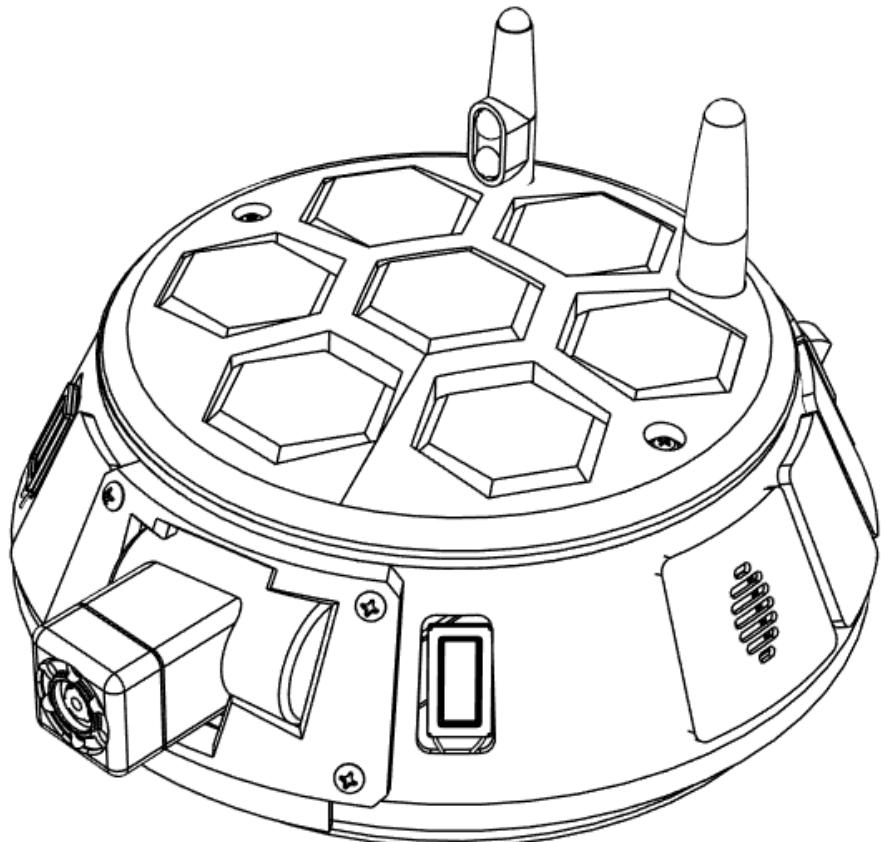

Skuttlebot

235 E Ocean Blvd
Suite 800
Long Beach, CA, 90803

Skuttlebot Dev Kit Assembly Instructions



We're so glad to have you join us in the development of Skuttlebot! This guide is meant to provide team specific information with regards to assembly of the Skuttlebot Command Unit-Dev Kit Assembly.

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What is Skuttlebot?

Our mission

Skuttlebot aims to create personal AIs that interact with the user through drones, ‘scuttling’ between devices. We seek to do this by creating both hardware and offboard software applications that can take advantage of existing systems resources. End result being an AI system that has the owners well-being at heart, able to be a lifelong companion as humanity enters its next wave of tech integration.

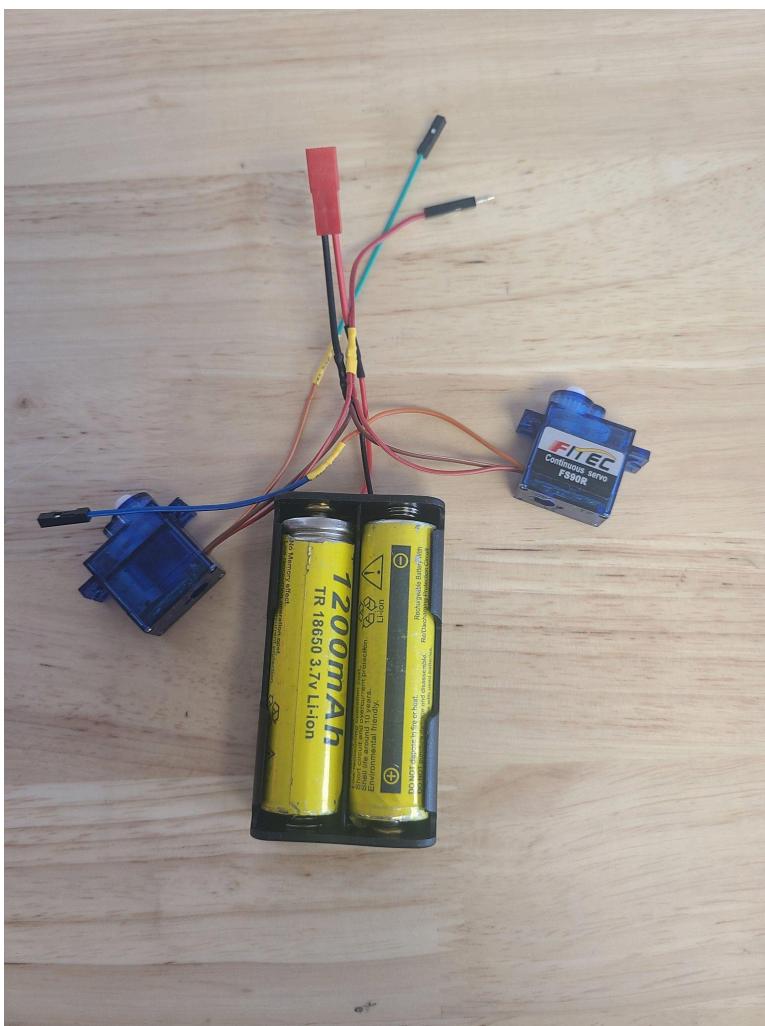
The team

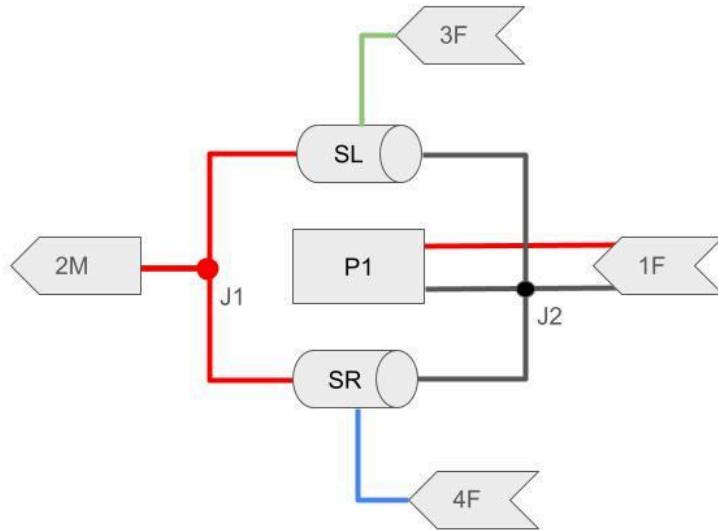
We have a core team led by our leading mad scientist, but we also look strongly to the community to join us in the development of Skuttlebot. We strongly believe in widespread involvement in AI & Robotic systems being the best path forward. We are developing the framework and the core OS while encouraging developers to create their own applications and subroutines. Our goal is to create an open marketplace for such apps, similar to many other devices.

Wiring Harnessing

Wiring Harness A

Wiring Harness A is the lower half of the Wiring Harness, attached to the base of the system, connecting directly to the battery. The positive and negative terminals are attached to the positive and negative leads from 1F, respectively. A single 1 pin male (2M) splits to 2 lines at junction J1, providing power to the 2 servos. Two control wires with female, 1 pin connectors, at 4F and 3F. Both servos ground line attach to the negative pole of the battery pack (P1 -).

