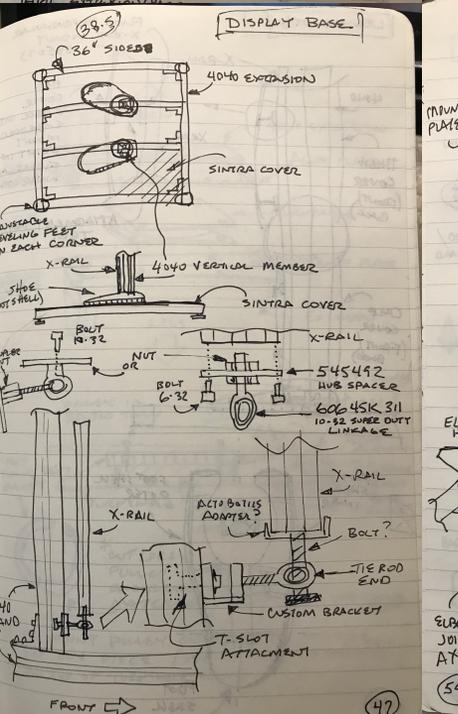
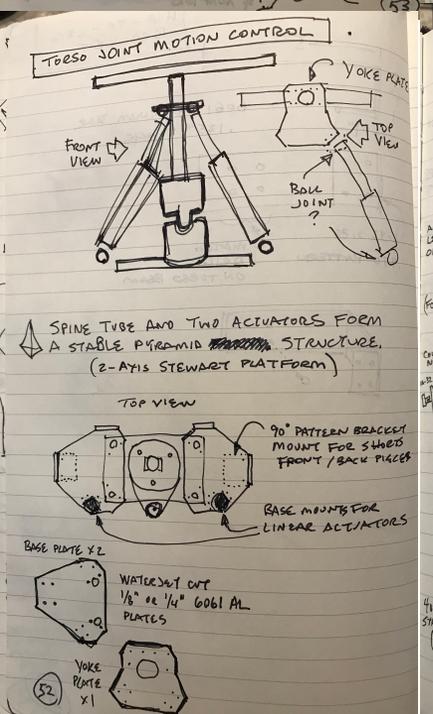
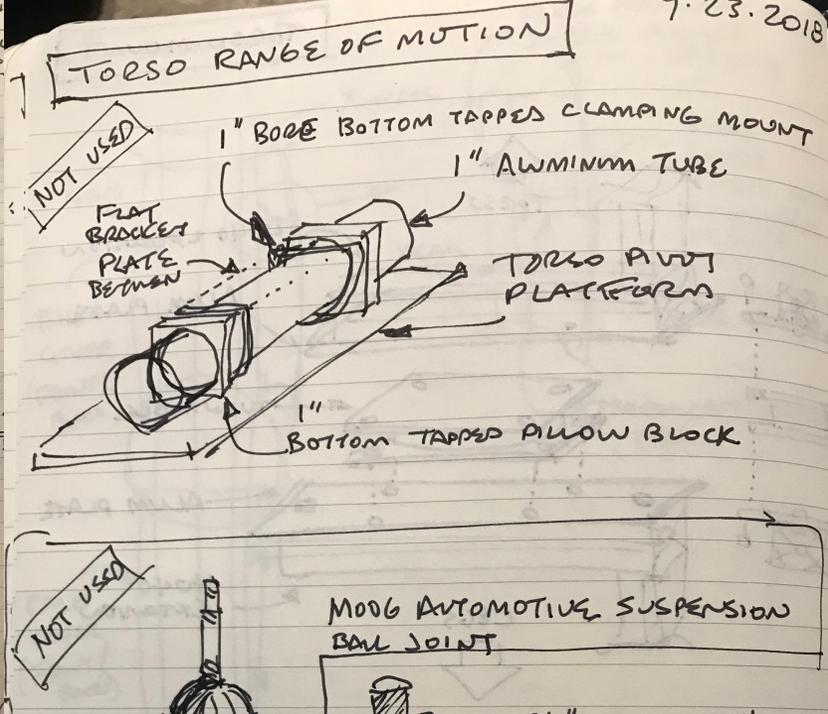
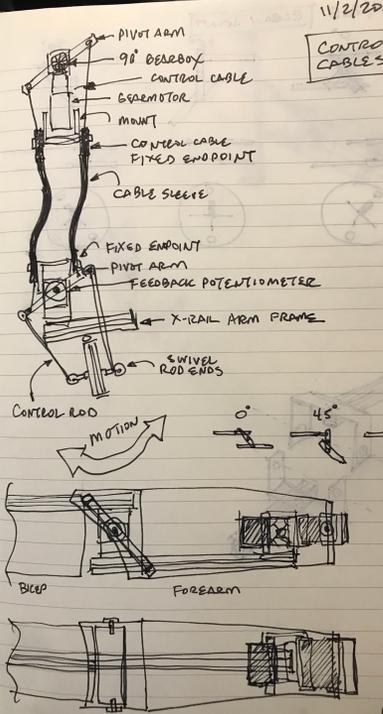
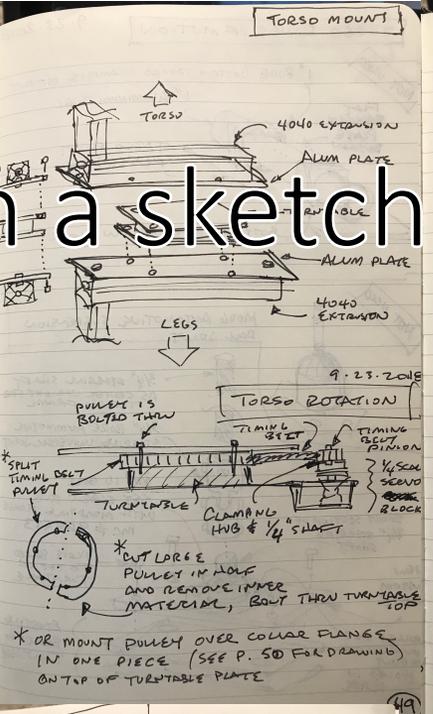
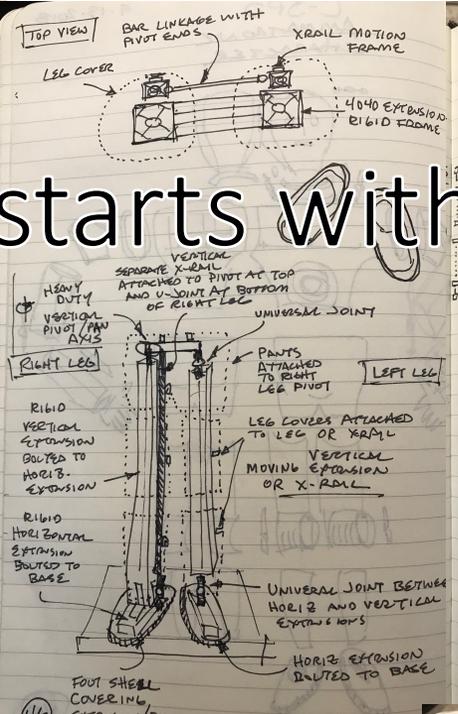
- 3D printed body shells
- Mechanical subassemblies
- Actuators
- Electronic subsystems
- Figure finish
- Animation pipeline
- Show control system



SHOULDER AND ELBOW JOINTS



It all starts with a sketch



3D Printed Body Part Shells

- Head
- Torso
- Shoulder Bells and Rings
- Arms
- Hands
- Pants
- Legs
- Shoes
- Greeblies

Models:

STL files created by friends Jesse Maricelli, Tim O'Sullivan, and Gordon Tarpley

Printers:

Two Formbot T-Rex2's, a Creality CR-10S4, and a Monoprice Maker Select V1

Settings:

*0.8mm nozzle and 0.8mm wall
at 210c nozzle/60c plate*

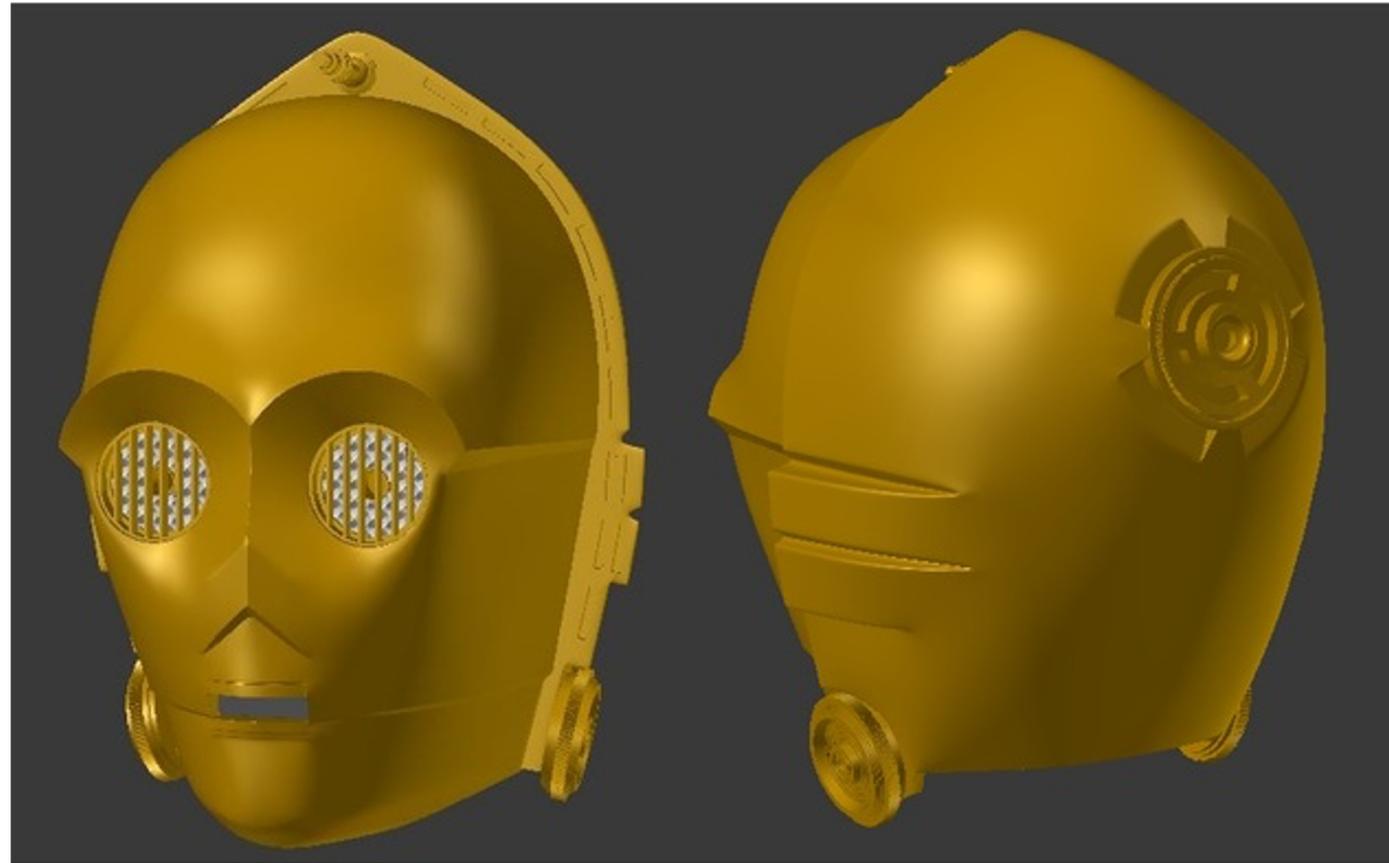
Material:

