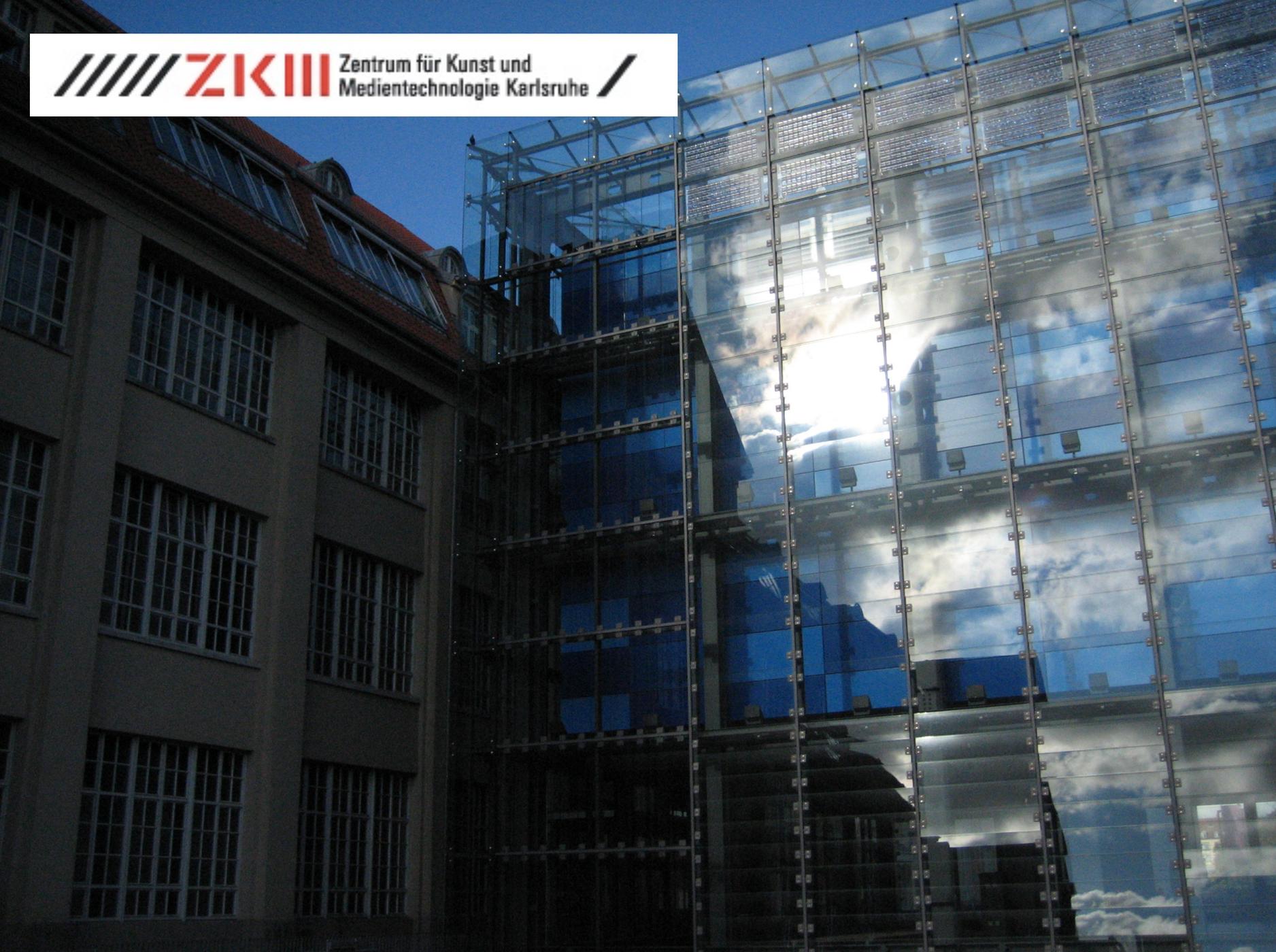


<http://www.iantraffordphotos.com/gallery/>

<http://www.iantraffordphotos.com/gallery/photo-lib/>

How it started

\\internationaler
\\medien\\preis\\2005
für wissenschaft und kunst

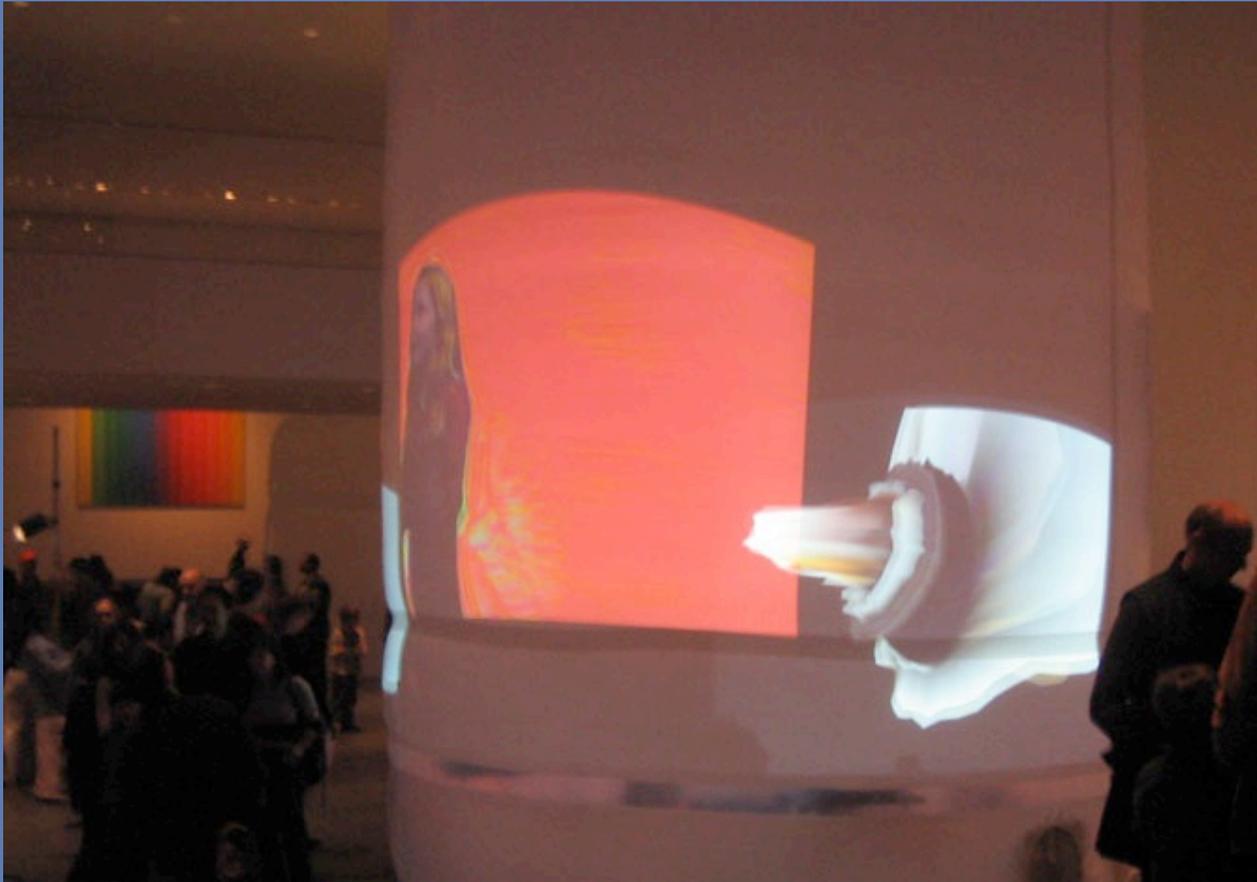






realtime image manipulation

input >> manipulation >> output



input

microphone > sound waves

camera > light waves

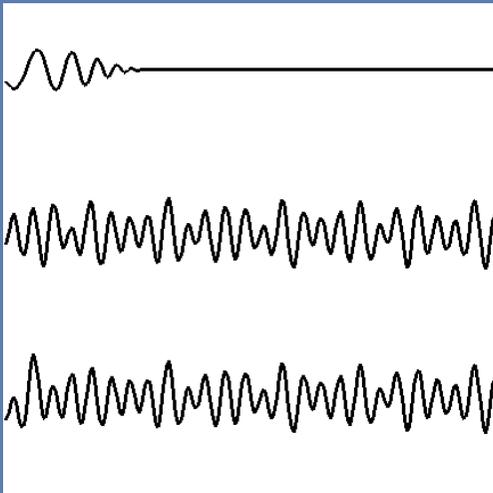
input

microphone > sound waves

camera > light waves

EEG > brain waves

For the computer it's just numbers



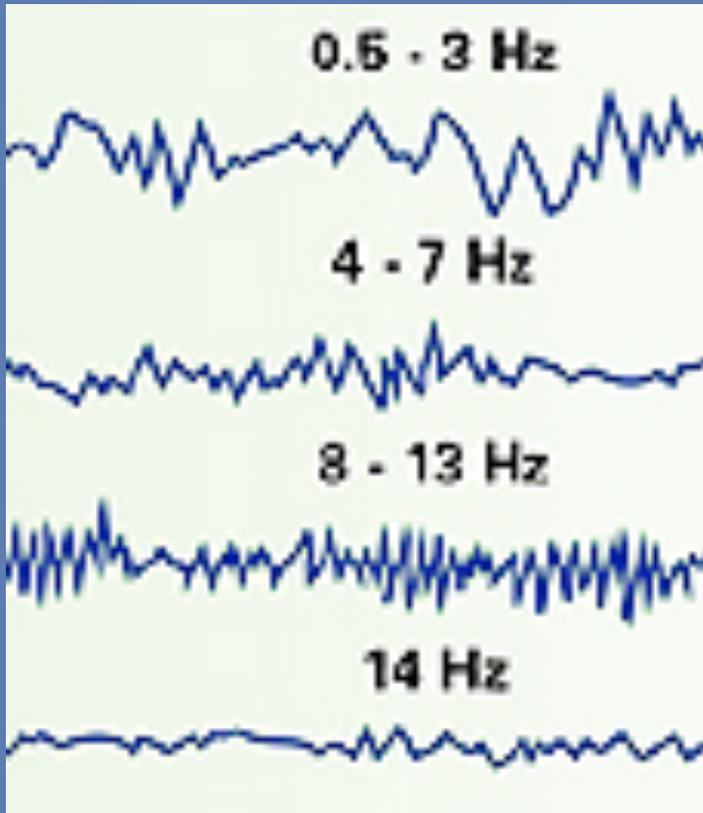
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111001100111001000000  
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011100101101110111011  
001000000111000001100  
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001100101011100101101
```

A little about EEG

electroencephalography



brain wave frequencies

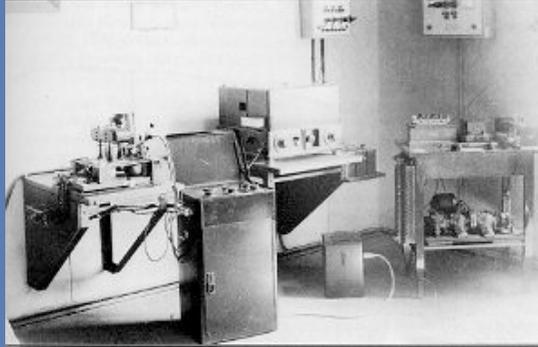
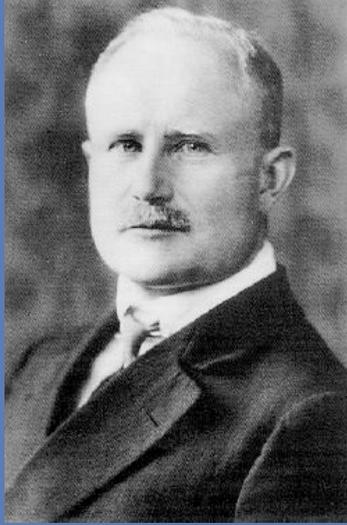


delta

theta

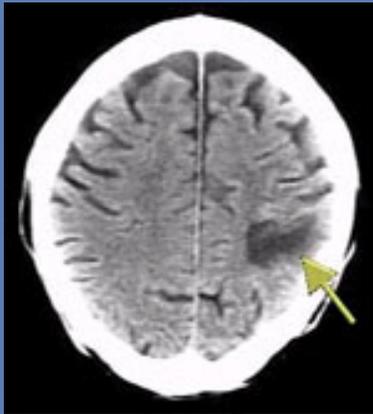
alpha

beta