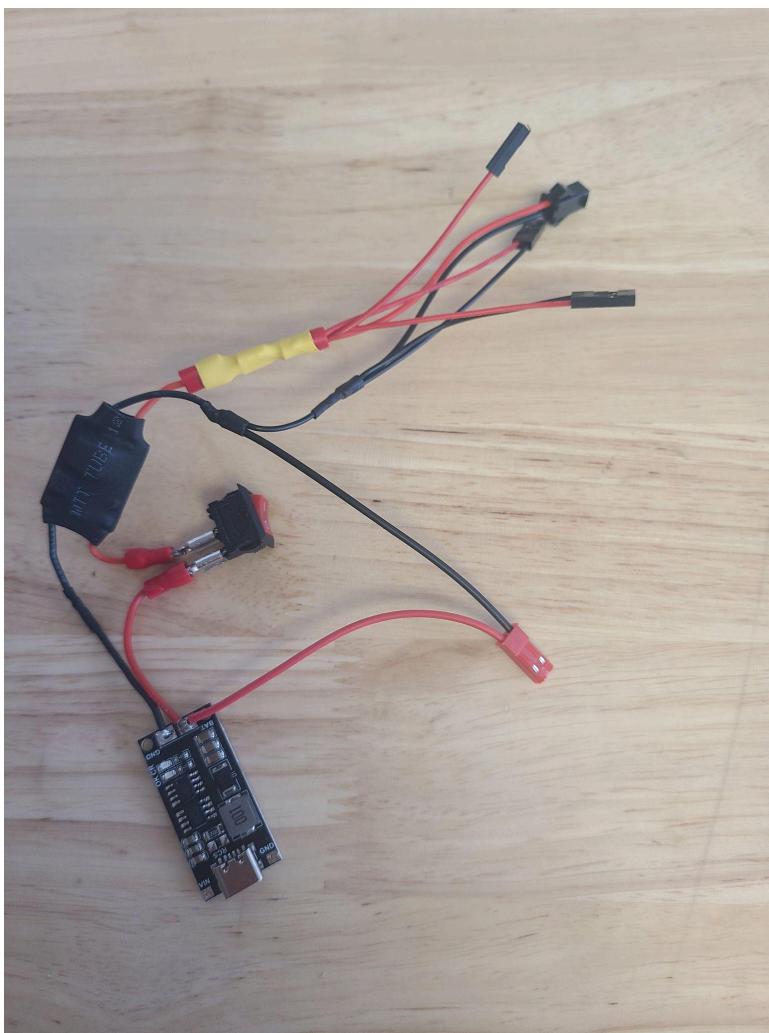


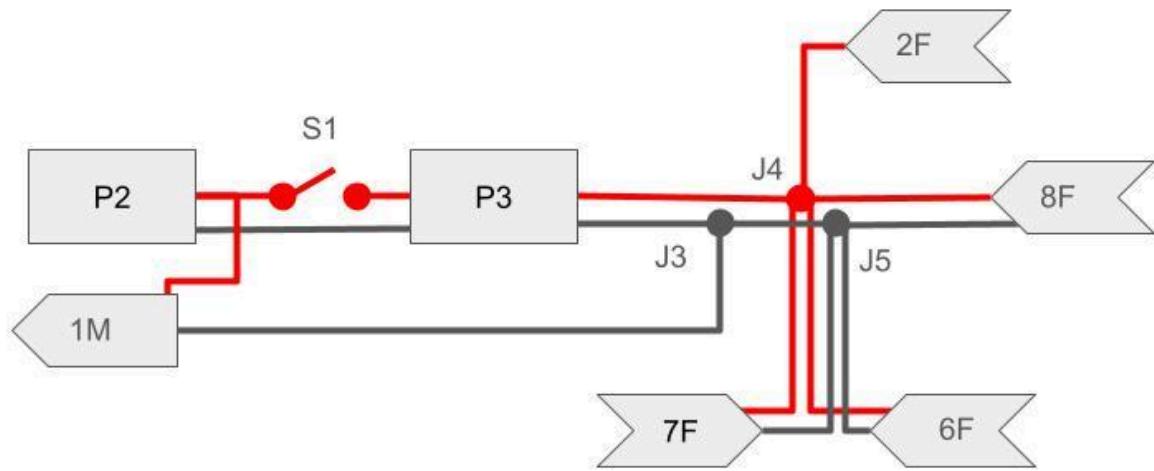


Lower Wiring Harness Connectors				
From	To	Connector	Color	Approx Length
P1-	J2	Junction	Black	1.5"
P1+	1F	Main Power, Female	Red	2.5"
J2			Black	1"
J2	SR	Junction	Black	2.5"
J2	SL	Junction	Black	2.5"
SL	J1	Junction	Red	2.5"
SR	J1	Junction	Red	2.5"
J1	2M	Single Pin, Male	Red	2.5"
SR	4F	Single Pin, Female	Blue	5"
SL	3F	Single Pin, Female	Green	5"

Wiring Harness B

Wiring Harness B is the upper power distribution harness, installed in the dome, and includes the battery charger board, power switch, voltage regulator and connectors power connectors to the battery, drive servos, camera servo, amp and the CPU. From the charger board, (MRB045) a 2 pin male connector (1M) is connected, black lead to the negative terminal and red to the positive. Additionally, from the positive terminal a single line connects to one pole of the switch, S1. From The second pin of the switch, connect to a Voltage regulator, and from its output, 4 red wires attach to the positive side of female connectors 6F, 7F and 8F and a single pin connector 2F. The negative wire from 6F, and 7F meet at J2 and a single line from J2 connects to the negative pole of the power regulator, which in turn connects to the negative lead of the main connector.

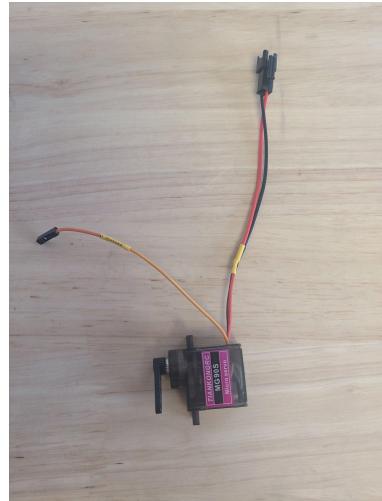
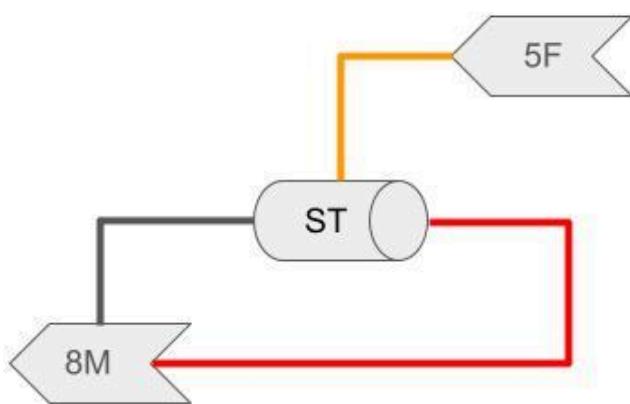




Wiring Harness B Connectors				
From	To	Connector Type	Color, Gauge	Approx Length
P2+	1M	Main Power, Male	Red	2.5"
J3	1M		Black	2.5"
P2+	S1 (in)	Spade, Female	Red	1.5"
P3+ (in)	S1 (out)	Spade, Female	Red	1.0"
P2-	P3-(in)	-	Black	2.5"
P3+ (out)	J4	Junction	Red	1.0"
P3- (out)	J3	Junction	Black	1.0"
J4	2F	Single Pin, Female	Red	2.5"
J3	J5	-	Black	1.0"
J4	6F	2 Pin, Female	Red	2.5"
J5			Black	2.5
J4	7F	2 Pin, Female	Red	2.5"
J5			Black	2.5
J4	8F	Camera Power, Female	Red	2.5"
J5			Black	2.5

Wiring Harness C

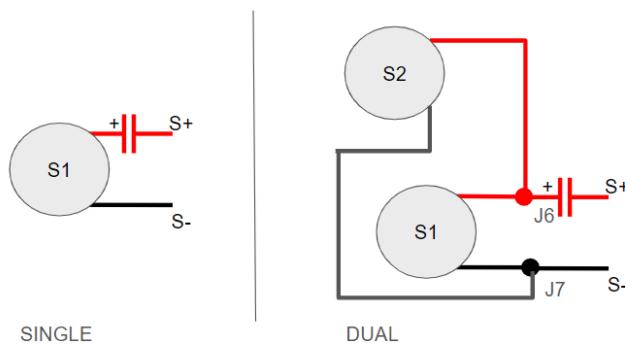
Wiring Harness C is the harness devoted to the camera servo, consisting of a 2 pin male connector (8M) attached to the power leads of the servo. A single line ending in a female connector serves as the control line, 5F.



