

GENERAL DESCRIPTION

xMotion P3

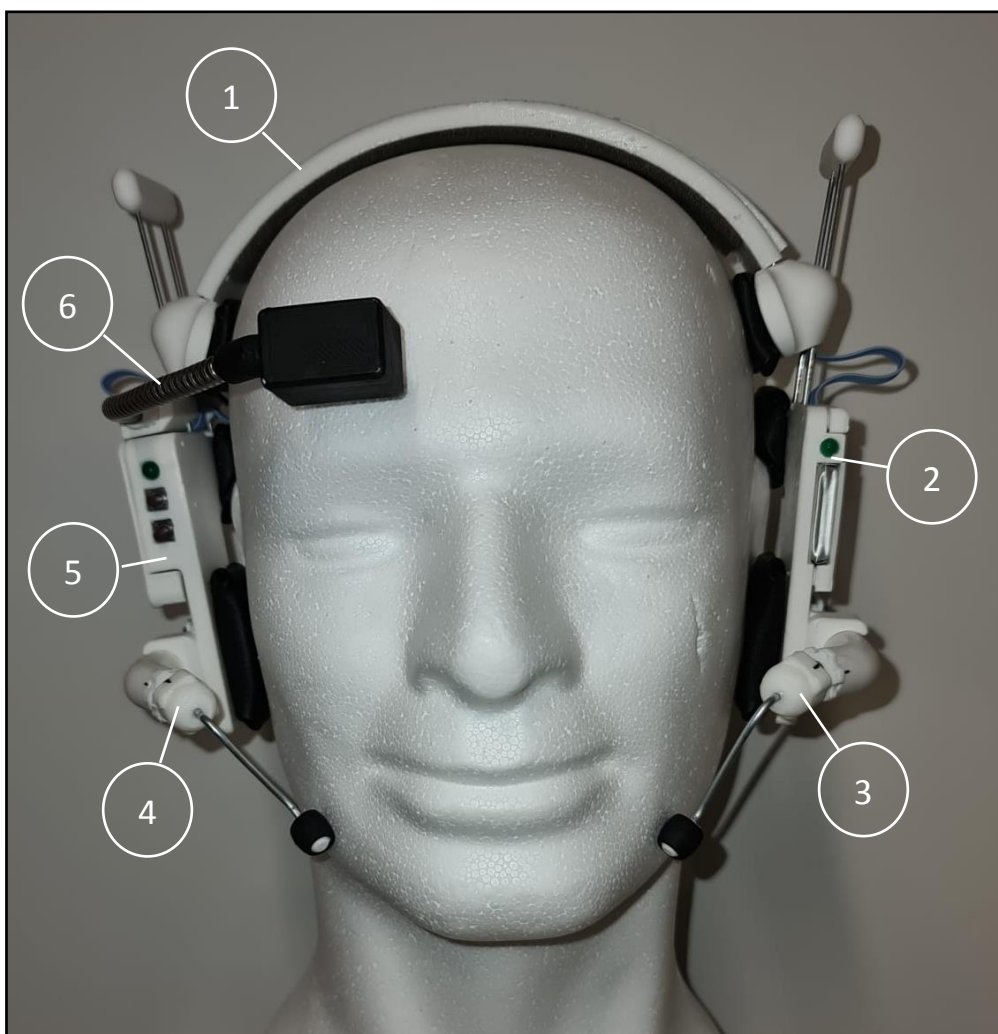


xMotion – Prototype 3 (P3)

P3 is a fully adjustable light-weight wireless headset that measures voluntary movements of the face and translates them into mouse/keyboard commands sent via Bluetooth Low Energy (BLE) to any PC, iOS or Android device.

P3 consists of a padded headband (1) designed to provide extensive-use comfort; two hubs (2, 4) housing an Arduino-compatible Bluefruit nRF52 Feather board that is automatically recognized via BLE as a human-interface device (HID) by any PC, iOS or Android device, and a rechargeable built-in battery that delivers hours of wireless use in a single charge; and three probes (3, 4, 6) that detect voluntary movements of the face. Two mechanical contact probes (3, 4) capture orofacial movements bilaterally via magnetic-based sensing, and a contactless probe (6) captures forehead movements via optical sensing.

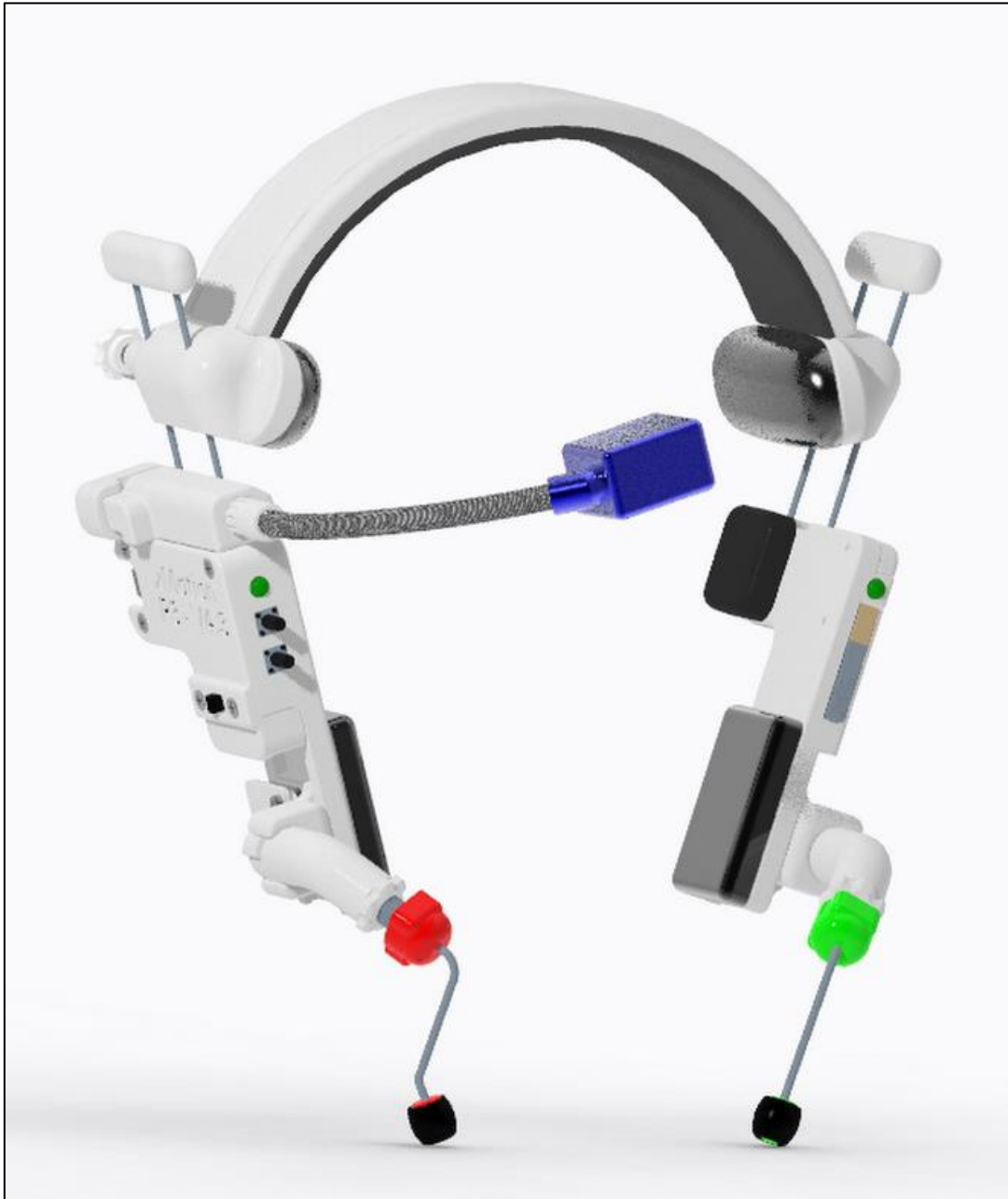
Designed for easy setup, **P3** is calibration-free and only requires an initial mechanical adjustment to ensure a stable and comfortable fit for all-day use of mainstream devices without hands.



P3 components. (1) Head band; (2) Left hub; (3) Left magnetic probe; (4) Right magnetic probe; (5) Right hub; (6) Optical probe.