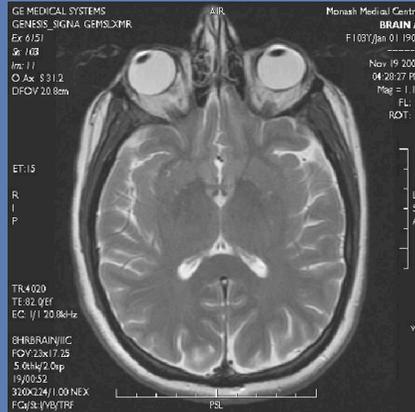


Hans Berger, 1924

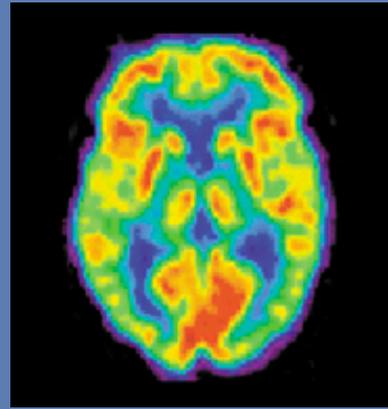
fancier ways of looking at the brain



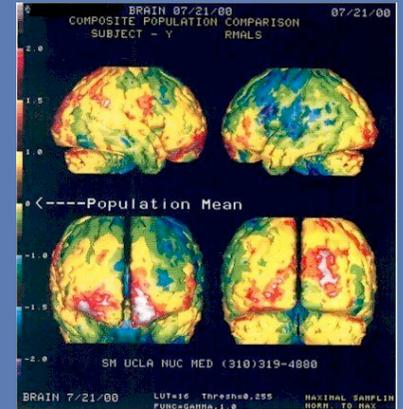
CAT



MRI

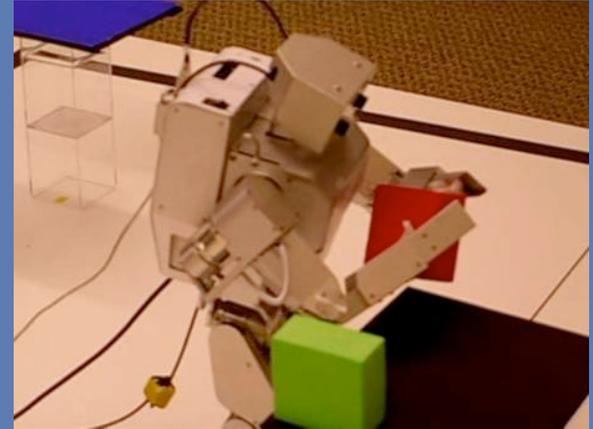


PET



SPECT

EEG art



neurofeedback



IBVA - a simple EEG system



3 electrodes - wireless - MIDI output



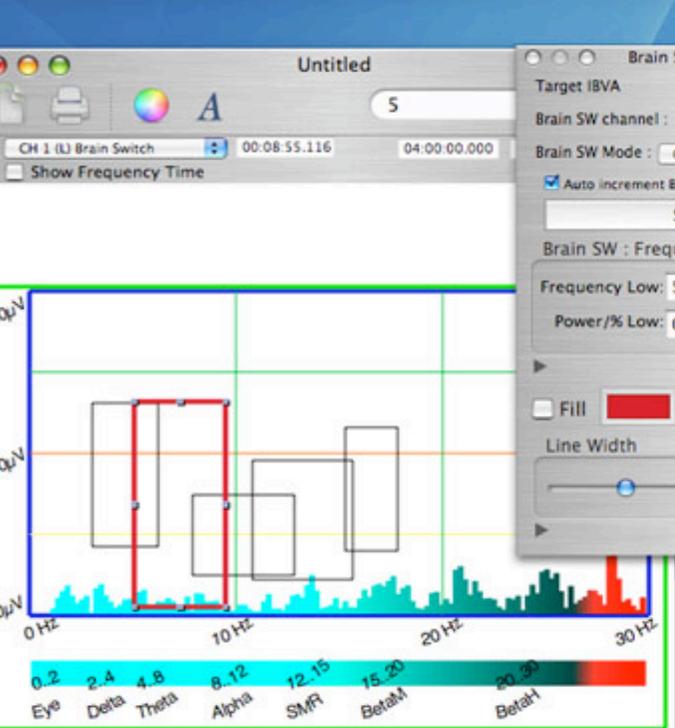
128 electrodes



65 electrodes



Boston Cyberarts Festival - I



Brain Switch Inspector

Target IBVA: CH 1

Brain SW channel: Brain SW 5

Brain SW Mode: ON when data in the selection

Auto increment Brain SW channel by create object

Set Brain SW

Brain SW : Frequency & Power

Frequency Low: 5.14 Hz High: 9.57 Hz

Power/% Low: 0.45 Micro V/% High: 13.33 Micro V/%

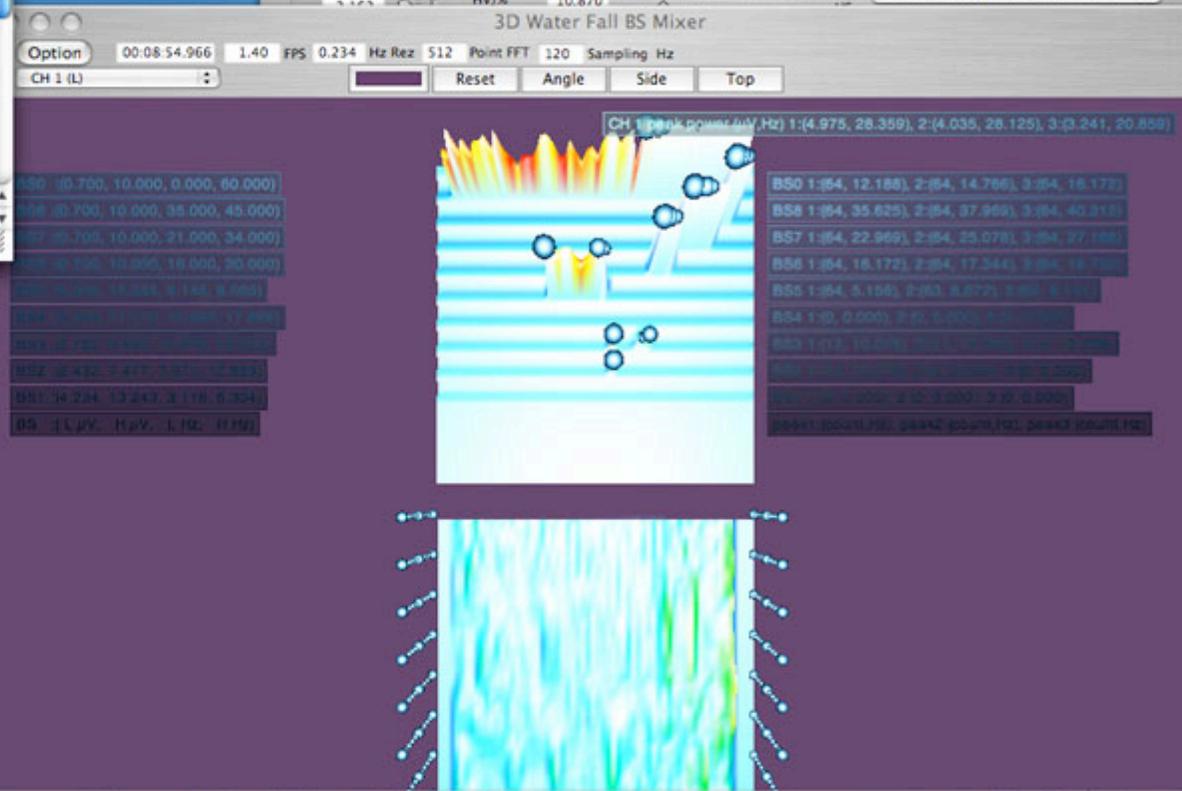
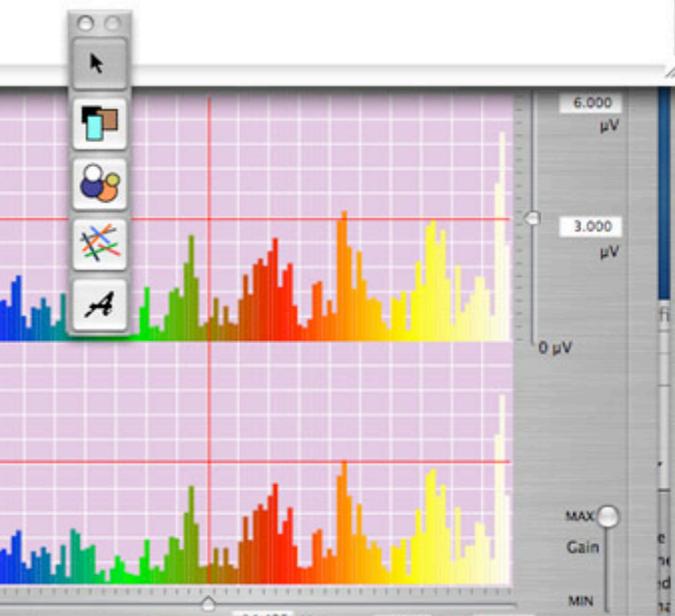
Fill Line

Line Width: 3.4

BS Mixer

Target IBVA Data: CH 1 (L) Default this CH Default all CH ReLoad SW from Inspector

SW	SW Level	LF	HF	Brain SW Mode
SW 8	10.000 LV/% 0.700 HV/%	35	45.000 HF	ON when data in the selection
