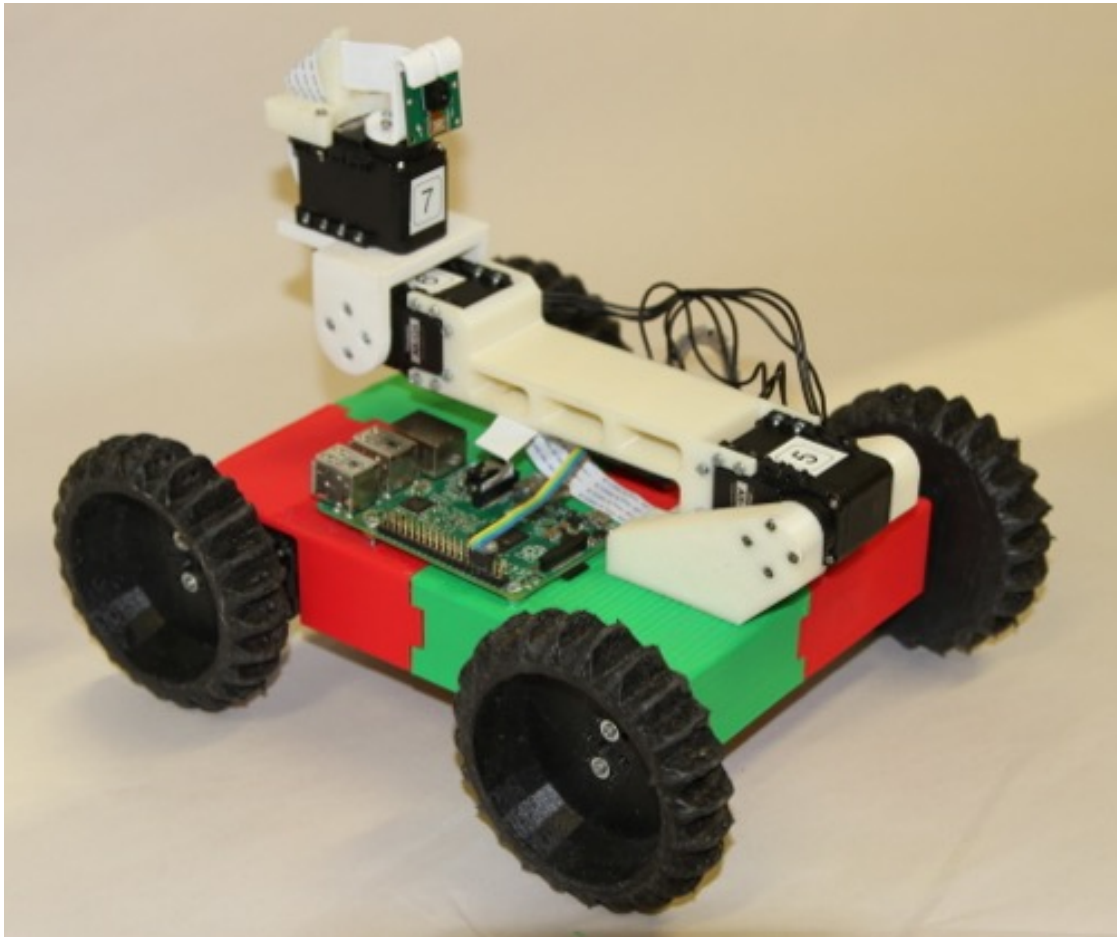Open Academic Robot Kit Instructable

For the EMU

by justadandtguy
Version 1 - November 2015

For recent information on the project and to tell us about your build visit
oarkit.intelligentrobots.org

Open Academic Robot Kit Instructable

Introduction:

Listed below is a set of build instructions for the Open Academic Robot Kit (OARKit)
This is a Open Source multi platform teaching and learning project. Recent updates
and background information on this Project can be found here.

Before you begin this Instructable you will need to 3D print the main chassis parts
from here and the additional camera arm parts here.

Additional information and resources for the project can be found here

Enjoy ☺

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Step 1: Once you have successfully 3D printed the individual parts you will need to slightly adjust the interference fit of the base parts; I used a small flat file and fine grade (180) sandpaper to accomplish this.

Hand file and sandpaper

Step 2: You should now have 2 halves of the base chassis fitting together.
(I printed mine in Green and Red for Port and Starboard direction clarity when driving later on)
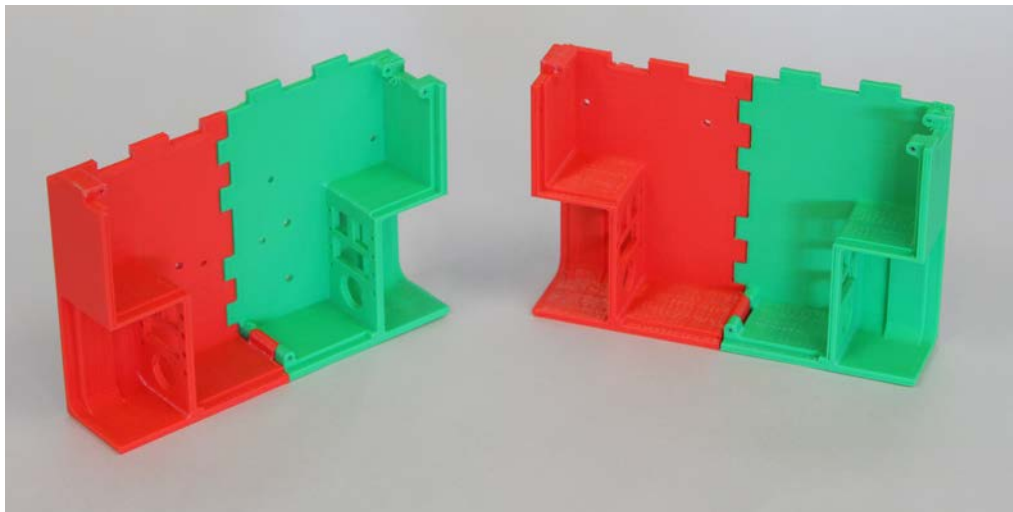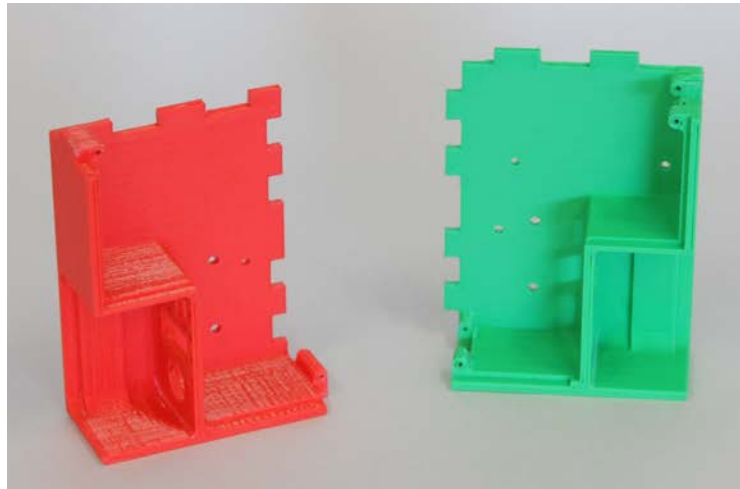
Halves of the OAR EMU Chassis