ASSEMBLY DESCRIPTION

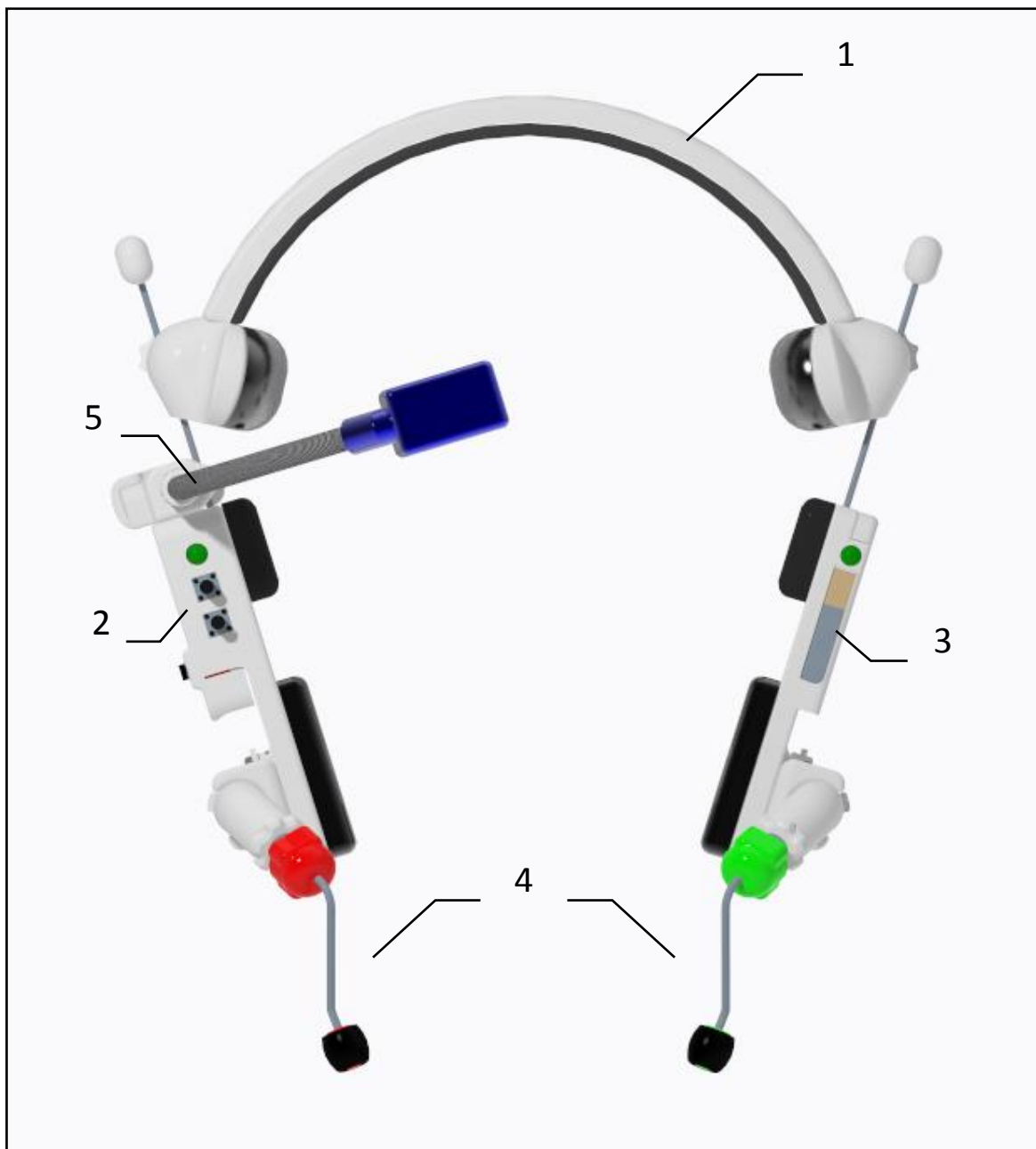
xMotion P3



CONTENTS

| | |
|---|----|
| xMotion P3 | 3 |
| General assembly | 5 |
| 1. Headset band sub-assembly..... | 6 |
| Fabrication process | 7 |
| 2. Right Hub sub-assembly | 8 |
| Fabrication process | 9 |
| 3. Left Hub sub-assembly..... | 11 |
| Fabrication process | 12 |
| 4. Magnetic probe sub-assembly..... | 13 |
| Fabrication process | 14 |
| 5. Optical probe sub-assembly | 17 |
| Fabrication process | 18 |
| Optical sensor circuit schematic..... | 20 |
| PCB optical sensor Layout | 21 |
| PCB optical sensor parts list (PCB-PL)..... | 21 |
| Electronic parts list (EPL) | 22 |
| General circuit schematic..... | 23 |
| Mechanical parts list (MPL) | 24 |
| Printed parts list (PPL) | 25 |

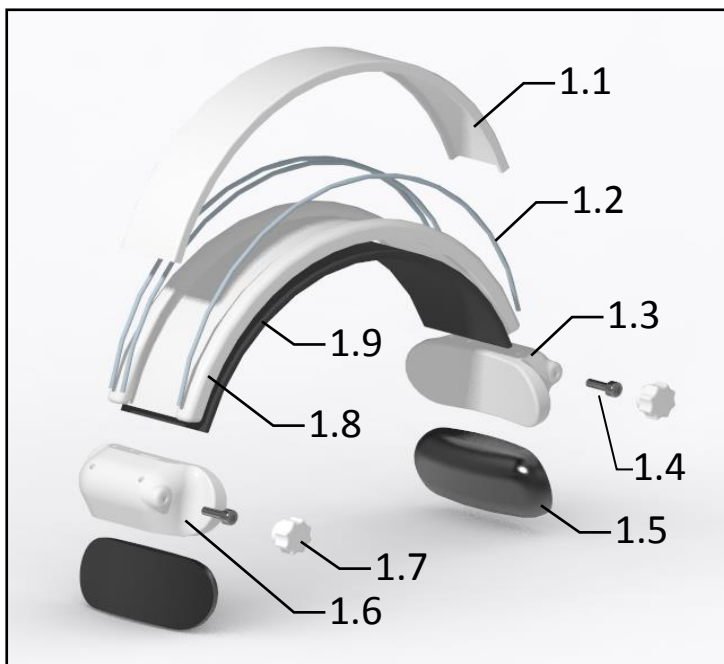
General assembly



| N° | Part description | Abbreviation | Quantity |
|----|---|--------------|----------|
| 1 | Headset band sub-assembly | HB | 1 |
| 2 | Right hub sub-assembly | RH | 1 |
| 3 | Left hub sub-assembly | LH | 1 |
| 4 | Magnetic probe sub-assembly | MP | 2 |
| 5 | Optical probe sub-assembly | OP | 1 |

1. Headset band sub-assembly

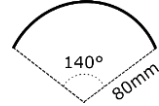
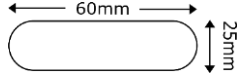
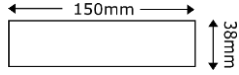
The padded headset band ensures stable yet adjustable (Right and Left hubs) functionality for all-day comfort.



| N° | Part description |
|-----|--------------------------|
| 1.1 | Flexible top cover |
| 1.2 | Curved spring wires (3x) |
| 1.3 | Right side node |
| 1.4 | Allen screw M3x10 (2x) |
| 1.5 | Side padding (2x) |
| 1.6 | Left side node |
| 1.7 | Locking wheel (2x) |
| 1.8 | Flexible headband |
| 1.9 | Top padding |

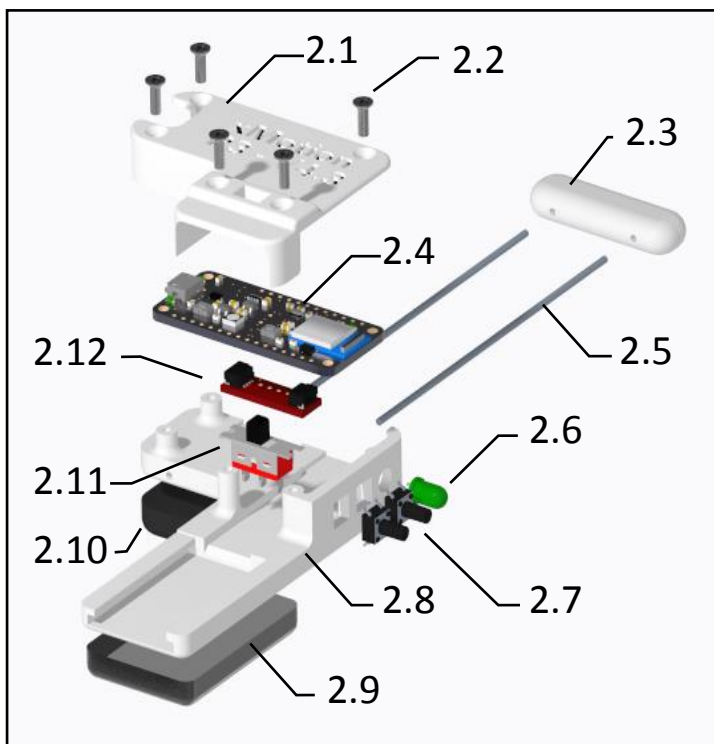
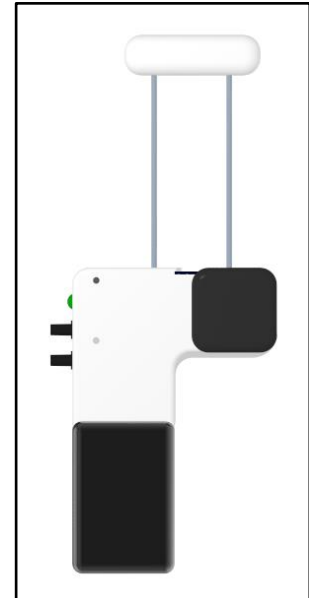
FABRICATION PROCESS

