

4.s52, MIT Architecture Fall 2022

Feeling Architecture: Affective Computing and Digital Heritage

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Practice Assignment 2: Introduction to Affective Computing

Schedule

Wednesday, September 28: Assignment out, Demo

Wednesday, October 5th: Due (Short presentation and discussion)

Overview

Experience the space of your choice with wearable EEG/GSR on you. Combine the recorded EEG/GSR metrics together with the video recording of your experience, and present your analysis by comparing the two.

Your task

1. Make a team of three students. Discuss and select a space for this experiment.
 - If you have not looked at this video, this (by Prof. Picard's video) is the best reference for this exercise.
<https://www.youtube.com/watch?v=ujxriwApPP4>
2. One person will be the "Explorer" who experiences the space
 - The Explorer will wear the EEG/GSR
 - The other students will be "Assistants" who help logging the EEG/GSR metrics
 - The team also will simultaneously record the experience in video footage. The video may be made through a camera worn by the Explorer (first person view), or a camera held by one of the assistants (third person view) pointing at the Explorer.
 - Make sure you have some means later to synchronize the EEG/GSR metrics and the video
 - Consider whether you ask the Explorer to look around from a constrained area, move within a space, or to traverse across some connected spaces.
 - Consider whether you ask the Explorer to move on a previously agreed path, or to move spontaneously on any path
 - (If onsite EEG/GSR measurement does not work for some reason, Explorer may watch a pre-recorded video as replacement of the physical experiment.)
3. Repeat the step 2 with each member of your team taking a turn to become the "Explorer"
4. In video editing software, combine the EEG/GSR data metrics and video recording
 - Use the format similar to the one Prof. Picards is using in her presentation video.
 - Make sure to synchronize the EEG/GSR data and the video recording
5. In the next class, make a presentation (15 min per team).
 - Summarize your design of your exercise (location, time, constraints, and expected result)
 - What was the result? Extract the indicative portion of the "combined" sequences for your presentation.
 - Reflect your thoughts about the method of your experiment (What worked/did not work)
 - Include your findings about the spatial experience and the feeling associated with it



Submission

Please submit your presentation files before the class. Dropbox location will be announced.

Reference

- Sussman, A., & Hollander, J. B. (2021). *Cognitive Architecture: Designing for How We Respond to the Built Environment*. Routledge.
- Picard, R. W. (2000). *Affective Computing*. Cambridge, MA: MIT Press.
- Farahi, B. (2020). Emotional intelligence: Affective computing in architecture and design. In *Architectural Intelligence* (pp. 235-251). Springer, Singapore.
- Ergan, S., Radwan, A., Zou, Z., Tseng, H. A., & Han, X. (2019). Quantifying human experience in architectural spaces with integrated virtual reality and body sensor networks. *Journal of Computing in Civil Engineering*, 33(2), 04018062.
- Shemesh, A., Talmon, R., Karp, O., Amir, I., Bar, M., & Grobman, Y. J. (2017). Affective response to architecture—investigating human reaction to spaces with different geometry. *Architectural Science Review*, 60(2), 116-125.