Wiring Harness C Connectors				
From	To	Con Type	Color, Gauge	Approx Length
Servo	8M	Camera Power, Male	Black&Red	1.5"
Servo	5F	Single Pin, Female	Orange	2.5"

Wiring Harness D

Wiring Harness D is the speaker assembly, consisting of either one or two speakers and a 10k pF capacitor in series.



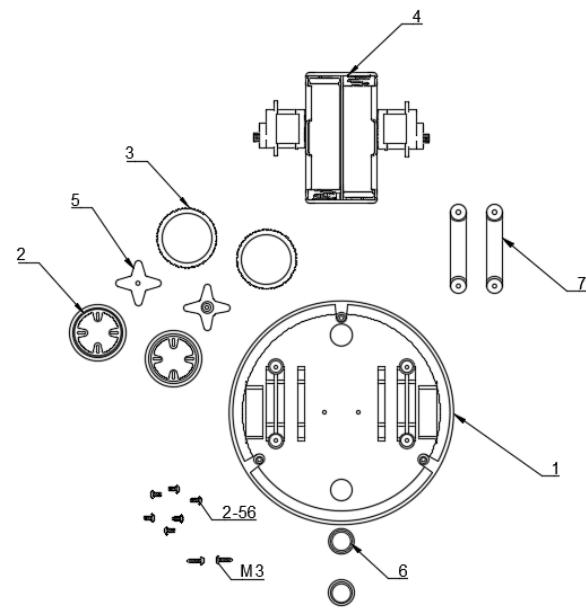
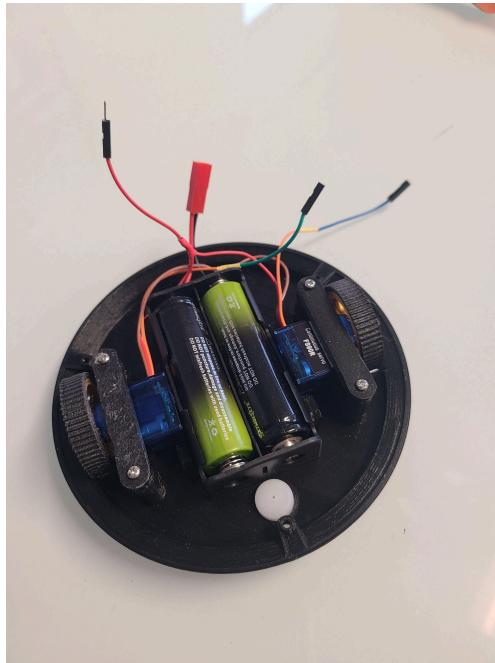
Wiring Harness D Connectors (Single)				
From	To	Con Type	Color, Gauge	Approx Length
S1	S+	Capacitor lead ‘-’	Red	3”
S1	S-	Bare Wire	Black	3”

Wiring Harness D Connectors (Dual)				
From	To	Con Type	Color, Gauge	Approx Length
S1	J6	Junction’	Red	3”
S1	J7	Junction	Black	3”
S2	J6	Junction’	Red	3”
S2	J7	Junction	Black	3”
J6	S+	Capacitor lead ‘-’	Red	1.5”
S7	S-	Bare Wire	Black	1.5”

Hardware Assembly

Physical assembly of the device is fairly straightforward with 3 major subassemblies. The base, the dome and the camera assemblies:

Base Assembly



Parts List		
QTY	Name	REF
1	Base	1
2	Hub	2
2	Tires	3
1	Wiring Harness A	4
2	Cross Arm	5
2	Rollers	6
2	Motor Brackets	7
2	screw	M3

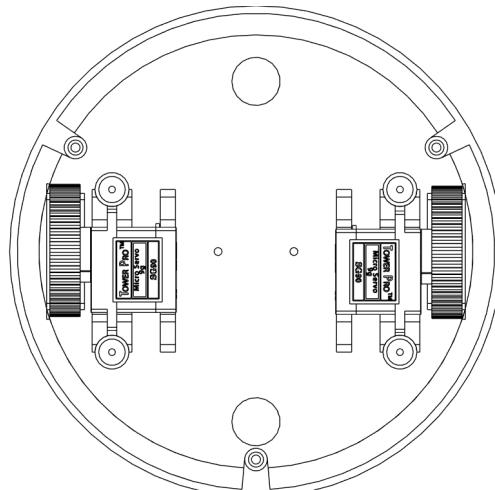
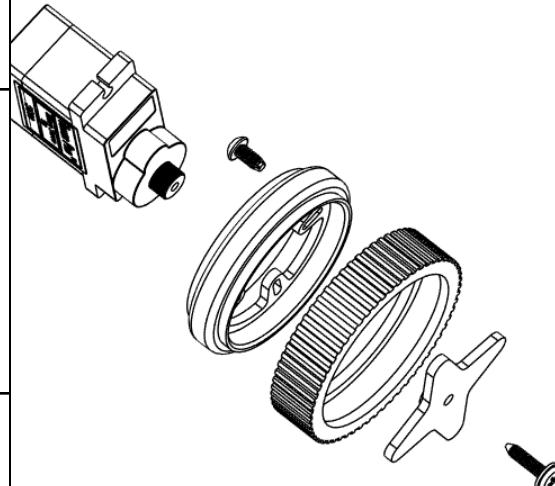
6	screw	2-56 3/8" Tap Screw
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1. (2X) Install the tires to the hubs, by stretching the tire around the retaining ridge on the hub.

2. (2X) Place the Cross arm into the hub from the beveled side of the hub, so that the receptacle cap on the arm using a single 2/56 screw from the receptacle side, through the hub slot and into the cross arm.

3. (2X). Attach the hub assembly to each motor on the Wiring Harness
A. Secure with a single M3 screw in the center of the arm.

4. Align the base so that the central internal mating tab is in the 6 o'clock position as shown.

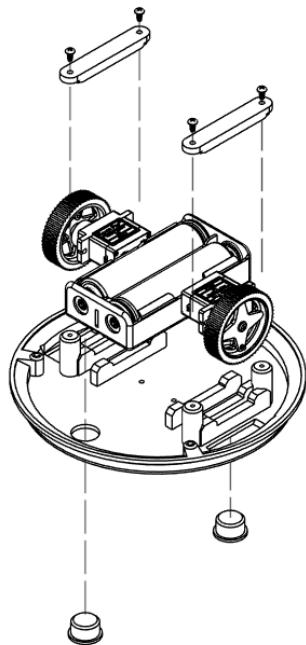


5.

