

# Brain-Duino

open-source, high-quality  
brain-computer interface

[Brain-Duino.fractalfox.FOSDEM2016](http://Brain-Duino.fractalfox.FOSDEM2016)

A surreal image featuring a laptop on a wooden pier. The laptop screen displays a code editor with syntax-highlighted text. A heron stands on the pier next to the laptop, looking at the screen. The pier extends into a body of water with a pink and orange sunset reflection. In the background, there are overwater bungalows with thatched roofs and lit-up windows.

control your computer by thought.



play video games by the power of your mind.



enhance your well-being evidence-based.



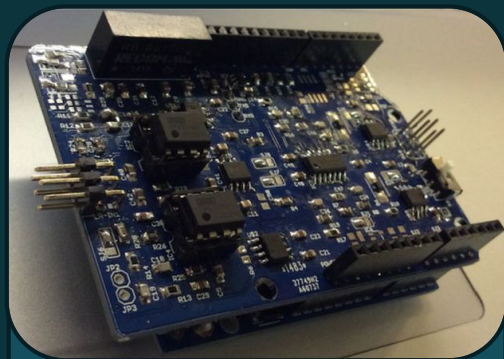




now this!



- reliable, hackable, affordable
- high sampling rate, low noise



brain-duino v.0.2  
as Arduino UNO Shield



brain-duino v.0.3 (24 bit)  
box (Arduino Pro Mini)



brain-duino v.0.3  
headset (Arduino Pro Mini)

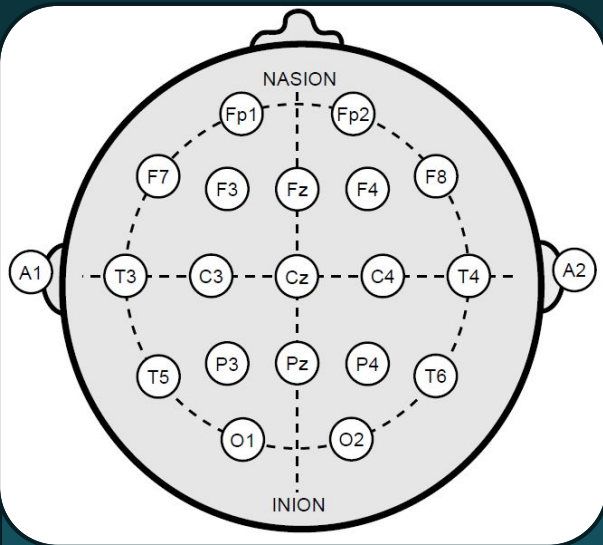


based on the IBVA (30 years of development) by Masahiro Kahata

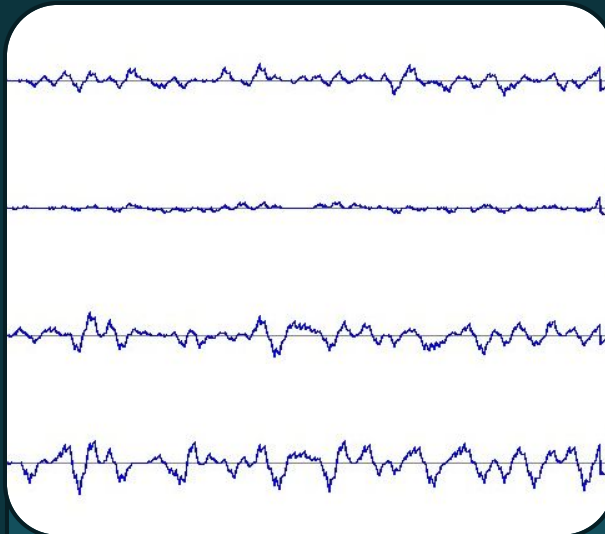
# EEG + BCI Basics

just a very brief overview!