SW 7	10.000 LV/% 0.700 HV/%	21.000	34.000 HF	ON when data in the selection
SW 6	10.000 LV/% 0.700 HV/%	16.000	20.000 HF	ON when data in the selection
SW 5	13.333 LV/% 0.450 HV/%	5.145	9.565 HF	ON when data in the selection
SW 4	11.712 LV/% 3.964 HV/%	15.362	17.899 HF	ON when data in the selection
SW 3	9.640 LV/% HV/%	10.870	15.725 HF	ON when data in the selection

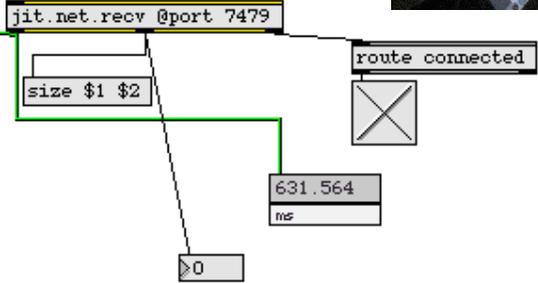
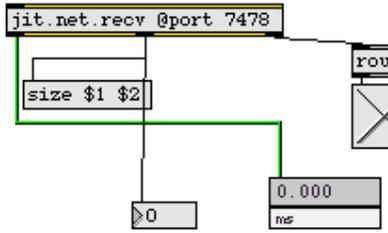
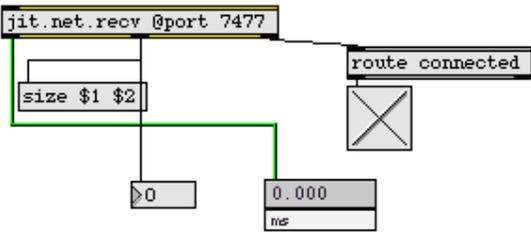
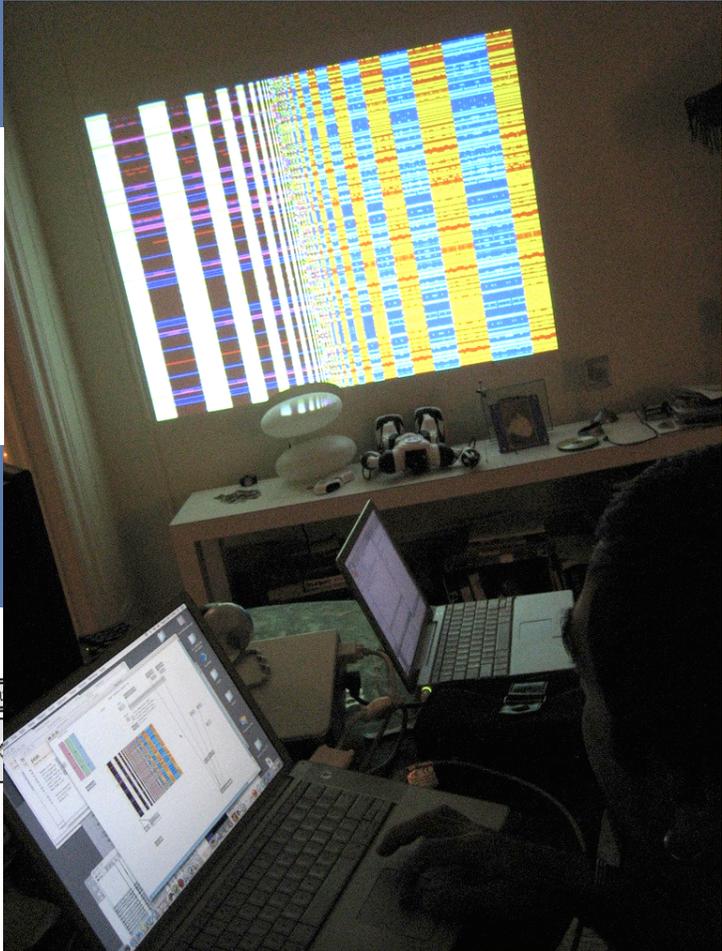
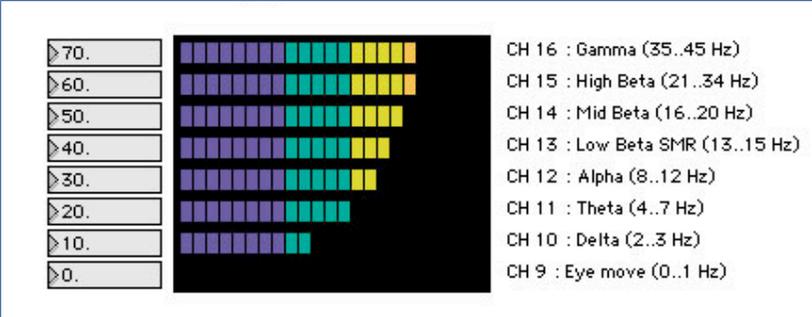


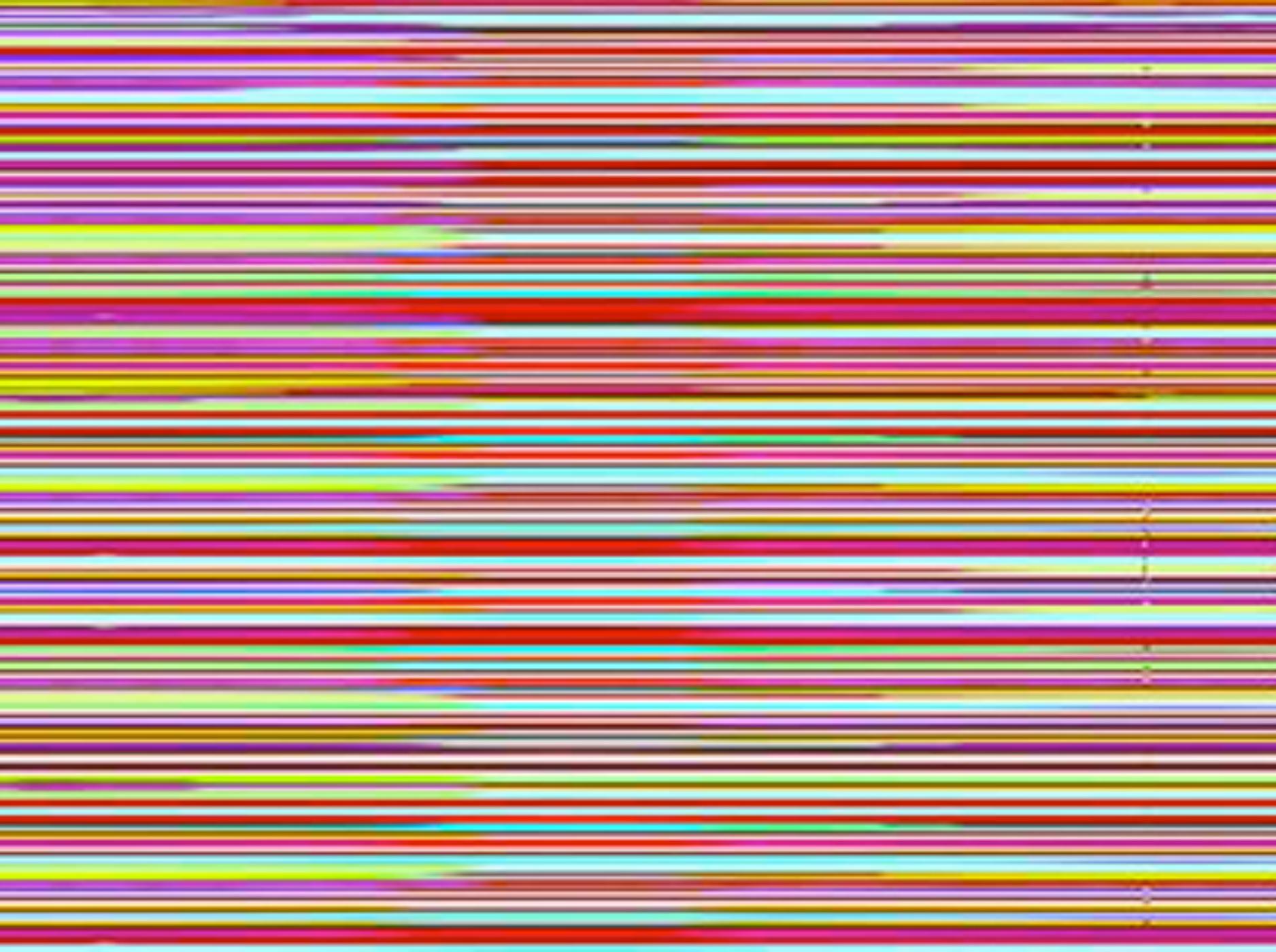
first experiments

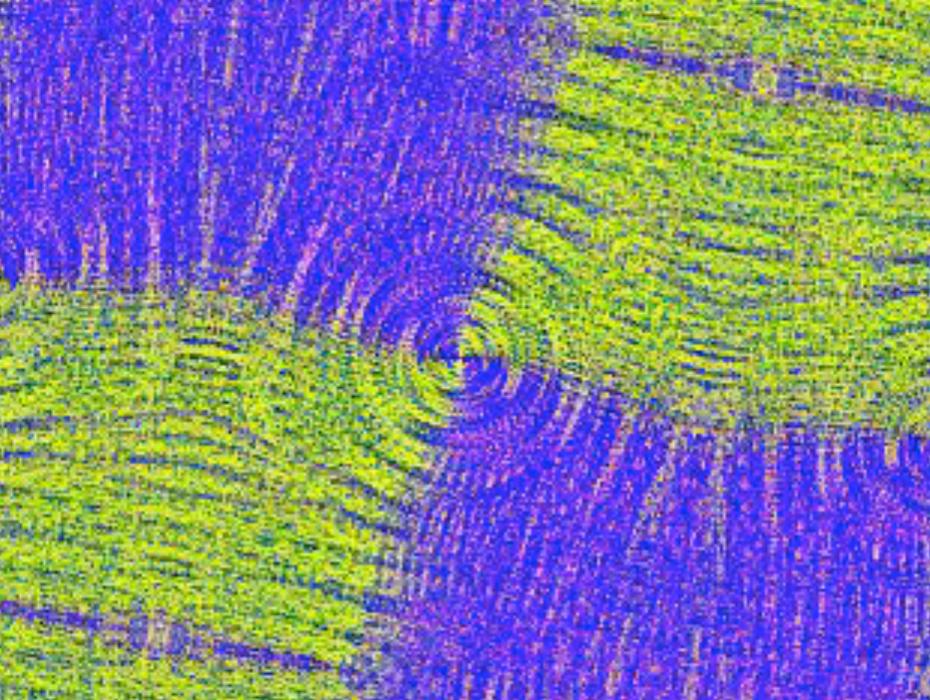
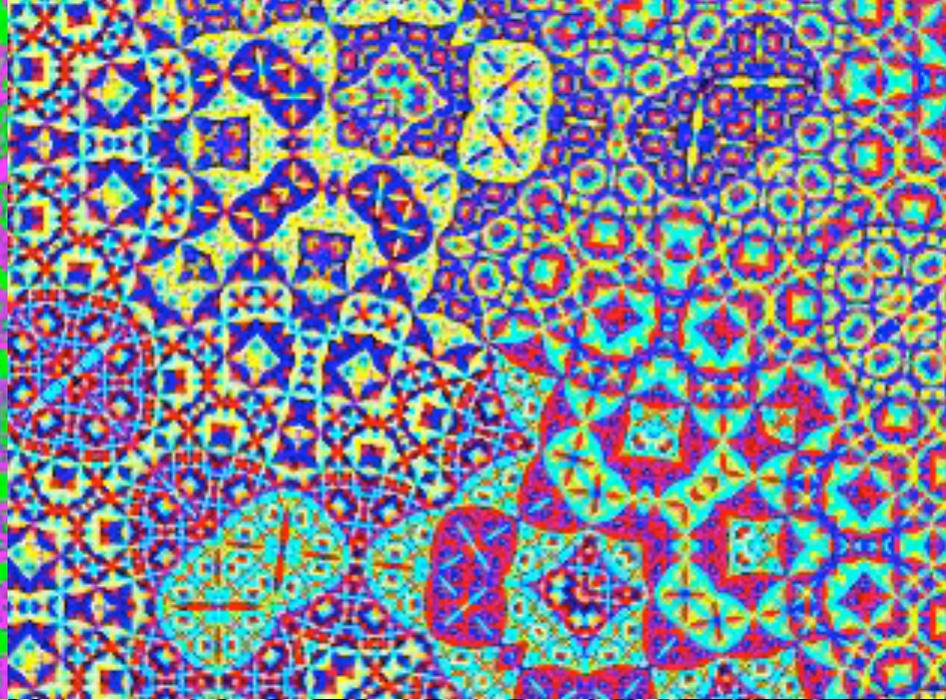
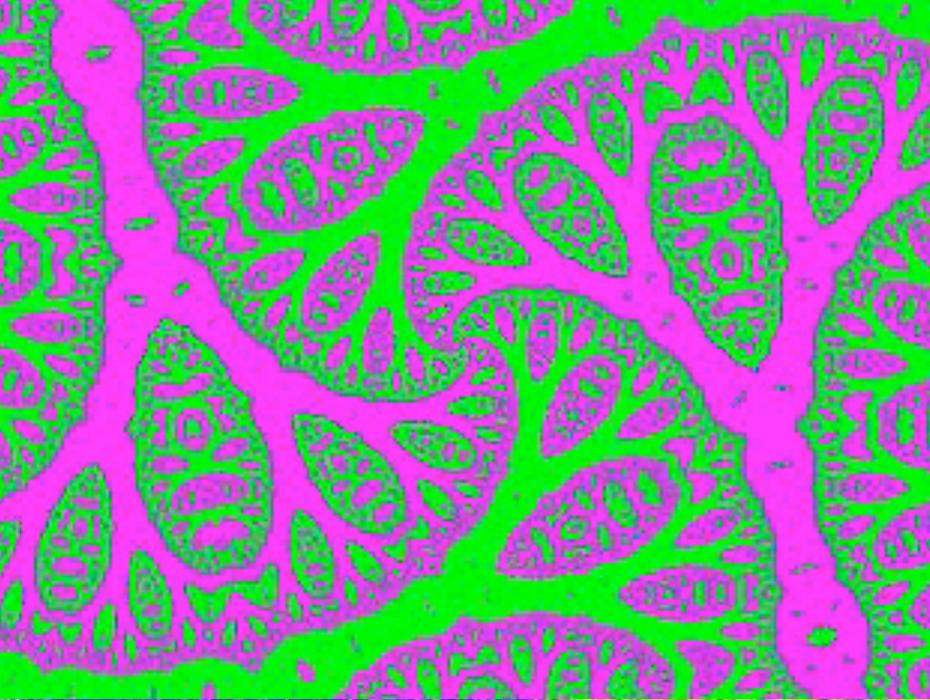
simple color feedback system

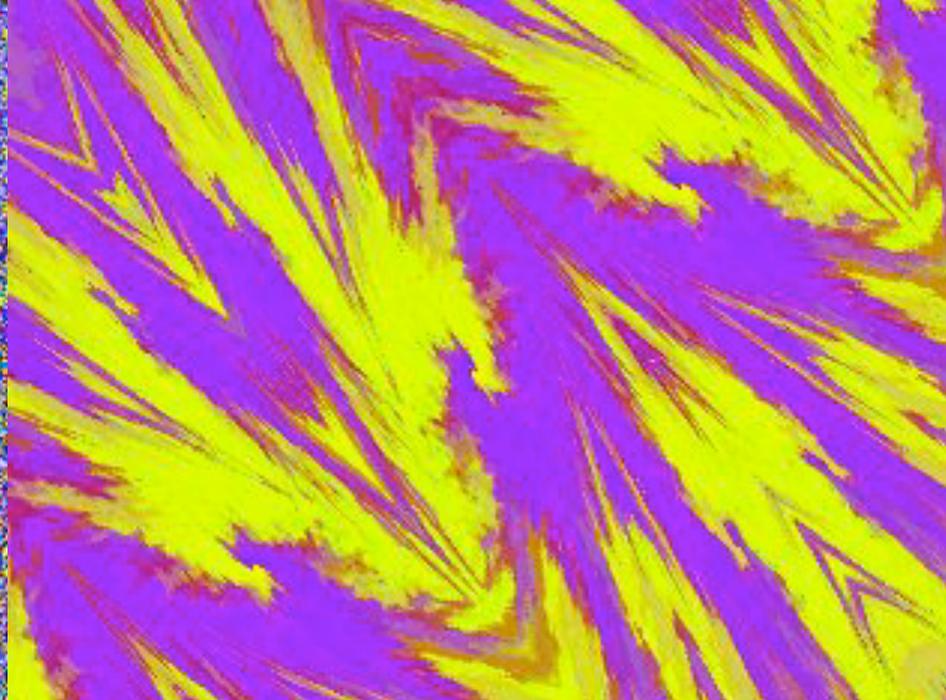
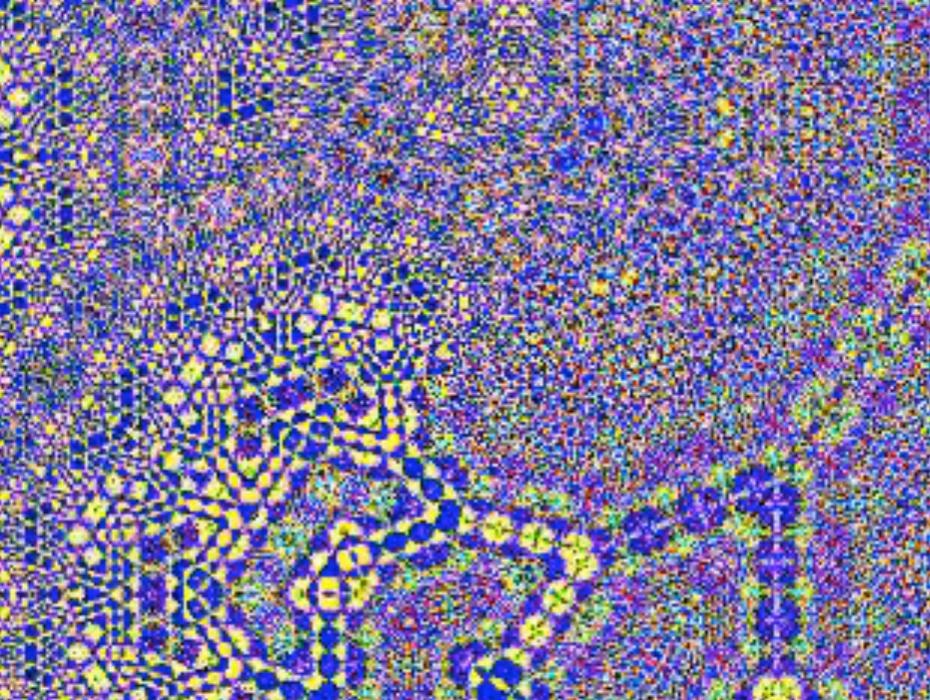
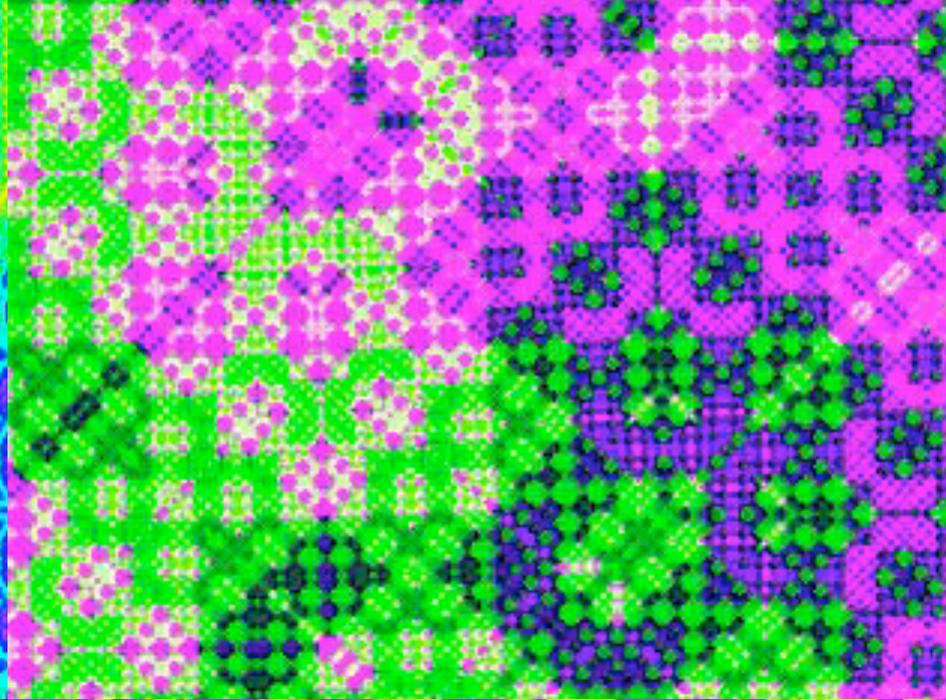
google images search

remote transmission











<http://www.cctvstuff.co.uk/hongkong/images/DEP0112>



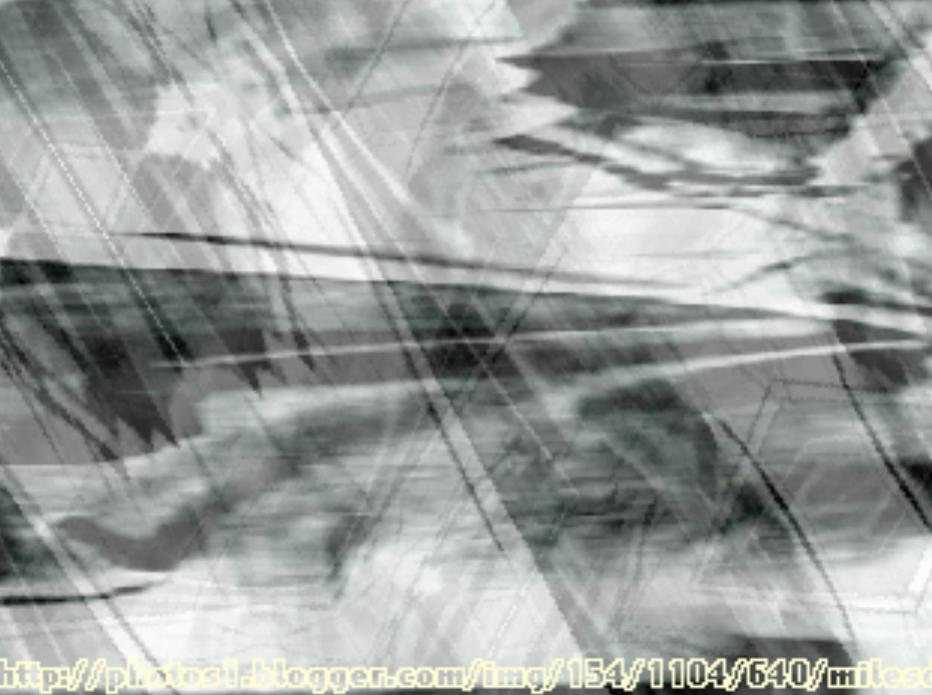
<http://clinton4.nara.gov/media/jpg/red.jpg>