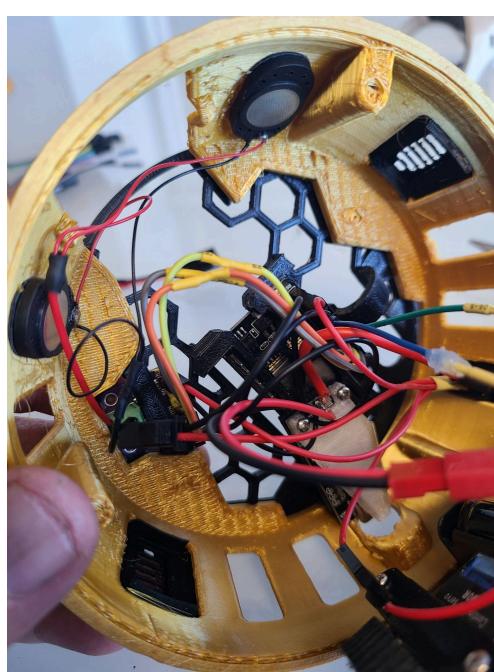
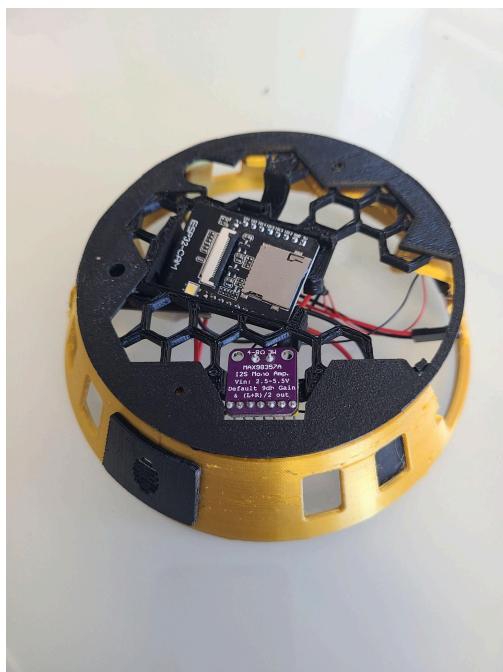
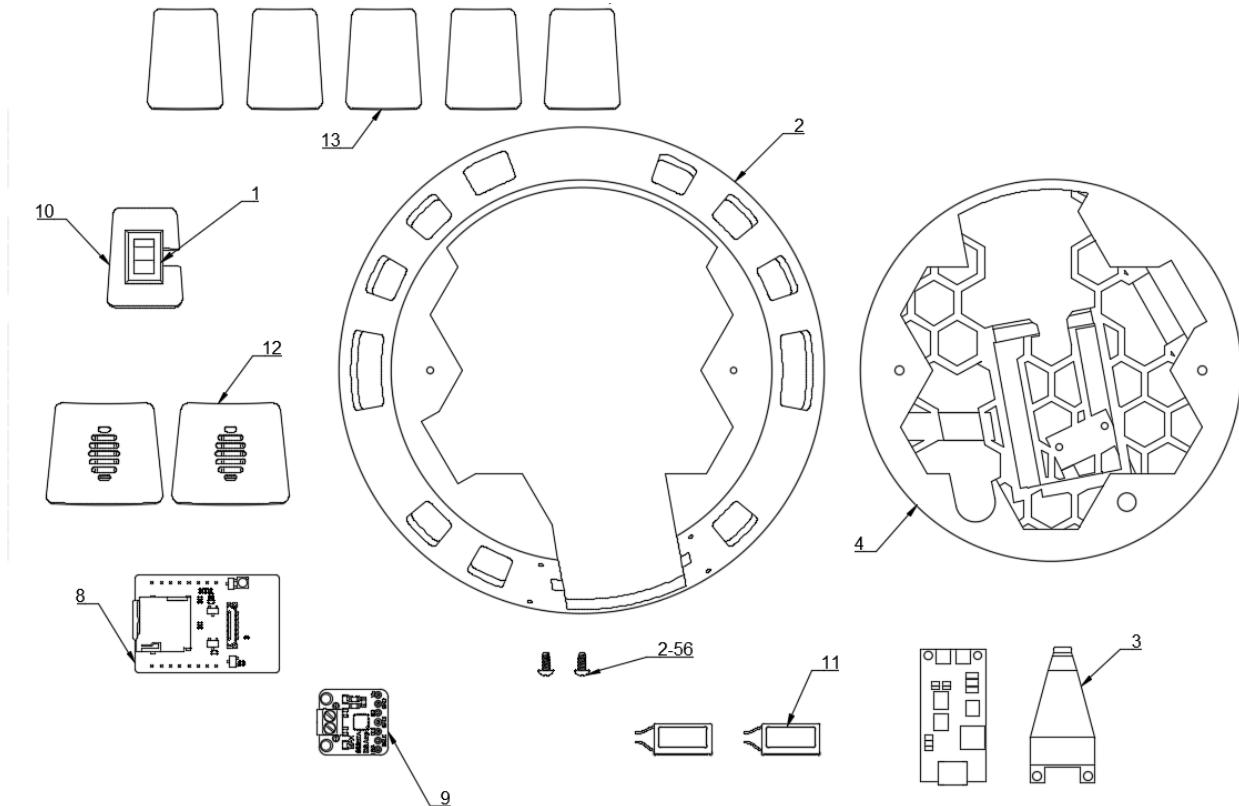
6. Insert the left and right into their respective brackets. Secure with servo brackets and 2 screws (2-56) for each bracket.

7. Insert rollers into mounting holes. Secure with adhesive if necessary.

8. Place the battery pack into the space between the servo mounts. A light interference will be present when rollers and motors are installed. Secure with adhesive or screws optional.

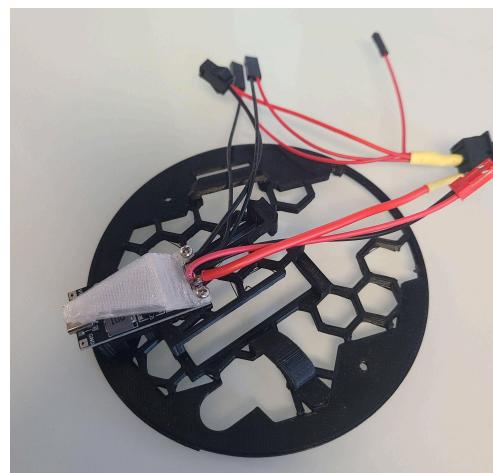


Dome Assembly

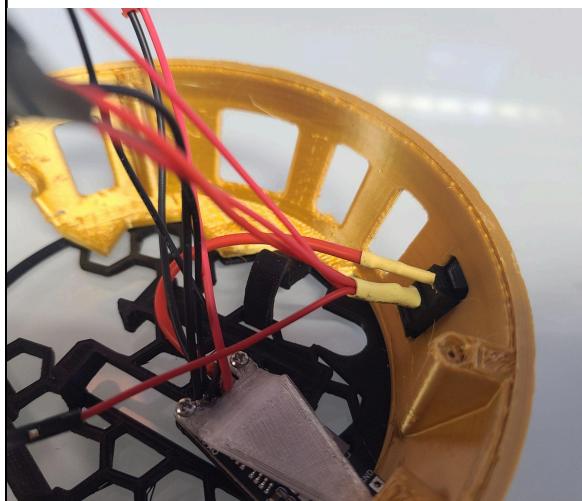


Parts List		
QTY	Name	Ref
1	Wiring Harness B	1
1	Dome	2
1	LED Indicator	3
1	Electronics Manifold	4
1	4" F2F Jumper -Grey	5
1	4" F2F Jumper -White	6
1	4" F2F Jumper -Purple	7
1	ESP32 AI Thinker-Cam	8
1	MAX 98357A	9
1	Switch Panel	10
2	Speakers	11
2	Mic Plate	12
5	Small Dome Plate	13
2	Screws	2-56

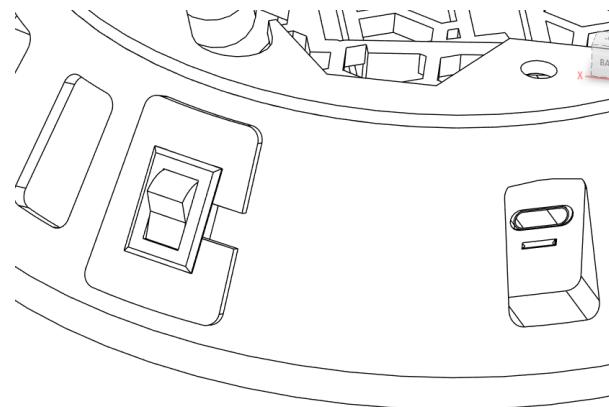
9. Attach the charger on Wiring Harness B with the LED Indicator to the electronics manifold using 2 screws.