MATERIALS NEEDED can be found in Mechanical Part List (MPL, page 24), Printed Parts List (PPL, page 25) and Electrical part list (EPL, page 22)

| Step | Description | Materials needed |
|------|--|--|
| 1 | Curved spring wires (Part N°1.2) Bend the three spring wires as illustrated with a bending radius of 80 mm and cut them to an angle of 140°. | <ul style="list-style-type: none"> Spring wires of Ø1.6 mm (MPL N°2) Pattern for each wire:  |
| 2 | Headband assembly (Parts N°1.1, 1.2, 1.3, 1.6, 1.8) <ol style="list-style-type: none"> Insert two of the three curved spring wires (Part N°1.2) into the flexible headband. Slide them into the two side nodes (right/left) (Parts N°1.3, 1.6) connecting the nodes with the flexible headband (Part N°1.7). Insert the third spring wire (Part N°1.2) into each side node (Parts N°1.3, 1.6) and cover up with the flexible top cover (Part N°1.1). A pair of pliers may be helpful. | <ul style="list-style-type: none"> Curved spring wires (3x) (Step 1.1) Flexible headband (PPL N°5) Flexible top cover (PPL N°1) Right side node (PPL N°2) Left side node (PPL N°3) Flat pliers (Tool) |
| 3 | Padding (Parts N°1.5, 1.9) <ol style="list-style-type: none"> <u>Side padding (Part N°1.5)</u>: Cut (2x) memory foam pieces of 12 mm thickness as illustrated. <u>Top padding (Part N°1.9)</u>: Cut (1x) thin foam of 3 mm thickness with the pattern of the top foam as illustrated. Cover the foams from steps 1.3.1 and 1.3.2 with thin tissue using a sew machine. Attach the covered foams from step 1.3.3 to the side nodes (Parts N°1.3, 1.6) and the flexible headband (Part N°1.7) with double tape. | <ul style="list-style-type: none"> Memory foam (MPL N°3) Side padding pattern:  Thin Foam (MPL N°4) Top padding pattern:  Thin tissue for covering (MPL N°6) Sew machine (Tool) Pair of scissors/cutter (Tool) Headband assembly (Step 1.2) Double tape |
| 4 | Locking screws (Parts N°1.4, 1.7) <ol style="list-style-type: none"> Assemble the locking screws (2x) by fixing the locking wheel (Part N°1.7) on the head of the Allen screw (Part N°1.4). Screw them on each side node (Parts N°1.3, 1.6). When fully screwed, they will lock the sliding straight wires from the right/left hubs sub-assembly (Parts N°2, 3) into the desired position. | <ul style="list-style-type: none"> Allen screw M3x10 (MPL N°1) Locking wheel (PPL N°4) Headband assembly (Step 1.2) Right hub (Part N°2) Left hub (Part N°3) |
| 5 | Electrical wiring Insert and slide the flat cable through both side nodes (Parts N°1.3, 1.4) and the flexible headband (Part N°1.8). The flat cable will connect both hubs (Parts N°2, 3). | <ul style="list-style-type: none"> 6-contacts flat cable (EPL N°13) Headband assembly (Step 1.2) |

2. Right Hub sub-assembly

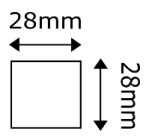
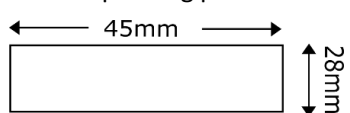
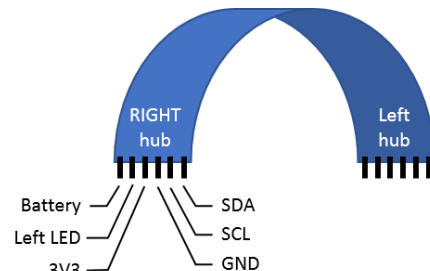
The right hub is topped with two straight spring wires (*Part N°2.5*) that slide within the corresponding right side node (*Part N°1.3*). The sliding range allows fine adjustment for stable and comfortable fit. The right hub houses a microcontroller Bluefruit nRF52832 feather (*Part N°2.4*), a sliding ON/OFF switch (*Part N°2.11*), two push-buttons (*Part N°2.7*), a green LED (*Part N°2.6*), a QWIIC I2C (*Part N°2.12*) adapter and wired connections.



| N° | Part description |
|------|-----------------------------|
| 2.1 | Right hub cover |
| 2.2 | Flat head screw M2.5x8 (5x) |
| 2.3 | Hub end part |
| 2.4 | Bluefruit nRF52832 feather |
| 2.5 | Straight spring wire (2x) |
| 2.6 | Green LED |
| 2.7 | Push-button (2x) |
| 2.8 | Right hub holder |
| 2.9 | Bottom padding |
| 2.10 | Top padding |
| 2.11 | Slide switch ON/OFF |
| 2.12 | QWIIC I2C ADAPTER |

FABRICATION PROCESS

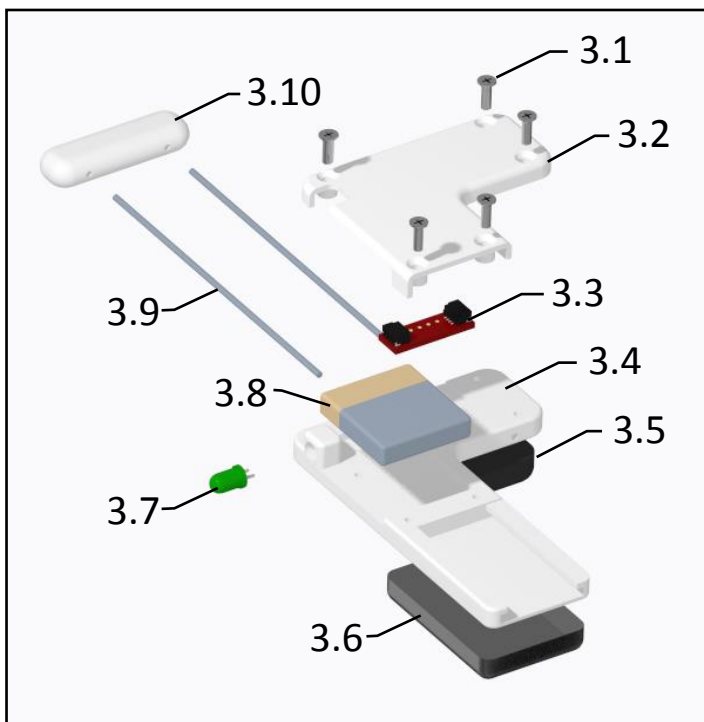
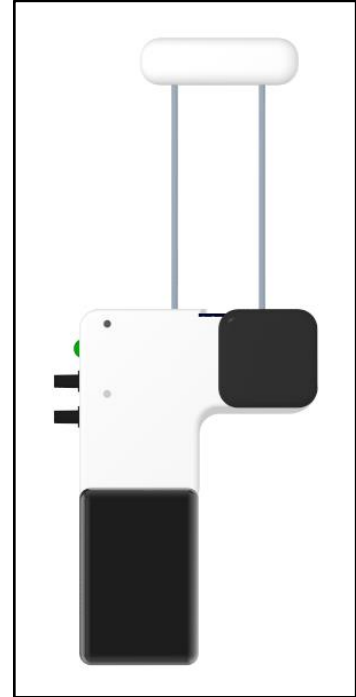
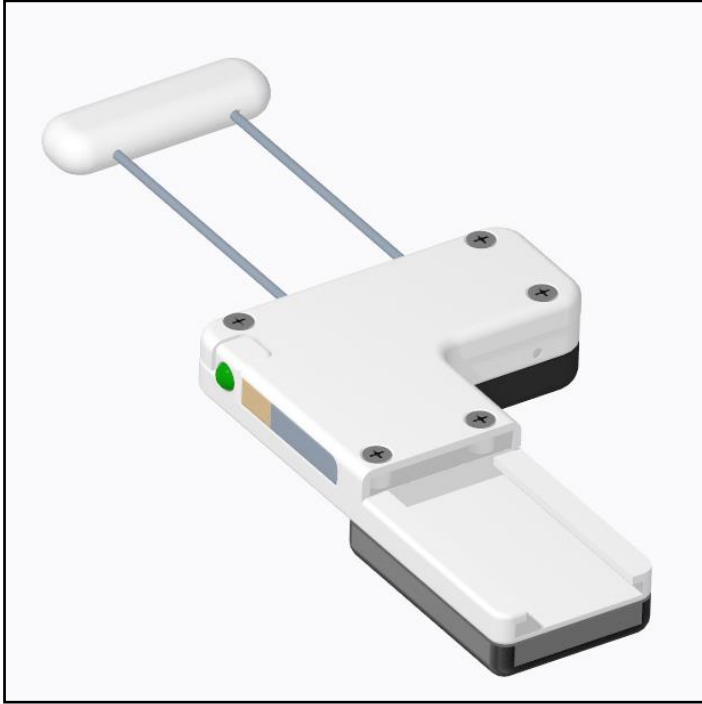
MATERIALS NEEDED can be found in Mechanical Part List (MPL, page 24), Printed Parts List (PPL, page 25) and Electronical part list (EPL, page 22)