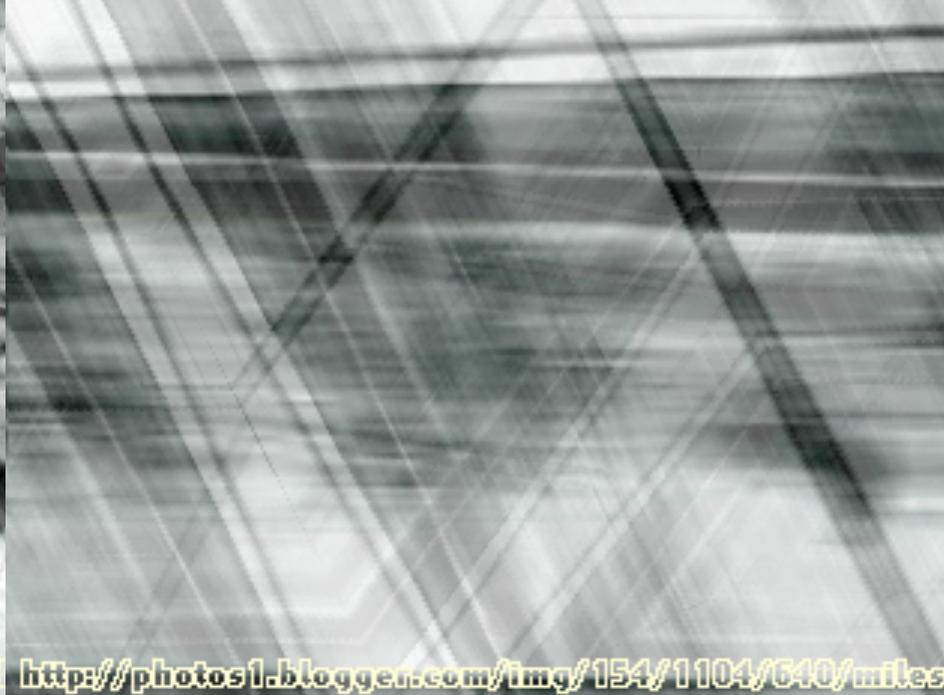
<http://www.iantraffordphotos.com/gallery/photo-lib/i>



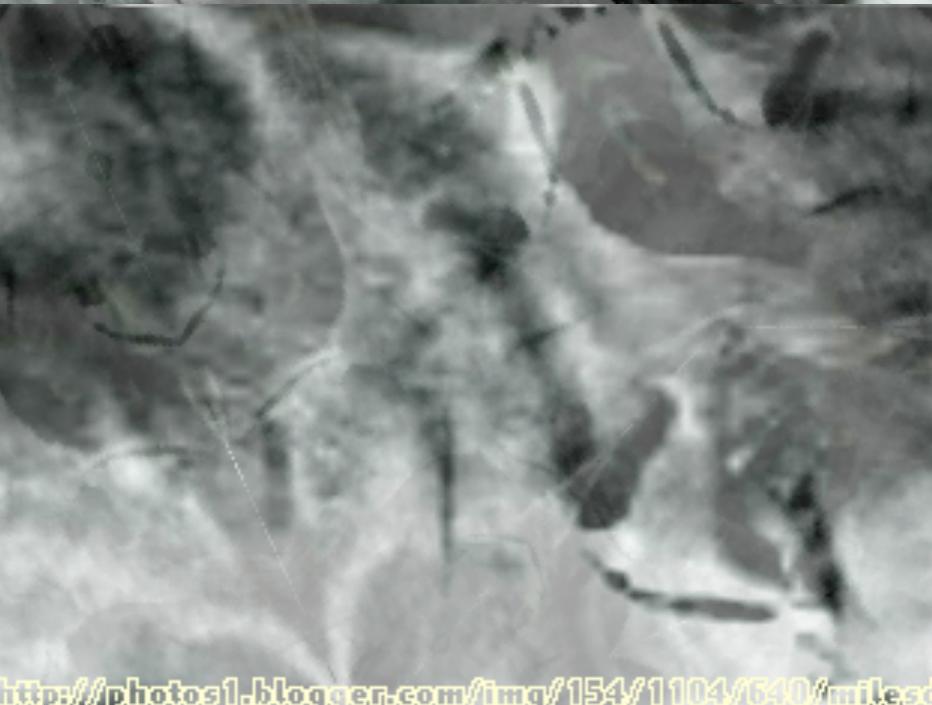
<http://www.iantraffordphotos.com/gallery/photo-lib/i>



<http://photos1.blogger.com/img/154/1104/640/milesd>



<http://photos1.blogger.com/img/154/1104/640/milesd>



<http://photos1.blogger.com/img/154/1104/640/milesd>



<http://photos1.blogger.com/img/154/1104/640/milesd>



<http://www.ambermine.com/images/green/28a.jpg>



<http://www.ambermine.com/images/green/28a.jpg>



<http://www.tempsdefrance.com/denver/archives/Hum>



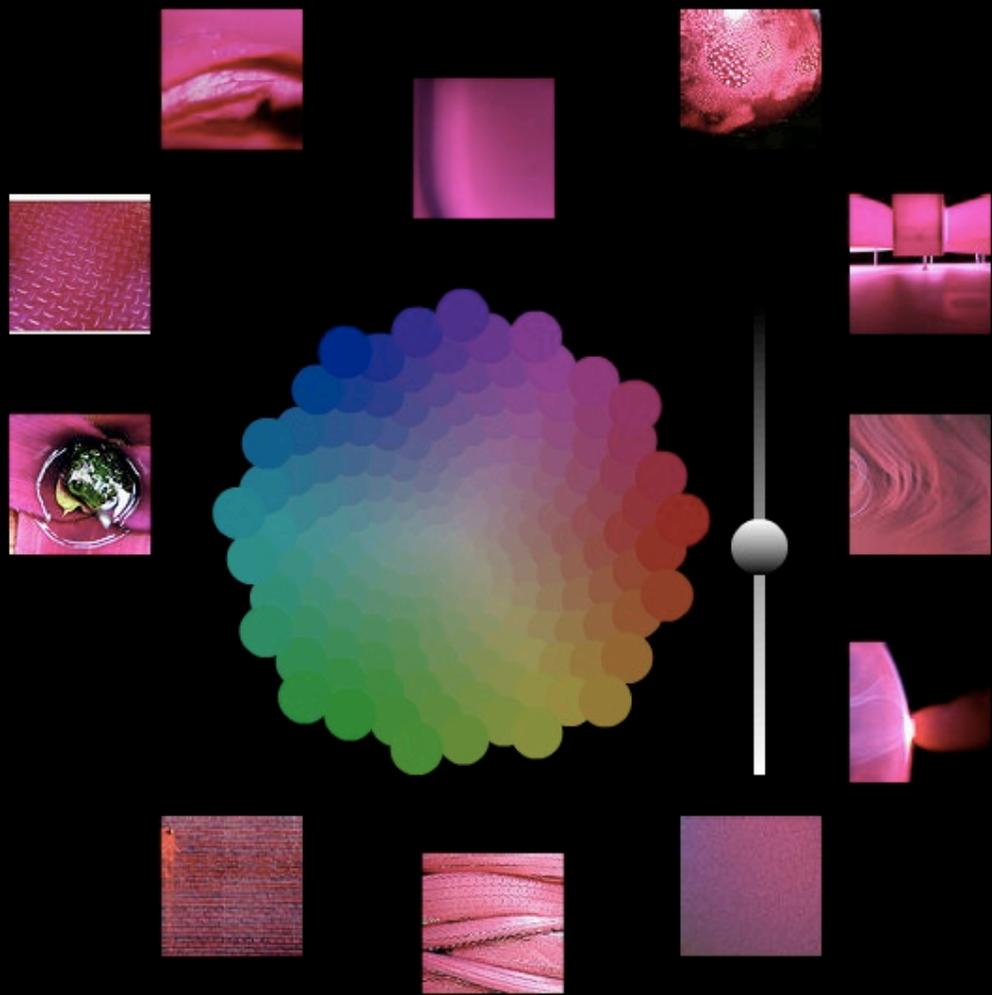
<http://www.ambermine.com/images/green/28a.jpg>

some inspirations

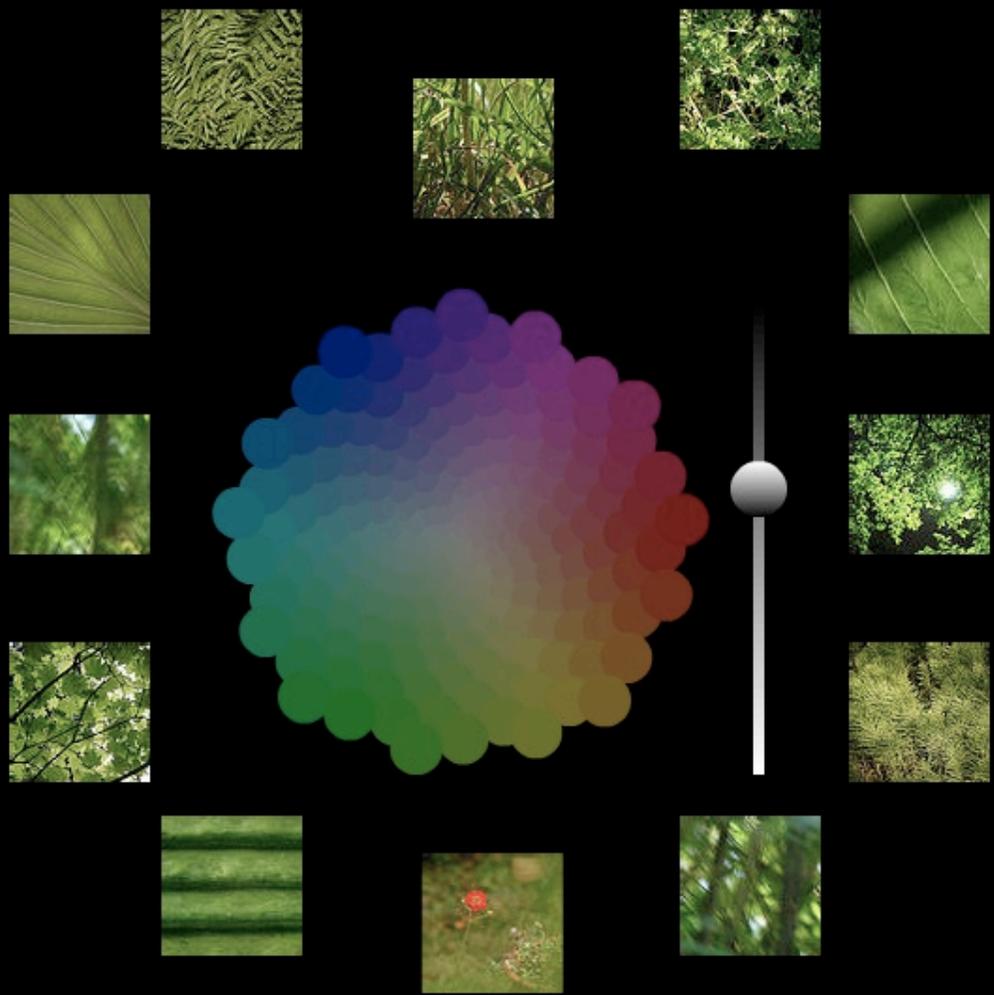
colrpickr

eyevisionbot

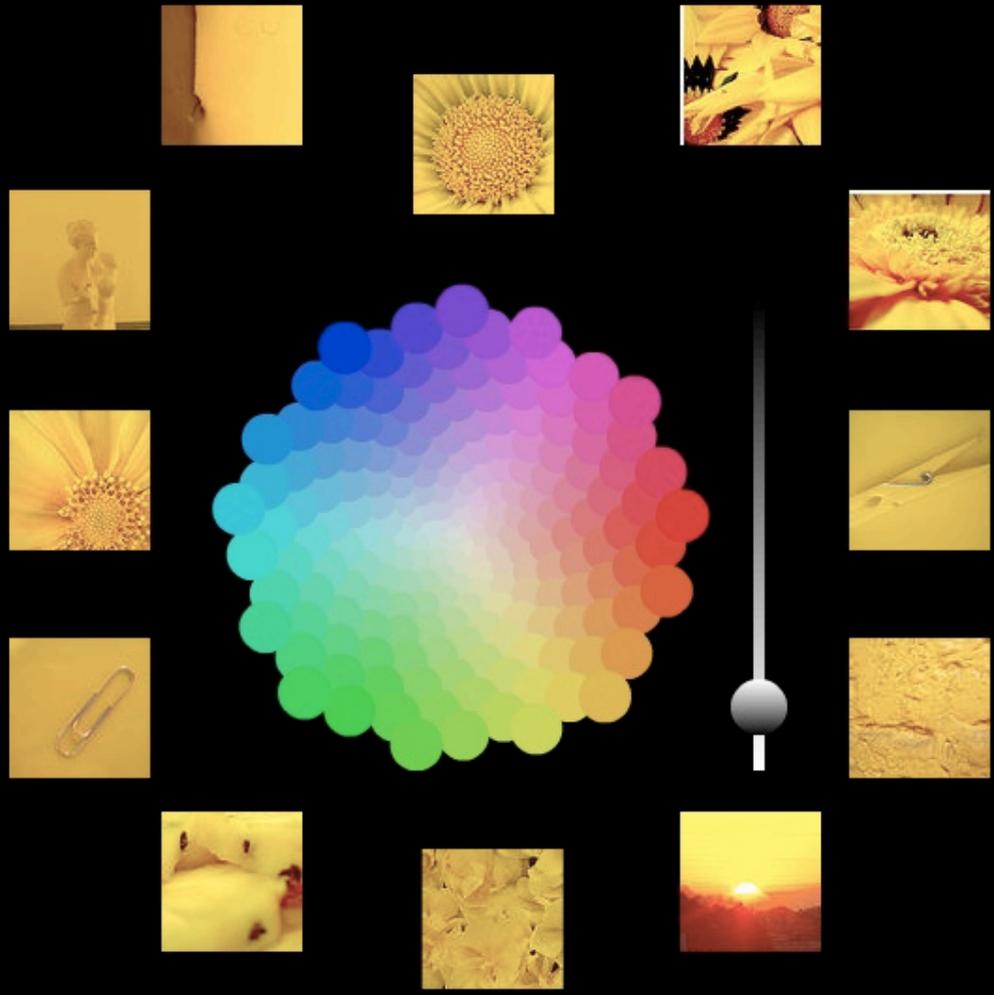
flickr Color Fields Experimental Color Picker - Jim Bumgardner



flickr Color Fields Experimental Color Picker - Jim Bumgardner



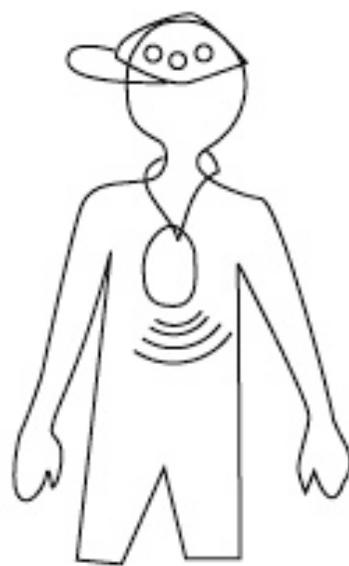
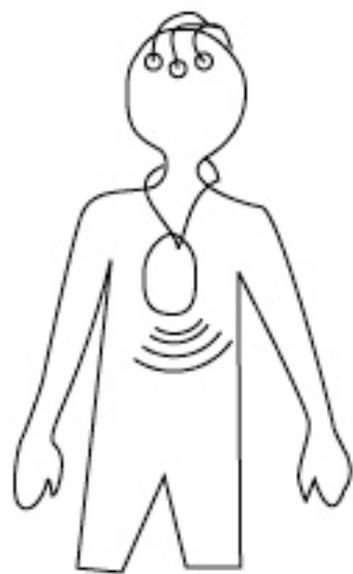
flickr Color Fields Experimental Color Picker - Jim Bumgardner





