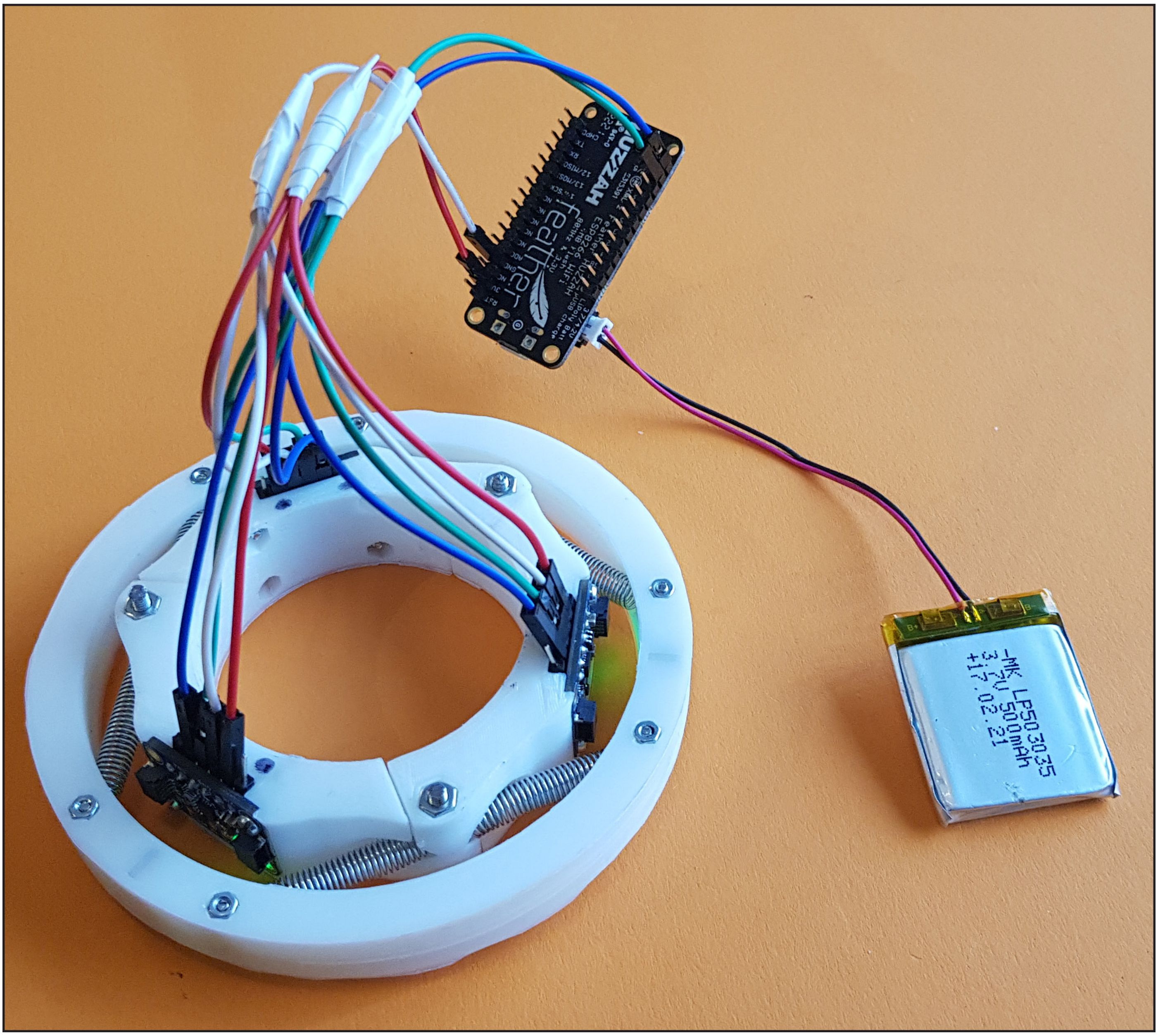
KRIS assembly Guide

By: Jorn Verheggen

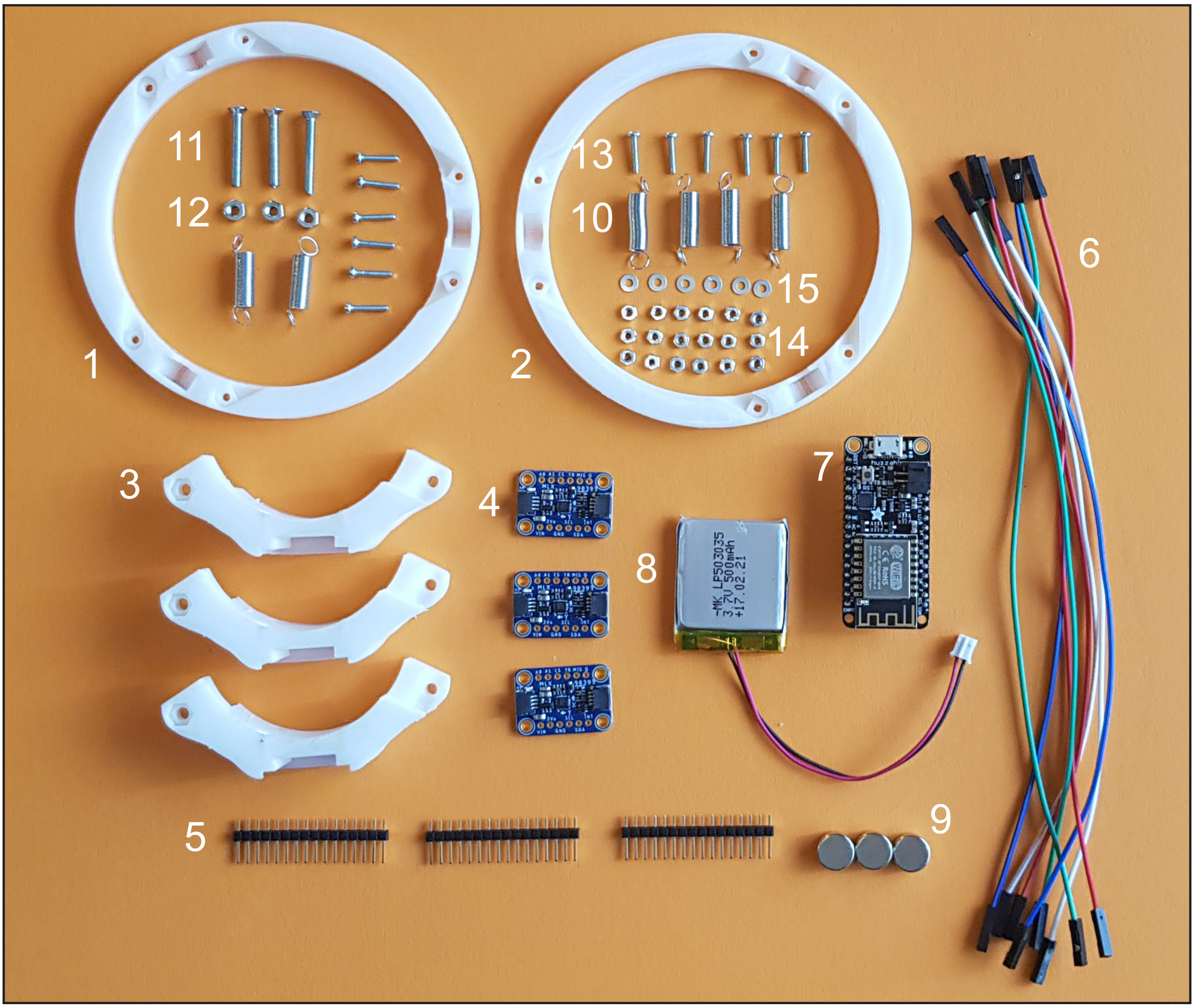
In this build guide we will take you through the step by step process to build an IRIS (Intuitive Robot Interaction System). The project was developed as the master thesis project of Jorn Verheggen at the Social AI lab of the VU university in Amsterdam. This project is provided under the MIT license.

We assume that the 3D printed parts have been produced and any support materials have been cleared off. We also assume that the user is familiar with through hole soldering.



Parts

These are the parts we used in the development of the IRIS sensor. We have provided some context as to why we selected certain parts please feel free to change or modify any aspect to suit your needs.
The CAD model for the 3D printed parts are available on the repository. The CAD models were created using 3D modeling software Blender which is available for free.