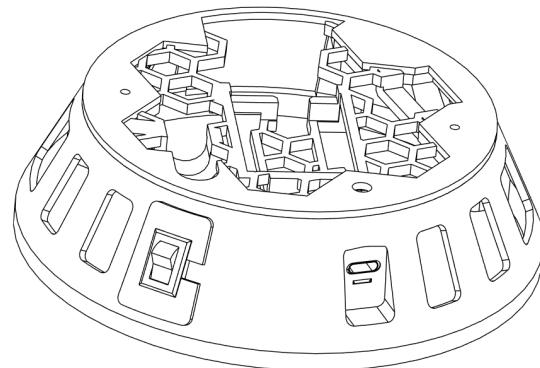
10. Feed the switch through the noted hole in the dome, and attach to the power panel.

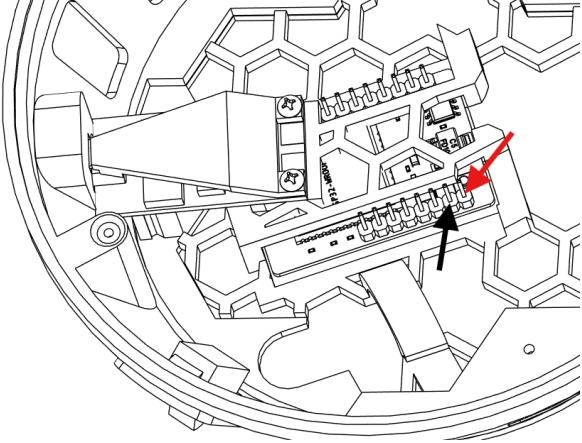
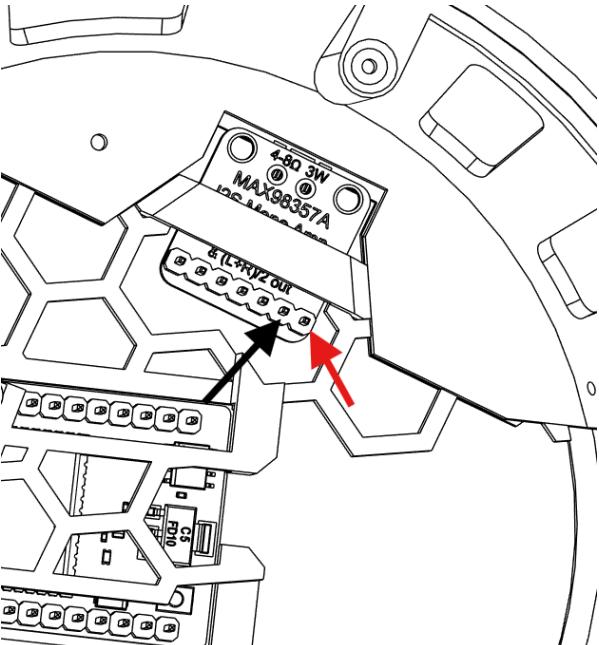
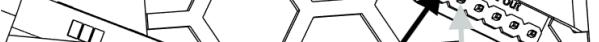


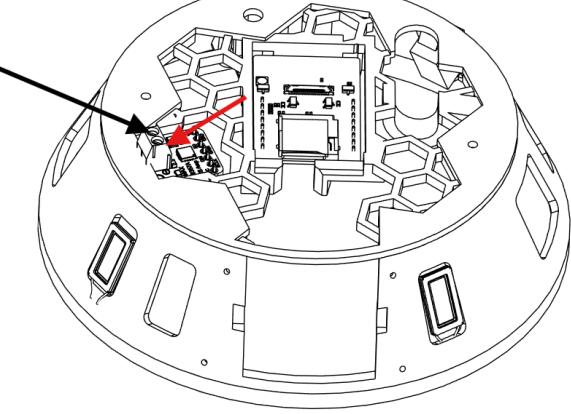
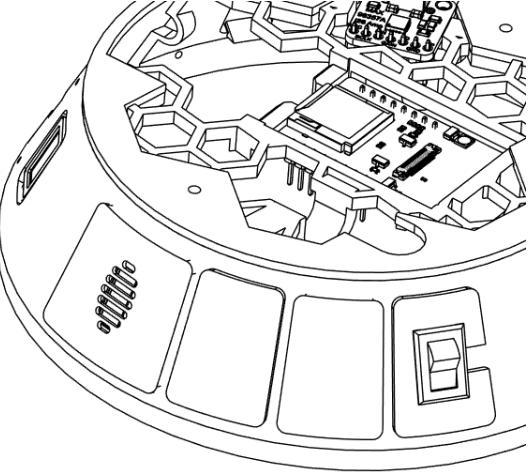
11. Snap the power panel into position on the dome



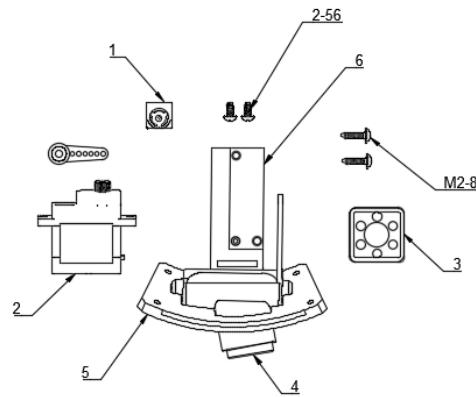
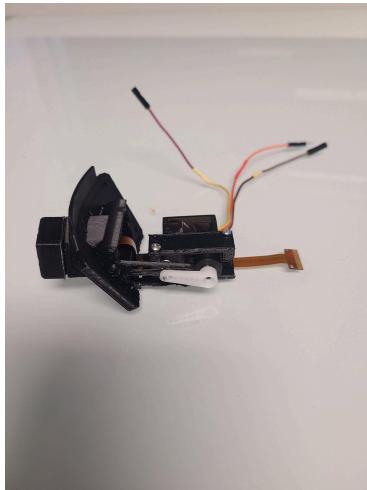
12. Place the electronics manifold into the top of the dome, allowing for raised features to align the parts together.