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Step 3: The two completed halves can be fitted together. Check for close fitting but be careful not to force the tabs and snap them.
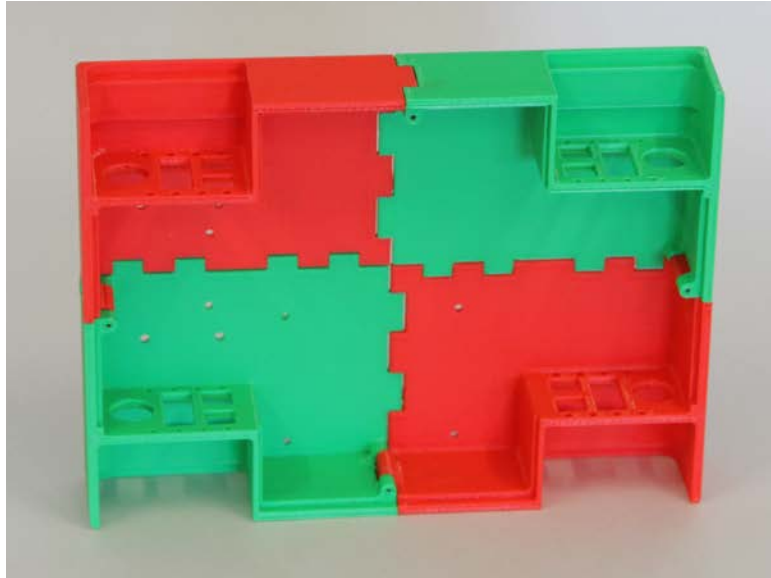
Emu chassis connected together

Step 4: Attach the 4 Servos to the corners, this is done using M2 x 30mm Set screws and M2 Nuts. You will find the nuts sit in slots on the face edge. There are 8 screws per Servo, you can use only 4 if you like. I have added some stickers to the servos at this stage this is to help with the programming at a later stage although it is not strictly necessary.
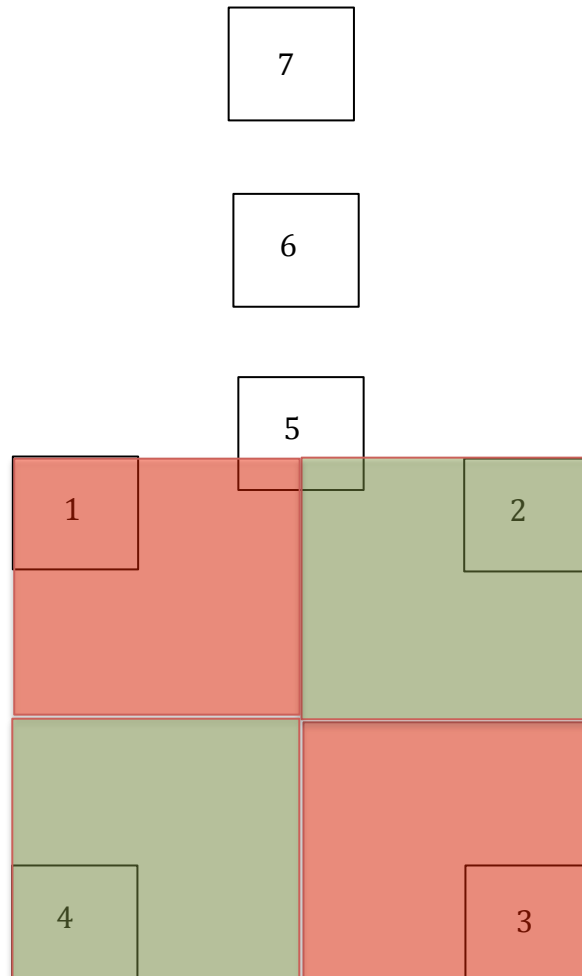
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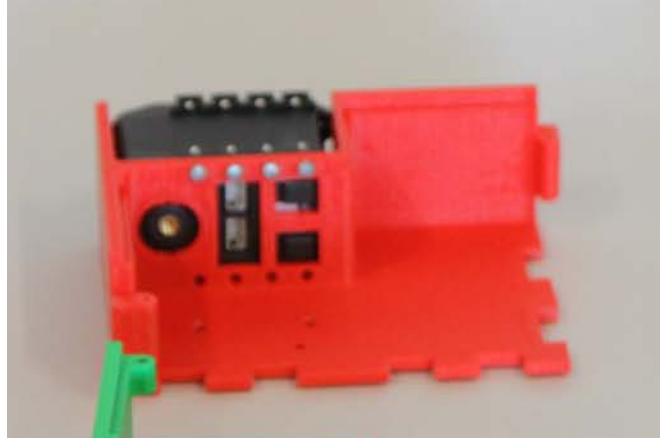The Servos used in this build are Dynamixel AX-12A

Click here for more info.

7	
6	
5	

1	2
4	3

Top View Plan of Servo Map for OAR Emu Robot

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Underside of 1/4 OAR EMU Robot with Servo connected

Step 5: The chassis parts can be connected together to form 2 halves. There is no need to screw these together at this stage.
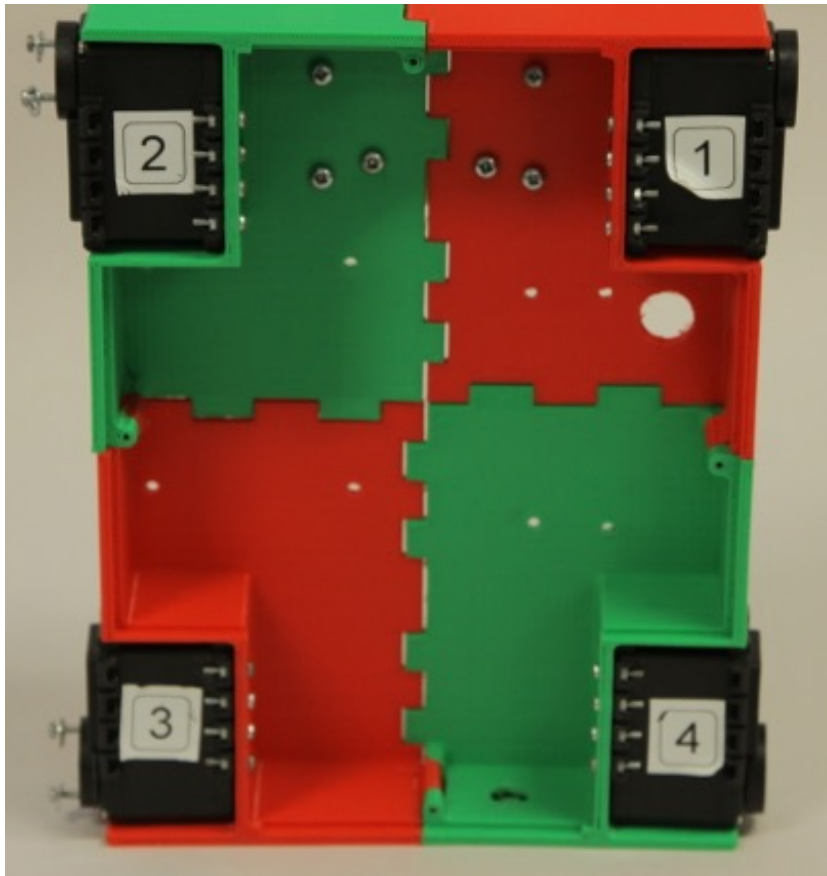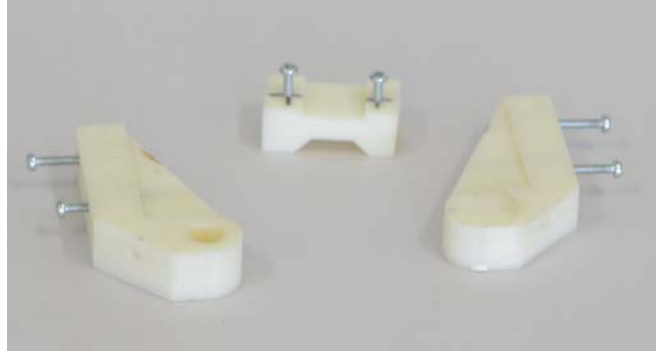