future possibilities

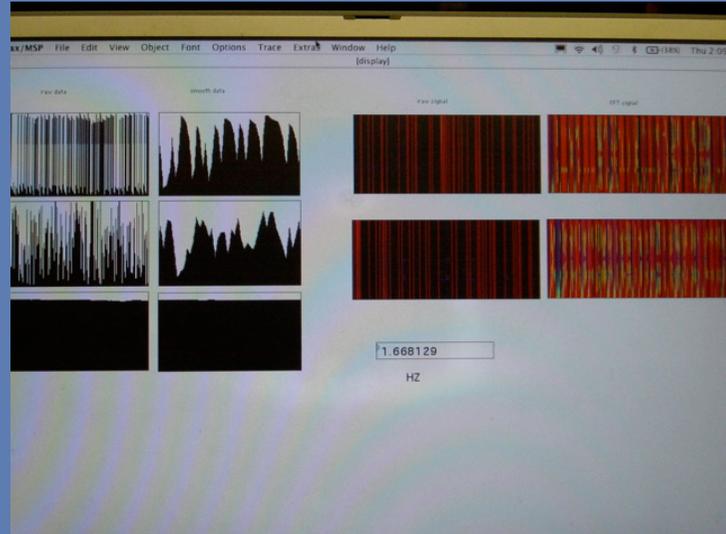
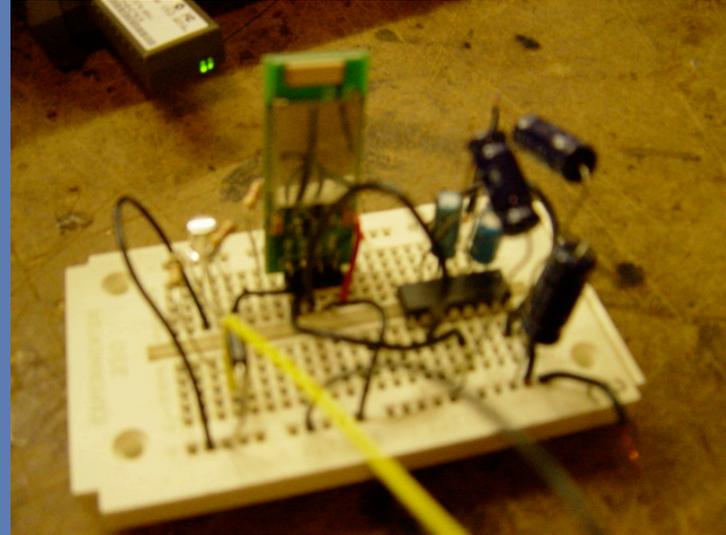
improve wearability
open source EEG system
game for two players
audio component

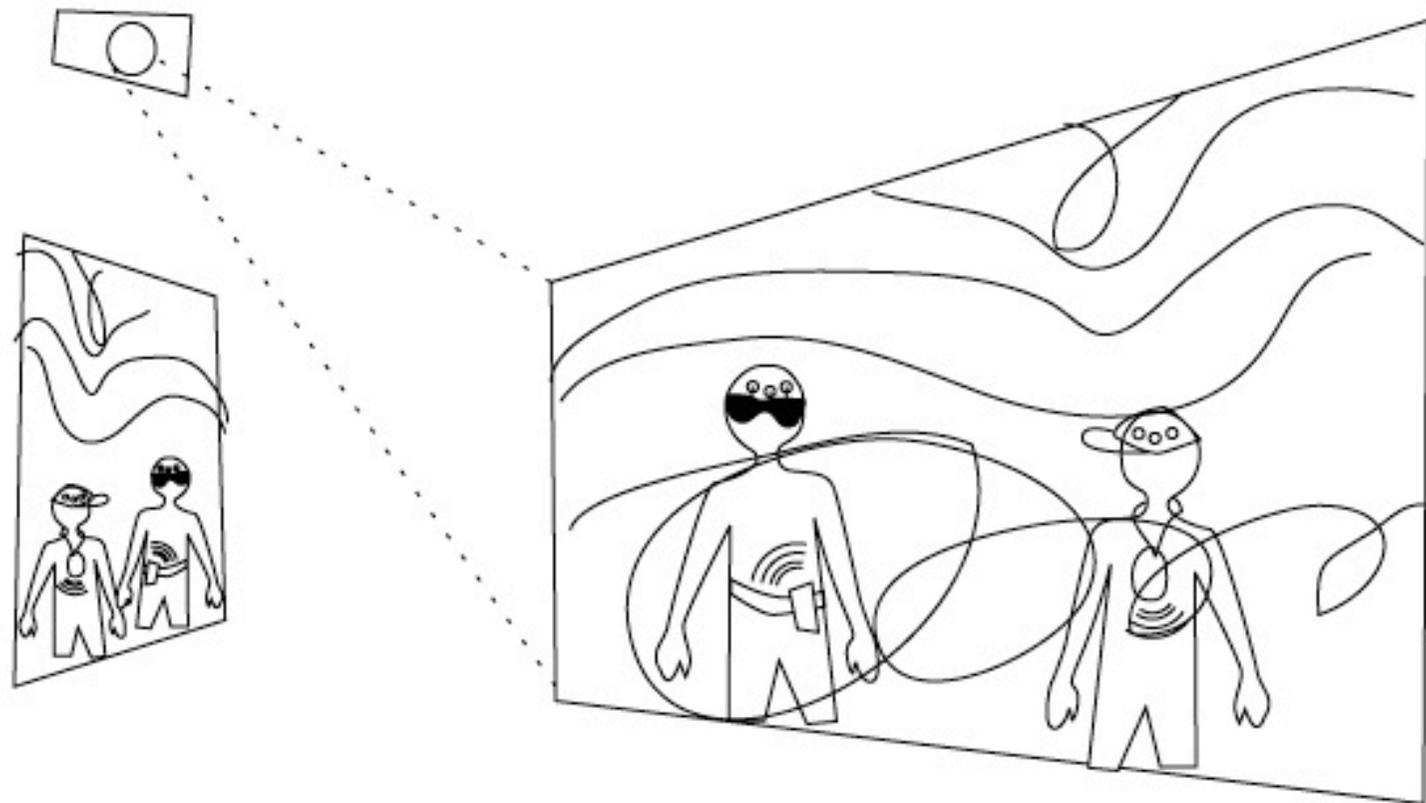


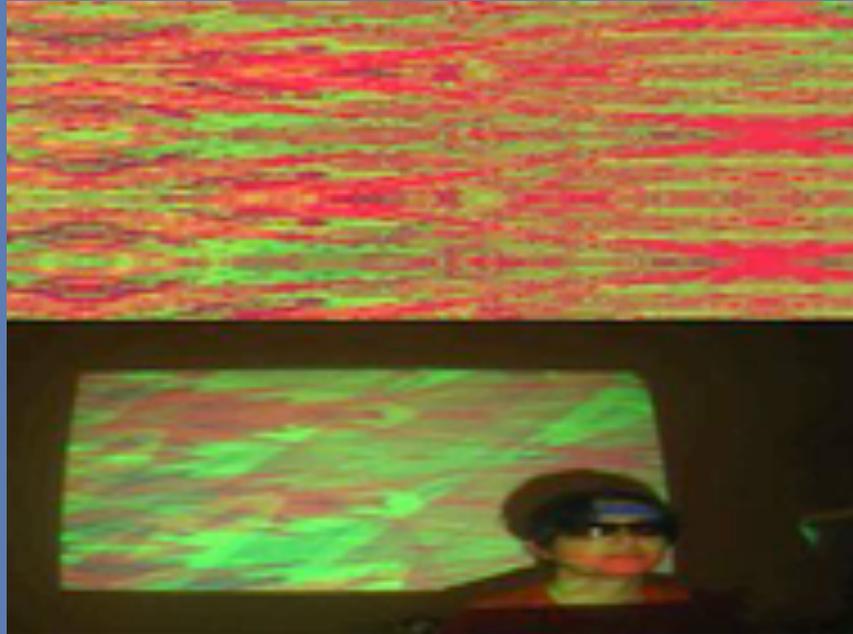


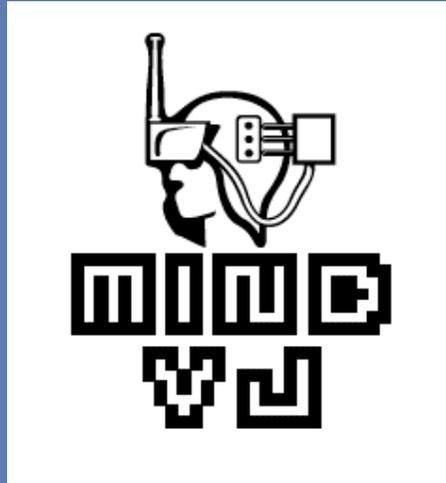
OpenEEG

openeeg.sourceforge.net
EEG for the rest of us!









www.mindvj.com

lenara@lenara.com

□



MIND VI - presentation by Lenara Verle
for the Planetary Collegium Summit
Montreal 2007

<http://summit.planetary-collegium.net>

□



The beginning of the MIND VJ project was in 2005 when I won the ZKM Media Art Award with my net-art animation Gridcosm 1000-000 - a piece based on the Sito.org Gridcosm project - <http://www.sito.org/synergy/gridcosm>

□



As part of the award, I was invited to do a 3-month residency at the ZKM Institute in Karlsruhe, Germany and develop a media art project there.

▣



For a while I had been talking to my friend Marlon Barrios (www.dance-tech.net) to do a collaboration. This is a picture of us getting ready for a Halloween party in Williamsburg, NYC