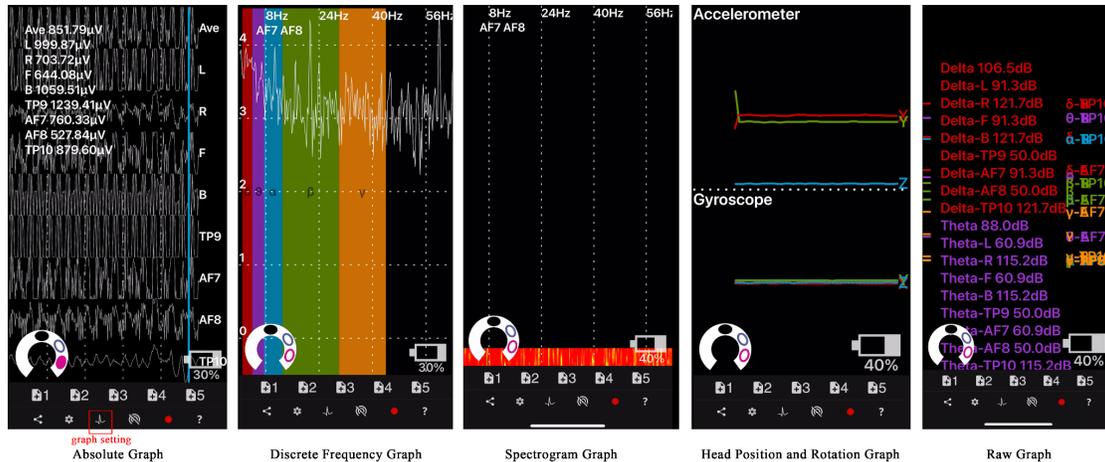
EEG Device Manual

You can watch the video version of EEG and GSR manual [here](#).

Mobile Device Setting Up

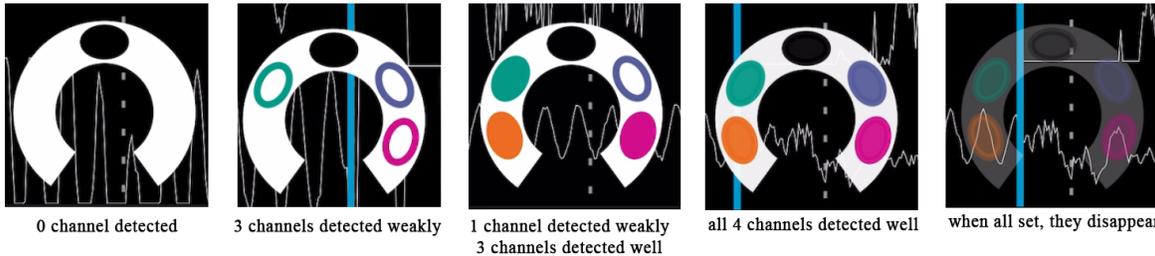
- To know more about the muse device, see [here](#).
- Download [Mindmonitor](#) on your phone; It will cost \$15 per account (per team) (up to 5 family members can use this app with family sharing enabled).
- Open the bluetooth connection of your phone.
- **Press 1 second** to turn on your Muse 2. If not connected successfully, check the following:
 1. If you have [Muse Meditation](#) app, delete it. Mindmonitor and Muse Meditation can not be used and installed in the same phone, muse 2 device will confuse on it.
 2. Update your [Mindmonitor](#) to the latest version.
 3. Muse turns on when you see the red LED on.
 4. For help with Bluetooth pairing visit [here](#).
- Go to the **settings**  (second left on the bottom), change the following settings:
 - Recording Interval -> **constant** (1000 data row per second)
 - Recording Upload -> **Dropbox or Email** (if under 10 Mb – 10 minutes recordings usually)
 - Connect to your email/dropbox to convey the csv file of the EEG data in the future.
- Tap **graph settings**  (third left on the bottom) icon to cycle through the different graph views. These are: Absolute, Raw, Discrete Frequency, and Spectrogram. More technical manual, see [here](#).





Device Wearing

- Now, Let's start wearing our Muse 2 on your head! It usually takes 1-3 minutes to get all the connections well, and be patient.
 1. Adjust the muse on your front head. See this [video](#) for some adjusting tips. For more information on signal quality and how to get a better headband fit, please visit [here](#).
 2. You should see 4 solid circles on the horseshoe . This is the horseshoe, it represents the sensors on the Muse and how they are connected. Solid ovals are good connections. Outlines are poor connections and an empty space means no connection.