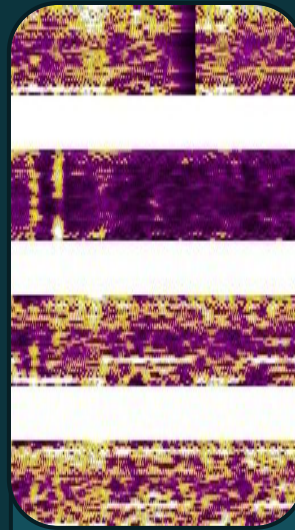




typical placement of electrodes  
10-20 system

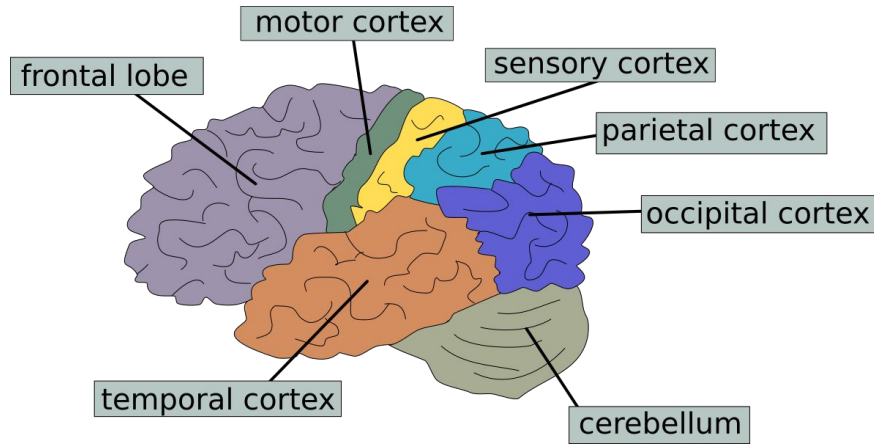


raw data stream

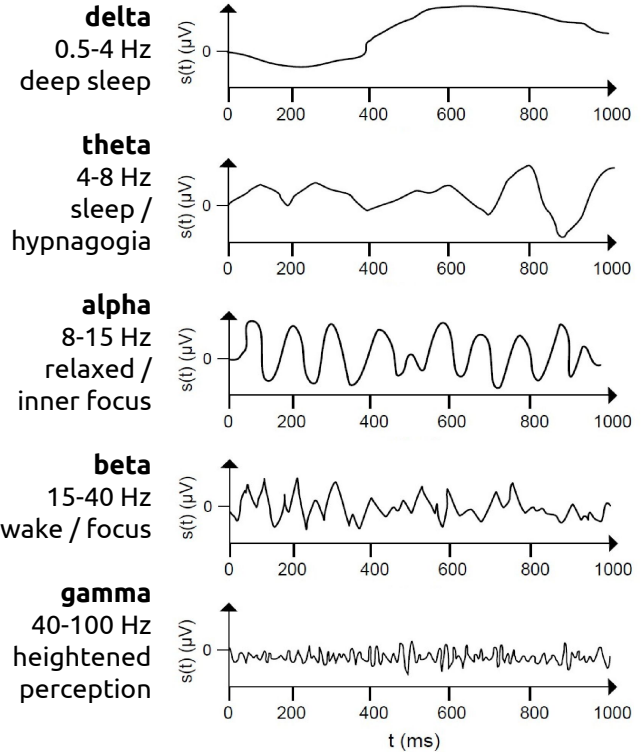


frequencies

- unmix signal (spatial, freq)
- decode brain processing



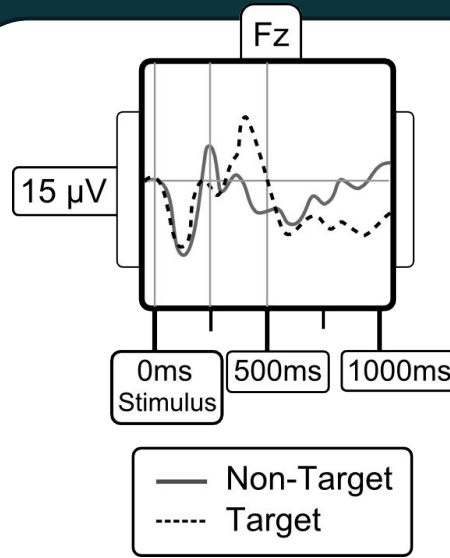
functional brain areas (simplified)