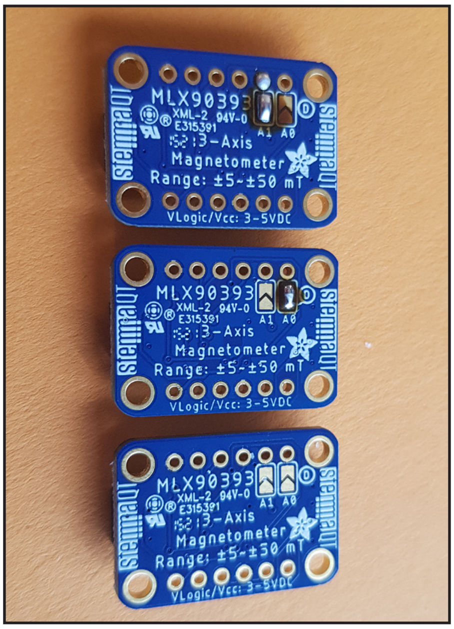


1. Bottom outer ring (3D printed)
2. Top ring (3D printed)
3. Inner ring (3X, 3D printed)
4. Magnetic sensor Adafruit MLX90393 (3X)
5. Header pins (3X 6 pins)
6. Female to female jumper cables 20cm (8X)
7. Microcontroller, adafruit Feather HUZZAH ESP 8266
8. Lipo battery
9. Magnets (3X)
10. Springs (6X)
11. M3 bolts 20mm (3X)
12. M3 nuts (3X)
13. M2 bolts 10mm (12X)
14. M2 nuts (18X)
15. M2 washers (6X)

Step 1 Soldering the analog pins on the PCB

We are using the I2C communication protocol between the sensor PCB’s and the microcontroller. The MLX90393 sensor allows for its I2C addresses to be modified. This enables it to connect up to four sensors along a single I2C line. The way this is achieved is by connecting the A0 and A1 pins on the sensor to VCC. The Adafruit PCB has two handy soldering pads that achieve this effect.

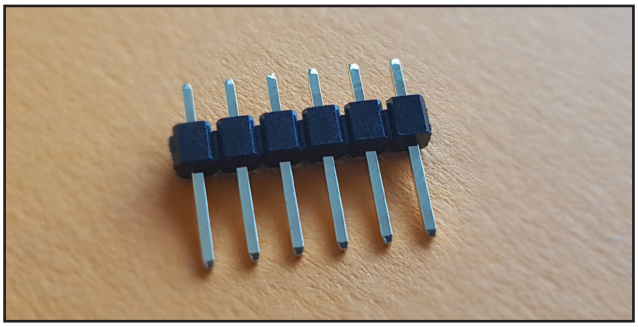
For sensor one, don’t connect any of the pads. For sensor two, connect the pad that indicates A0. For sensor 3 connect the pad that indicates A1.

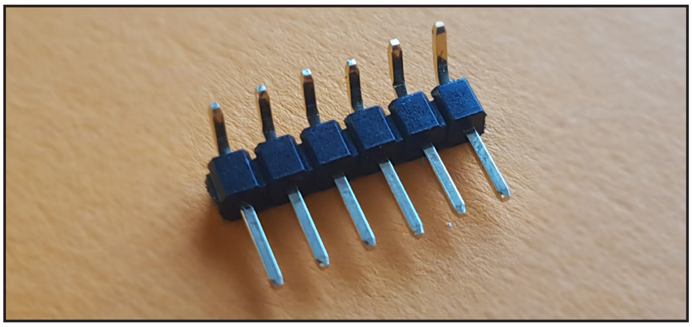


Step 2 Bend the headers 90 degrees

During the making of the project we could not find any 90 degree header pins, therefore we simply bend our own.

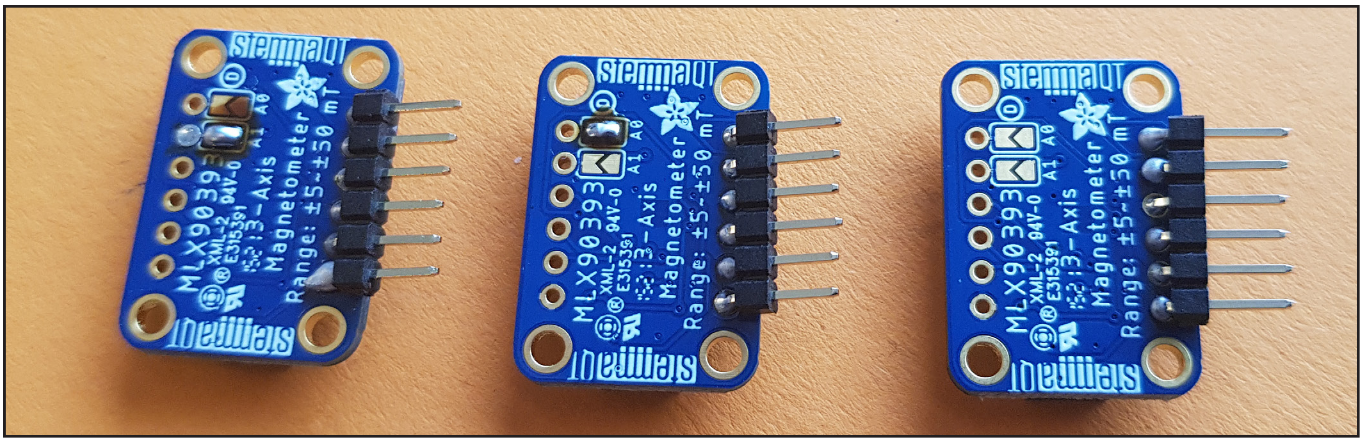
Be sure to keep enough length to make the female jumper cables connect correctly.