Hatchbox PLA 1.75mm filament

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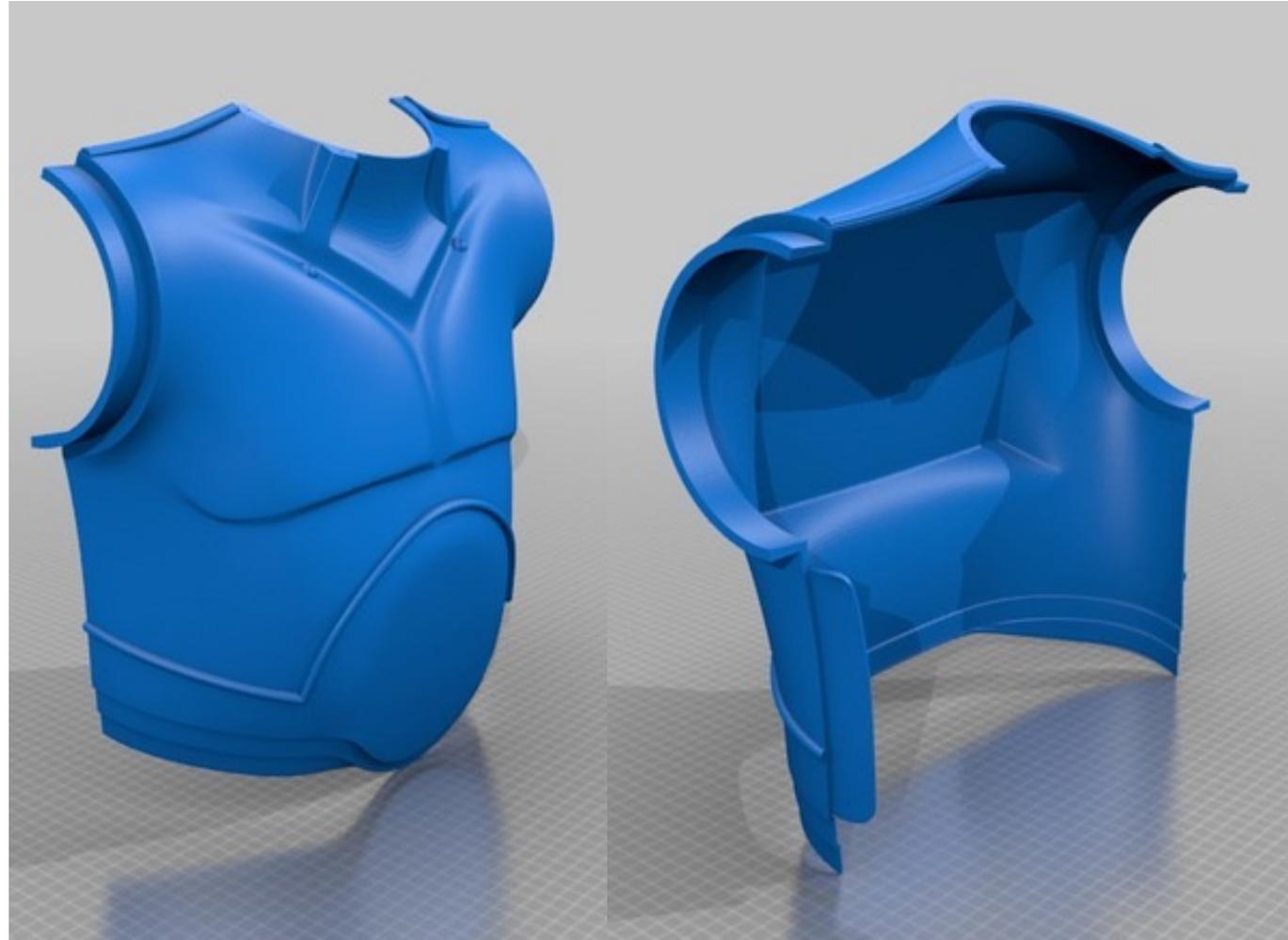
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- Torso and Neck Ring
- Shoulder Bells and Rings
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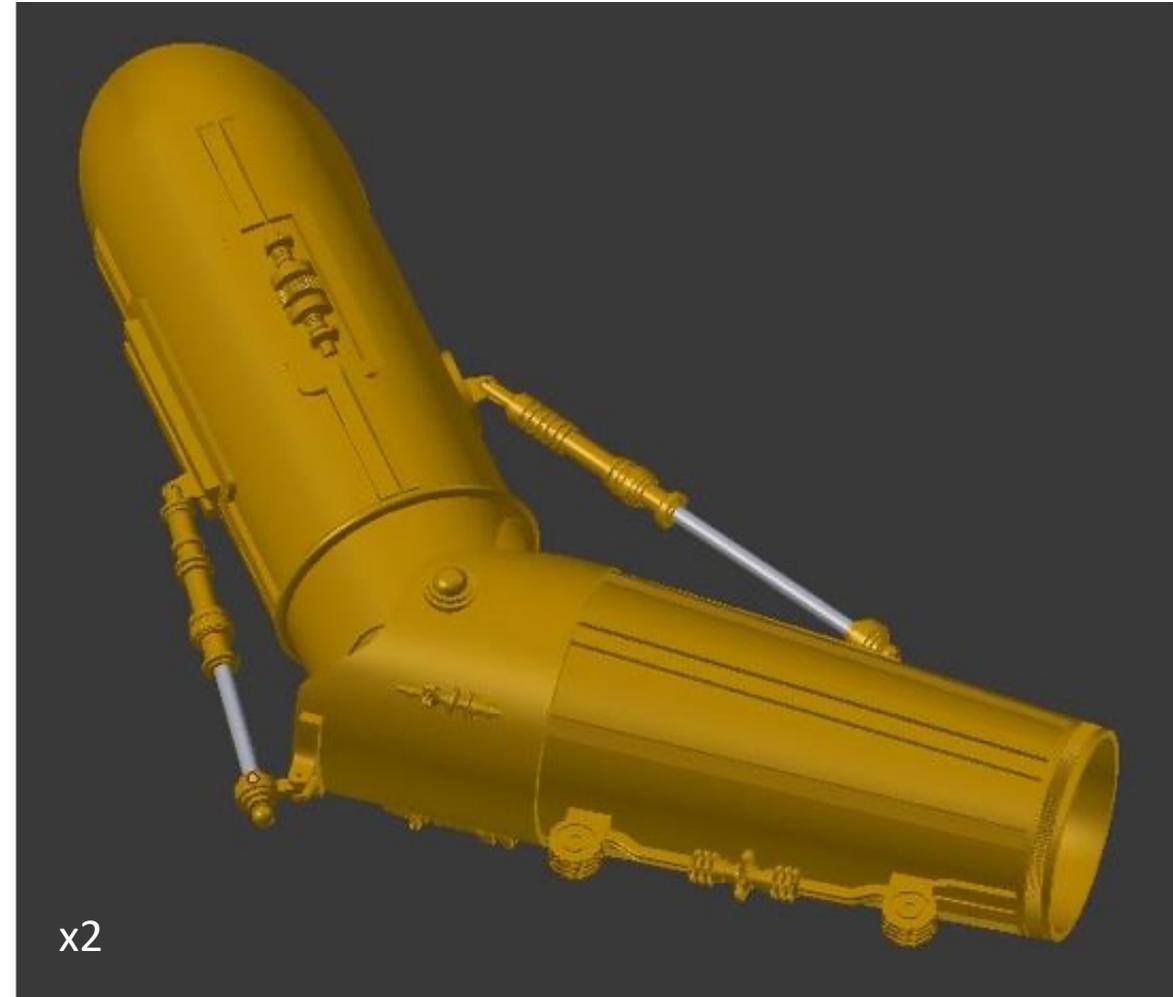
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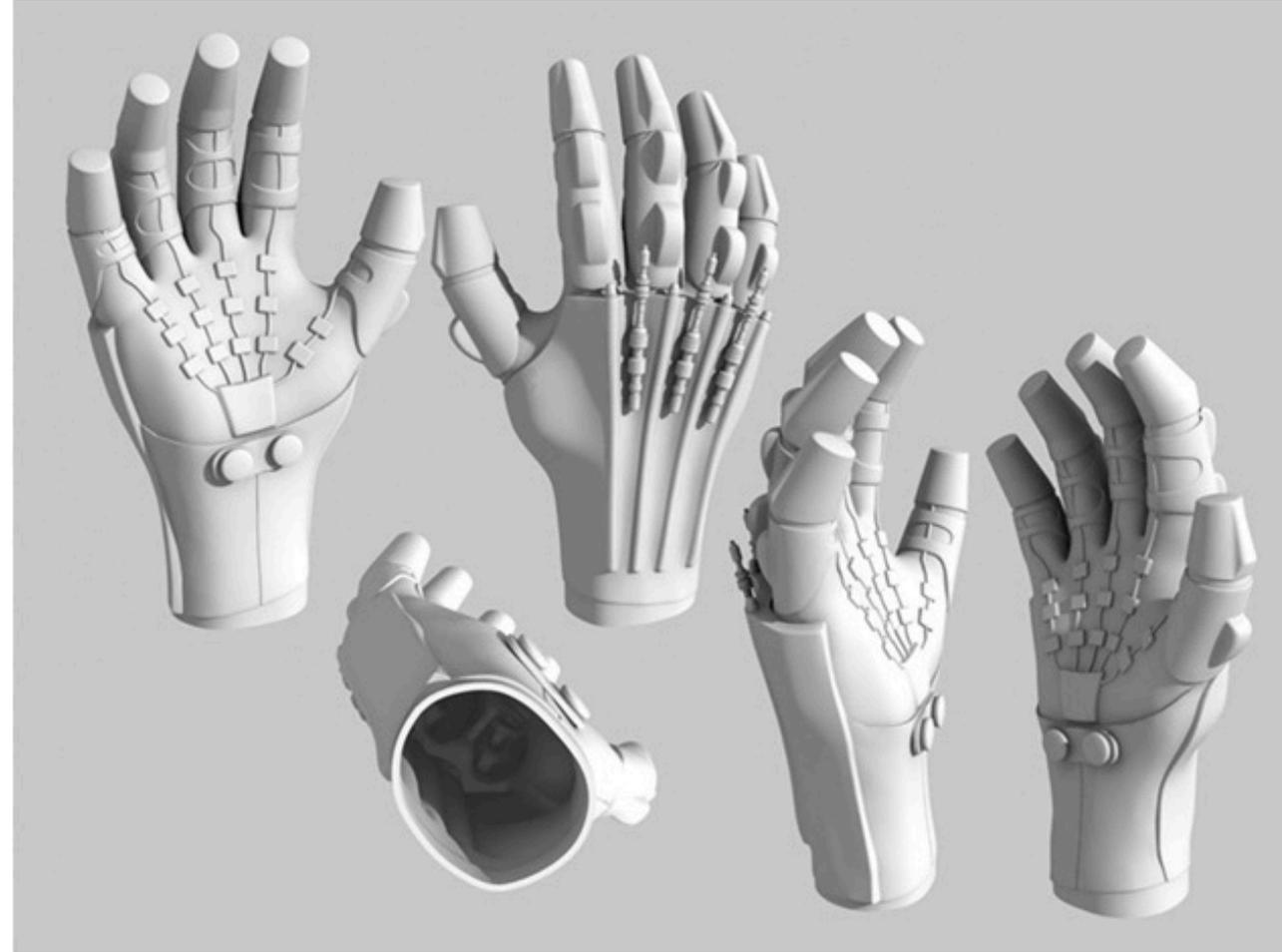