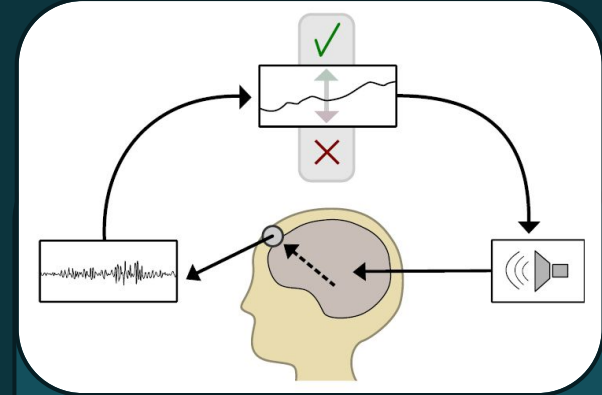
frequency bands

SMR / motor imagery  
imagining movement  
(Pfurtscheller et. al, 2006)

SSVEP  
response to flickering  
stimulus  
(Jeffreys et. al, 1972)

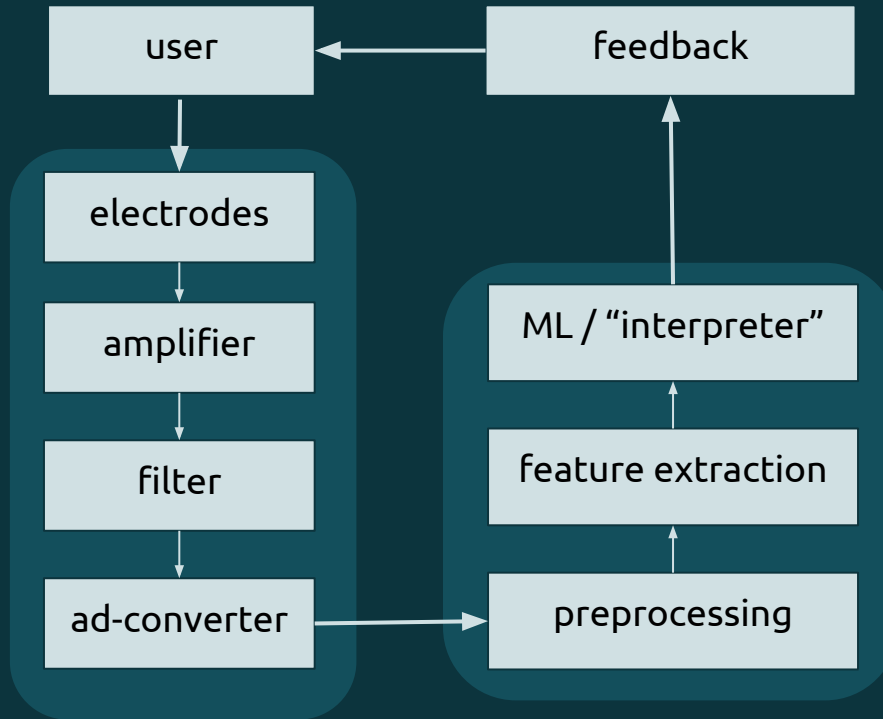


P300 / P3a / P3b  
attention-driven reaction  
to stimulus  
(Polich et. al, 2007)