| Step | Description | Materials needed |
|------|---|---|
| 1 | Straight spring wires (Part N°2.5) <ol style="list-style-type: none"> Cut (4x) 90 mm long straight spring wires (Another pair for the left hub). Insert (2x) the bottom end of the straight spring wires (Part N°2.5) into the right hub holder (Part N°2.8). <p>A pair of pliers may be helpful.</p> | <ul style="list-style-type: none"> Spring wire of $\varnothing 1.6$ mm (MPL N°2) Right hub holder (PPL N°6) Flat pliers (Tool) |
| 2 | Padding (Parts N°2.9, 2.10) <ol style="list-style-type: none"> <u>Top padding (Part N°2.10):</u> Cut (2x) memory foam of 12 mm thickness as illustrated (one for the Left hub). <u>Bottom padding (Part N°2.9):</u> Cut (2x) memory foam of 12 mm thickness as illustrated aside (one for the Left hub). Cover the foams from step 2.2.1 and 2.2.2 with thin tissue using a sew machine. Attach one pair of the covered foams from step 2.2.3 to the back side of the right hub holder (Part N°2.8) with double tape within the specified areas. | <ul style="list-style-type: none"> Memory foam (MPL N°3) Top padding pattern: <div style="text-align: center;">  </div> Bottom padding pattern: <div style="text-align: center;">  </div> Thin tissue for covering (MPL N°6) Sew machine (Tool) Pair of scissors or cutter (Tool) Double tape |
| 3 | Electrical wiring (Parts N°1, 2.4, 2.6, 2.7, 2.11, 2.12) <ol style="list-style-type: none"> Connect the Green LED (Part N°2.6), the two Push-button (Part N°2.7), the ON/OFF switch (Part N°2.11) and the QWIIC I2C ADAPTER (Part N°2.12) with the Bluefruit nRF52832 feather (Part N°2.4) following the electrical schematic (Pag. 23). Connect the right hub (Part N°2) with the headband's flat cable (Part N°1) following the flat cable's pinout. | <ul style="list-style-type: none"> Green LED (EPL N°8) Push-button (EPL N°6) QWIIC I2C ADAPTER (EPL N°9) Slide Switch ON/OFF (EPL N°5) Bluefruit nRF52832 feather (EPL N°1) Headset band (Part N°1) Flat cable pinout (right side): <div style="text-align: center;">  </div> |

| | |
|---|---|
| <p>4 Assembly with the Right hub cover (<i>Part N°2.1, 2.2 – Step 2.3</i>)</p> <p>Attach the right hub cover (<i>Part N°2.1</i>) to the assembly from step 2.3 by adding (5x) Flat head screw M2.5x8 (<i>Part N°2.2</i>).</p> | <ul style="list-style-type: none"> ○ Flat head screw M2.5x8 (MPL N°5) ○ Right hub cover (PPL N°6) |
| <p>5 Assembly with headset band (<i>Parts N°1, 2</i>)</p> <ol style="list-style-type: none"> 1. Slide the top end of the straight spring wires (<i>Part N°2.5</i>) through the right node (<i>Part N°1.3</i>). 2. Insert the top end of the straight spring wires (<i>Part N°2.5</i>) into the hub end-part (<i>Part N°2.3</i>). 3. Use the locking screw (<i>Step 1.4</i>) to lock both together into the desired sliding position. | <ul style="list-style-type: none"> ○ Straight spring wires (Step 2.1) ○ Headset band (Part N°1) ○ Hub end-part (PPL N°7) |

3. Left Hub sub-assembly

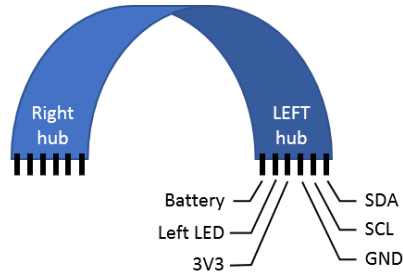
Like the right hub, the left hub is topped with two straight spring wires that slide within the corresponding (left) side node (*Part N°1.3*). The sliding range allows fine adjustment for stable and comfortable fit. The left hub houses a QWIIC I2C adapter (*Part N°3.3*), a green LED (*Part N°3.7*), a battery (*Part N°3.8*) and wired connections.



| N° | Part description |
|------|-----------------------------|
| 3.1 | Flat head screw M2.5x8 (5x) |
| 3.2 | Left hub cover |
| 3.3 | QWIIC I2C ADAPTER |
| 3.4 | Left hub |
| 3.5 | Top padding |
| 3.6 | Bottom padding |
| 3.7 | Green LED |
| 3.8 | Battery Li-Po 3.7V – 350mA |
| 3.9 | Straight spring wire (2x) |
| 3.10 | Hub end-part |

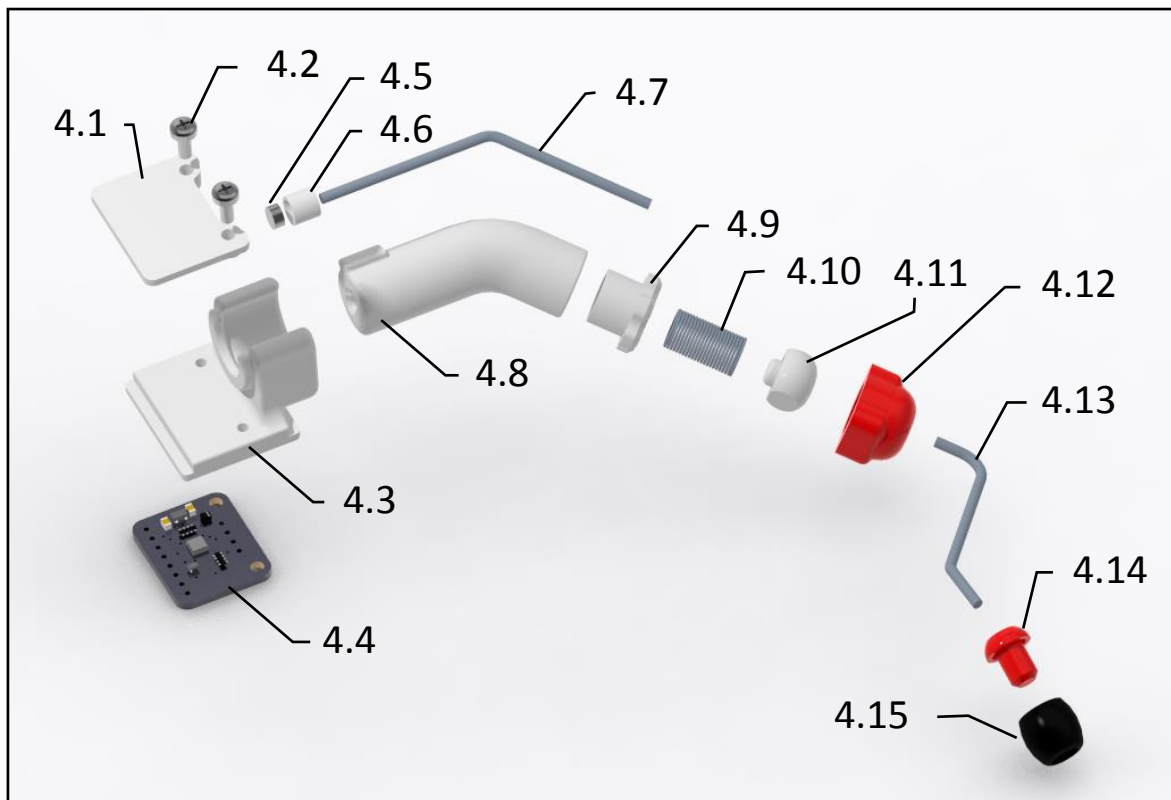
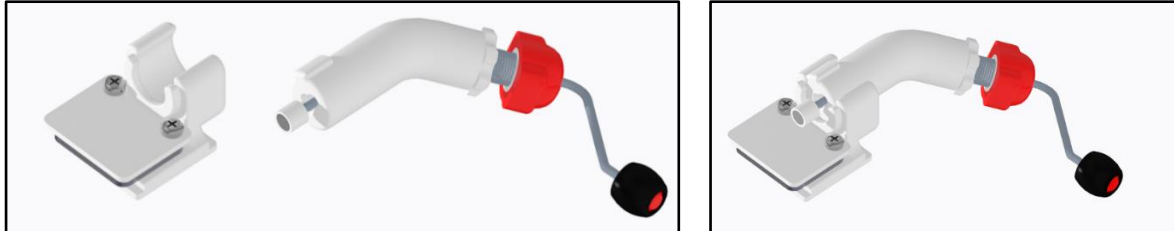
FABRICATION PROCESS