□



I met Marlon at a Planetary Collegium session in Arizona, at the Consciousness Reframed Conference in 2000. This is a picture of us working at the ZKM labs.

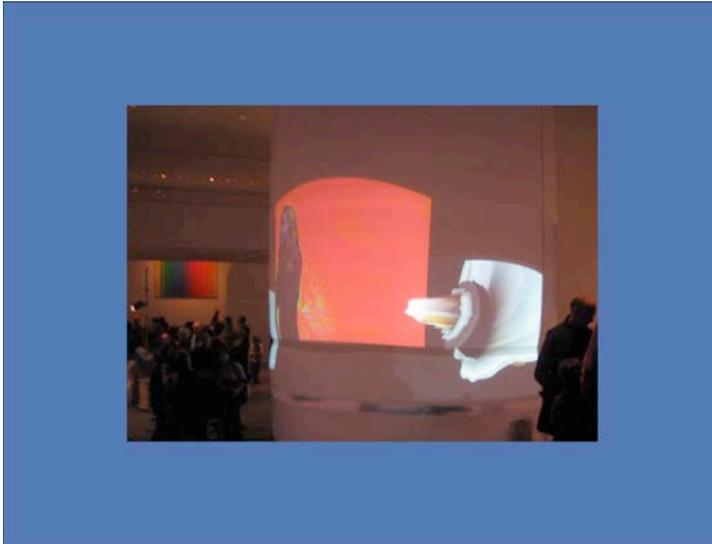
▣

realtime image manipulation

input >> manipulation >> output

Marlon's area of research is Dance & Technology and recently he had been working a lot with realtime image manipulation, mostly using MAX/MSP/Jitter to process different types of input and generate visual images.

□



He had been performing as a VJ at various venues and events. This is a picture of a performance at the MoMA NY.

▣

input

microphone > sound waves

camera > light waves

Marlon was experimenting with input from different microphones and cameras for his image manipulation patches.

▣

input

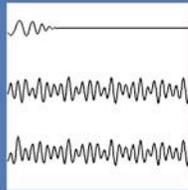
microphone > sound waves

camera > light waves

EEG > brain waves

I suggested to use brainwaves recorded by an EEG equipment in real time as input for the image processing.

For the computer it's just numbers