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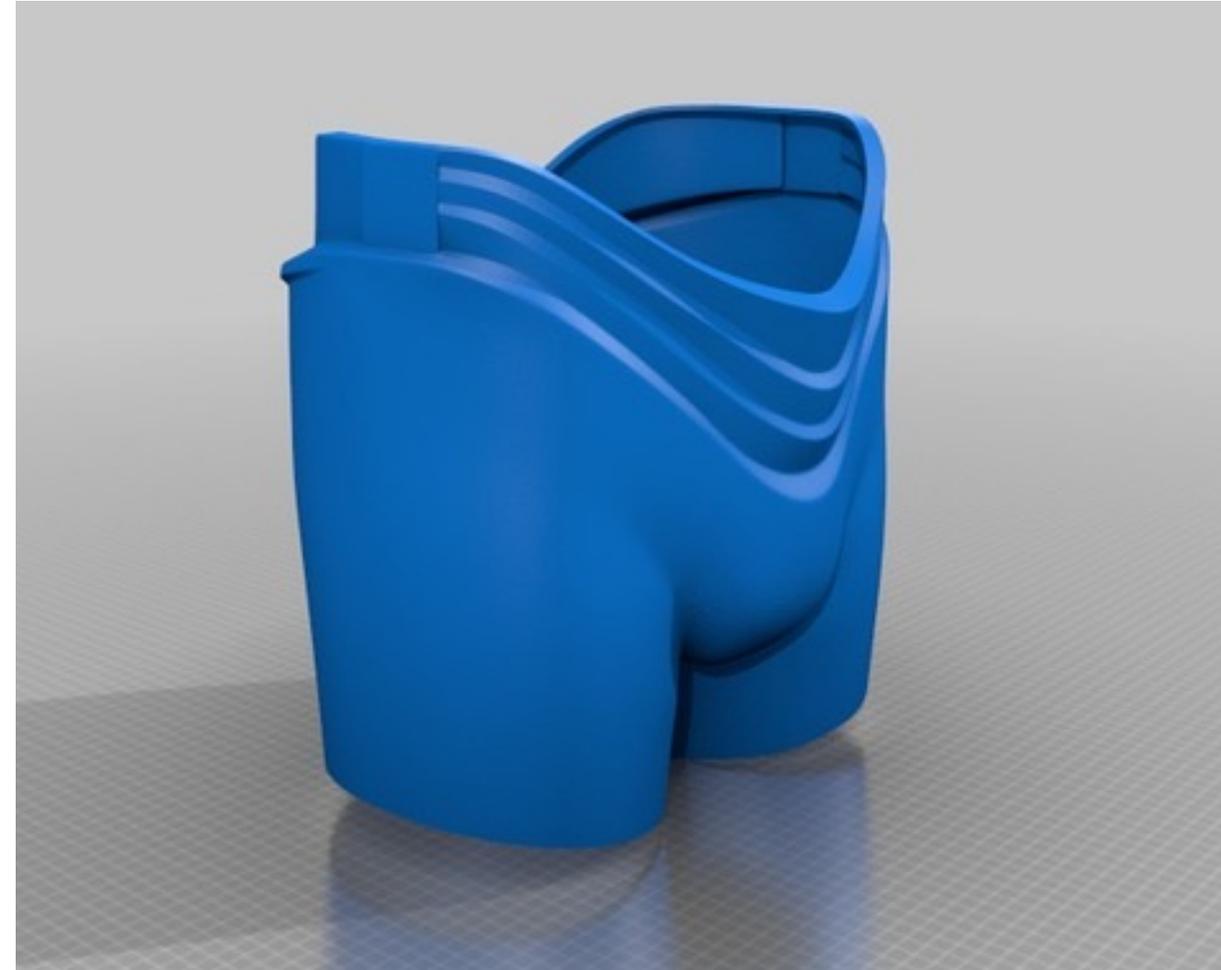
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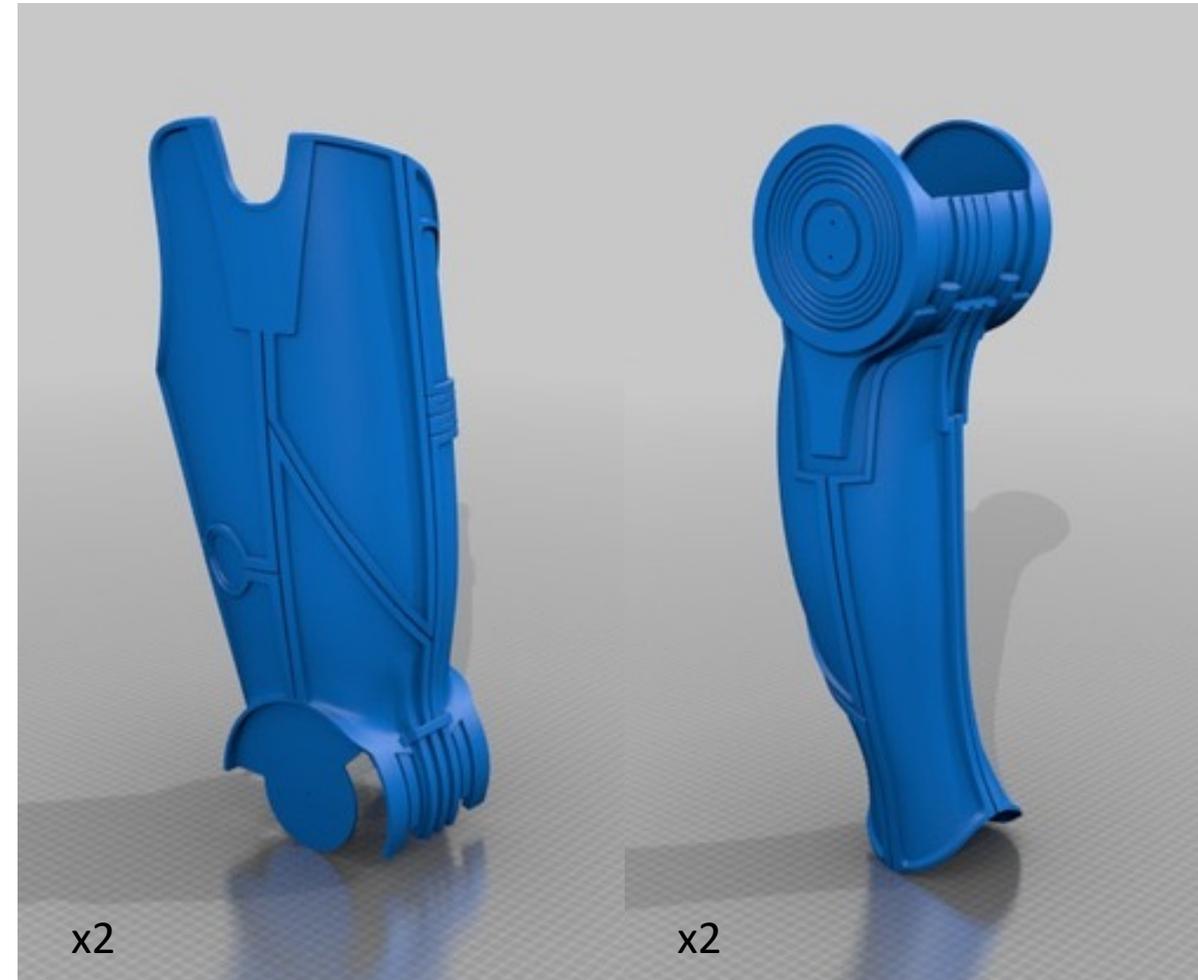
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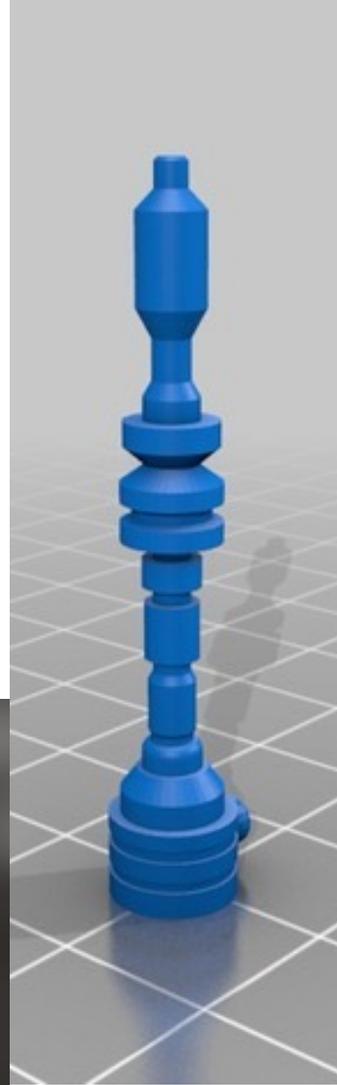
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3D Printed Body Part Shells