MATERIALS NEEDED can be found in Mechanical Part List (MPL, page 24), Printed Parts List (PPL, page 25) and Electronical part list (EPL, page 22)

| Step | Description | Materials needed |
|------|---|--|
| 1 | Straight spring wires (Part N°3.9) Insert (2x) the bottom end of the straight spring wires (Step 2.1) into the left hub holder (Part N°3.4). A pair of pliers may be helpful. | <ul style="list-style-type: none"> ○ Straight spring wires (Step 2.1) ○ Left hub holder (PPL N°9) ○ Flat pliers (Tool) |
| 2 | Padding (Parts N°3.5, 3-6) Attach the top and bottom padding (Step 2.2) covered foams to the back side of the left hub holder (Part N°3.4) with double tape within the specified areas. | <ul style="list-style-type: none"> ○ Top padding (1x) (Step 2.2) ○ Bottom padding (1x) (Step 2.2) ○ Double tape |
| 3 | Electrical wiring (Parts N°1, 3.3, 3.7, 3.8) Connect the battery (Part N°3.8), the Green LED (Part N°3.7) and the QWIIC I2C ADAPTER (Part N°3.3) with the headband's flat cable (Part N°1) following the flat cable's pinout and the electrical schematic (Pag. 23) . | <ul style="list-style-type: none"> ○ Green LED (EPL N°8) ○ Battery Li-Po 3.7V – 350mA (EPL N°2) ○ QWIIC I2C ADAPTER (EPL N°9) ○ Headset band (Part N°1) ○ Flat cable pinout (left side):  |
| 4 | Assembly with the Left hub cover (Part N°3.1, 3.2 – Step 3.3) Attach the left hub cover (Part N°3.2) to the assembly from step 2.3 by adding (5x) Flat head screw M2.5x8 (Part N°3.1). | <ul style="list-style-type: none"> ○ Flat head screw M2.5x8 (MPL N°5) ○ Left hub cover (PPL N°10) |
| 5 | Assembly with headset band (Parts N°1, 3) <ol style="list-style-type: none"> 1. Slide the top end of the straight spring wires (Part N°3.9) through the left node (Part N°1.6). 2. Insert the top end of the straight spring wires (Part N°3.9) into the hub end-part (Part N°3.10). 3. Use the locking screw (Step 1.4) to lock both together into the desired sliding position. | <ul style="list-style-type: none"> ○ Straight spring wires (Step 2.1) ○ Headset band (Part N°1) ○ Hub end-part (PPL N°7) |

4. Magnetic probe sub-assembly

Both magnetic probes (*Part N°4*) consist of a mechanical unit that translates orofacial movements into a moving magnet (mobile unit), and a magnetometer Adafruit MLX90393 (*Part N°4.4*) sensing unit that measures the magnet's magnetic field (fixed unit). The probes slide vertically through the corresponding (right/left) hub (*Parts N° 2, 3*) to fit the contour of any face.

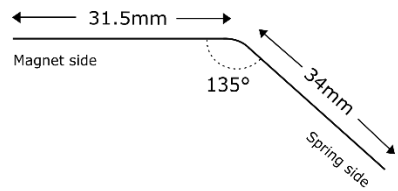
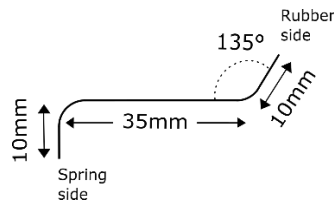


| N° | Mechanical part description |
|------|------------------------------------|
| 4.1 | Magnetometer top cover |
| 4.2 | Cylindrical head screw M2.5x6 (2x) |
| 4.3 | Magnetometer support |
| 4.4 | Adafruit MLX90393 |
| 4.5 | Axial disc magnet |
| 4.6 | Magnet holder |
| 4.7 | Top beam |
| 4.8 | Right or Left tube |
| 4.9 | Spring holder part 1 |
| 4.10 | Traction spring of 13 mm long |
| 4.11 | Spring holder part 2 |
| 4.12 | Spherical socket |
| 4.13 | Bottom beam |
| 4.14 | End part holder |
| 4.15 | Rubber end part |

FABRICATION PROCESS

Both (left/right) probes share the same process except step 4.5 which involve different (left/right) tubes (*Part N°4.8*).

MATERIALS NEEDED can be found in Mechanical Part List (MPL, page 24), Printed Parts List (PPL, page 25) and Electronical part list (EPL, page 22)

| Step | Description | Materials needed |
|------|--|---|
| 1 | Top and bottom Beams (<i>Parts N°4.7, 4.13</i>) Make the top (<i>Part N°4.7</i>) and bottom (<i>Part N°4.13</i>) beams as illustrated with a steel wire of $\varnothing 2$ mm. | <ul style="list-style-type: none"> Steel wire of $\varnothing 2$ mm (MPL N°10) Pattern for the top beam:  Pattern for the bottom beam:  |

| | |
|--|--|
| <p>2 Elastic coupling assembly (Parts N°4.9, 4.10, 4.11)</p> <ol style="list-style-type: none"> 1. Cut the traction spring of 1m long to have (2x) a 13 mm piece (Part N°4.10). 2. Apply metal glue inside of each spring holder (Part N°4.9, 4.11) and fix them to each side of the 13mm long traction spring (Part N°4.10). 3. Let the glue dry during 2 hours before continuing. | <ul style="list-style-type: none"> ○ Traction spring of 1m long (MPL N°11) ○ Spring holder part 1 (PPL N°18) ○ Spring holder part 2 (PPL N°19) ○ Metal glue: CYANOACRYLATE INSTANT ADHESIVES such as Ergo®5011 or Ergo®5901 |
| <p>3 Top beam and elastic coupling assembly (Part N°4.7 – Step 4.2)</p> <ol style="list-style-type: none"> 1. Fill the central hole in the spring holder part 2 (Part N°4.11) with metal glue. 2. Insert the spring side of the top beam (Part N°4.7) into the elastic coupling (Step 4.2) and guide it through the glued central hole (step 4.3.1) in the spring holder part. | <ul style="list-style-type: none"> ○ Top beam (Step 4.1) ○ Elastic coupling (Step 4.2) ○ Metal glue: CYANOACRYLATE INSTANT ADHESIVES such as Ergo®5011 or Ergo®5901 |
| <p>4 Bottom beam assembly (Parts N°4.13, 4.12, 4.14, 4.15)</p> <ol style="list-style-type: none"> 1. Apply metal glue on both ends of the bottom beam (Part N°4.13). 2. Insert the spring side of the bottom beam (step 4.1.2) through the spherical socket central hole (Part N°4.12). 3. Insert the rubber side of the bottom beam (step 4.1.2) through the end-part holder (Part N°4.14) central hole. 4. Insert the end-part holder (Part N°4.14) into the rubber end-part (Part N°4.15). 5. Let the glue dry before continuing. | <ul style="list-style-type: none"> ○ Bottom beam (Step 4.1) ○ Spherical socket (PPL N°20) ○ End-part holder (PPL N°21) ○ Rubber end-part (MPL N°13) ○ Metal glue: CYANOACRYLATE INSTANT ADHESIVES such as Ergo®5011 or Ergo®5901 |
| <p>5 Mobile unit assembly (Parts N°4.5, 4.6 – Step 4.3, 4.4)</p> <ol style="list-style-type: none"> 1. Assemble the resulting parts from steps 4.3 and 4.4 by inserting the spring holder part 2 (Part N°4.11) into the spherical socket (Part N°4.12). 2. Insert the resulting part from step 4.5.1 through the tube (left/right) (Part N°4.8). 3. Insert the magnet side of the top beam (step 4.1.1) into the magnet holder. 4. Place the axial disc magnet into the magnet holder (Part N°4.6). | <ul style="list-style-type: none"> ○ Top beam and elastic coupling assembly (Step 4.3) ○ Bottom beam assembly (Step 4.4) ○ Magnet holder (PPL N°15) ○ Axial disc magnet (MPL N°12) ○ Right/left tube (PPL N°16, 17) |