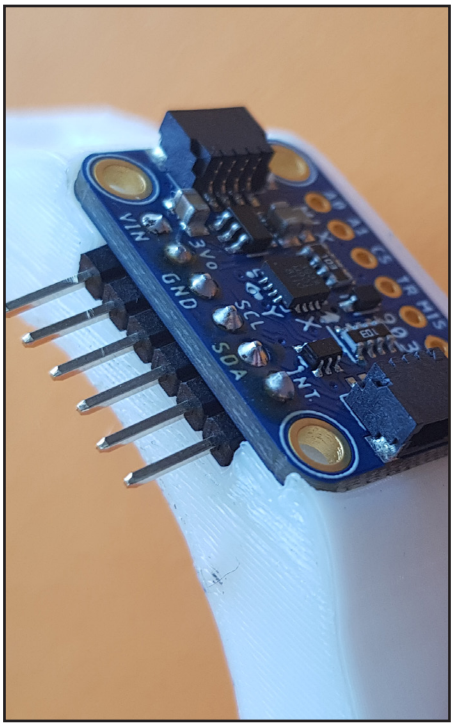
Step 3 Solder the header pins on the PCB

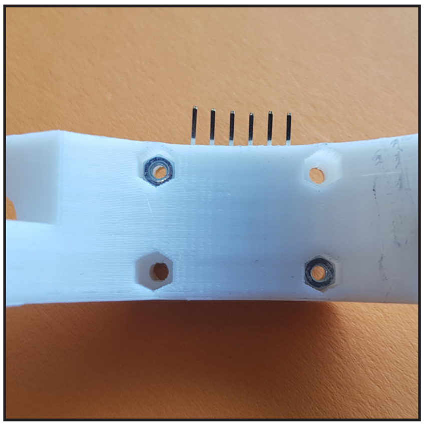
Solder the header pins on the side with the pins (5v, 3V, gnd, sda, scl, int). The other side is not required and the PCB will not fit in the enclosure if these pins are soldered.

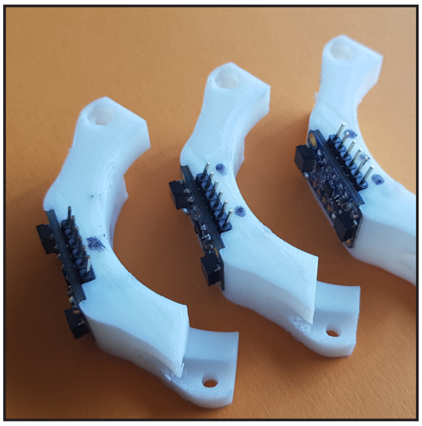


Step 4 Screw the sensor PCB to the enclosures

Place a M2 nut in the hole on the backside of the part and fasten the PCB to the 3D printed part with an M2 bolt.
We believe that two bolts is plenty to securely fasten the PCB to the part.
Be careful to place the PCB precisely in the 3D printed part since the position of the sensor is important to get accurate measurements.