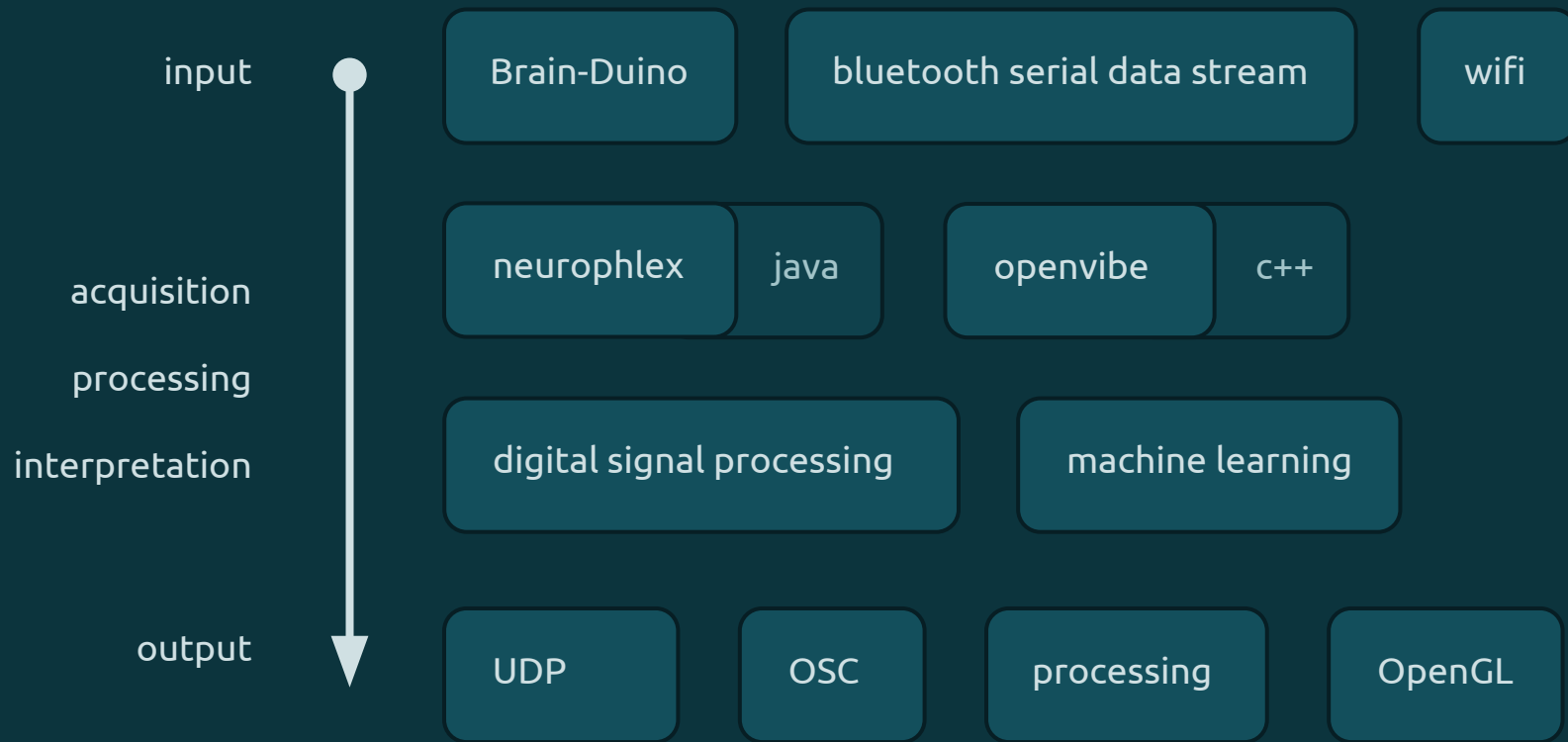
neurofeedback training  
(Elbert et. al, 1980)