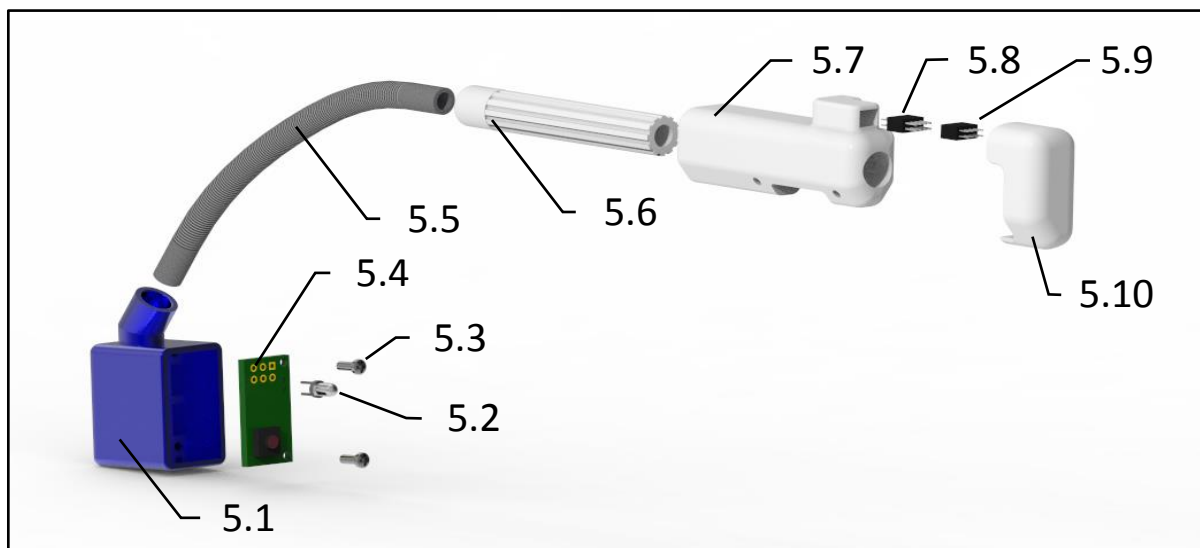
| | |
|---|---|
| <p>6 Fixed and mobile unit assembly (Parts N°4.1, 4.2, 4.3, 4.4 – Step 4.5)</p> <ol style="list-style-type: none"> 1. Fix the Adafruit MLX90393 (Part N°4.4) between the magnetometer support (Part N°4.3) and the magnetometer top cover (Part N°4.1) using (2x) cylindrical head screws M2.5x6 (Part N°4.2). 2. Slide the mobile unit (Step 4.5) into the magnetometer support (Part N°4.3). | <ul style="list-style-type: none"> ○ Adafruit MLX90393 (EPL N°3) ○ Magnetometer support (PPL N°14) ○ Magnetometer top cover (PPL N°13) ○ Cylindrical head screw M2.5x6 (MPL N°9) ○ Mobile unit assembly (Step 4.5) |
| <p>7 Electrical wiring (Parts N°2, 3, 4.4)</p> <ol style="list-style-type: none"> 1. Insert the JST SH 4-PIN cable (connector side) in the right side of the QWIIC I2C ADAPTER (Part N°2.12, 3.3). 2. Connect the JST SH 4-PIN cable (wires side) to the Adafruit MLX90393 (Part N°4.1) following the electrical schematic (Pag. 23). | <ul style="list-style-type: none"> ○ Adafruit MLX90393 (EPL N°3) ○ JST SH 4-PIN cable (EPL N°12) ○ QWIIC I2C ADAPTER (EPL N°9) |
| <p>8 Assembly with the right or left hub (Parts N° 2, 3 – Step 4.7)</p> <p>Slide the assembly from step 4.7 into the bottom part of the right/left hub following the general assembly (Pag. 5).</p> | <ul style="list-style-type: none"> ○ Right hub (Part N°2) ○ Left hub (Part N°3) |

5. Optical probe sub-assembly

The optical probe (*Part N°5*) measures voluntary forehead movements. A flexible metal conduit (*Part N°5.5*) and a sliding joint (*Parts N°5.6, 5.7*) allow to finely adjusting the position and orientation of the optical sensing unit (*Parts N°5.1, 5.4*) respect the forehead.



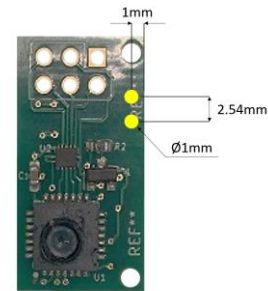
| N° | Mechanical part description |
|------|------------------------------|
| 5.1 | Optical sensor case |
| 5.2 | White LED L3-W36N-BVW |
| 5.3 | Phillips screw M2x6 (2x) |
| 5.4 | Optical sensor PCB |
| 5.5 | Flexible metal conduit |
| 5.6 | Sliding joint male |
| 5.7 | Sliding joint female |
| 5.8 | 8pos 1.27mm male connector |
| 5.9 | 8pos 1.27mm female connector |
| 5.10 | Wires cover |



FABRICATION PROCESS

MATERIALS NEEDED can be found in Mechanical Part List (MPL, page 24), Printed Parts List (PPL, page 25) and Electrical part list (EPL, page 22)

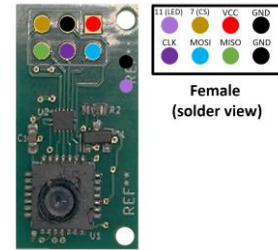
| Step | Description | Materials needed |
|------|--|--|
| 1 | Flexible metal conduit (Part N°5.5) Cut a piece 136mm long of Interlock Type-C Conduit. | <ul style="list-style-type: none"> Flexible metal Conduit of 10m (MPL N°8) |
| 2 | Housing assembly (Parts N°5.1, 5.5, 5.6) <ol style="list-style-type: none"> Insert one end of the flexible metal conduit (Part N°5.5) into the optical sensor case (Part N°5.1) side opening. Insert the other end of the flexible metal conduit (Part N°5.5) into the sliding join male (Part N°5.6). Secure the assembly applying metal glue at around the contours interfacing the flexible metal conduit (Part N°5.5) with the optical sensor case (Part N°5.1) and the sliding join male (Part N°5.6). Let the glue dry before continuing. | <ul style="list-style-type: none"> Optical sensor case (PPL N°9) Flexible metal conduit (Step 5.1) Sliding join male (PPL N°10) Metal glue: CYANOACRYLATE INSTANT ADHESIVES such as Ergo®5011 or Ergo®5901 |
| 3 | Sensing unit assembly (Parts N°5.2, 5.4) <ol style="list-style-type: none"> Drill the optical sensor PCB (Part N°5.4) with 2x 1mm diameter holes as indicated in the figure in yellow. Insert the white LED (Part N°5.2) pins through the drilled holes in step 5.3.1. Secure the white LED (Part N°5.2) on the optical sensor PCB (Part N°5.4) with hot glue. | <ul style="list-style-type: none"> White LED (EPL N°7) Optical sensor PCB (PCB-PL P.21, EPL N°4) Driller (tool) Silicone hot gun (tool) |