3D Printed Body Part Shells



Mechanical Subassemblies

- **Base and leg uprights**
- Torso motion
 - 3DOF: twist, forebend, sidebend
- Shoulder motion
 - 2DOF each: forward, swing
- Elbow motion
 - 1DOF each
- Wrist motion
 - 2DOF each: twist, in/out
- Neck motion
 - 3DOF: nod, tilt, turn



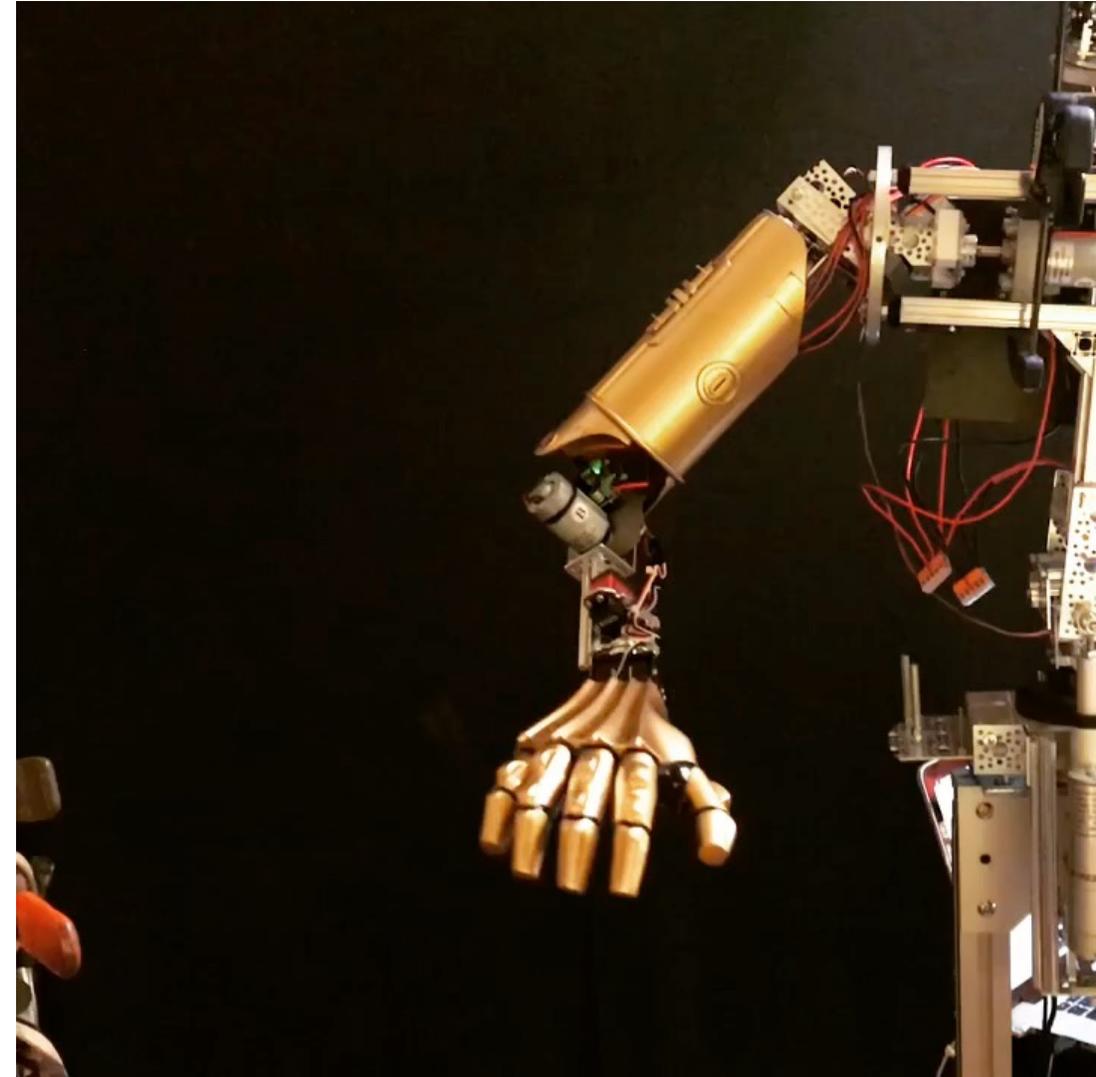
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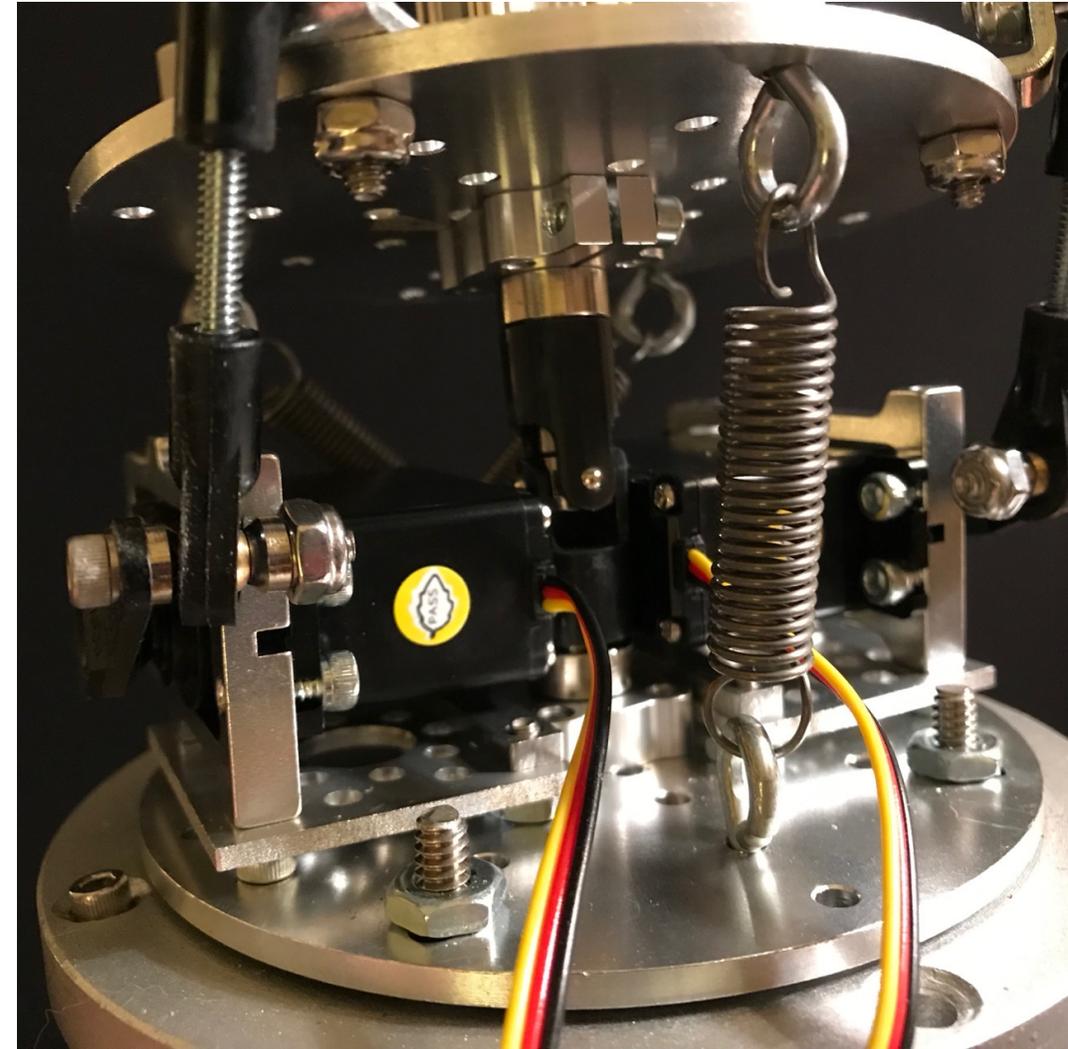
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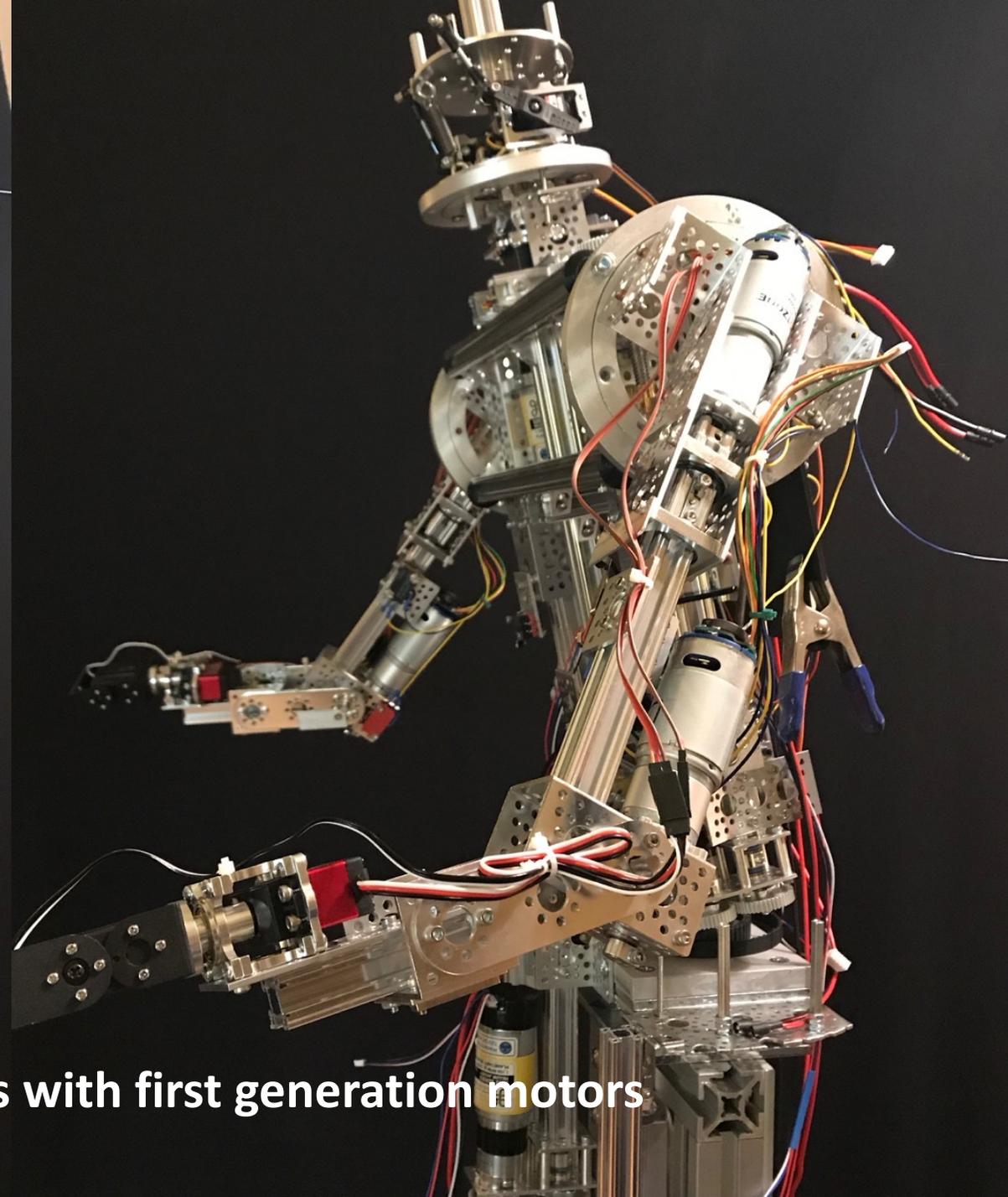
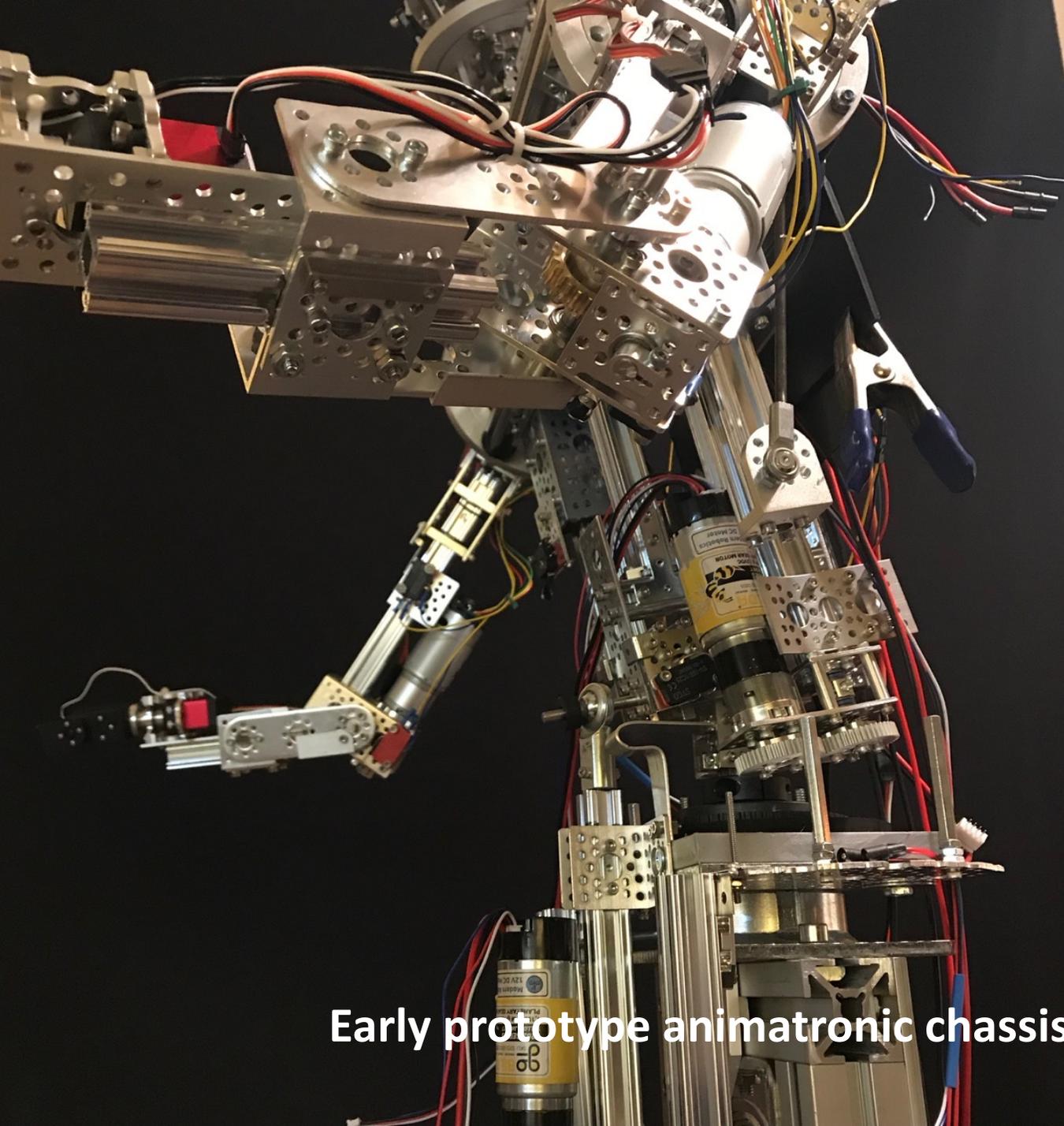
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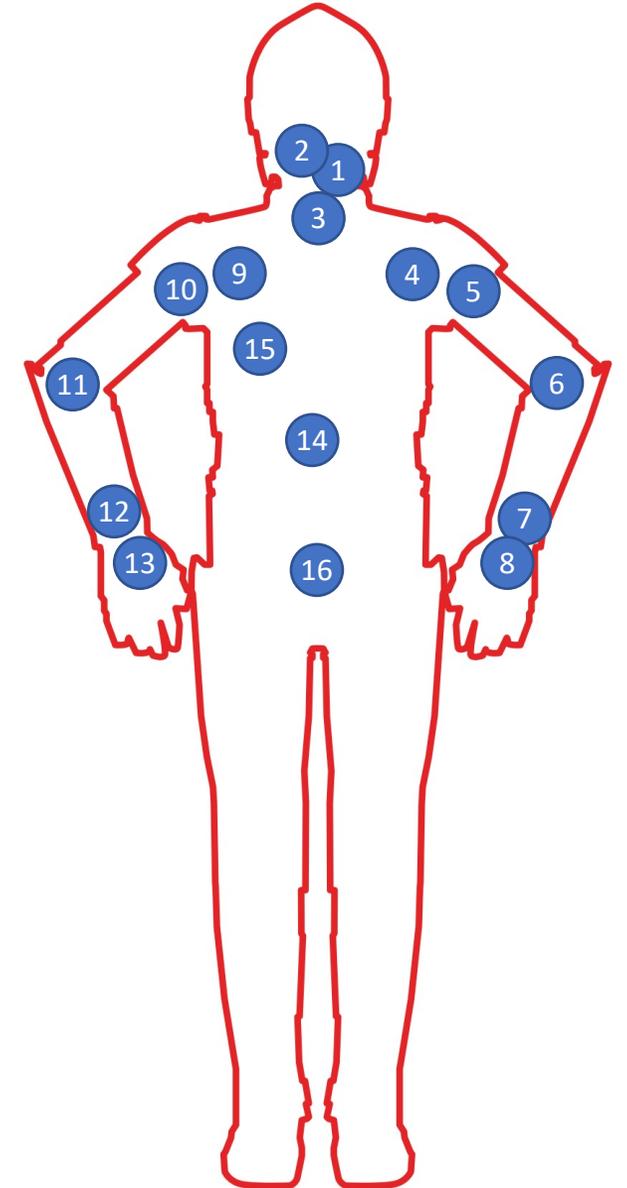