```
00110000101110000110  
11100110011100100000  
0011001010111001010  
100000110000101110000  
00100110000101110000  
10110111001100111001  
011100101101110111011  
001000000111000001100  
10000011010010110111  
001100001011100000110  
11001100111001000000  
001100101011100101101
```

This idea was fairly simple to try, as far as the tech setup, since for the computer it would be just another stream of numbers. I wanted to start by experiment with the system in a very basic and simple way, to try to understand its possibilities.

▣

A little about EEG

electroencephalography

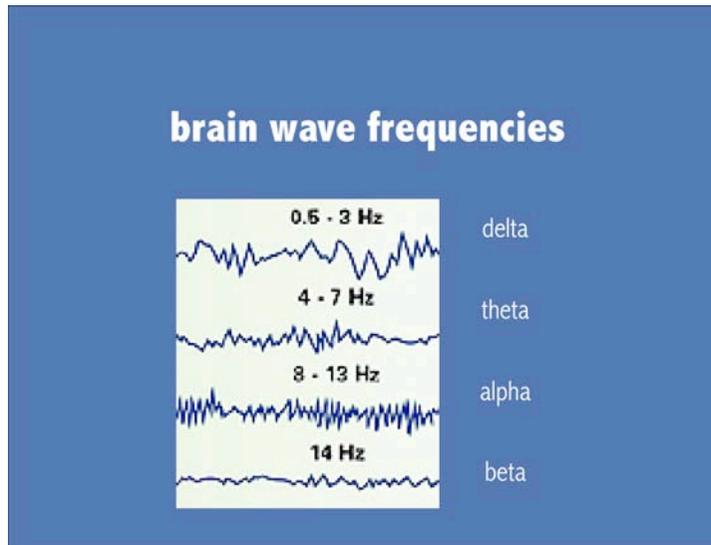
For this, I had to do some research about EEG and brainwaves, so I reviewed lots of literature on the subject, in search of information, inspiration, and also to make sure I was not doing anything medically harmful in the process of my artistic experimentation

□



First of all, trying to listen to a faint thing like electrical brain activity through something as thick as the human skull, is akin to trying to hear your neighbors whispering to each other through a brick wall. A big deal of signal amplification is required, and the signal is easily disturbed by louder events outside the skull like forehead muscle movements or even eye blinks.

□



The brainwaves are normally divided into 4 main frequency ranges which are connected to different attention states:

delta - deep sleep.

theta - dreaming, daydreaming, hypnagogic states.

alpha - relaxed concentration, meditation.

beta - alert focus, awake concentration

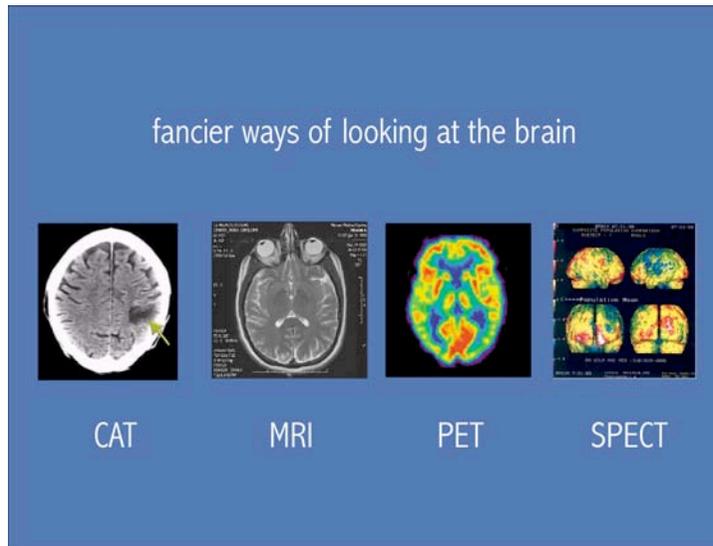
□



Hans Berger, 1924

Hans Berger invented EEG technology in Germany around 1924. Other scientists around the world were working on similar technologies, recording brain activity from electrodes placed inside and outside the skull of animals and humans.

□

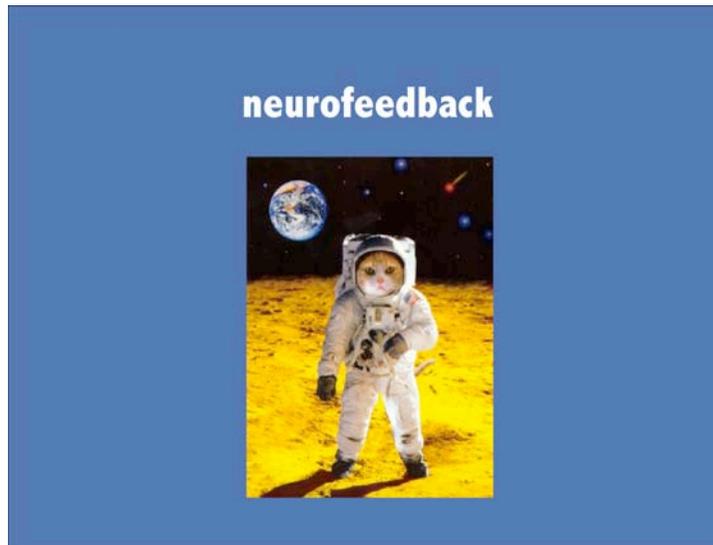


Since the invention of the EEG, new ways of looking into brain activity were developed, which offer a lot more resolution and information. Despite that, electrical brainwaves are still a quite interesting subject and have been used in many art projects.



This is just a quick selection to give an idea of the many artists doing EEG art.

1. Mariko Mori - Wave UFO
2. BIOS (Bidirectional Input Output System) - Thomas Tirel, Sven Hahne, Jaanis Garancs, Norman Muller - Academy of Media Arts Cologne
3. EEG driven Robot - Neural Systems Lab at the University of Washington.
4. Atau Tanaka – biomuse EEG & biosensor performance
5. Janine Antonil - Slumber
6. Jean Decary / Hexagram Montreal - Hallucinotron v. 2.4

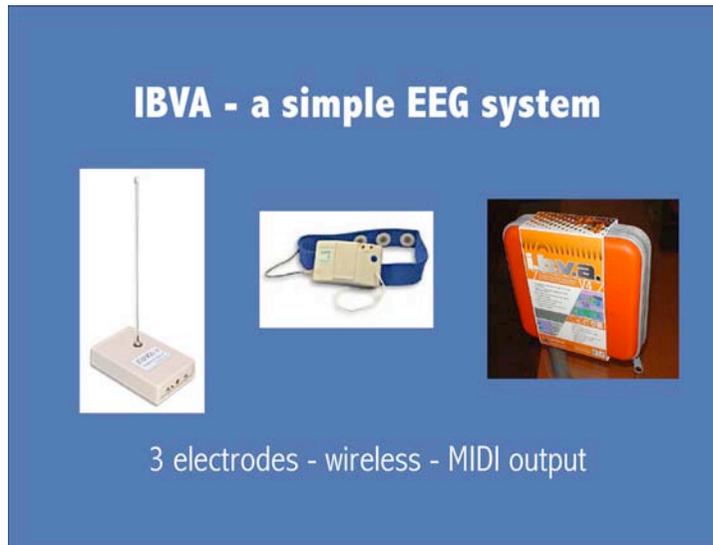


It is possible to train oneself to control (more or less) one's brainwaves through a process called neurofeedback.

This slide illustrates an experiment that quite by accident established the first medical application for neurofeedback. It involved cats and rocket fuel. (<http://www.google.com/search?hl=en&q=neurofeedback+cats+rocket+fuel>)

To train a person many sessions (10 or more) are necessary. Besides medical applications like treatment of drug-resistant epilepsy, neurofeedback is also used in a more "new age" setting to help achieve trance or meditative states. Research has also been done by connecting experienced meditators to EEG and registering their brainwave patterns.

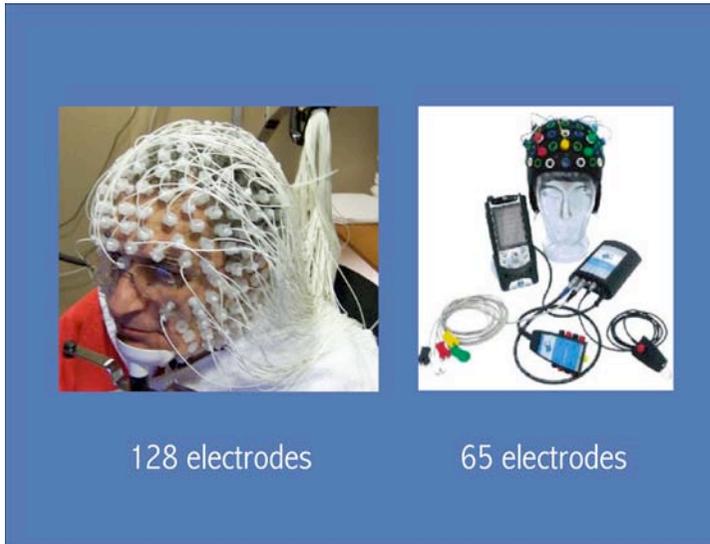
□



The EEG system that we chose for this project is a quite simple one, consisting of only 3 electrodes that can be applied to the forehead and held together by a headband. It has a wireless transmitter (the new version, pictured on the right, uses bluetooth so the receiver shown on the left is not necessary anymore) and outputs MIDI signals.

IBVA stands for Interactive Brainwave Visual Analyser (<http://www.ibva.co.uk>)

□



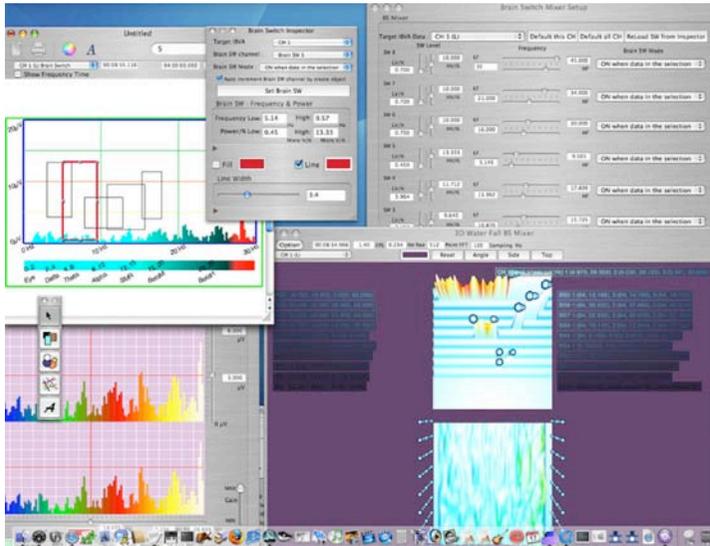
To have an idea about how simple a 3-electrode system is, pictured on the left is a scientific EEG system composed of 128 electrodes with their accompanying wires (<http://www.egi.com>) and a general use commercially-available system that can use up to 65 electrodes and is wireless (<http://www.gtec.at>)

□



In this picture Marlon is wearing the IBVA system and I'm wearing a helmet which has nothing to do whatsoever with EEG just for the sake of photo aesthetics and interestingness.

□