<p>13. Place the ESP32 into the cradle of the electronics manifold and the 6F connector to the 5V and adjacent ground pin. >>CAUTION<< ensure powered lead (red) is on the 5V pin of the ESP32. Misalignment will damage or destroy the chip.</p> <p>Note: if using an external antenna ensure the lead is connected</p>	
<p>14. Place the MAX 98357A into the cradle of the electronics manifold. Use Jumpers to connect the ESP32 3.3V and ground to the VIN and adjacent ground pin respectively..</p> <p>>>CAUTION<< ensure powered lead (red) is on the VIN pin of the MAX 98357A. Misalignment will damage or destroy the chip when powered.</p>	
<p>15. Use the 4" F2F Purple jumper to connect the IO14 pin on the ESP32 to the LRC of the I2S amp.</p>	
<p>16. Use the 4" F2F White (black arrow in illustration) jumper to connect the IO02 pin on the ESP32 to the BCLK of the I2S amp.</p>	
<p>17. Use the 4" F2F Grey jumper to connect the IO04 pin on the ESP32 to the DIN of the I2S amp.</p>	

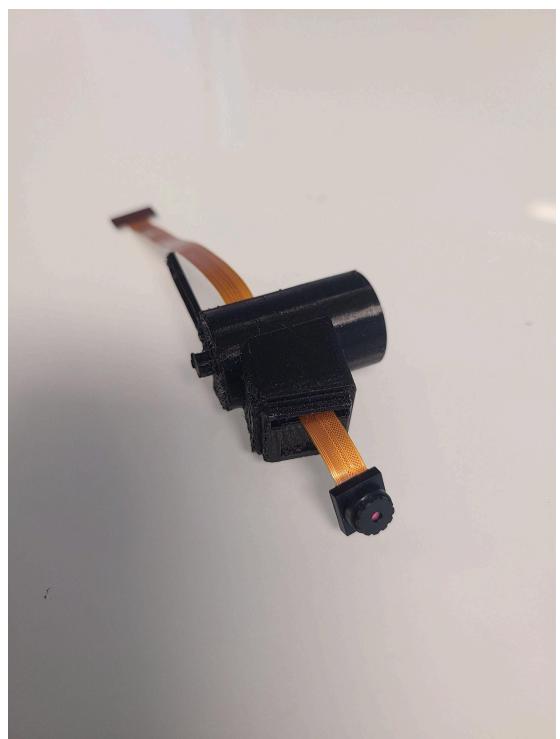
<p>18. Remove the protective tape and adhere both speakers to their respective positions as shown.</p>	
<p>19. Attach the speakers wires to the terminal of the I2S Amp.</p>	
<p>20. Snap into place 5 of the small dome plates</p>	
<p>21. Snap into place 2 of the microphone housing plates</p>	

Camera Assembly



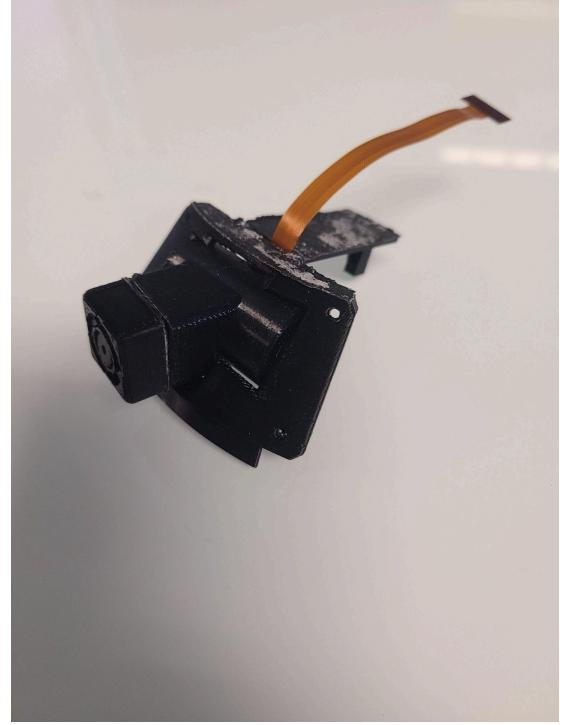
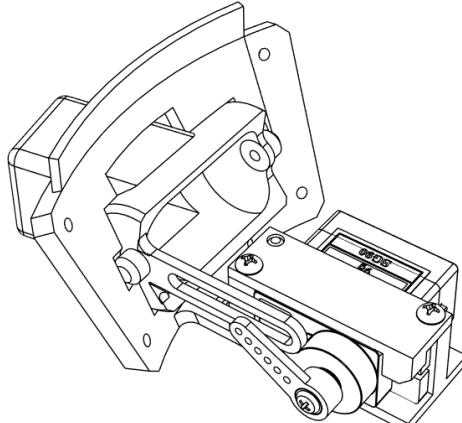
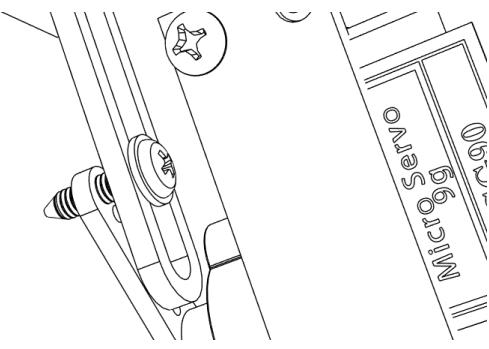
Parts List		
QTY	Name	REF
1	Camera	1
1	Wiring Harness C	2
1	Camera Cap	3
1	Camera Housing	4
2	Camera Mount	5
2	Camera Bracket	6
2	screw	2-56
2	screw	M3

22. Thread the camera connector tab through the horizontal slot of the camera housing.

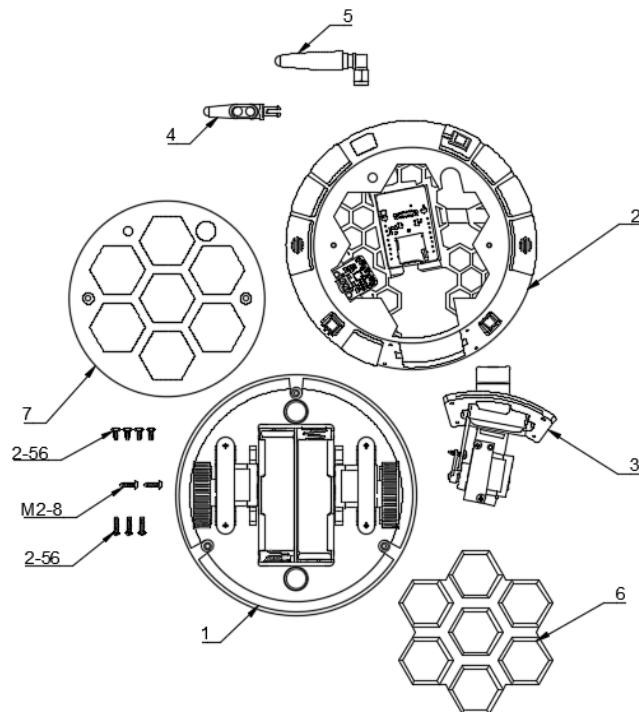


23. Press camera cap to the camera housing to secure and align camera.



<p>24. From the ‘inside’ of the camera mount, insert the camera housing with the vertical slot for the camera connector in the up position. This will be a very loose fit, to be secured later in the assembly.</p>	
<p>25. Insert the camera connector tab through the slot on the camera mount, so the flat cable is on ‘top’.</p>	
<p>26. Secure the camera with the servo bracket and attach with 2x 2-56 screw</p>	
<p>27. Insert the servo of Wiring Harness C as shown and install the mounting arm using a M3 screw.. Note: Rotate the motor arm to its full counter clockwise position, then remove and position the arm to align with the top corner of the housing, nearest the camera (see illustration).</p>	
<p>28. Connect the camera housing to the servo arm with a single M3, flanged screw. It should remain free to move and not pull on the cable arm, so a few turns should be sufficient.</p>	