Early prototype animatronic chassis with first generation motors

Function/Actuator List

Function #	Function Group	Function Name	Label	Voltage	CAT6 Bus	Uno	Pin	Actuator Type
1	Neck	Head Nod	HNOD	7.4	A 1	1	3	Rotary - small
2	Neck	Head Tilt	HTLT	7.4	A 2	1	5	Rotary - small
3	Neck	Head Turn	HTUR	7.4	A 3	1	6	Rotary - small
4	Arm - Left	Left Arm Forward	LAF	24	D 1	2	3	Rotary - large
5	Arm - Left	Left Arm Swing	LAS	24	D 2	2	5	Rotary - large
6	Arm - Left	Left Elbow	LE	7.4	B 1	2	6	Rotary - medium
7	Arm - Left	Left Wrist Twist	LWT	7.4	B 2	2	9	Rotary - small
8	Arm - Left	Left Wrist In/Out	LWIO	7.4	B 3	2	10	Rotary - small
9	Arm - Right	Right Arm Forward	RAF	24	D 3	3	3	Rotary - large
10	Arm - Right	Right Arm Swing	RAS	24	D 4	3	5	Rotary - large
11	Arm - Right	Right Elbow	RE	7.4	C 1	3	6	Rotary - medium
12	Arm - Right	Right Wrist Twist	RWT	7.4	C 2	3	9	Rotary - small
13	Arm - Right	Right Wrist In/Out	RWIO	7.4	C 3	3	10	Rotary - small
14	Torso	Torso Forebend	TF	12	F 1	1	9	Linear
15	Torso	Torso Sidebend	TS	12	F 2	1	10	Linear
16	Torso	Torso Twist	TT	24	E 1	1	11	Rotary - large