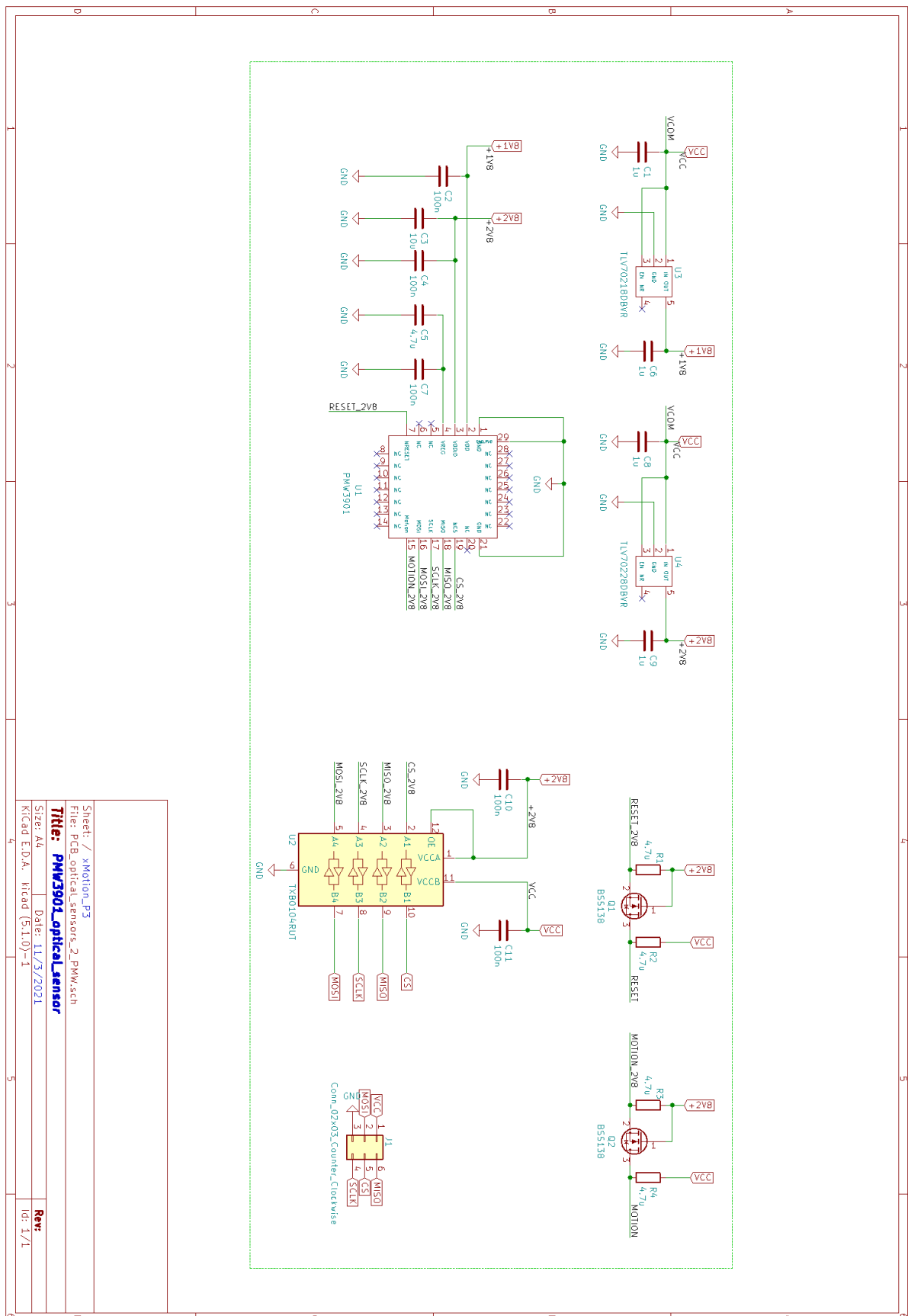
4 Electrical wiring

1. Cut 8 wires with a length of 150 mm and solder them with the pins of the optical sensor.
2. Twist the wires and pass them through the probe created at the step 2 by the side of the optical sensor case (*Part N°5.1*).
3. Solder the wires coming out of the sliding join male (*Part N°5.6*) with the female connector (*Part N°5.9*) according to the figure beside.
4. Cut 8 electric wires and solder them on the Male connector (*Part N°5.8*).
5. Insert the Male connector (*Part N° 5.8*) with the soldered wires inside the housing located on the Sliding join female (*Part N°5.7*).
6. Secure the Male connector (*Part N°5.8*) on the Sliding join female (*Part N°5.7*) with hot glue.
7. Assemble the Sliding join female (*Part N°5.7*) above the right hub.
8. Solder the wires coming out of the Sliding join female (*Part N°5.7*) with the Bluefruit NRF52 Feather (*Part N°2.4*) according to the [electrical schematic \(Pag. 23\)](#).

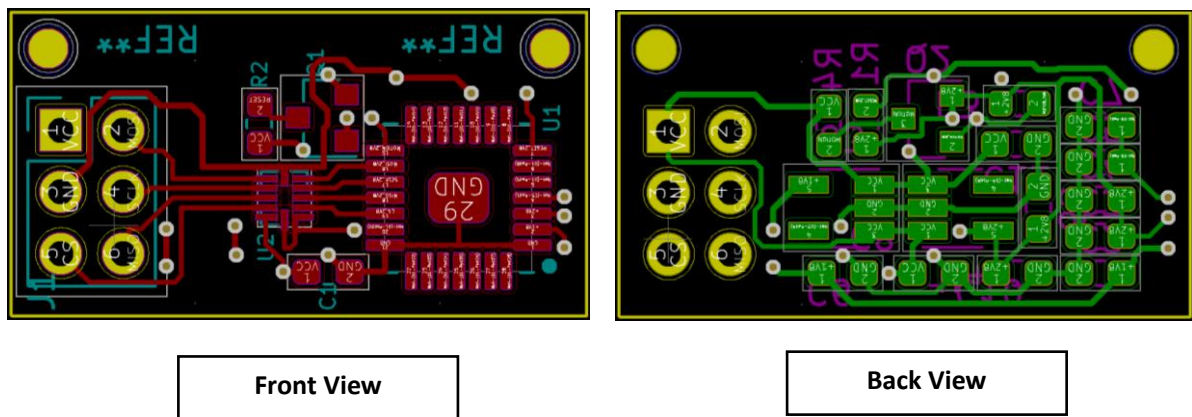
- 28AWG wires or 30AWG wires
- Silicone hot gun (tool)
- Sliding join female ([PPL N°11](#))



Optical sensor circuit schematic
















PCB optical sensor Layout

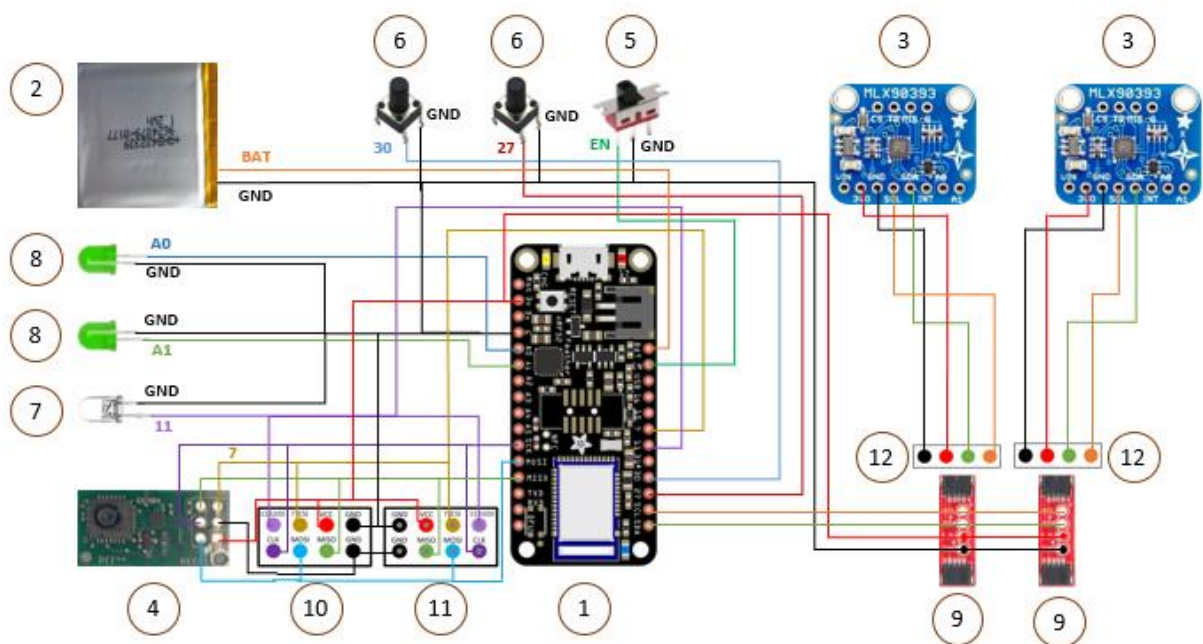


PCB optical sensor parts list (PCB-PL)