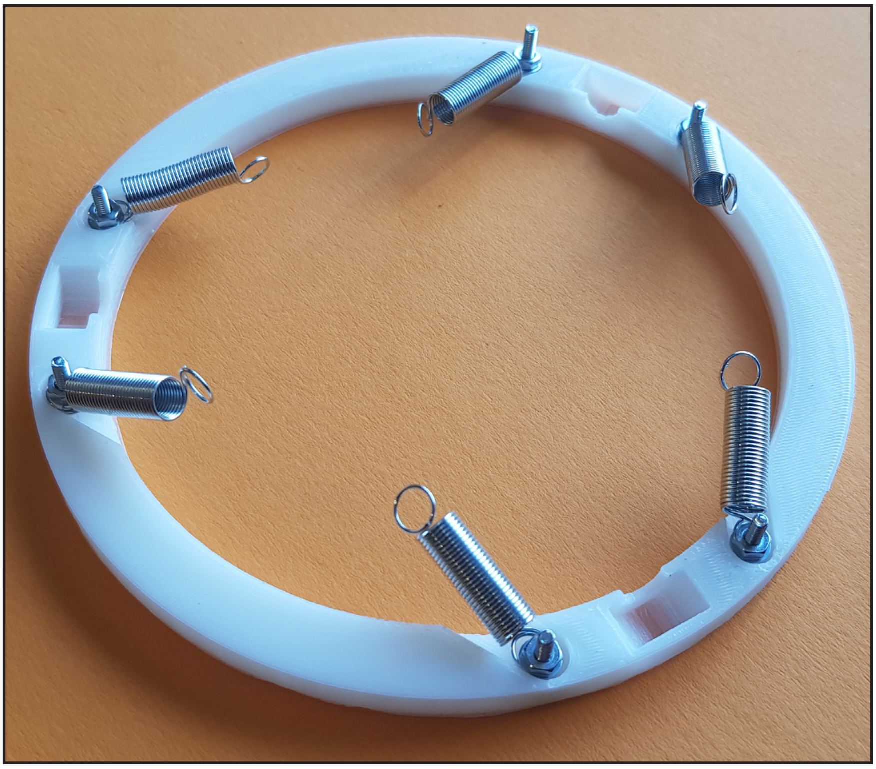


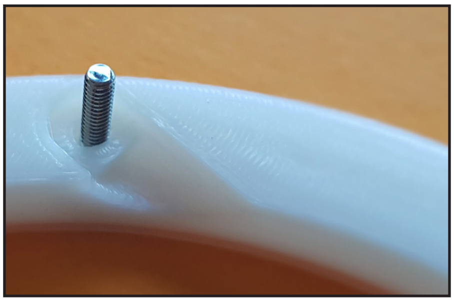


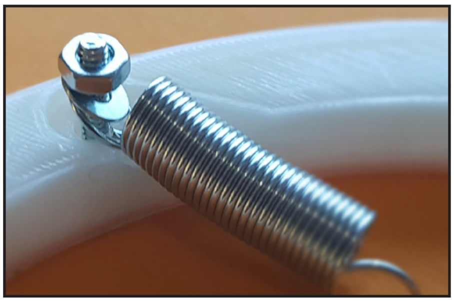


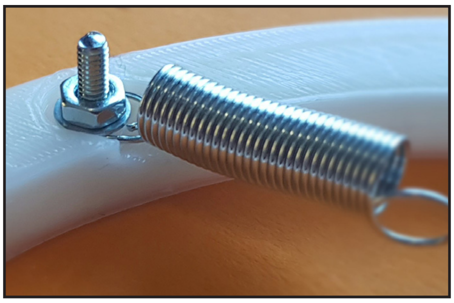
Step 5 Prepare the bottom part of the outer ring

Place bolts through the predefined holes on the outer ring 3D printed part. Then first put a spring, then a washer and then a nut on this bolt. This washer and bolt are there to make sure that the magnet does not pull the springs out of place during assembly.