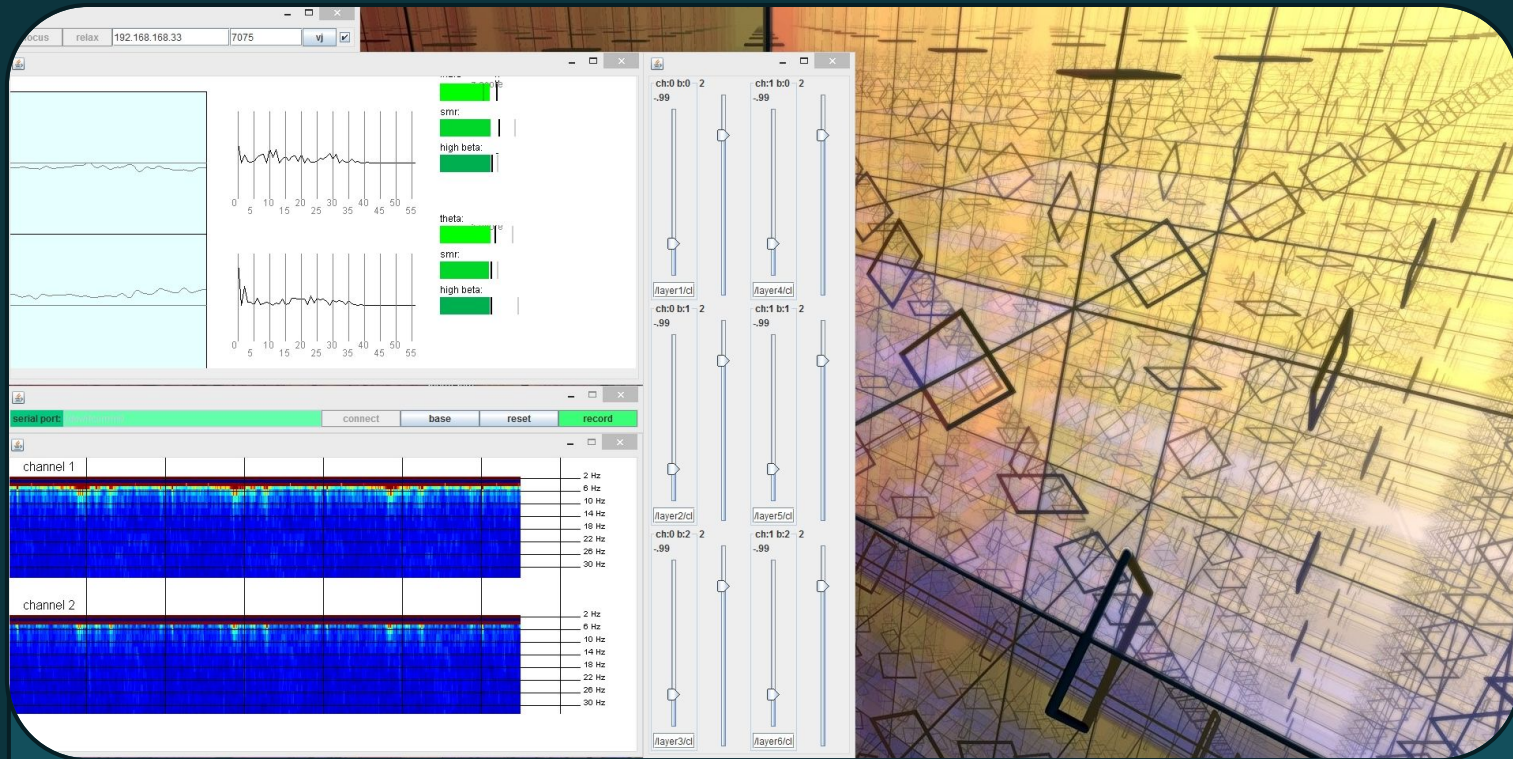


# Status Quo

hardware, software & interfaces







neuroplex

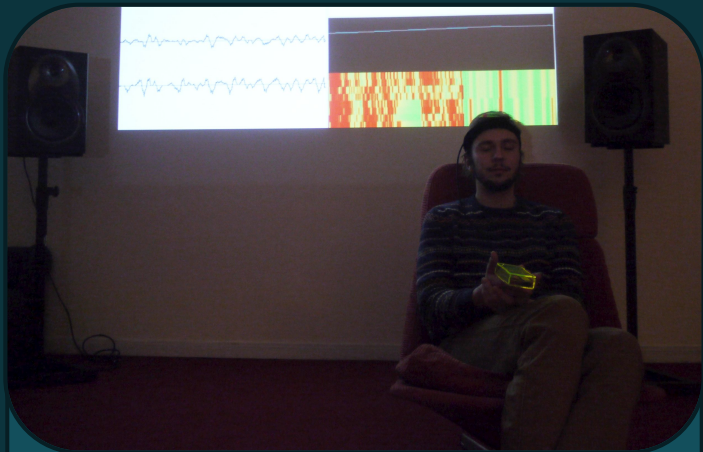
<https://github.com/brain-duino/neuroplex> (soon-ish! ;)