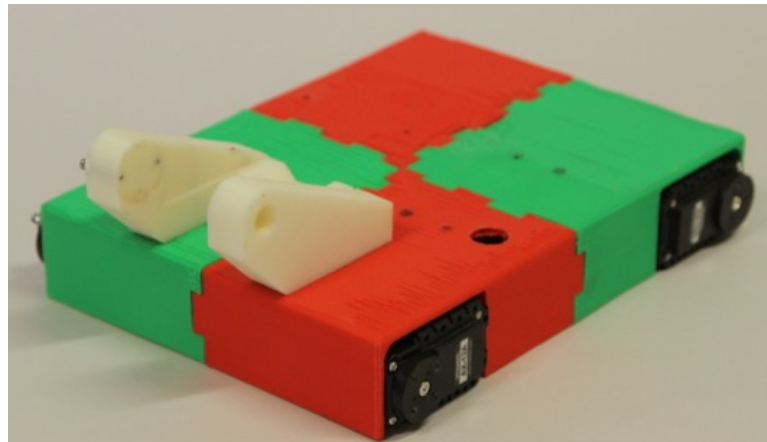Underside of OAR EMU Robot with Servos connected

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Step 6: The Base Mounting for the Arm can be screwed to one set of the halves, use M4x 30mm for the camera cable keeper (middle section) and M3 x 40mm for the Base Mountings. Again you might need to slightly adjust the ends of the camera keeper with a file or sandpaper to fit snugly.

Base Mounting assembly detail
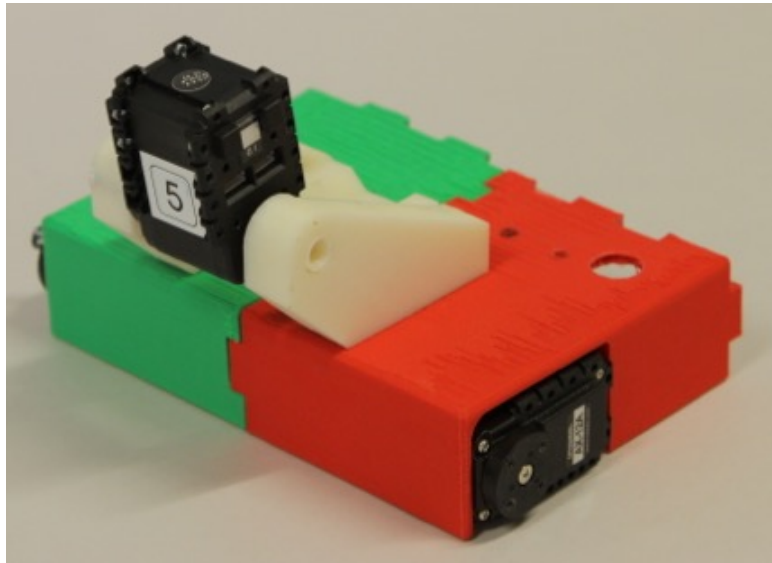

Base Mounting attached to Chassis

Step 7: The Arm Servo (5) can be connected to the Base Mounting. Use M2 x 20mm on the Right Hand Side as longer screws can penetrate the servo plate into the motor. Use a M3 x 15 with the **spacer Bush on the Left Hand Side**

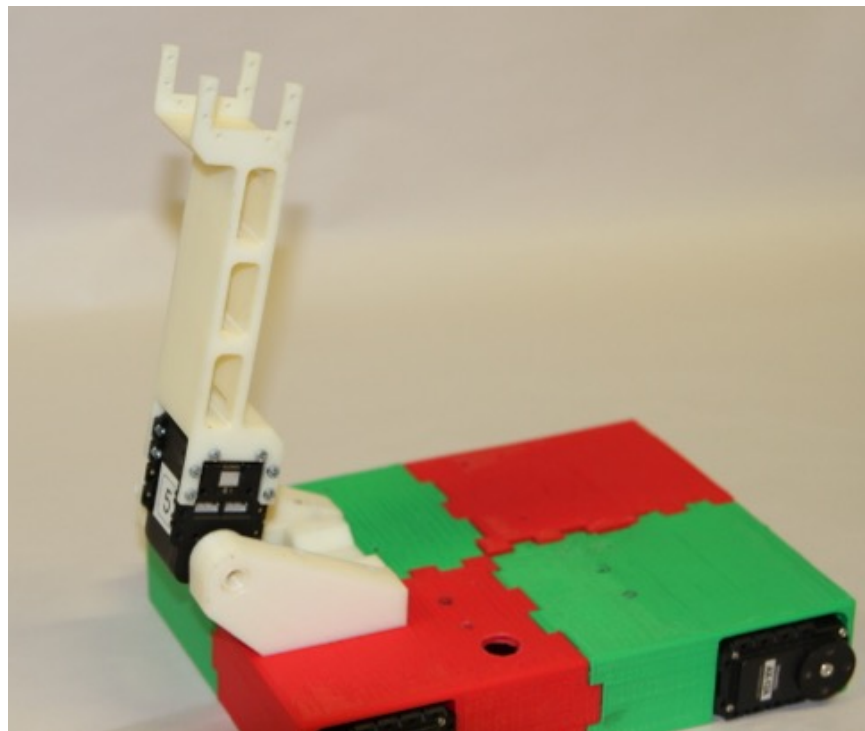Servo 5 connecting details with spacer for Left Hand Side

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Servo 5 attached to Base Mounting

Step 8: The main Arm can be attached to this servo body. Use 12 x M2 x 15mm for the arm to Servo body screws. Take care with the orientation of the arm!
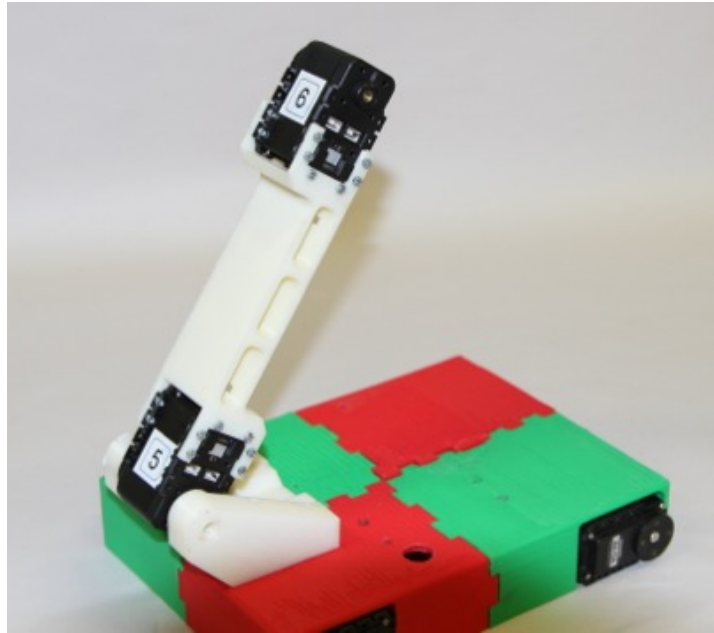

Arm attached to Servo 5.