Actuators

Linear 12VDC
35lb dynamic
75lb static



Rotary small
7.4VDC
35kg/cm



Rotary medium
7.4VDC
60kg/cm

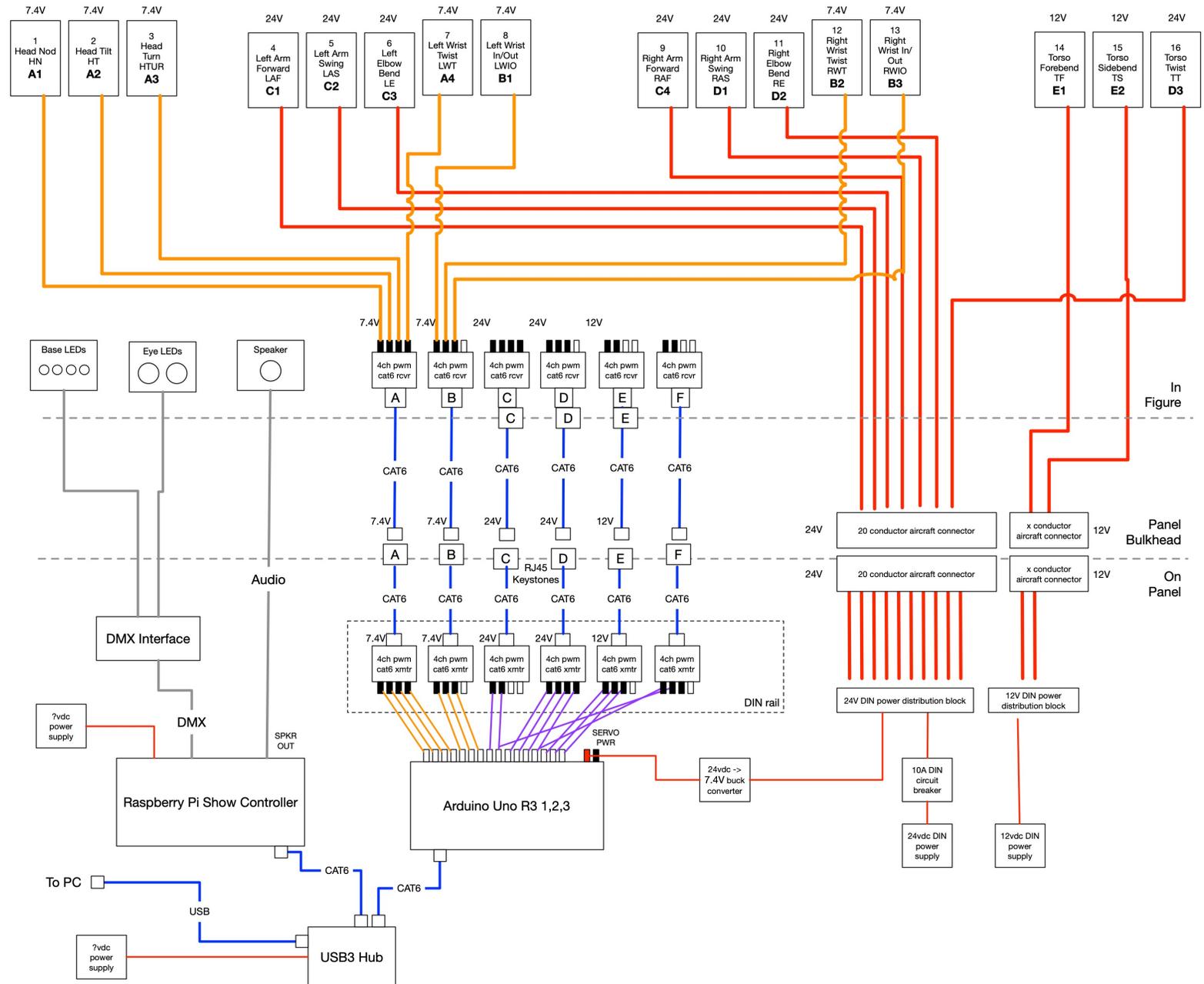


Rotary large
24VDC
380kg/cm

Single-line Wiring Diagram

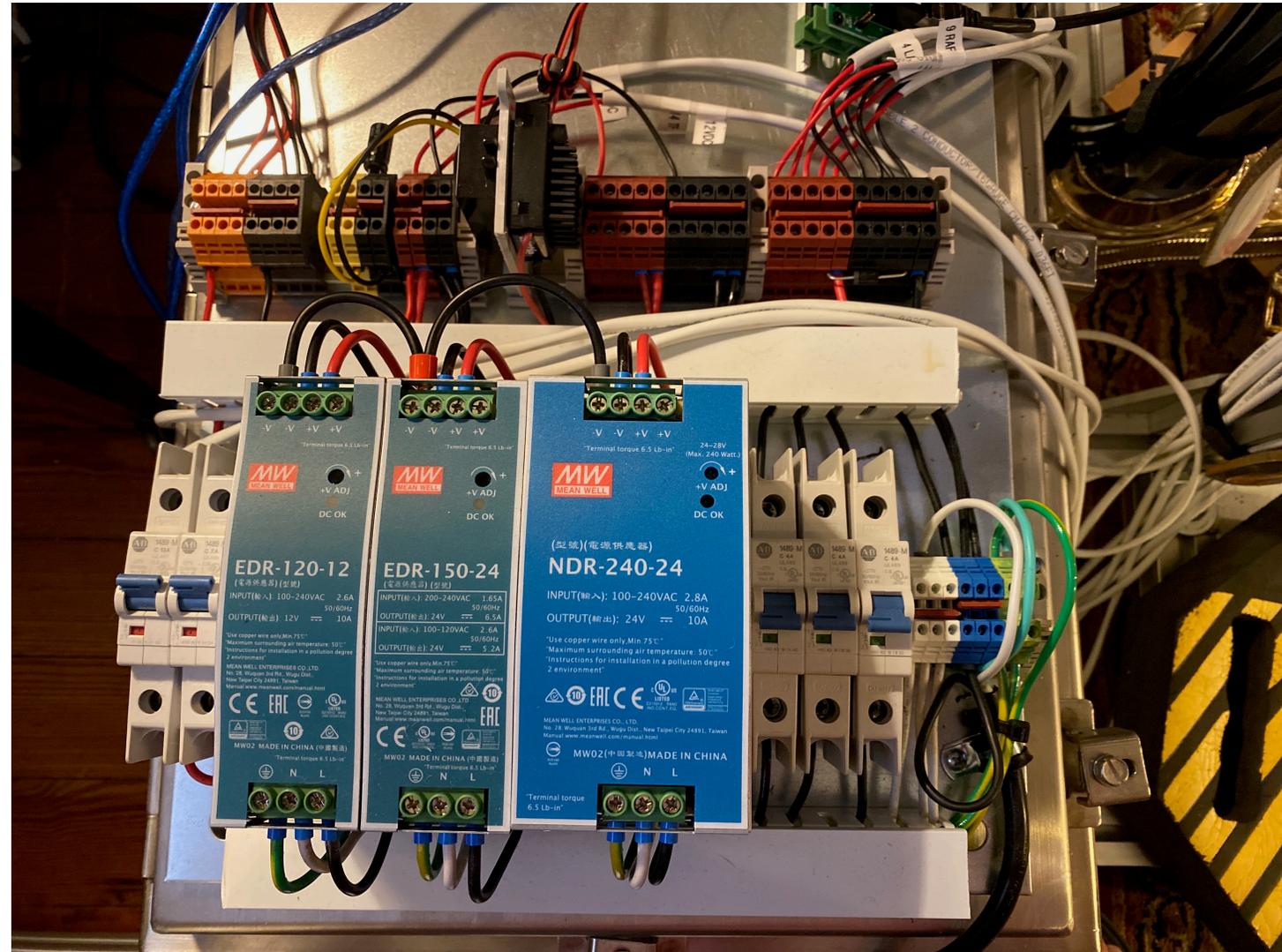
(Original version 1 with mods)

needs revision)



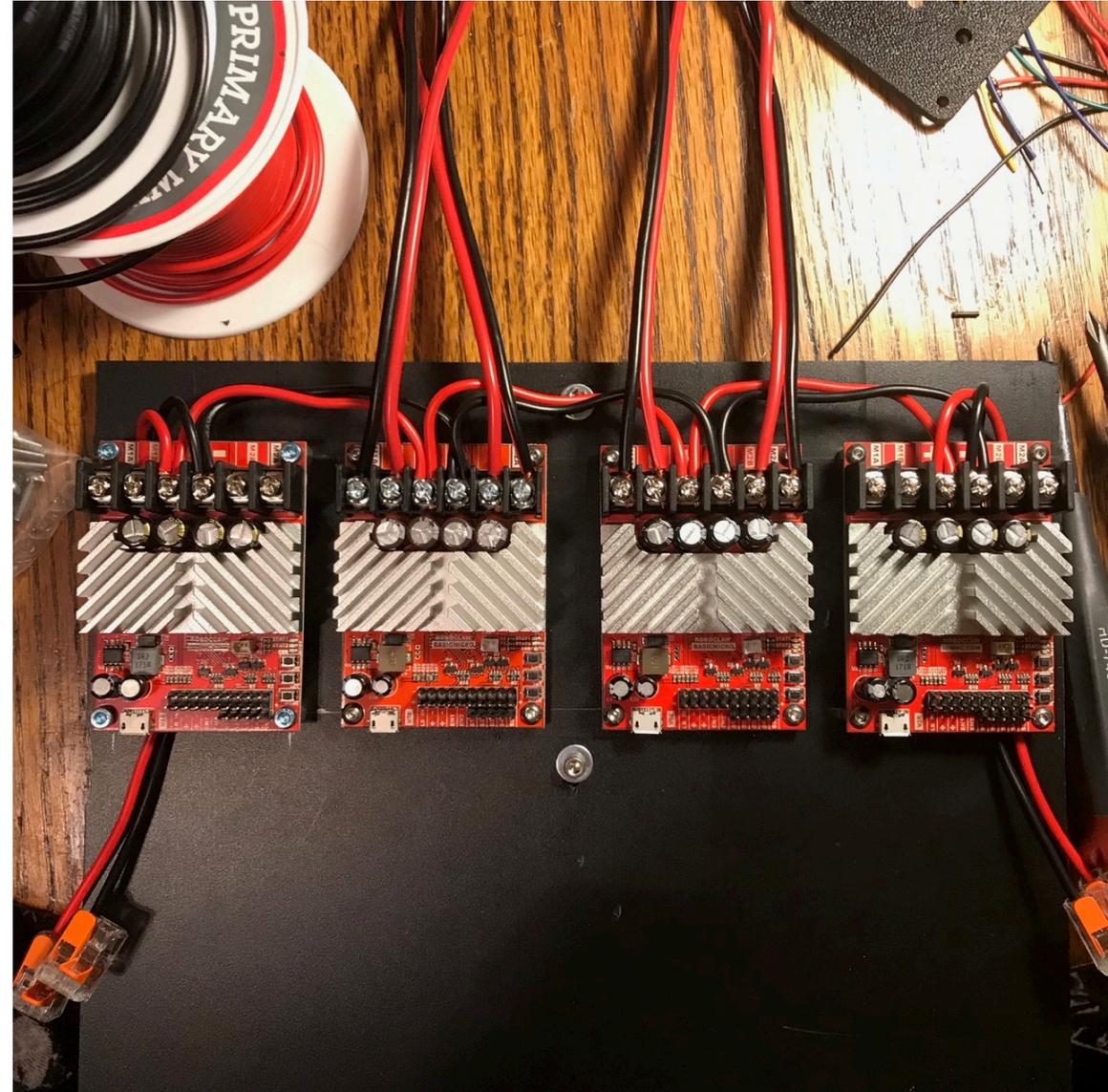
Electronic Subsystems

- **Power distribution**
- Motion control
- Eye lighting
- Audio system
- Base lighting
- Wire management



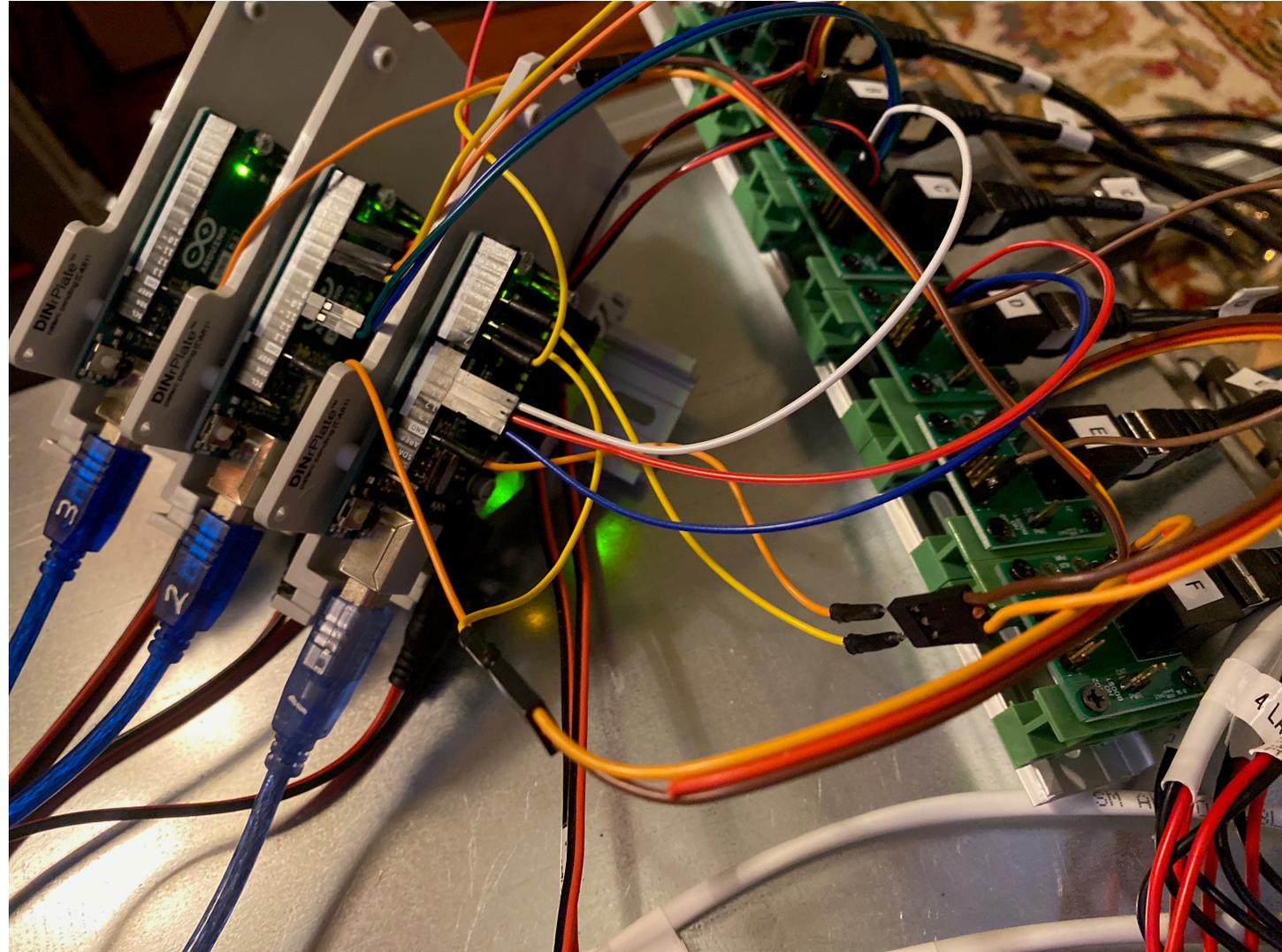
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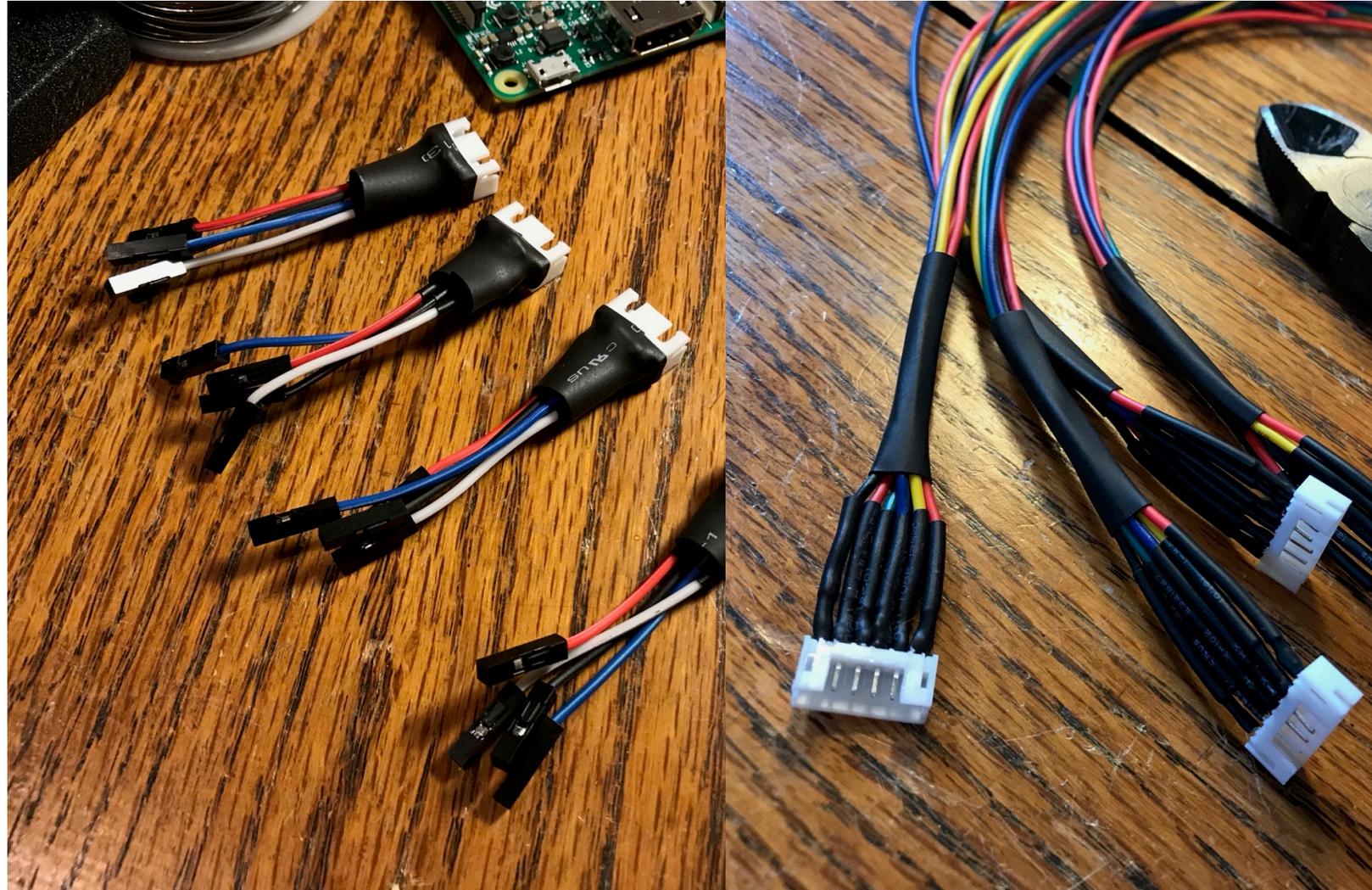