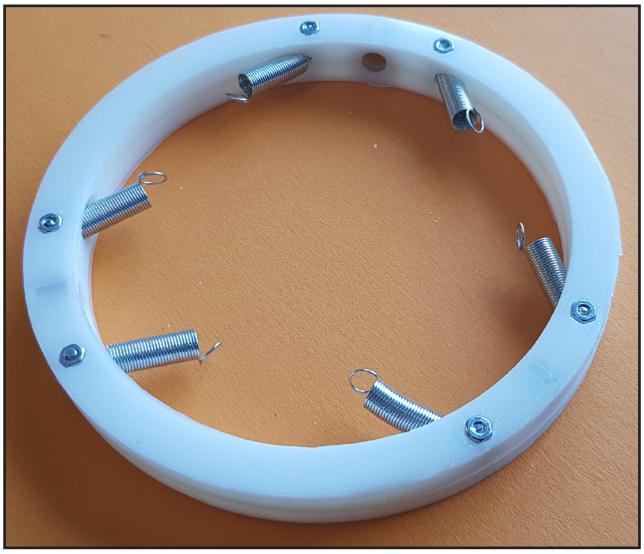


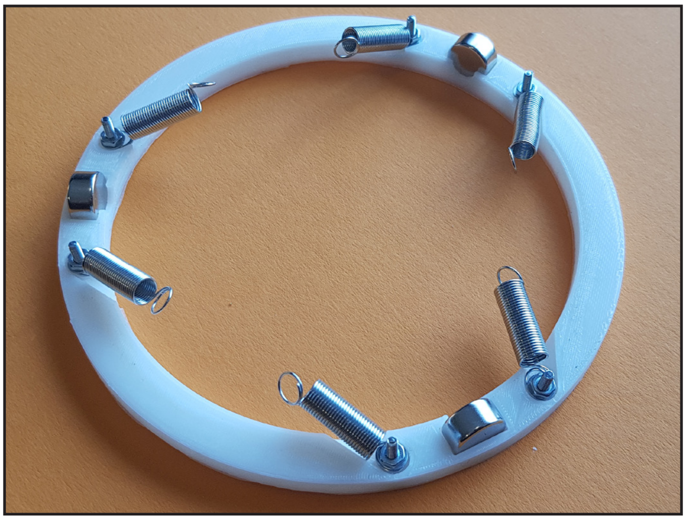




Step 6 Place the top part of the outer ring on the bottom part

Place the magnets in the pockets.
Make sure that the polarity is in the same direction for all magnets.
So either all north poles face towards the inner ring or all south poles face towards the inner ring.

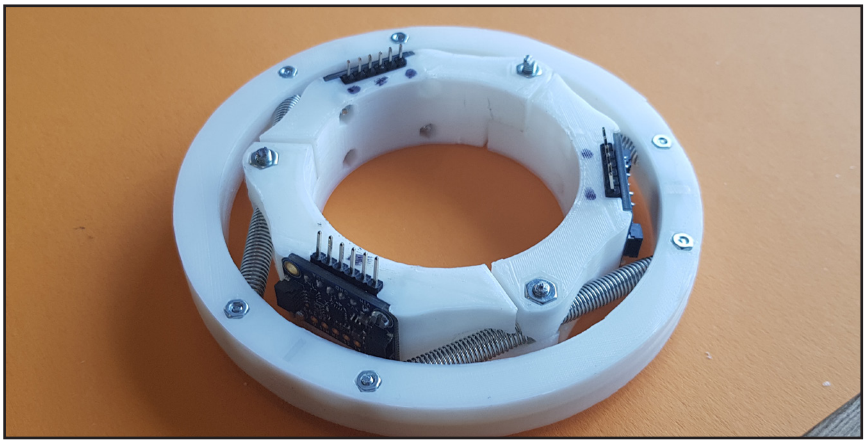


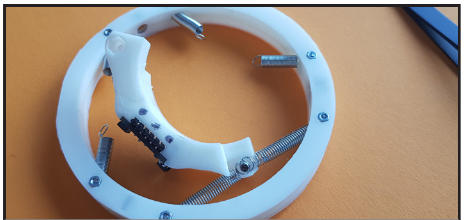


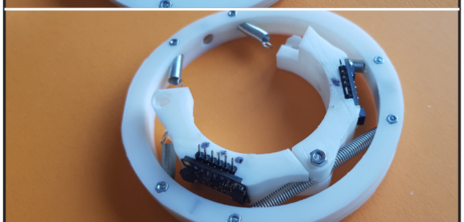
Fasten the top part with M2 nuts.

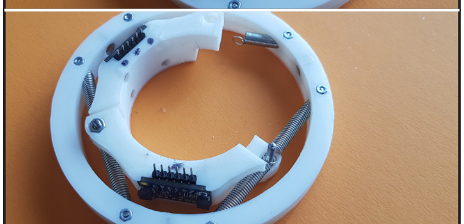
Step 7 Assemble the inner ring

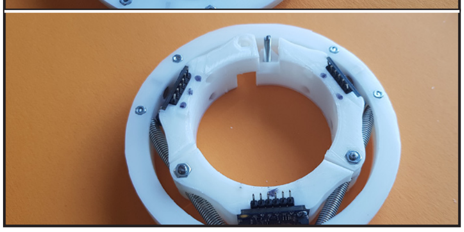
Take two 3D printed inner ring parts. Put an M3 bolt through the first one, then through two springs that are next to each other but don't have a magnet in between, then through the second 3D printed inner ring part. Finally fasten the whole thing with an M3 nut. Repeat this process to create the full inner ring.
We have found that this part can be very fiddly. A strong pair of tweezers can be very helpful with this task. Also, if you wish to place the IRIS on a robot you have to place the inner ring around it during this step.