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Step 9: Attach the Wrist Servo (6) to the other end of the Arm. Use 12 x M2 x 10mm for this.

Servo 6 attached to Arm

Step 10: Attach the Camera Servo (7) to the Camera Mounting. Use 8 x M2 x 15mm for this.

Camera Servo attached to Servo 7

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Step 11: Attach the Camera Mounting to Servo (6). Use 1 x M3 x 15 and 4 x M2 x 15mm for this

Camera mount attached to Servo 6

Step 12: Attach the Camera Plate to the top of the Servo (7). Use 3 x M2 x 10mm for this. Take care with the orientation of the Plate. Ensure the line on the Servo (7) and plate align.
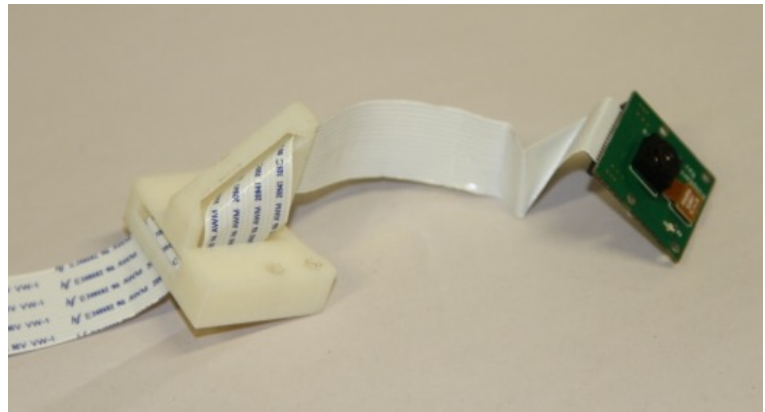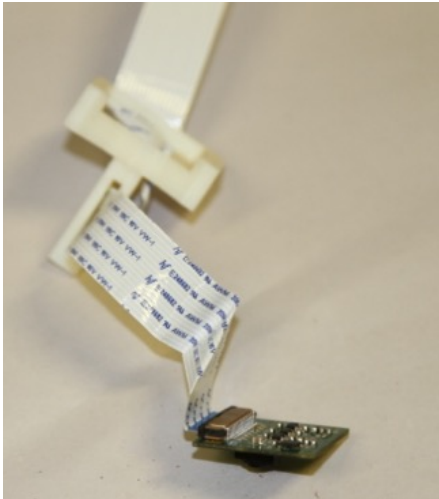

Camera plate attached to Servo 7

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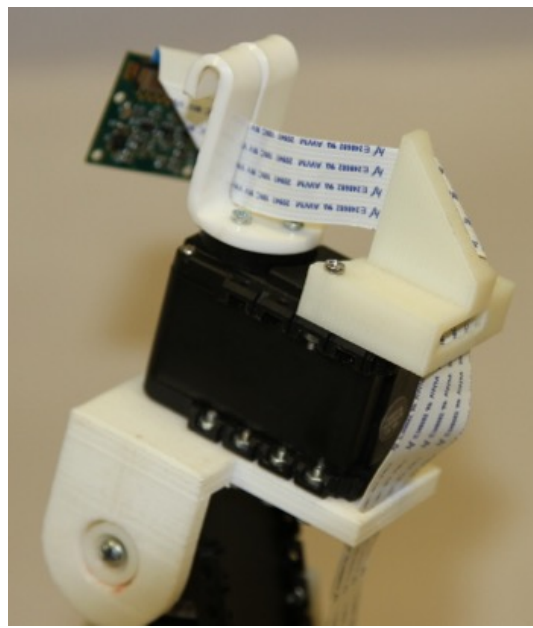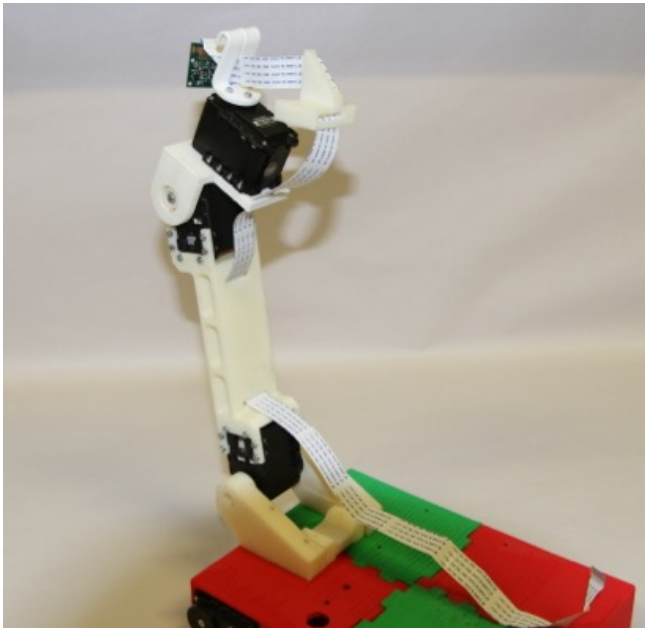oarkit.intelligentrobots.org

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Step 13: Thread the camera cable through the top guide plate, there is a fair bit of 'origami' needed here so take care with the bending.