Recording CSV

- **Recorded files** (5th left on the bottom) – the recordings are saved by default as plain text CSV (comma separated values) format to your email or dropbox. it will ask to link to your dropbox. turn to square means recording. tap the square again stop recording.
- **Other option for coders: OSC Streaming** (4th left on the bottom) let you stream data directly from Mind Monitor to an OSC data receiver such as [Interaxon MuseLab](#), and [Muse Player](#). **It is optional** for students unless you have some programming background, we do not recommend that unless you decide to spend some extra time on the codes.

Downloading

- Go to your **dropbox**, go to -> **recents**, the zip file from Muse should be the first file on your dropbox list;
- **Or go to email** to your inbox.
- **Download** and unzip the CSV from your email/dropbox.
- The following data is recorded in CSV files:
 - **TimeStamp:** Time in milliseconds of your phone



- **Absolute:** Brain wave values are absolute band powers, based on the logarithm of the Power Spectral Density (PSD) of the EEG data for each channel.
 - The frequency spectrums of these are:
 - **Delta** (1-4Hz)
 - **Theta** (4-8Hz)
 - **Alpha** (7.5-13 Hz)
 - **Beta** (13-30 Hz)
 - **Gamma** (30-44Hz)
 - The channels of the EEG data are:
 - **TP9** - Left ear
 - **AF7** - Left forehead
 - **AF8** - Right forehead
 - **TP10** - Right ear
 - **AUXR** - Right Auxiliary (MU-02/MU-03 only)
- **Raw:** Raw EEG values show each sensor's raw data in microvolts(μV), the range of which is {0:~1682}.
- **Accelerometer:** xyz position of the head – The effect of gravity on the headband, measured in g (9.81m/s²).
- **Gyro** (MU-02 only): xyz rotation of the head
- **HeadBandOn:** if the handband is on
- **HSI:** HorseShoe Indicator / Sensor connectivity
- **Battery:** Battery level of your MUSE
- **Elements:** if you are blinking your eyes or clenching your jaw

Visualization Data

ONLINE ANALYSIS TOOLS

- **You** can create graphs of your CSV file recordings, online at Mind-Monitor.com/Chart.php
 Upload .CSV file -> **Choose file**
 Select -> **All Data Points**
 If you want animation in seconds -> **Animate -> 0 ms loading delay**
 In the dashboard, you can choose different data to display:



Right click this  to "Save As" a PNG Image.



- 1 Upload CSV file
- 2 Choose All Data Points
- 3 Choose Frequency and channels
- 4 Choose Data Type
- 5 Range of the table
- 6 Animate with 0 ms Delay
- 7 Save the PNG file
- 8 Check sigle data value
- 9 Average data description
- 10 Single data description

- **Optional:** You can see more developer documents about [muselab](#) and [museplayer](#) if you want to explore in your own visualization.

EXCEL ANALYSIS TOOLS

Or you can Graphing CSV data from Mind Monitor in Microsoft Excel, following [Muse Graphing with Excel Tutorial](#).

PYTHON ANALYSIS TOOLS

If you are familiar with python, you can run the [code](#) to do the analysis of EEG CSV files using Google Colab and your Google Drive.

Recording the Experience with millisecond timing

- Download [Millisecond Clock](#) from Appstore, if you are using iphone
- Start the video by shooting the screen of your phone using [Millisecond Clock](#)





Then, we can synchronize our EEG data with other data, such as video, by the TimeStamp (Clock in CSV file).

GSR Device Manual

PC Setting Up

- To know more about the Neulog GSR sensor, see [here](#).
- Download [PC application](#) ver. 7.124.140 for windows system. (Neulog does not offer applications for the latest Mac system, if you have Catalina & Big Sur systems, you can download PC applications for mac.)
- Double Click neulog_ver_122_138.dmg file to install the application in your computer -> run anyway -> choose the install location -> next -> accept the agreement -> finish

GSR Sensor Connection

- Join your [USB Module](#) with your [GSR logger sensor](#)
- Link your USB Module to your PC with the cable
- Open Neulog, you should see a white hand with blue background icon showing you connected with your GSR sensor successfully