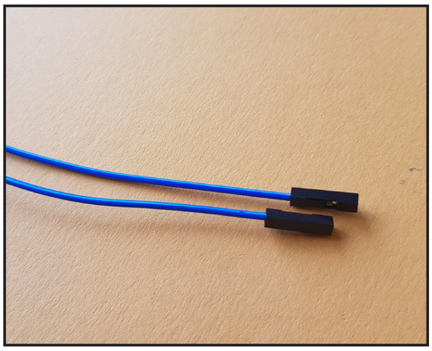
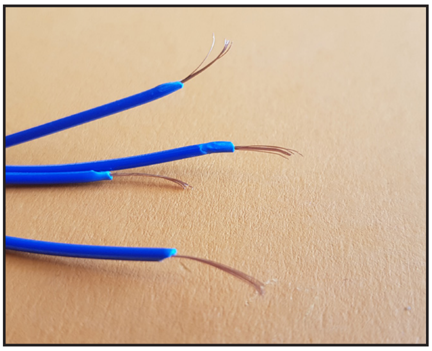
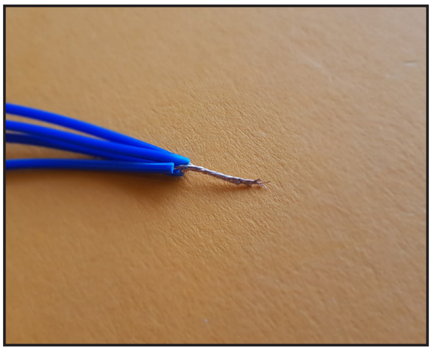
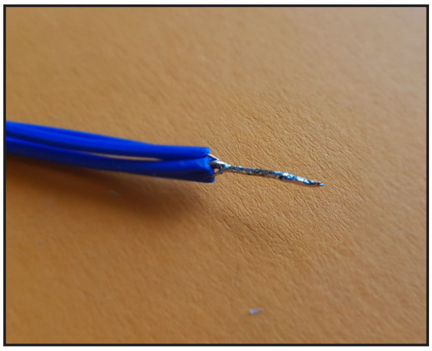
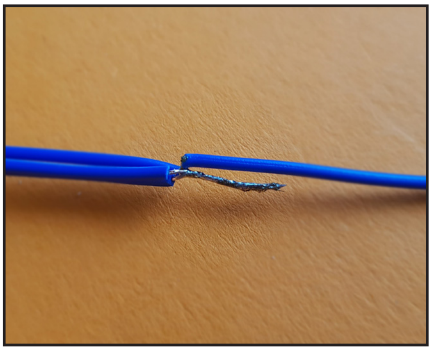
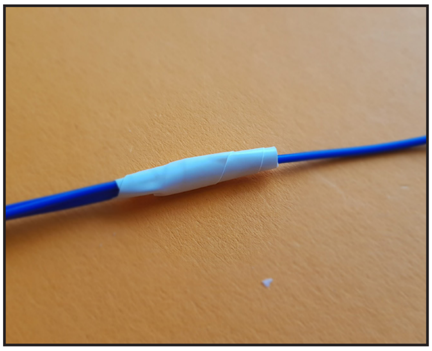
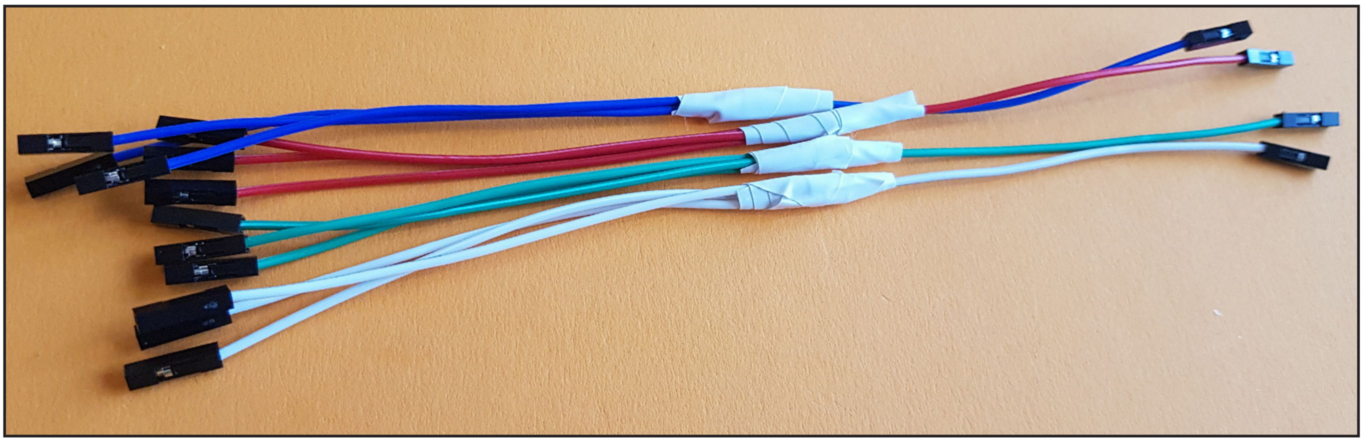