Final Assembly

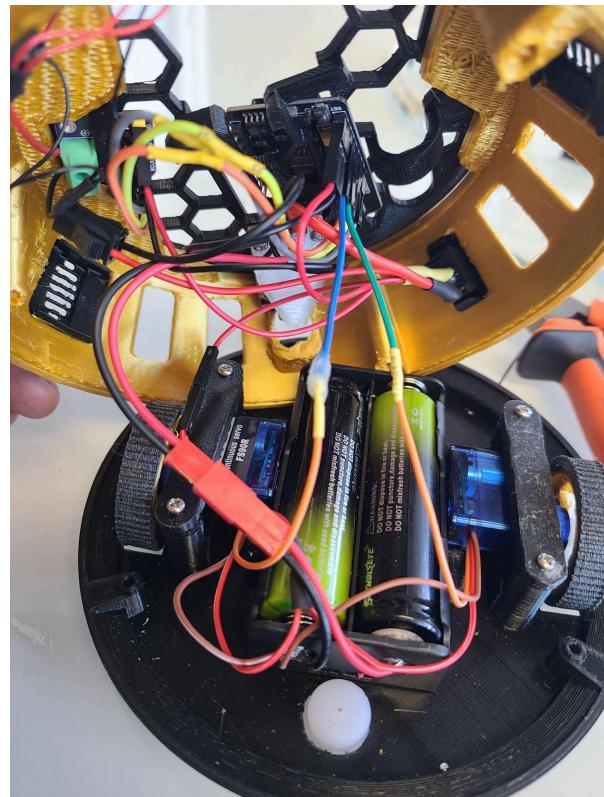


Parts List		
QTY	Name	Ref
1	Base Assembly	1
1	Dome Assembly	2
1	Camera Assembly	3
1	Faux Antenna Clip	4
1	Antenna	5
1	Hex Fill	6
1	Hex Cap	7
2	Screws	M3
4	Screws	2-56
3	Screws	M2-4x8

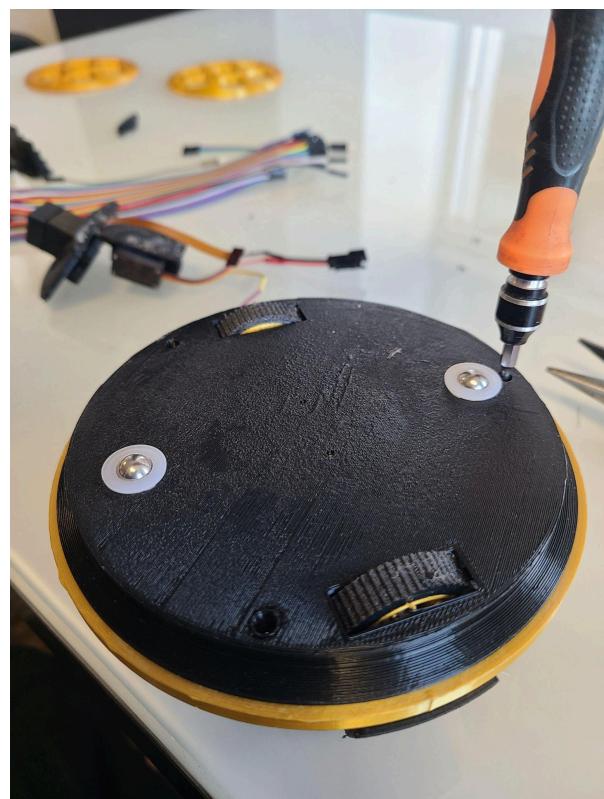
29. From the base assembly connect power leads 1F to 1M and the single 2M to 2F

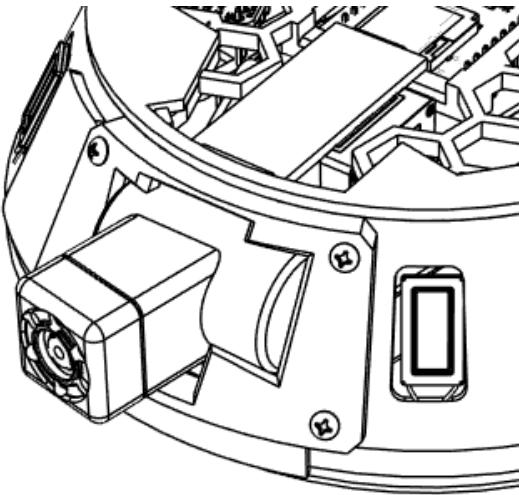
30. Connect control lead 3F to IO12 on the ESP32

31. Connect control lead 4F to IO13 on the ESP32

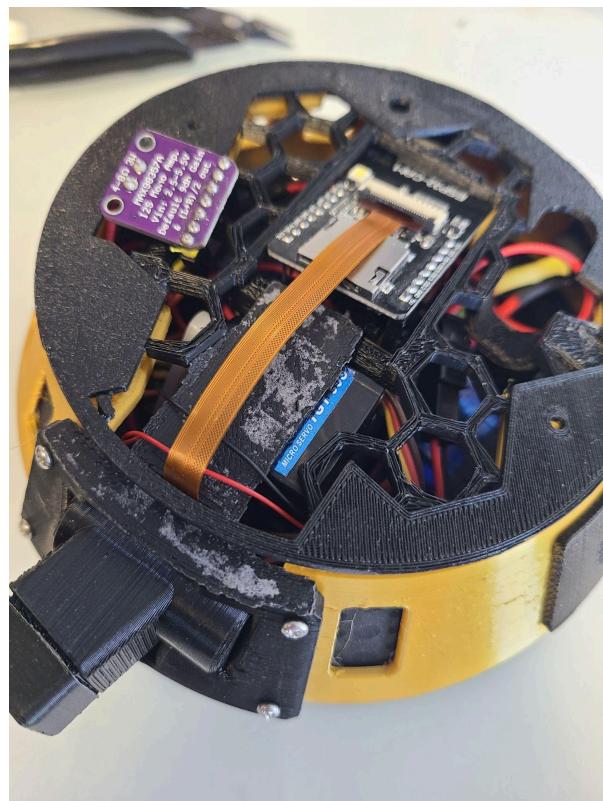


32. Carefully seat the upper assembly onto the 3 mounting features, so that the opening for the camera is opposite of the middle feature. Fasten using the 3 M2-4x8 screws

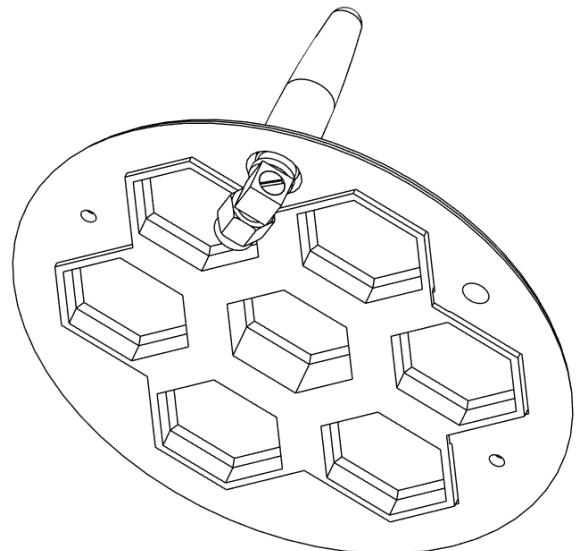


33. Connect connectors 8M to 8F, ensuring red leads are aligned.	
34. Connect the control lead 9F to IO15 on the ESP32.	
35. Slide the camera assembly from the front of the dome. Features on the manifold should align the assembly. Ensure speaker wires are not caught during insertion.	
36. The camera housing pins should be captured by features on the dome and the camera mount. When the fit is snug with the dome, secure the assembly with 4 screws, aligning to the mating holes. At this stage, the threads are not modeled, instead we rely on the threads of the screw to grab printed material. Do not over tighten as a result.	