Threading the camera cable through the top guide plate

Step 14: Thread the Camera Cable through the Arm downwards towards the Arm Mounting. Attach the Guide onto the top of Servo (7) after sliding the camera into the plate. Use 2 x M2 x 15 for this. Slide the cable and camera into place. Finally thread the camera cable through the bottom of the Arm mount at the base.
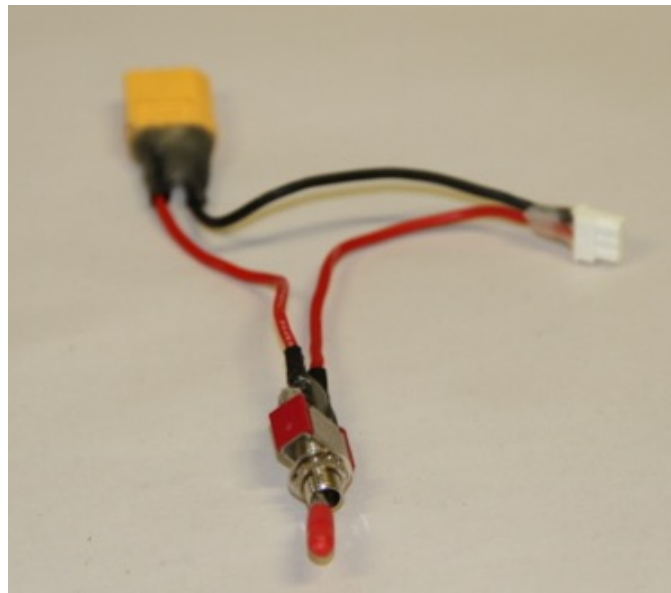
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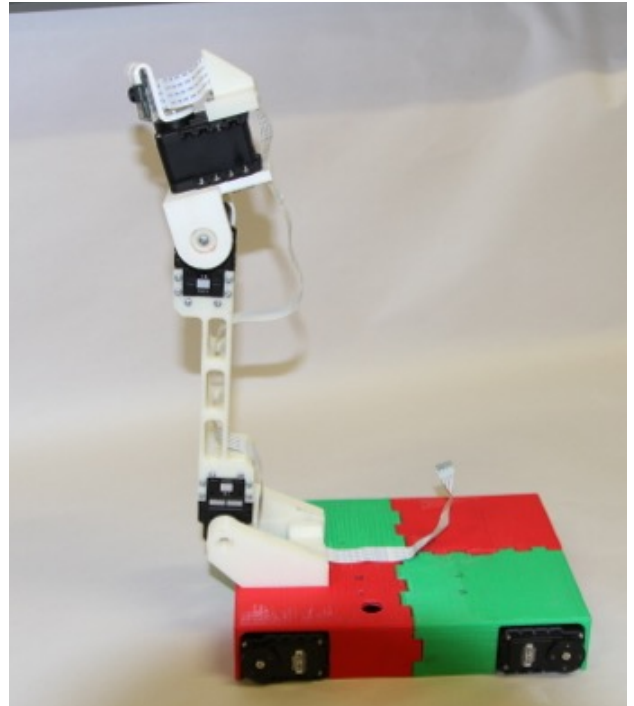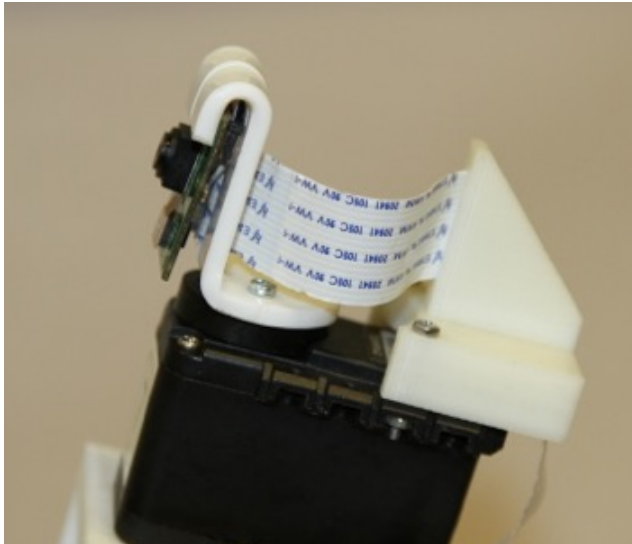
Camera attached to plate and threaded through the arm

Step 15: Following the wiring diagram from the website here (Note this build is slightly different to the link). These components are basic to allow power to the CM Board and Raspberry Pi. Note there is insulation around the contacts at every junction. The Li-Po battery can give a large Current surge if a short-circuit is to occur and **WILL DAMAGE** the electronic circuitry.
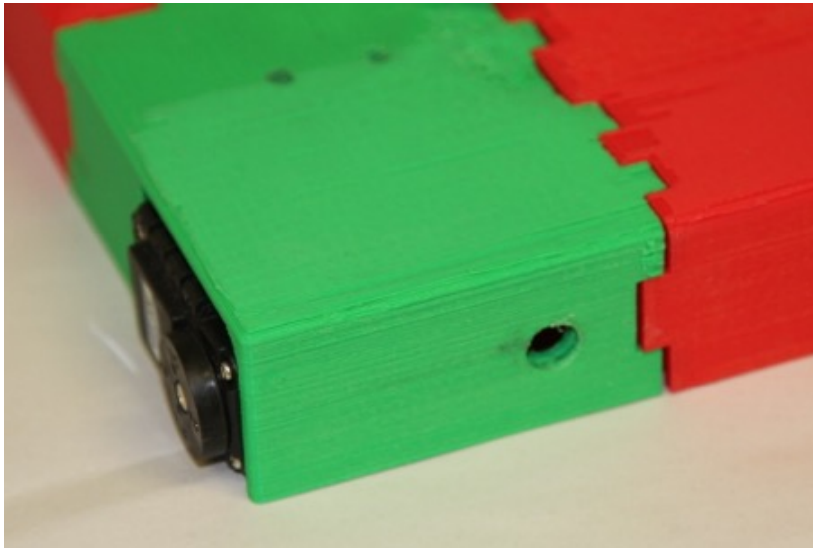

Power switch circuit

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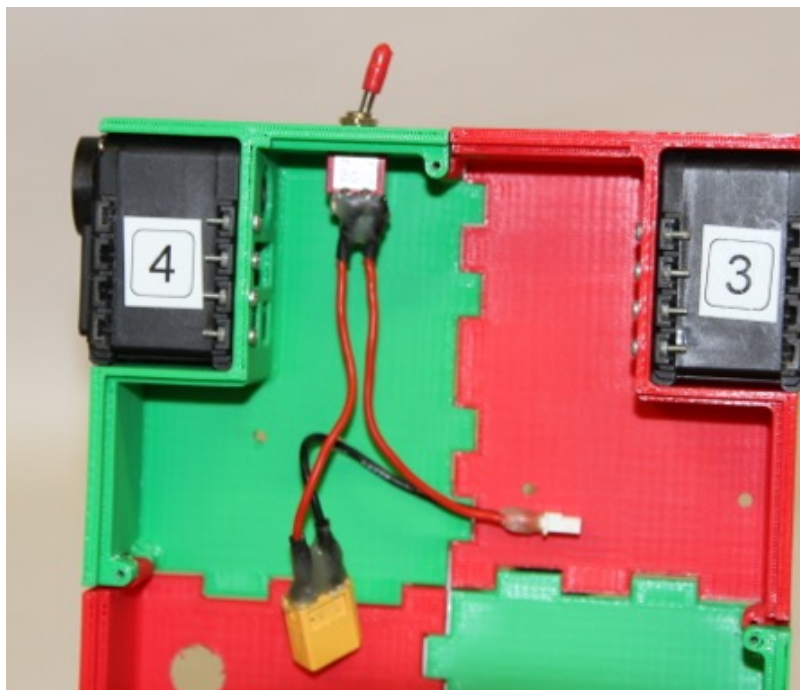oarkit.intelligentrobots.org

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Step 16: Drill a suitable hole at the rear section of the EMU to locate the Power Switch. I drilled a 7mm hole on the Left Hand Rear Section.

7mm Hole drilled in rear of EMU to accept the Power switch

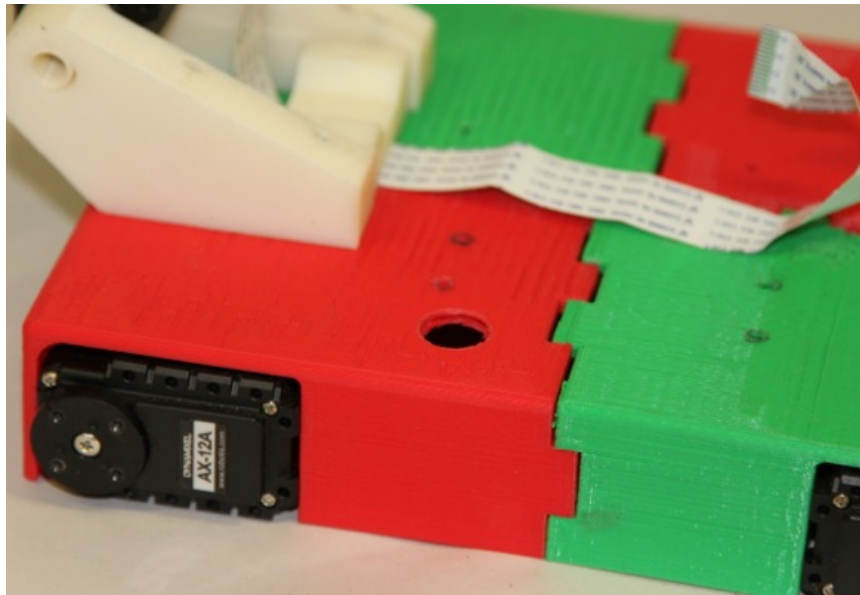**Step 17:** Attach the Power switch to the underside base of the EMU.