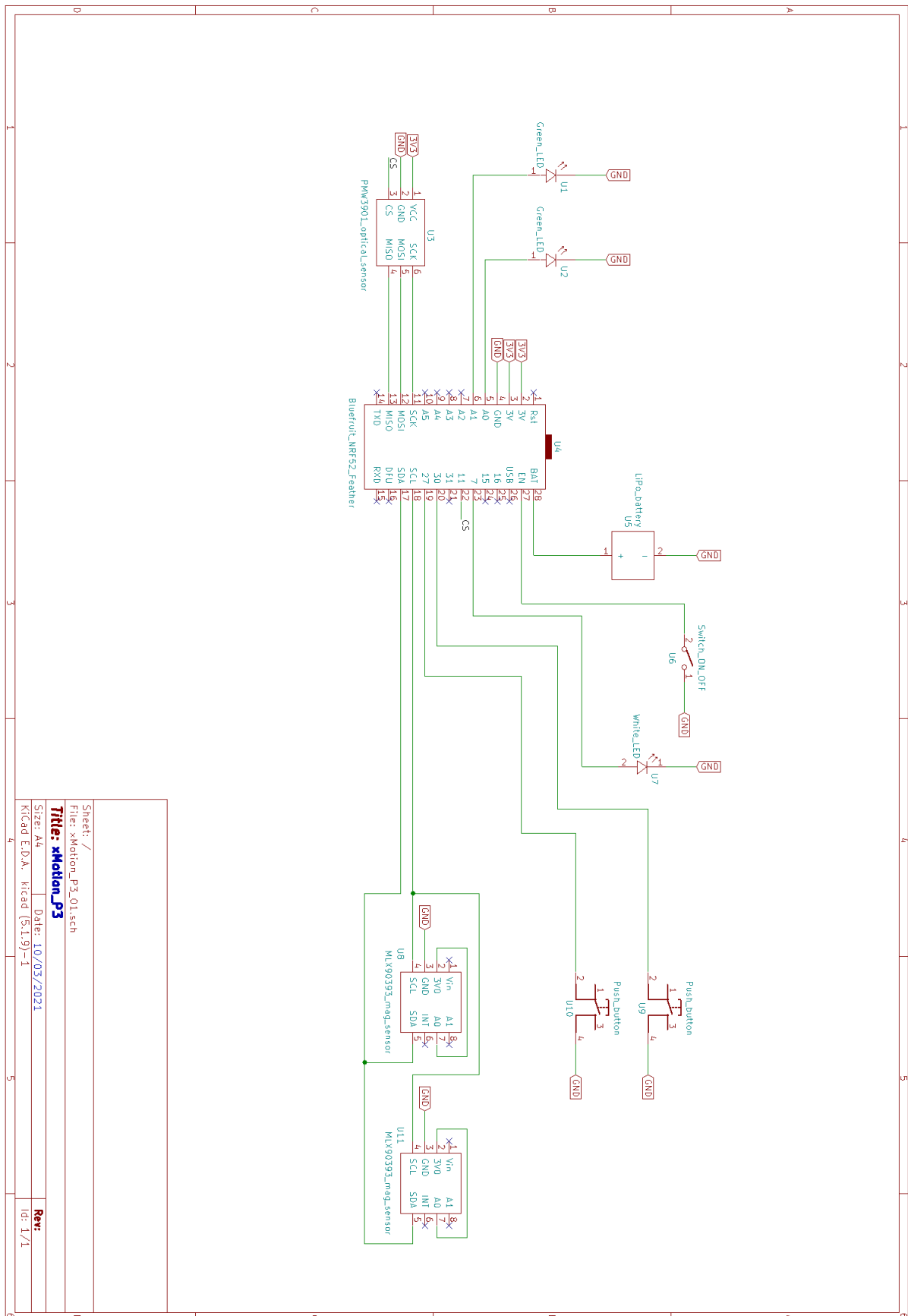
| N° | PCB part description | Quantity | Datasheet | Supplier link |
|----|--|----------|-----------|---------------------------------------|
| 1 | Motion tracking sensor PMW3901 | 1 | | PMW3901MB-TXQT |
| 2 | Translation Bidirectional 4- channel voltage levels | 1 | | TXB0104RUTR |
| 3 | MOSFET SOT-23 N-CH LOGIC BSS138 | 2 | | BSS138 |
| 4 | SMD resistors 0603 4.7KΩ 5% | 4 | | SFR03EZPJ472 |
| 5 | TLV70218 Voltage regulators 1.8V, LDO, 300mA | 1 | | TLV70218DBVR |
| 6 | TLV70228 Voltage regulators 2.8V, LDO, 300mA | 1 | | TLV70228DBVR |
| 7 | Ceramic Capacitors SMD 6.3V 100nF 0603 10% | 3 | | 0603C104K5RECAUTO7411 |
| 8 | Ceramic Capacitors SMD 6.3V 1uF 0603 10% | 4 | | C0603C105K9RAC7411 |
| 9 | Ceramic Capacitors SMD 6.3V 4.7uF 0603 10% | 1 | | GMK107BBJ475KA-T |
| 10 | Ceramic Capacitors SMD 6.3V 10uF 0603 10% | 1 | | C0603C106M8PACTU |

Electronic parts list (EPL)

| N° | Part description | Quantity | Datasheet | Supplier Link |
|----|--|----------|---|-------------------------------|
| 1 | Bluefruit nRF52 Feather | 1 |  | Nrf52 |
| 2 | Rechargeable battery Li-Po 3.7V 350mAh | 1 |  | ICP602823PA |
| 3 | Triple-axis Magnetic sensor | 2 |  | MLX90393 |
| 4 | Motion tracking optical sensor | 1 |  | PMW3901 |
| 5 | Slide Switch ON/OFF | 1 |  | RND 210-00581 |
| 6 | Push button | 2 |  | PTS647SK70 |
| 7 | White LED | 1 |  | L3-W36N-BVW |
| 8 | Green LED | 2 |  | WP7113LGD |
| 9 | QWIIC I2C ADAPTER | 2 |  | DEV-14495 |
| 10 | 8pos 1.27mm female connector | 1 |  | 200213 |
| 11 | 8pos 1.27mm male connector | 1 |  | 20021111 |
| 12 | JST SH 4-PIN cable | 2 |  | 4209 |
| 13 | 6-contacts flat cable | 300 mm |  | flat cable |



General circuit schematic



Mechanical parts list (MPL)

ASSEMBLY: Headset band (HB), Right hub (RH), Left hub (LH), Magnetic probe (MP), Optical probe (OP)

| N° | Part description | Assembly | Quantity | Link |
|----|-------------------------------|------------|---------------------|-------------------------------|
| 1 | Allen screw M3x10 | HB | 2 | [M3x10] |
| 2 | Spring wire of Ø1.6 mm | HB, RH, LH | 1 (m) | [Spring wire] |
| 3 | Memory foam of 12mm thickness | HB, RH | A4 (210 x 297 mm) | [Foam 1] |
| 4 | Thin foam of 3 mm thickness | HB | A4 (210 x 297 mm) | [Foam 2] |
| 5 | Flat head screw M2.5x8 | RH, RL | 10 | [M2.5x8] |
| 6 | Thin tissue for covering | RH, RL | 500 mm ² | [tissue] |
| 7 | Philipps screw M2x6 | OP | 2 | [M2x6] |
| 8 | Flexible metal Conduit of 10m | OP | 10 m | [S-4N] |
| 9 | Cylindrical head screw M2.5x6 | MP | 4 | [M2.5x6] |
| 10 | Steel wire of Ø2mm | MP | 500 mm | [Steel wire] |
| 11 | Traction spring of 1m long | MP | 1 m | [Spring] |
| 12 | Axial disc magnet | MP | 2 | [Magnet] |
| 13 | Rubber end-part | MP | 2 | [Rubber] |

Printed parts list (PPL)

ASSEMBLY: Headset band (HB), Right hub (RH), Left hub (LH), Magnetic probe (MP), Optical probe (OP)

| N° | Part description | Assembly | Quantity | Part name | Printing material |
|----|------------------------|----------|----------|--|-------------------|
| 1 | Flexible top cover | HB | 1 | flexible_top_cover.stl | TPU |
| 2 | Right side node | HB | 1 | right_side_node.stl | Tough PLA or ABS |
| 3 | Left side node | HB | 1 | left_side_node.stl | Tough PLA or ABS |
| 4 | Locking wheel | HB | 2 | locking_wheel.stl | TPU |
| 5 | Flexible headband | HB | 1 | flexible_headband.stl | TPU |
| 6 | Right hub cover | RH | 1 | right_hub_cover.stl | Tough PLA or ABS |
| 7 | Hub end part | RH, LH | 2 | hub_end_part.stl | Tough PLA or ABS |
| 8 | Right hub holder | RH | 1 | right_hub_holder.stl | Tough PLA or ABS |
| 9 | Left hub holder | LH | 1 | left_hub_holder.stl | Tough PLA or ABS |
| 10 | Left hub cover | LH | 1 | left_hub_cover.stl | Tough PLA or ABS |
| 9 | Optical sensor case | OP | 1 | optical_sensor_case.stl | Tough PLA or ABS |
| 10 | Sliding join male | OP | 1 | sliding_join_male.stl | Tough PLA or ABS |
| 11 | Sliding join female | OP | 1 | sliding_join_female.stl | Tough PLA or ABS |
| 12 | Wires cover | OP | 1 | wires_cover.stl | Tough PLA or ABS |
| 13 | Magnetometer top cover | MP | 2 | magnetometer_top_cover.stl | Tough PLA or ABS |
| 14 | Magnetometer support | MP | 2 | magnetometer_support.stl | Tough PLA or ABS |
| 15 | Magnet holder | MP | 2 | magnet_holder.stl | Tough PLA or ABS |
| 16 | Right tube | MP | 1 | right_tube.stl | Tough PLA or ABS |
| 17 | Left tube | MP | 1 | left_tube.stl | Tough PLA or ABS |
| 18 | Spring holder part 1 | MP | 2 | spring_holder_part1.stl | Tough PLA or ABS |
| 19 | Spring holder part 2 | MP | 2 | spring_holder_part1.stl | Tough PLA or ABS |
| 20 | Spherical socket | MP | 2 | spherical_socket.stl | TPU |
| 21 | End-part holder | MP | 2 | end_part_holder.stl | Tough PLA or ABS |