37. Connect the camera to the ESP32, carefully inserting the flat harness lead into the exposed video connector.



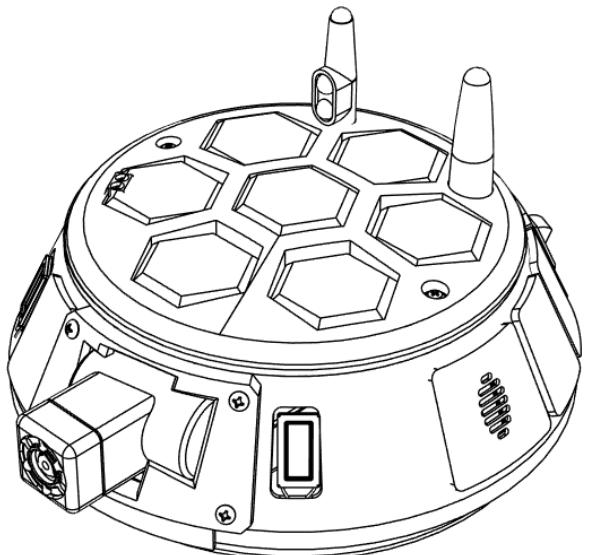
38. Snap the hex fill component to the hex cap. Then insert the external antenna into the larger hole.



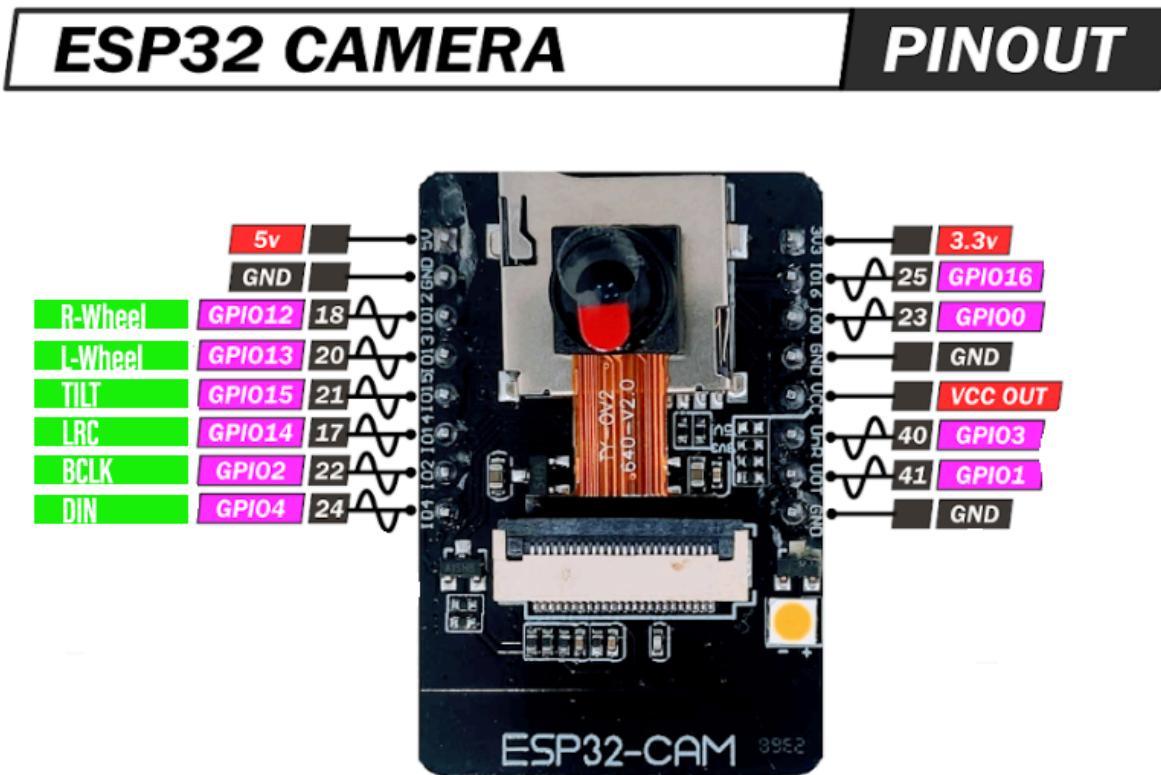
39. OPTIONAL if the external antenna will be used, connect the lead from the esp32 to the antenna receptacle

40. Position the cap assembly so the antenna rests in the antenna cradle of the manifold. Pin the layers together using the faux antenna clip.

41. Use the 2 M3 screws to secure the top to the body.



Appendix A: ESP32 Pinout



Appendix B: Fabricated Parts

The following parts required for the build may be purchased directly, or fabricated with latest STEP files.

QTY	Name	Material
1	Base	PETG/ABS/SLA
2	Hub	PETG/ABS/SLA
2	Tires	TPE
2	Motor Brackets	PETG/ABS/SLA
1	Dome	PETG/ABS/SLA
1	LED Indicator	PETG/ABS/SLA
1	Electronics Manifold	PETG/ABS/SLA
1	Switch Panel	PETG/ABS/SLA
2	Mic Plate	PETG/ABS/SLA
5	Small Dome Plate	PETG/ABS/SLA
1	Camera Cap	PETG/ABS/SLA
1	Camera Housing	PETG/ABS/SLA
1	Camera Mount	PETG/ABS/SLA
1	Camera Bracket	PETG/ABS/SLA
1	Hex Cap	PETG/ABS/SLA
1	Hex Fill	PETG/ABS/SLA
1	Faux Antenna Clip	PETG/ABS/SLA

Appendix C: COTS Parts List

The assembly involved the following components which can be purchased via retail.

QTY	Wire Harness Ref	Description	Link	Img
1	P1	18650 Battery Holder, 2 slots	Battery Holder	
2	SR, SL	FS90R 360 degree continuous rotation micro servo +Cross	Rotary Servo	
1	ST	MG90 Micro Servo	Servo	
1	1F, 1M	JST RCY Plug Connectors Cable Wire for RC Toys Battery	Main Power Connector	
1	8F, 8M	Micro Connector Set	Camera Power Connector	
1	2M, 2F, 3F, 4F, 5F, LRC, DIN, BCLK	Make from: Mixed Male-Female 10cm Jumper, Varying colors	Jumpers	

1	6F, 7F	Female-Female 70cm Jumper, 2 pin, Dupont, Red & Black	Power Jumper	
1	S1	Mini Boat Rocker Switch	Switch	
1	P2	Type C BMS 2S 2A 3.7V charge module	Charging Board	
1	A1	MAX98357 3W amp	Amp	
1	CPU	ESP32-CAM (AI Thinker)	ESP32	
1	P3	3A 5V DC-DC Converter Step Down UBEC Module	5V Regulator	
1	-	OV2640 Camera, 120mm lead	OV2640	

2	-	18650 9900mAh	Battery	
2	-	Mini Ball Transfer Bearing	Roller	
2	-	1W 8 Ohm Mini Speaker	Speaker	
3	-	M3-0.5, 12mm flanged screw	M3 Flanged Screw	
12	-	#2x1/4" pan Head Self Tapping Screws	#2 Self Tapping Screw	
3	-	M2-.04 Coarse x8mm	M2 Screw	
2	-	.11" Red Female Spade Wire Connector		
1	-	E6000	Adhesive	

Appendix D: Connector Map

Connector Map		
From	To	Note
1F	1M	Main Power
2M	2F	Motor Power
3F	ESP32-Pin 12	Right Servo
4F	ESP32-Pin 13	Left Servo
5F	ESP32-Pin 15	Tilt Servo
6F+	ESP32-5V	ESP32 WARNING!
6F-	ESP32-GND	Do Not Reverse, damage to chip will occur.
7F+	A1-Vin	I2S Amplifier WARNING!
7F-	A1-Ground	Do Not Reverse, damage to chip will occur.
8F	8M	Camera Power
ESP32-14	A1-LRC	I2S Amplifier input
ESP32-2	A1-BCLK	
ESP32-4	A1-DIN	
S+	A1-OUT+	I2S Amplifier output
S-	A1-OUT+	

Revisions

1.0	Initial Release	5/9/2024
1.1	Updated wiring harness diagrams and added the 5V 3A regulator into wire harness B	6/4/24
1.2	Updated Camera alignment information	6/10/24
1.3	Added wire harness D and top level schematic	