Power switch attached to EMU Chassis

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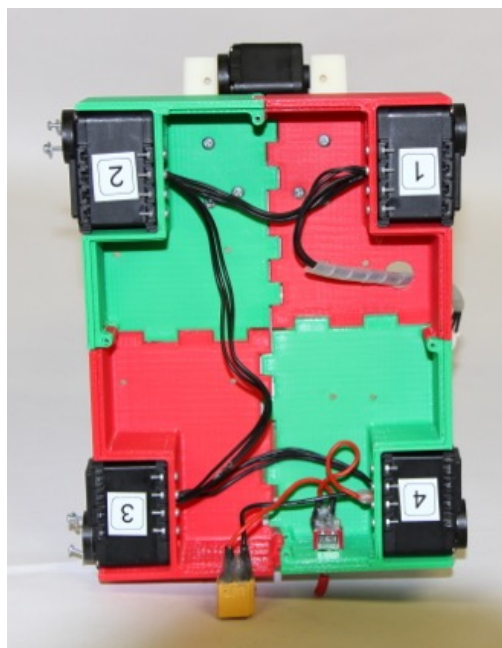
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Step 18: Drill a hole in the Front Left Hand section toward the outside of the mounting holes for the Power cable to pass to the CM Board. Use a 12mm drill, be careful not to crack the plastic.

Hole drilled in top of EMU Chassis

Step 19: Connect the cables for the power to the Servos. Note this should be done in a 'daisy chain' method. I plugged the cable from the Power switch into Servo 4 then Servo 3. From Servo 3 to Servo 2 and finally from Servo 2 to Servo 1. The Servo 1 cable then goes outside through the 12mm hole and will eventually connect to the CM Board. I used a protective sleeve here but it is not necessary.
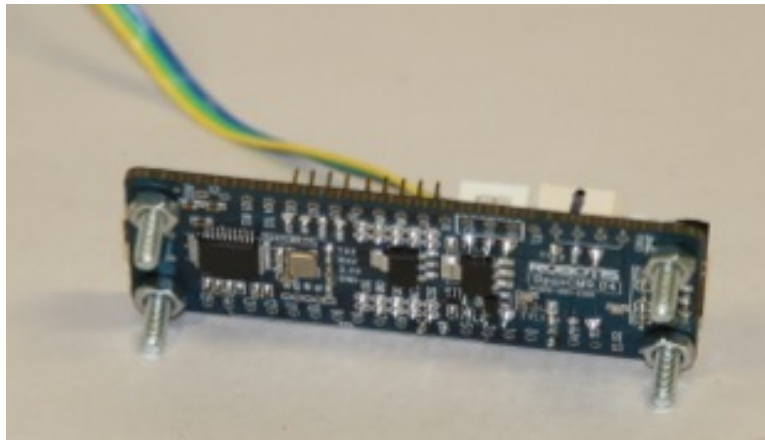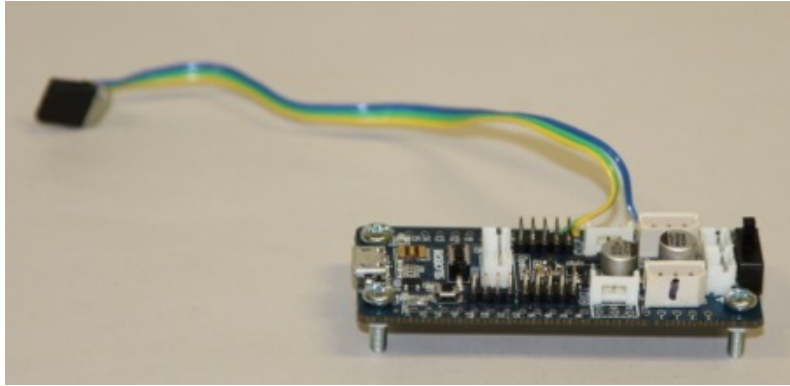

Daisy chain of cables

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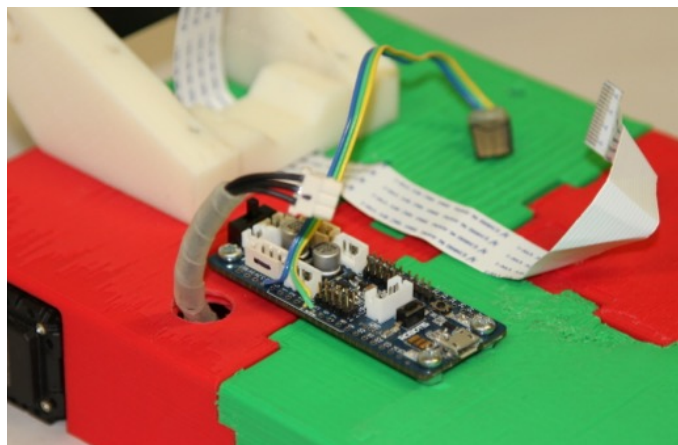oarkit.intelligentrobots.org

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Step 20: The main Power to the Servos is controlled via a CM Board. Specifications can be found [here](). Attach 4 x M3 x 10 screws through the mounting holes of the CM board then fix 4 x M4 nuts to these. This will space the board from the base of the EMU.

CM Board with mounting bolts attached and nuts on underside

Step 21: Attach the CM Board to the top of the EMU. Use 4 x M3 nuts for this. Note the orientation of the Board.

CM Board attached to EMU Chassis

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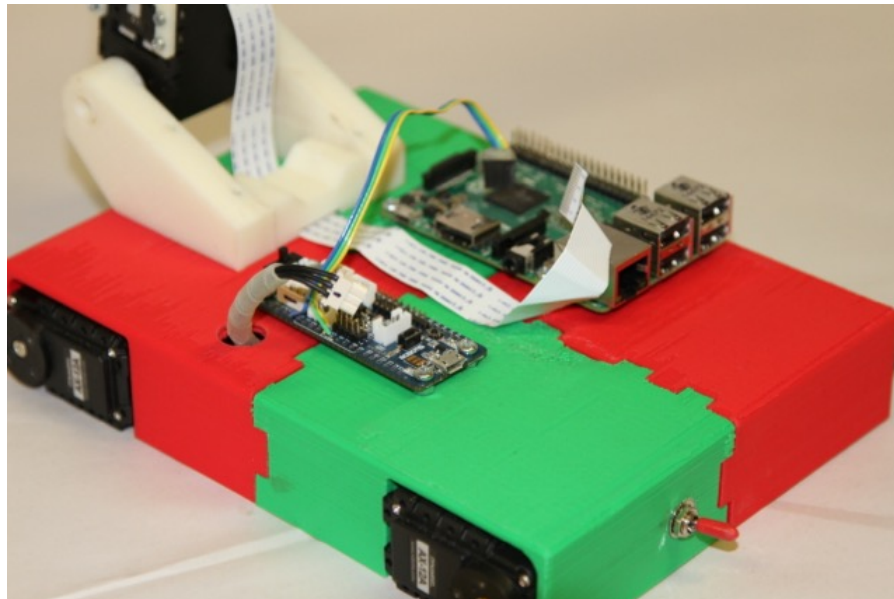oarkit.intelligentrobots.org

Step 22: The main Control System of the EMU is through a Raspberry Pi. Specifications can be found [here](). Attach 4 x M3 x 10 screws through the mounting holes of the Pi Board then fix 4 x M4 nuts to these. This will space the board from the base of the EMU.

