HARDWARE GUIDE

ELECTRODES

Materials:

* 3 pack of Ten20 conductive paste
* 10 gold electrodes
* Tape

Using the electrodes:

1. Scoop conductive paste into the gold electrode cup
2. Place the cup on the area of interest and secure with tape placed over it

Before using the gold electrodes, make sure your skin is prepared by washing it with mild soap and water. Use a light abrasive to remove dead skin if available.

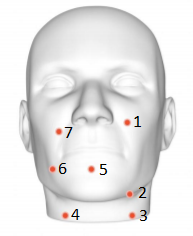
This [video](https://youtu.be/foIax2qm-vc?t=109) is helpful for learning how much Ten20 conductive paste to use and how to apply the electrodes. Help secure the electrodes by using any tape, even though it mentions medical/ surgical tape.

There is also this [guide from OpenBCI](https://docs.openbci.com/docs/01GettingStarted/02-Biosensing-Setups/EEGSetup) that also walks through the process.

MAKE SURE NOT TO USE TOO MUCH. The conductive area is based on the area of the paste. Only enough to fill the cup and have it spread to the border of the electrode when pressed onto the skin is needed.

For hygienic purposes, please don’t double dip. If more paste is needed, use a clean utensil to take the amount needed from the jar and add it to the electrode.

Please place the 7 electrodes in the corresponding places:



There will be two additional electrodes: one (1) bias electrode (BIAS on the board) should be attached to one earlobe; one (1) reference electrode (SRB on the board) should be attached to the other earlobe.

Cleaning the electrodes:

1. Dig out as much excess paste from the electrode cup.
2. Dip the electrodes in hot water 3-4 times or as needed, 1-2 seconds each time.
3. Wipe the electrodes dry with a paper towel.
4. If there is any paste that rubbed onto the wire part, also wipe it off using a damp towel.

HEADSET AND ENCLOSURES ASSEMBLY

Materials:

* 3D printed headset
* 3D printed battery and board enclosures
* 3D printed loops
* Copper wire
* Velcro
* Heat shrink tubing
* Glue

Procedure for the battery and board enclosures:

1. Attach a Velcro strip that is as wide as the enclosure and parallel with the cutout(s) on its back (i.e. the side without the sliding cover).
2. Measure and cut a separate Velcro strip that has the opposite surface (prickly or soft) from the one in step 1. Make sure the length is long enough so that when the strip is wrapped around the bicep, the strip’s two end meet.
3. When using the enclosure, line up the Velcro on the back of the board and the one around the bicep. Attach the two together so that the ends of the bicep strip meet in the middle of the enclosure strip (Figure 1).

Diagram

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*Fi*g*ure 1: Back of enclosure where the ends of the bicep Velcro strip meet. The red arrows point to the red line where the ends meet on the back of the enclosure. The bicep strip adhered to the Velcro strip on the enclosure.*

Procedure for assembling the headset:

1. Glue loops onto on either side of the headset, near the ends (Figure 2).
2. Thread a strip of Velcro through the loops and press it onto itself to secure it.
3. Measure a length of copper wire for each electrode that is placed on the face. The copper wire should be able to reach the measurement location on the face and has additional length to account for the amount being used to attach it to headset.
4. Glue three copper wires to the inner wall (closest to the face) of one end of the headset. Glue the remaining wires to the inner wall of the other end (Figure 3). If there is not enough space on the inner wall of either end, glue it onto the opposite facing wall of that end.
5. Thread the electrodes through the back of the headset and split them to either side (left or right) according to how many copper wires were attached to the side’s end plus one (for the bias or reference electrode). In summary, there will be four electrodes coming out of one end and five electrodes coming out the other.
6. Pair each measurement electrode to a copper wire and thread them through heat shrink tubing until no bare copper wire is exposed. Note: No copper wire is paired with the reference and bias electrode.
7. Heat up the heat shrink so that it constricts and secures the electrode wire together with the copper wire.

Shape

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*Figure 2: Top view (a) and side view (b) of a loop (yellow) attached to the headset (green). One loop is glued onto each of the two sides.*

Shape

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*Figure 3: Places to glue the copper wires. The red line marks the main wall for gluing the copper wire. If there is not enough space, use the backup (purple line).*

USING THE DEVICE

Materials:

* 3 pack of Ten20
* 10 gold electrodes
* OpenBCI Cyton Biosensing board + USB dongle
* Battery pack with no batteries
* Four (4) 1.5V AA batteries
* Tape (optional)

Note: The following procedure assumes the user has already installed the FTDI device drivers for the Cyton board. If not, the user should download the FDTI device drivers via following the appropriate [FTDI Installation Guide](https://www.ftdichip.com/Support/Documents/InstallGuides.htm) (depending on your OS) - the user will need the VCP and D2XX drivers.

How to use the headset and setup the device:

1. Place the board and battery in their respective enclosures.
2. Plug in battery connector and electrode wires to the appropriate insert/pins (NP1 - NP7 for the measurement electrodes, BIAS for the bias electrode, and SRB for the reference electrode) on the Cyton board. Note: The electrode wires should be inserted into the bottom pins of each channel on the board.
3. Attach board and battery enclosure to a bicep.
4. Rest headset on the shoulders or use the velcro strap and place it on top of the head to hang headset so that either end is next to the ears
5. Follow the Electrodes guide to attach the electrodes to the face and earlobes.
6. Connect the OpenBCI USB dongle to a USB port. Make sure the switch at the side is set to GPIO 6.
7. Turn on the Cyton board by setting the switch at the side to PC.

How to use the OpenBCI GUI for recording samples:

(This procedure assumes that the user has already followed the setup procedure and is wearing the device.)

Follow the tutorial described by this link: [Getting started](https://docs.openbci.com/docs/01GettingStarted/01-Boards/CytonGS).

The link will bring you to a page that will give all the instructions for setting up and using the OpenBCI GUI.

Here is the general idea:

1. Download the appropriate standalone application OpenBCI GUI (depending on you OS)
2. Extract the OpenBCI GUI folder - inside you should see the .exe file for running the app
3. Open the app named OpenBCI\_GUI.exe
4. Connect to the board in the app. The Cyton board in this guide has 8 channels.
5. Click Start Data Stream when you are ready to record.
6. Click Stop Data Stream to stop recording.
7. Press Start Data Stream again to start another recording.

Things to note about recording:

* The app automatically saves the recordings and places it in a folder named OpenBCISession\_name. The “name” is set when connecting the board (see Session Data > Name).
* The recording will start with a lot of noise (thick section of signals). This is normal. Still, say the word within a 2 sec window, starting the window at the immediate moment the recording starts.
* The signal you are recording is you saying “yes” or “no” to yourself - SILENTLY as if silently reading a word. Start a new session by exiting and reopening the app.
* Take 2 min long recordings for each word, giving 2 secs for each subvocalization, i.e. every 2 sec say the appropriate word.
* Turn off channel 8 that is unused.
* Try to be as still as possible, without moving the tongue or anything.