Here we can see a little bit of the IBVA software interface. It can show very pretty images of your brainwaves in realtime but we were mostly interested in the MIDI output control window, which lets you map frequencies and amplitudes to MIDI channels, pitch and etc...

▣

first experiments

simple color feedback system
google images search
remote transmission

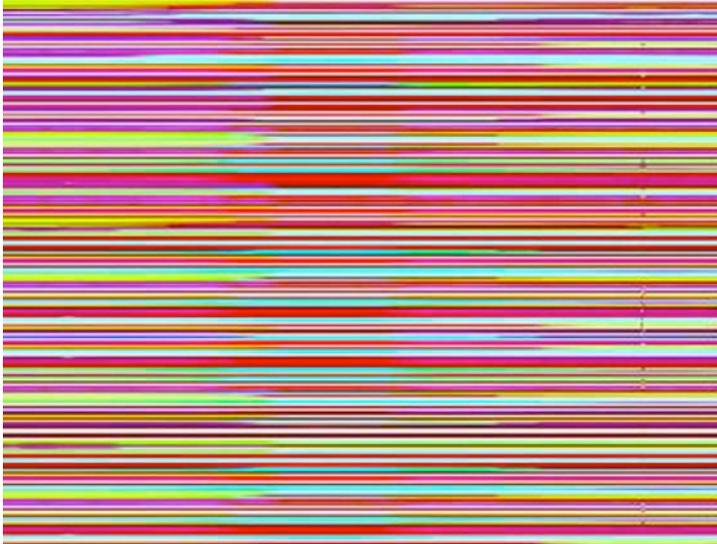
After setting up the system the idea was to start experimenting with very simple concepts. We hooked up the input to a basic color feedback patch, and then later added images retrieved from google images into the patch. Since I was in Germany for 3 months and Marlon only for 3 weeks, we also experimented with sending the brainwave readings in realtime over the Internet.

□



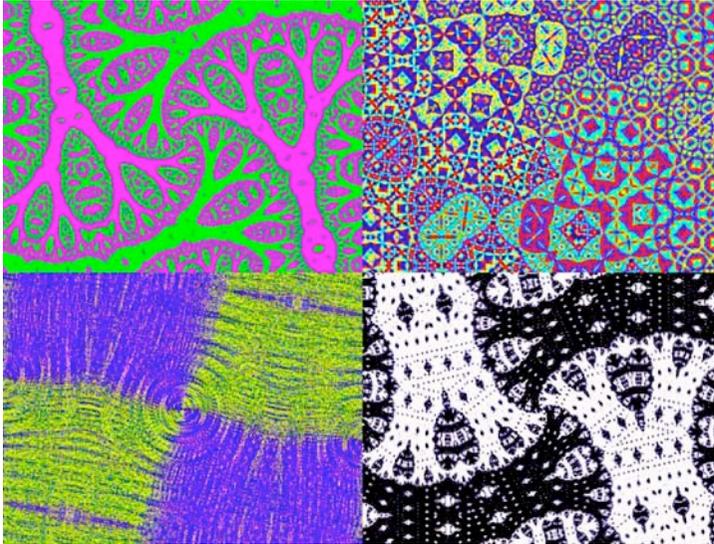
Sending brainwaves from Karlsruhe to NYC - in the left bottom corner we can see Claudia Robles (wearing the electrodes) and Florian Grond. On the top right is Marlon at his living room in New York. He is receiving brainwave data and sending back to us a video stream.

□



Short video clip from the color feedback module

□



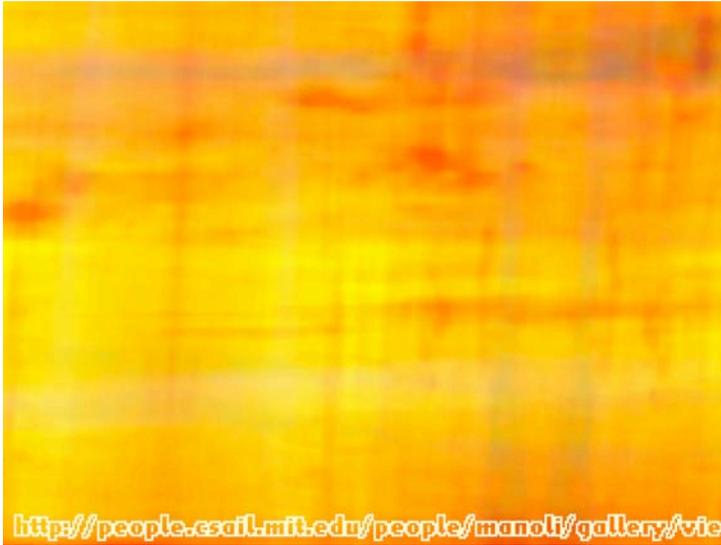
Screenshots from the color feedback module

□



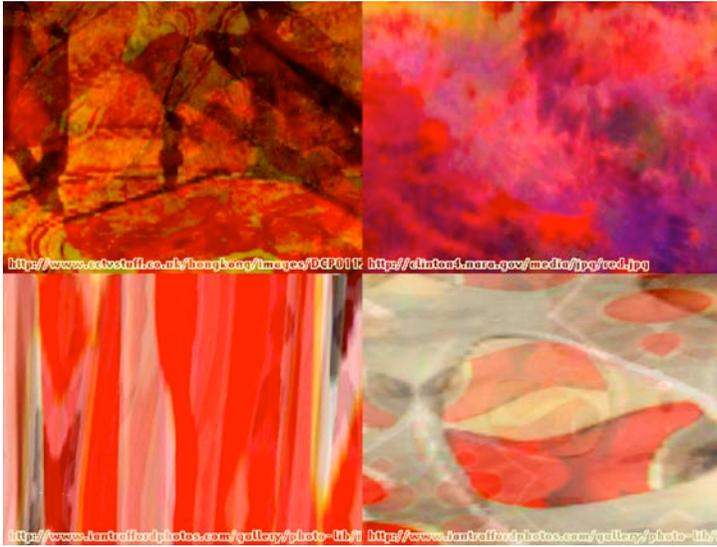
Screenshots from the color feedback module

□



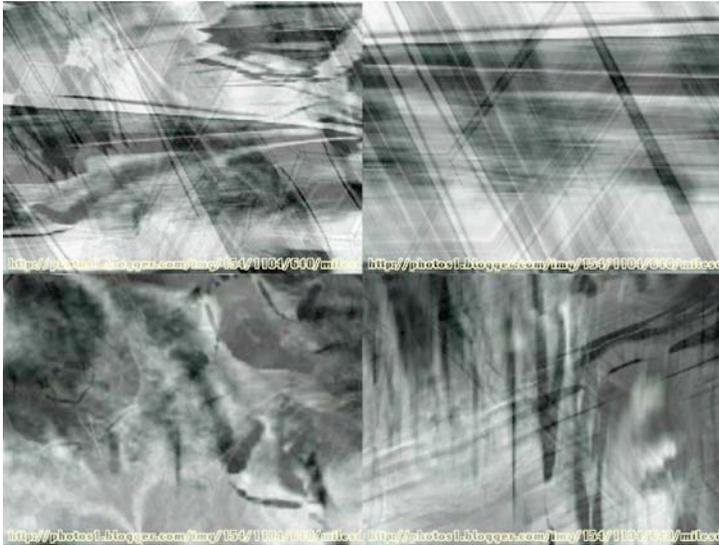
Short video clip from the google images module

□



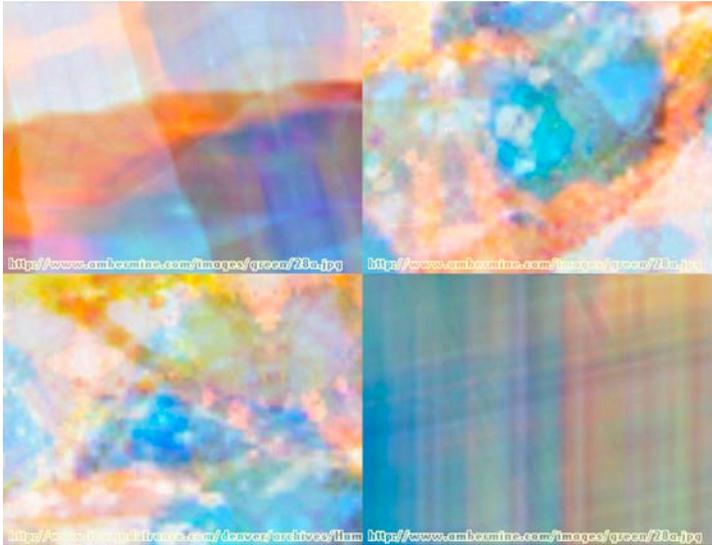
Screenshots from the google images module

□



Screenshots from the google images module

▣



Screenshots from the google images module

▣

some inspirations

colrpickr
eyevisionbot

We wanted to deal with basic image characteristics like colors and patterns, and some of the inspirations were:

colrpickr (<http://www.krazydad.com/colrpickr>) and

eye-vision-bot (<http://www.medienkunstnetz.de/works/eye-vision-bot>)

□



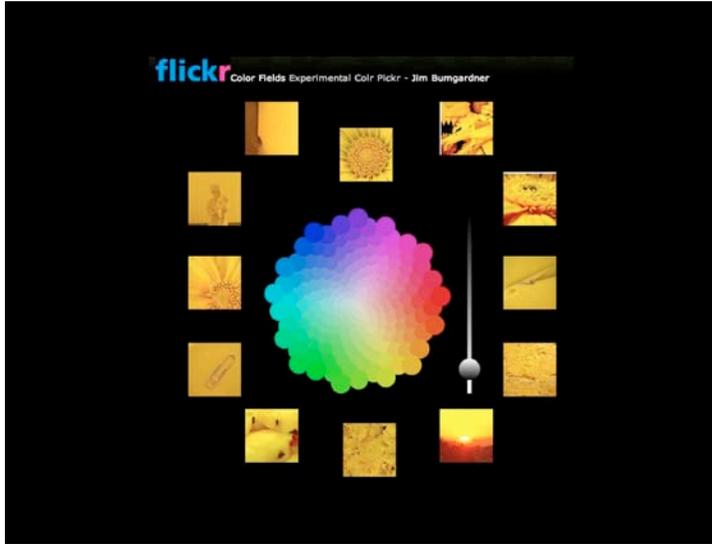
Screenshot from colrpickr - choosing a color in the picker triggers a search of Flickr images with the selected average hue/brightness/saturation

□



Screenshot from colrpickr - choosing a color in the picker triggers a search of Flickr images with the selected average hue/brightness/saturation

□



Screenshot from colrpickr - choosing a color in the picker triggers a search of Flickr images with the selected average hue/brightness/saturation

□



Eye-vision-bot - the interface is based on eye-tracking, the computer selects the image that received more eyeball attention and performs a search based on its visual characteristics (color, shape, etc) and any keywords attached to it.

More info about eye-vision-bot on Lasse Scherffig's MA Thesis, It's in Your Eyes:

<http://www-lehre.inf.uos.de/~lscherff/inyoureyes/inyoureyes72dpi.pdf>

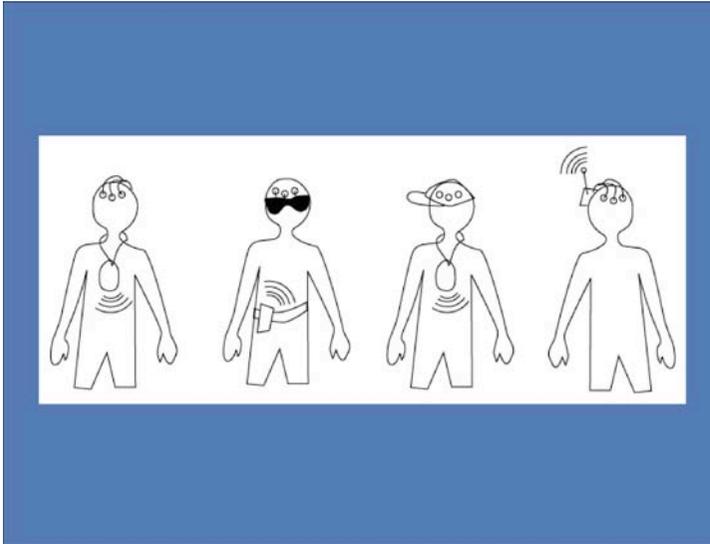
▣

future possibilities

improve wearability
open source EEG system
game for two players
audio component

After the initial experiments, which were lots of fun, we came up with some possible directions for expanding this work in the future.

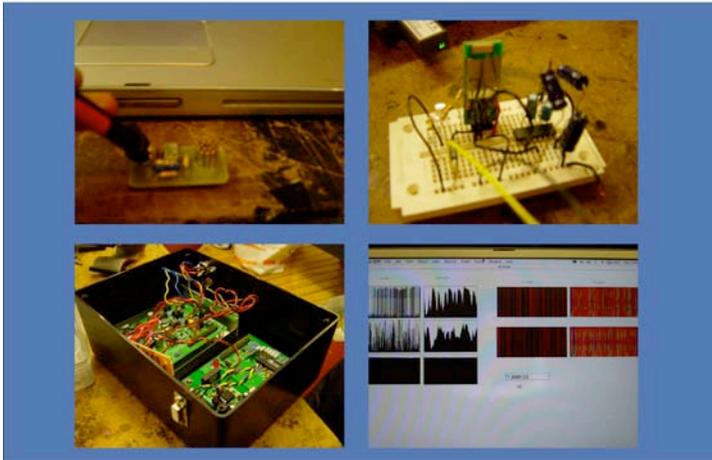
□



One thing that is quite necessary is to improve the system's wearability (and at the same time its aesthetics). Most people could not wear it for longer than 20-30 minutes without starting to feel uncomfortable. The electrodes were quite comfortable but the headband exerted too much pressure and the wireless transmitter was quite heavy.

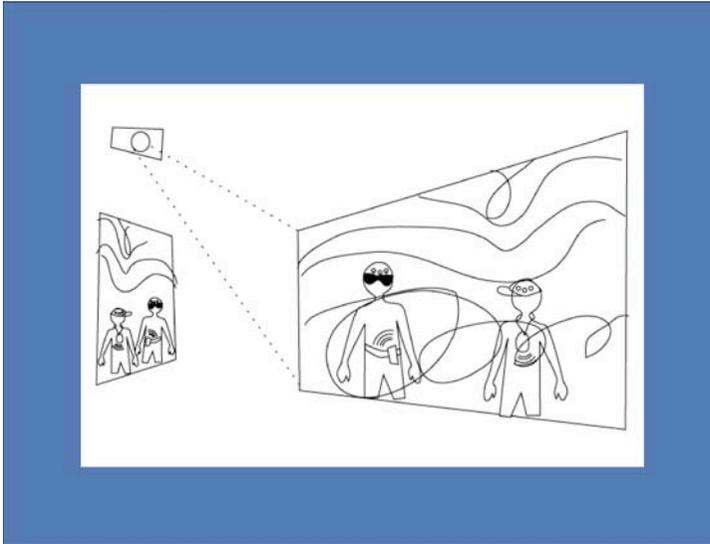
One option could be wearing the transmitter around the neck or on a belt, and incorporating the electrodes into sunglasses or a cap.

□



Another idea is to switch the EEG system to an open source solution like the OpenEEG project. The pictures show examples of OpenEEG's electrodes, circuit boards and software.

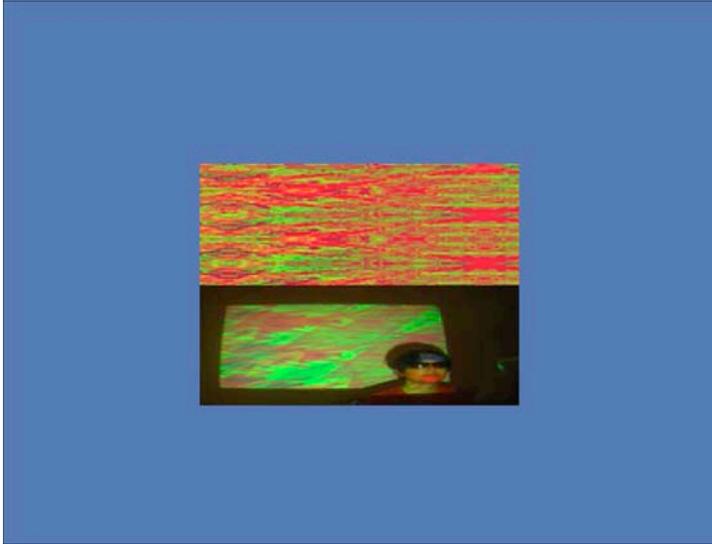
□



Another possibility that could be explored is to create an application with game characteristics, in order to engage two or more players in an interaction mediated by their brainwaves.

The pictured possible setup is inspired by an experiment we did with the EEG user in front of the projection screen (with a mirror installed on the opposite wall so he was able to look at the results)

▣



Here is a video of myself in front of the projection. The sound was not being generated by the system but quite by chance it matched very well the images (or at least many people thought so :)

▣



Thank you very much, and here is the project's website and my contact info.
Lenara Verle - April 24, 2007