Raspberry Pi Board with mounting bolts attached and nuts underside

Step 23: Attach the Pi Board to the top of the EMU. Use 4 x M3nuts for this. Note the orientation of the Board.
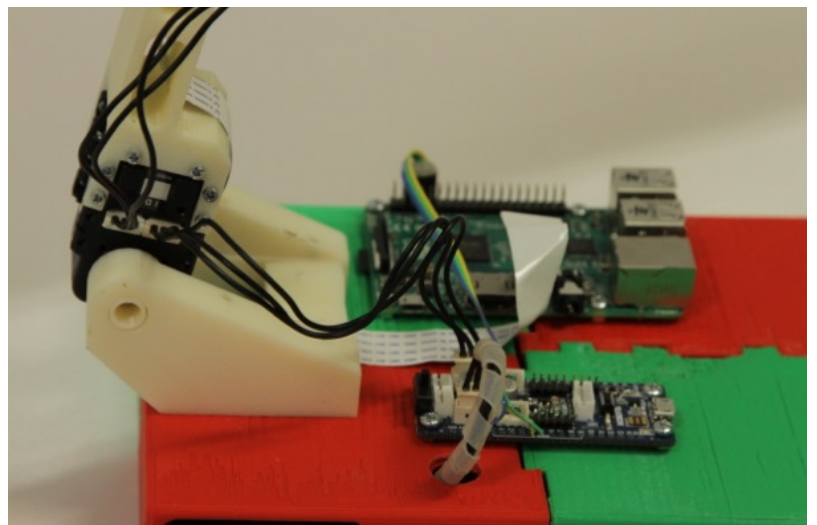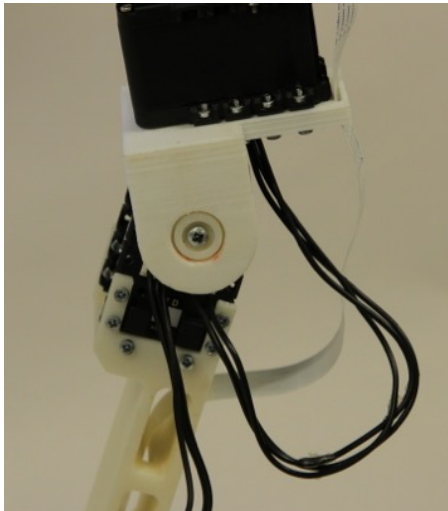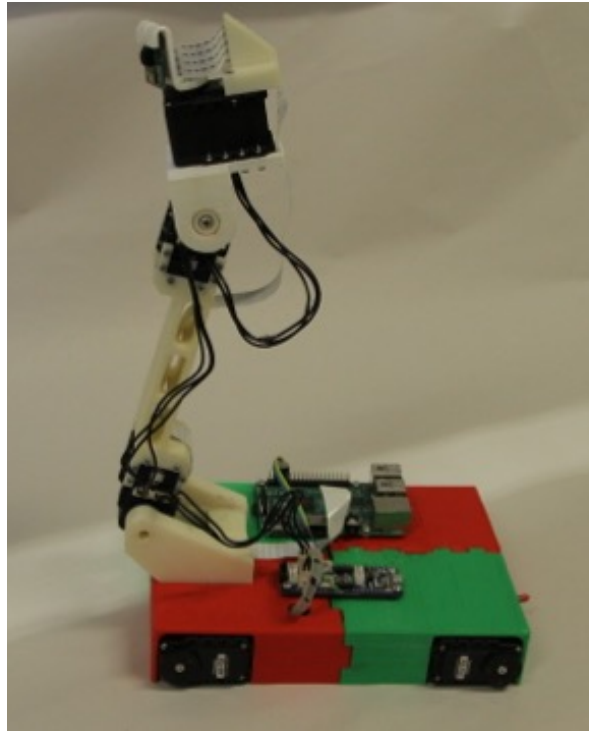