Figure Finish

- **Fiberglass interior coat**
- Mount points
- Priming
- Sanding
- Chroming
- Weathering



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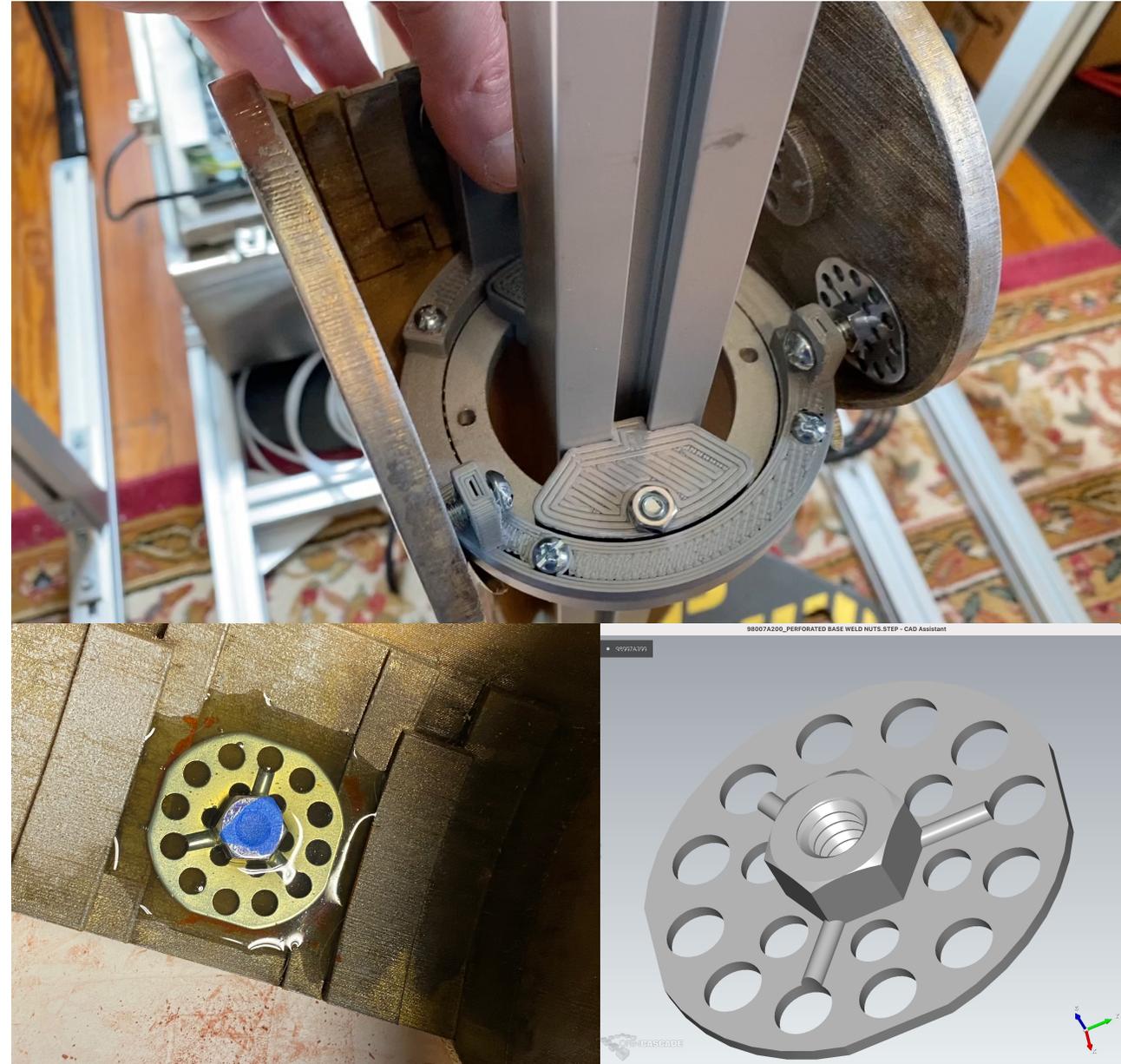
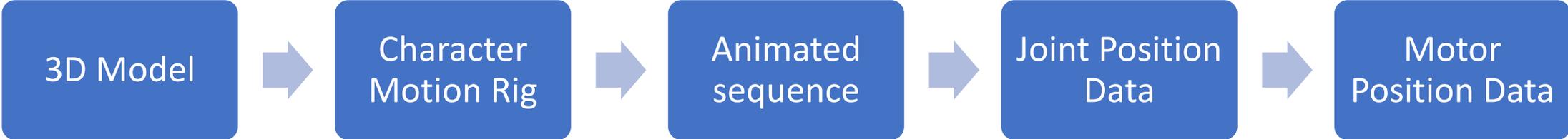


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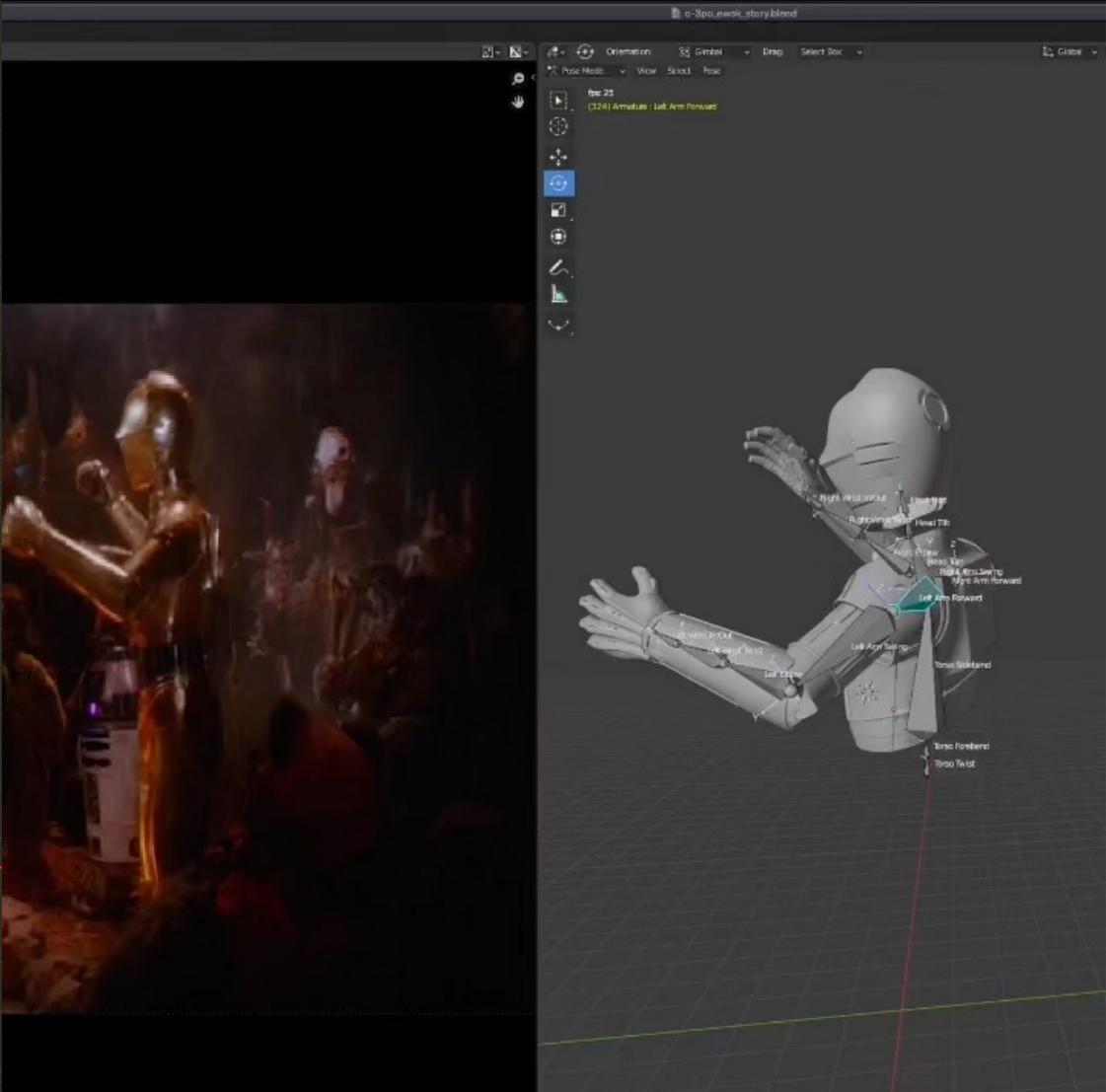
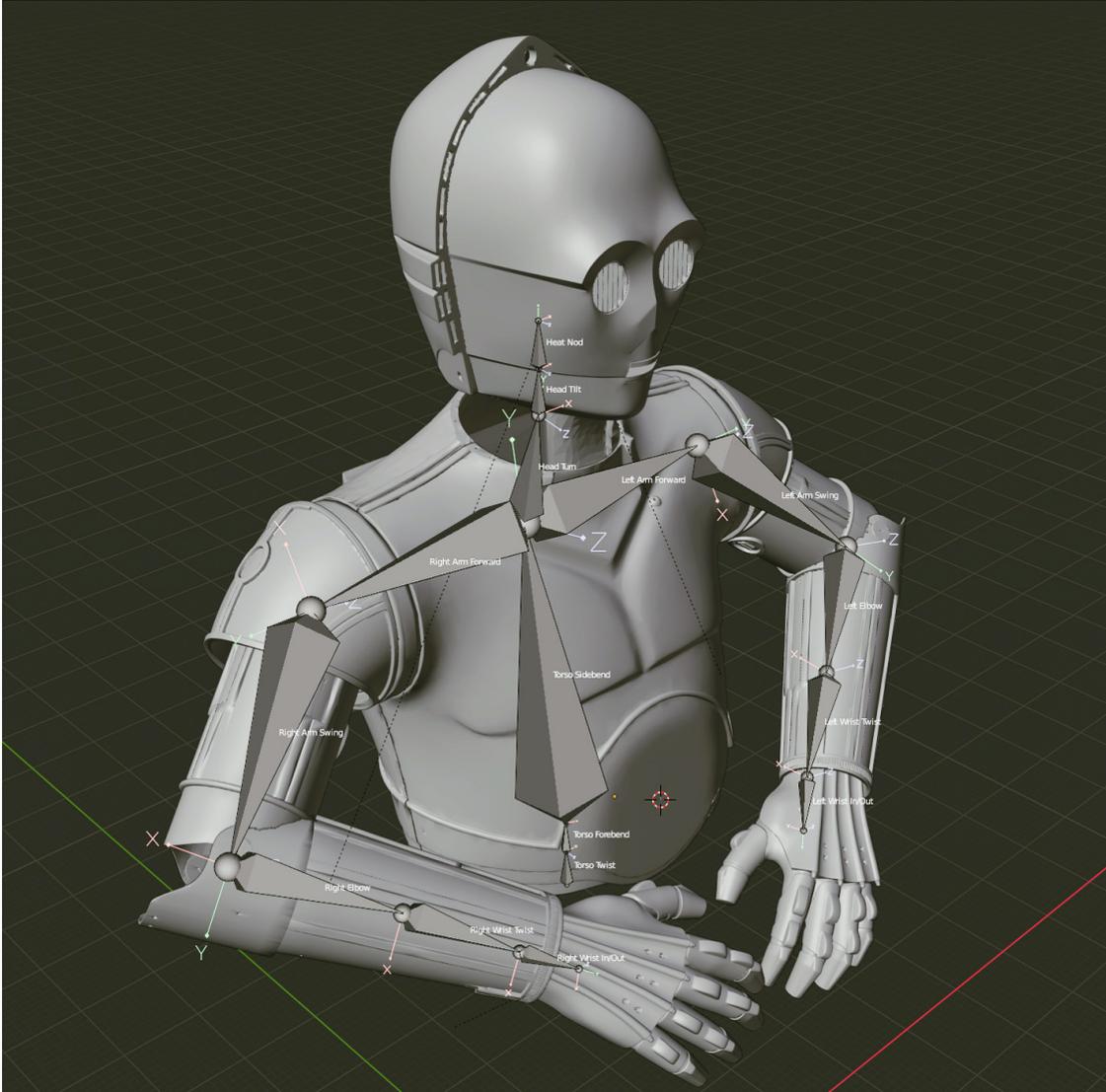
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- **Priming**
- **Sanding**
- **Paint/chroming**
- Weathering