status quo: interfaces

Brain-Duino.fractalfox

fosdem 2016

15



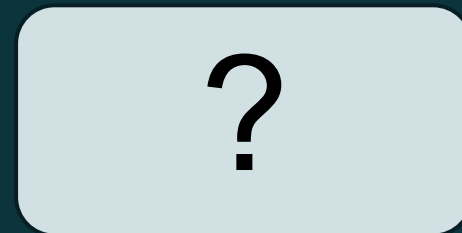
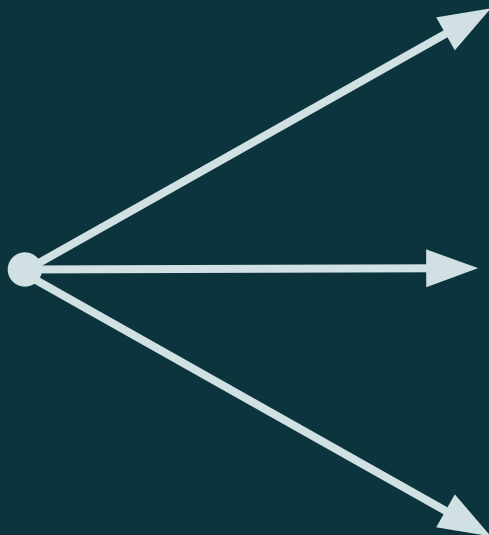
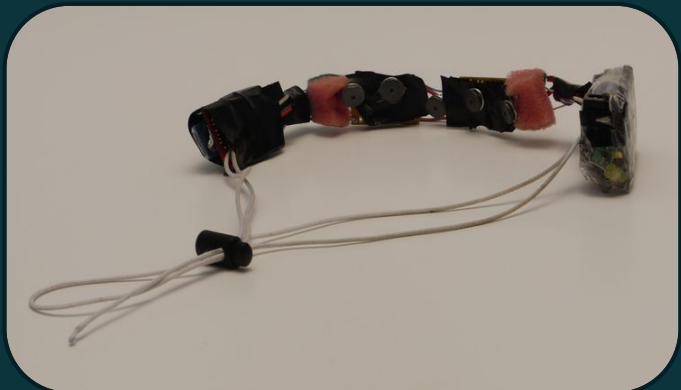
audio feedback  
installation @ berlin



audio-visual feedback  
installation @ berlin



visual feedback  
brainvj @ new york





# Call for Participation

let's do awesome things together!

# slack

( invitation on [brainduino.com](https://brainduino.com) )

# github

( [github.com/brain-duino](https://github.com/brain-duino) )

# meetup

( [meetup.com/Neurohacking-Berlin/](https://meetup.com/Neurohacking-Berlin/) )

software development

hardware development

community

research

neurogames

interfaces

circuit design

3d print / lasercut / ...

tutorials / methods

**CALL FOR PARTICIPATION**

[Brain-Duino.fractalfox](https://brain-duino.fractalfox)

fosdem 2016

## support our kickstarter!

- miniaturize pcb components
- lower price
- no fiddling
- assembled / make soldering optional
- easy accessibility



Willi Döring

software dev



Robert Langer

organizing



Masahiro Kahata

hardware dev



Silver Kuusik

hardware dev

- **Polich, John.** "Updating P300: an integrative theory of P3a and P3b." *Clinical neurophysiology* 118.10 (2007): 2128-2148.
- **Pfurtscheller, G., et al.** "Mu rhythm (de) synchronization and EEG single-trial classification of different motor imagery tasks." *Neuroimage* 31.1 (2006): 153-159.
- **Elbert, Thomas,** et al. "Biofeedback of slow cortical potentials. I." *Electroencephalography and Clinical Neurophysiology* 48.3 (1980): 293-301.
- **Jeffreys, D. A., and J. G. Axford.** "Source locations of pattern-specific components of human visual evoked potentials. I. Component of striate cortical origin." *Experimental Brain Research* 16.1 (1972): 1-21.
- **Y. Renard, F. Lotte, G. Gibert, M. Congedo, E. Maby, V. Delannoy, O. Bertrand, A. Lécuyer,** "OpenViBE: An Open-Source Software Platform to Design, Test and Use Brain-Computer Interfaces in Real and Virtual Environments", Presence : teleoperators and virtual environments, vol. 19, no 1, 2010