Step 8 Create the jumper wires

Cut the female to female jumper wires in half and strip the ends. Twist them together to create a single joint. Put solder over the going to strengthen the bond between the wires. Then bend one of the leads back and insulate the rest off with electrical tape. The wire that is bend back will go to the microcontroller while the others will go to the PCB’s. Do this four times. You will end up with one wire for power, one for ground and two for the I2C communication.

Step 9 Wire up the sensor PCB’s to the microcontroller

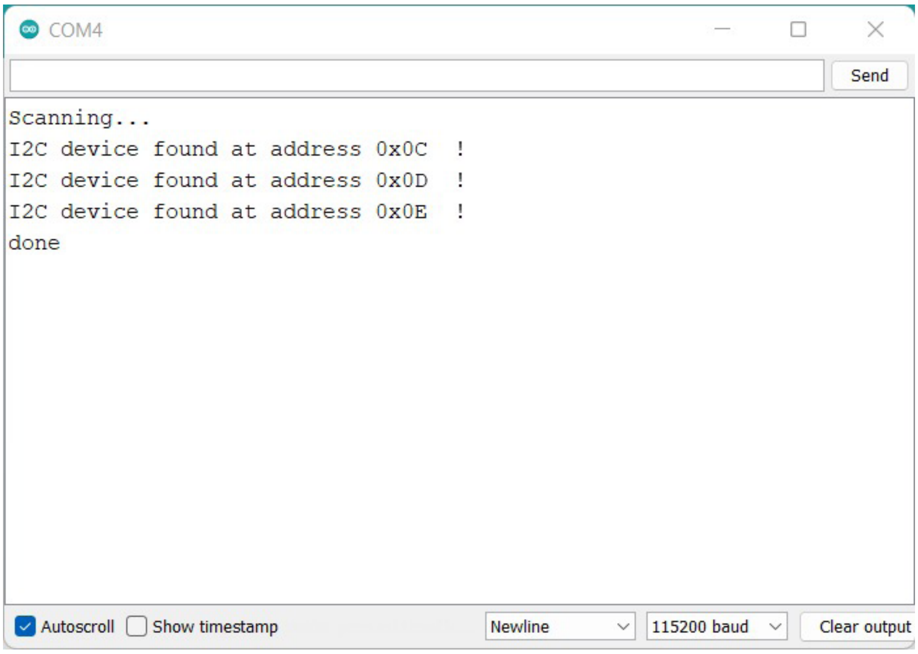
Create connections between 3V, Ground, SCL and SDA ports on the microcontroller and the sensor PCB’s. The correct ports are indicated on both the sensor and microcontroller PCB’s. You can also optionally use the battery as a power source for the microcontroller for a fully wireless setup..

Step 10 Prepare for flashing the board

Follow the steps on the Adafruit website to download and set up the Arduino IDE for using the microcontroller.
https://learn.adafruit.com/adafruit-feather-huzzah-esp8266/using-arduino-ide

Step 11 Prepare for flashing the board

Load the I2C_ID_scanner sketch in the Arduino IDE and upload it to the board. Then open the serial monitor and make sure that the Baud rate is set correctly. You should receive a message that the microcontroller has found 3 I2C devices on addresses 0x0C, 0x0D and 0x0E.



Step 12 Start sending sensor data

Open up the UDP_three_sensors.ino script in the arduino IDE. In this script, fill out the values for the WIFI_SSID, WIFI_PASS, TARGET_IP, TARGET_PORT and VIZ_PORT. Now open up the serial monitor. After uploading the script it should connect to the network. After connecting to the network it should start sending the sensor information over UDP to the target IP and ports.