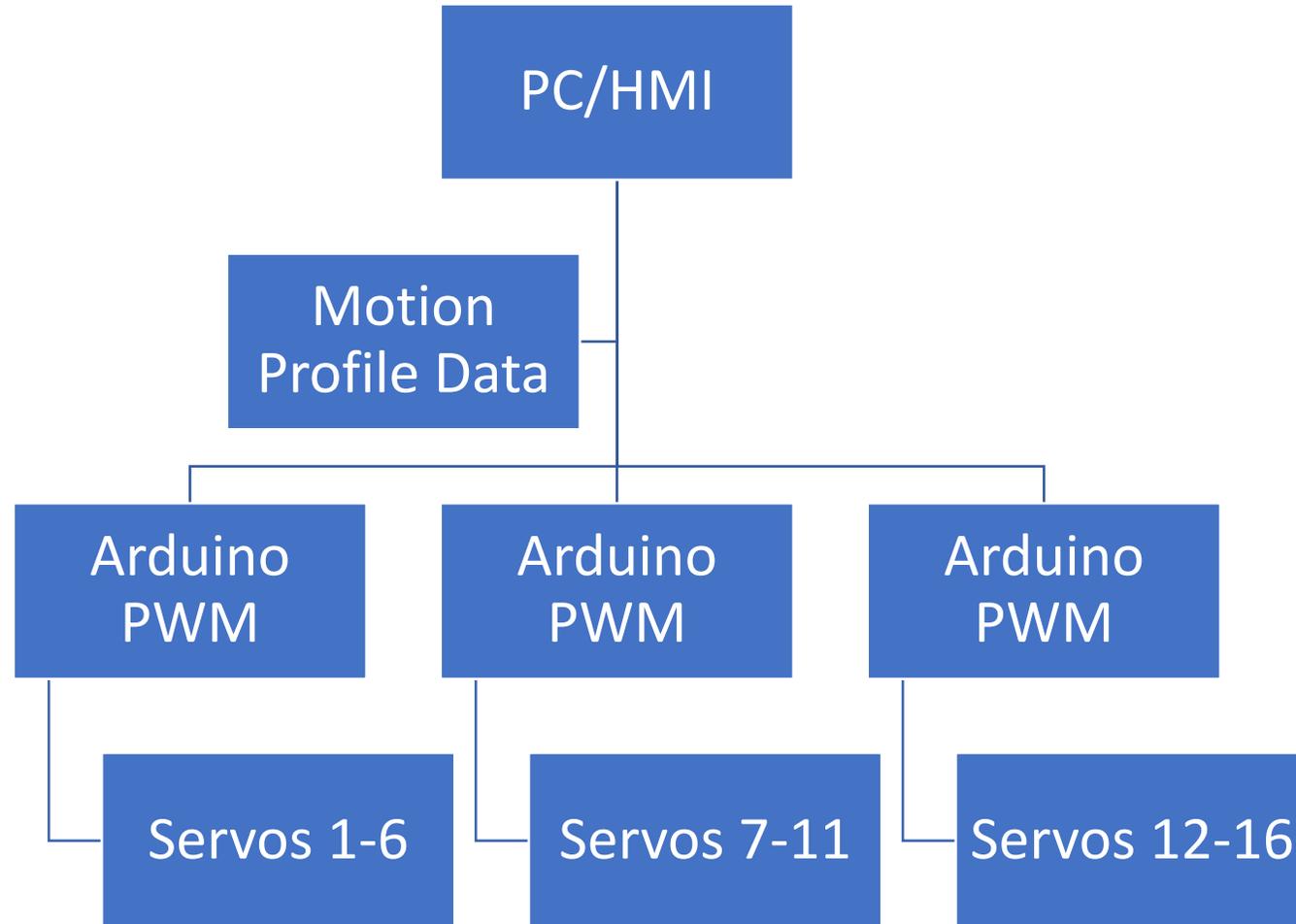
Animation Pipeline



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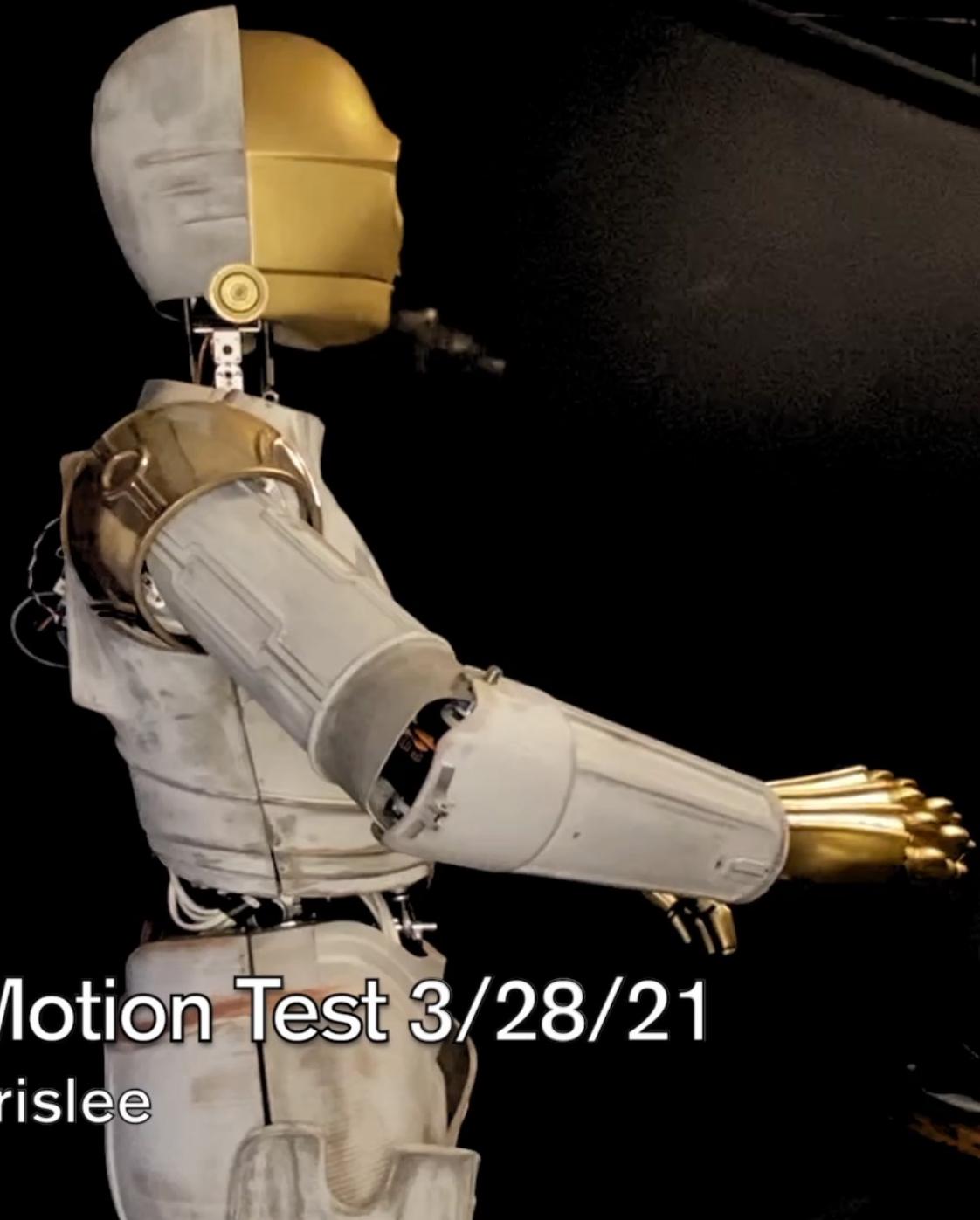


Show Control System





Meeting Anthony Daniels at Star Wars Celebration Chicago in 2019



Animatronic C-3PO Sync Motion Test 3/28/21

IG: @heyitschrislee

Thanks for watching.

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