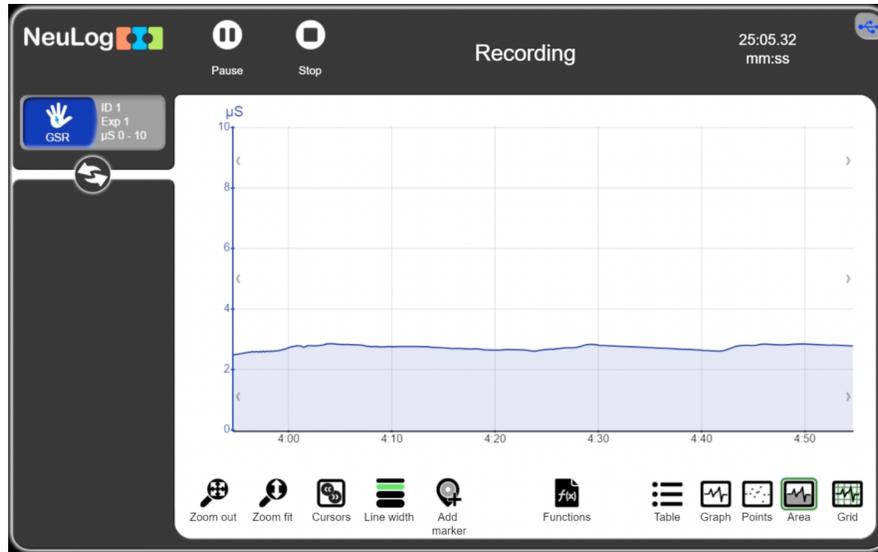
Device Wearing

- Wear the GSR sensor on your index and middle fingers of your right/left hand – see this [video](#) for more details of wearing.

Running experiment

- Click **Run experiment** on the top
 - Duration -> **30 minutes**
 - Rate -> **10 per second**
 - Trigger -> **Off**
 - Display while recording -> **yes**
- Click **Record** on the top to start recording
- You can choose different display model of chart on the right bottom: **Table, Graph, Points, Area, Grid**
- Click **zoom fit** to display the data clearly
- Click **Stop** when you finish recording





- Zoom out: set 10-0 us range of the data
- Zoom in: set the data range to a smaller one
- Cursor: highlight/choose the segment of the graph of interest
- Line width: change the width of line
- Add marker: add a highlight data marker
- Function: if you want to change the math expression of y axis using some functions
- Table: display the data using table
- Graph: display as graphs
- Point: display as point graph
- Area: display as line graph with area
- Grid: turn on/close the grid

Downloading

- Click **Export** to export csv or png of your recording on your computer
- Choose **Save file** -> enter file name and experiment name
- **Save graph image (.png)** and **Save value table (.csv)**

Visualization in Excel

- Open your file name.csv with excel
- **Select all your data** of column A (Time) and B (GSR data)
- Go to Insert -> Insert line or area chart -> line

Synchronize your data of EEG/GSR and video for presentation, refer to picard's video:

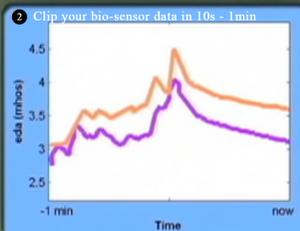
Now you can see your GSR data as a line chart!



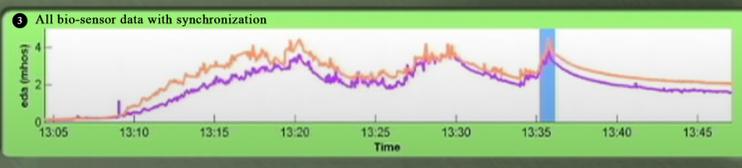
1 put your video here



2 Clip your bio-sensor data in 10s - 1min



3 All bio-sensor data with synchronization



LIVE

Full Session

1

2

- 1 Video
- 2 Clip your bio-sensor data in 10s - 1min
- 3 All bio-sensor data with synchronization