Raspberry Pi board attached to EMU Chassis

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Step 24: Connect another 'daisy chain' of cables from the camera Servo 7 to Servo 6. Connect from Servo 6 to Servo 5 and finally from Servo 5 to the CM Board. Connect the cable from Servo 1 (Step 19) also to the CM Board. Connect the Camera ribbon cable to the Camera slot on the Pi Board. Connect the Power / Data connection from the CM Board to the Pi Board. Take care with these final connections.
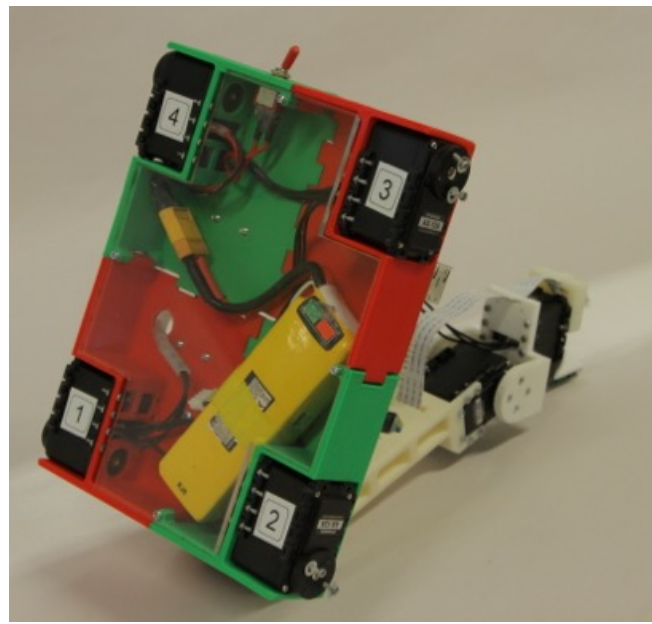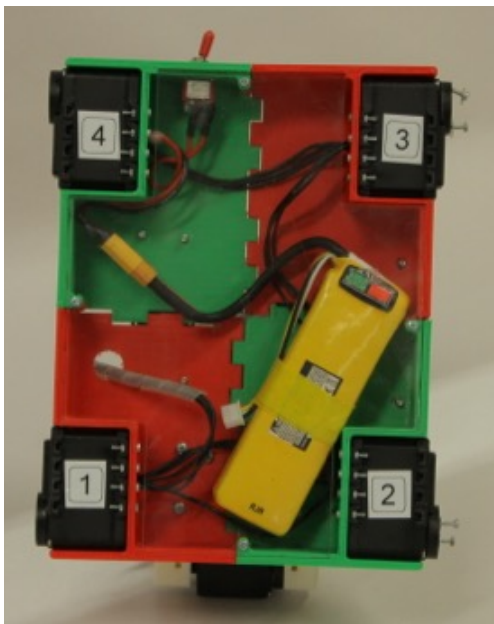
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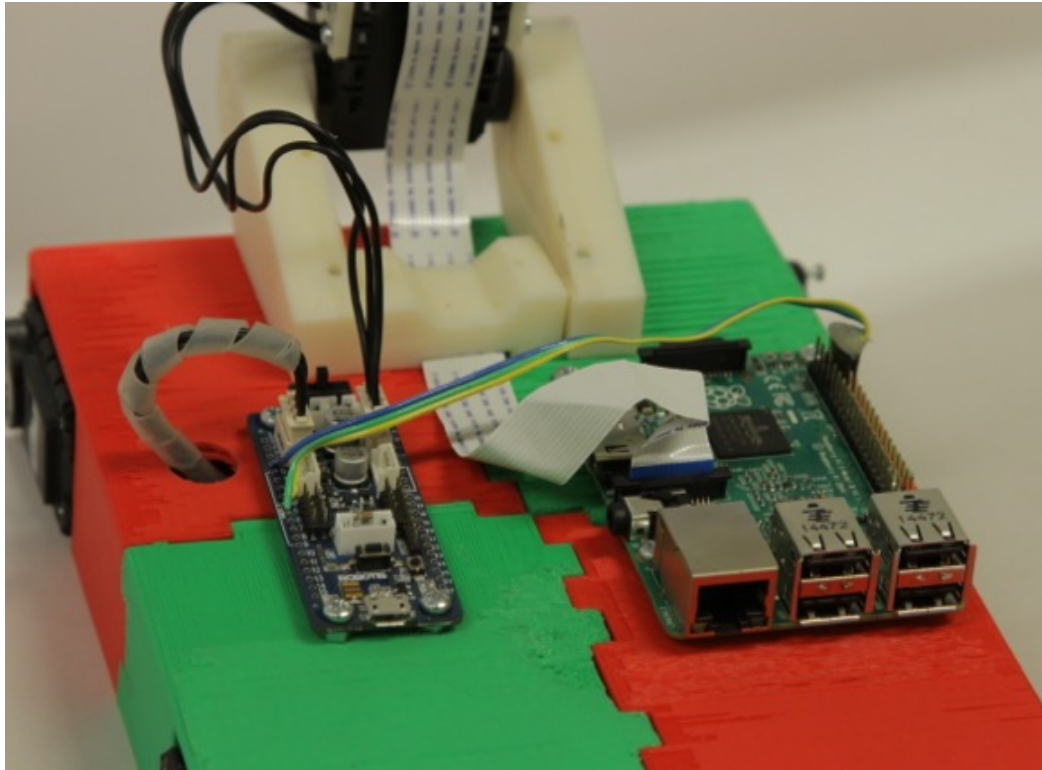
Servos connected, Camera cable and Raspberry Pi cable connections

Step 25: Connect a charged 11Volt Li-Po battery and attach the laser cut bash guard from here. Use 4 x M3 x 25mm bolts. This will secure the chassis and add substantial strength to the EMU.
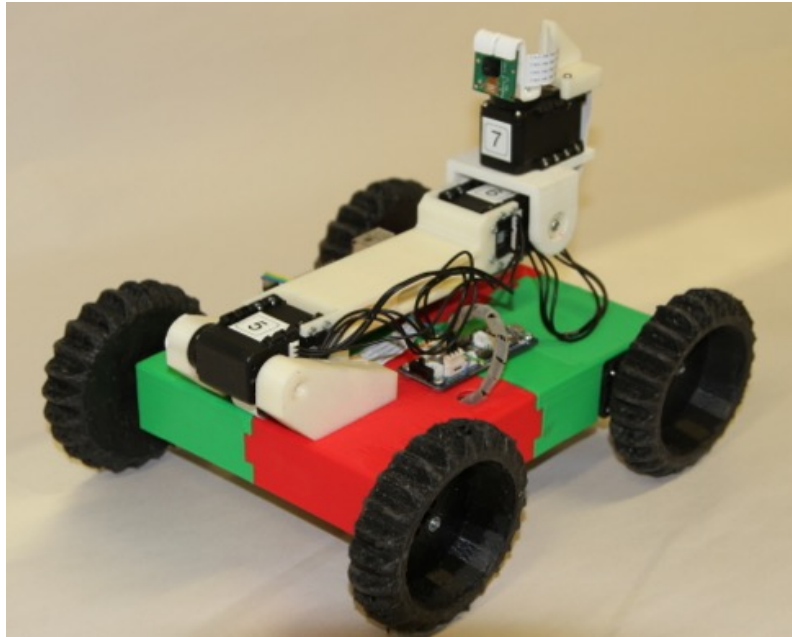

Main Battery and Bash Guard attached to EMU Underside of Chassis

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Step 26: Add the 4 wheels. Use 8 x M3 x 15mm bolts. You may need to use a drill bit once they have been printed to align the holes. I used a small washer with the bolts as well.

Step 27: Finally a power supply to the Pi Board is needed. A 5V, 1Amp battery is connected to the Micro USB socket of the Pi. A zip-tie or some Velcro dots can be used to keep this in place.

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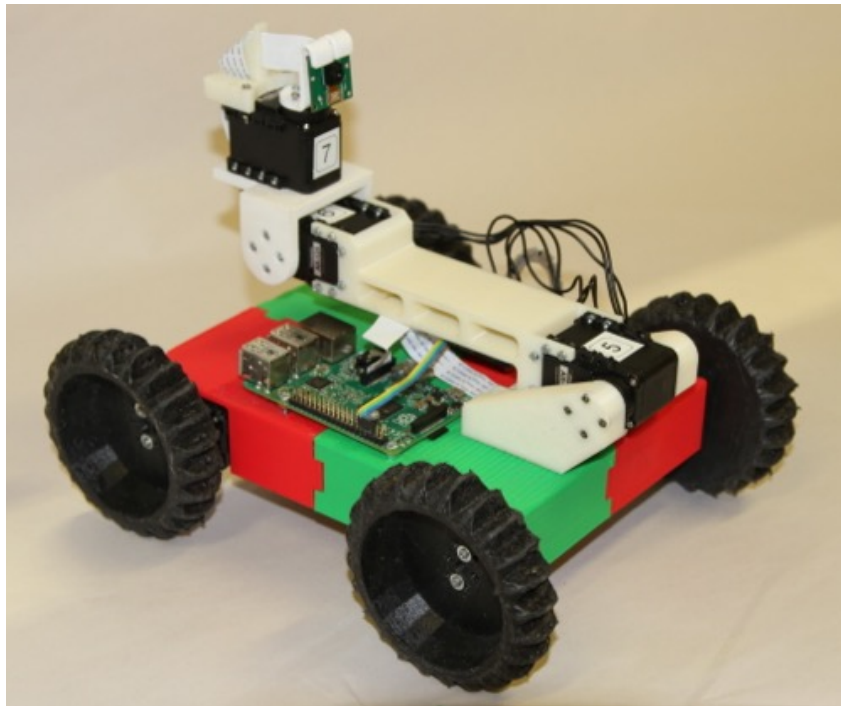oarkit.intelligentrobots.org

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Power battery for Raspberry Pi

Congratulations - You are now completed the Open Academic Robot Kit. Use the site here to tell us about your build, find programming codes, construct a practice arena to navigate and enter hear about upcoming competition events to try.

See you at the RoboCup !!

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