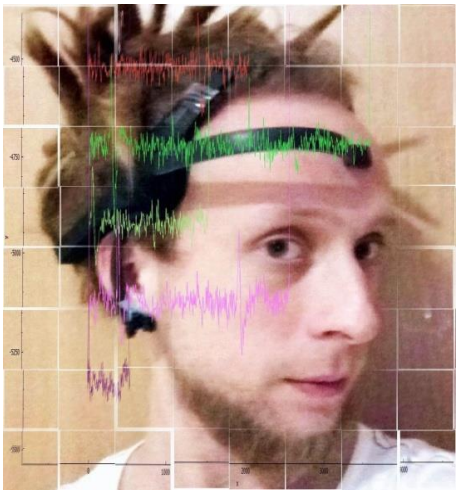
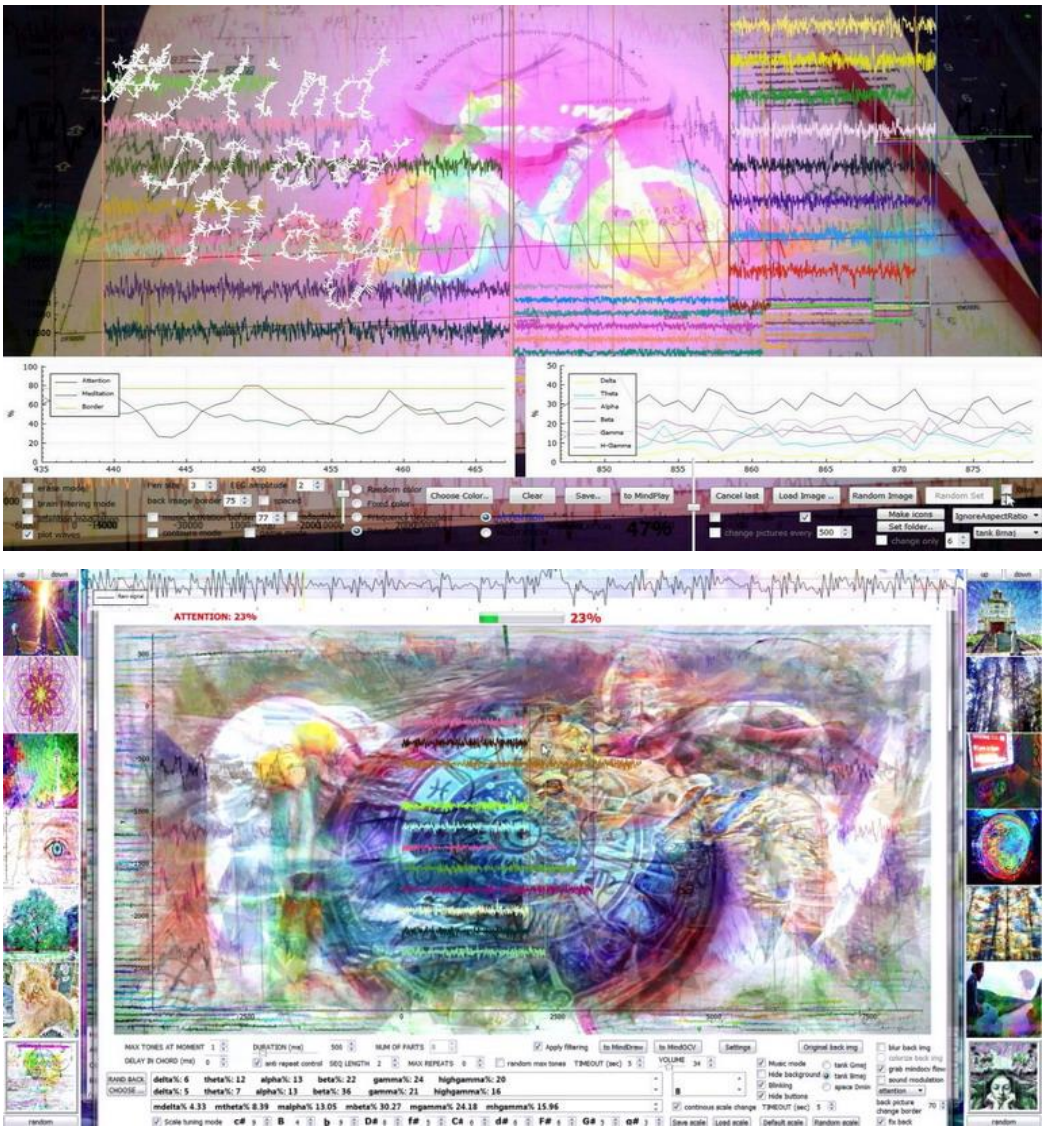
MindDrawPlay



MindDrawPlay – is a project of experimental interactive audio-visual art, representing translation of brain waves to drawing, graphical and musical space controls. It has been grown on a base of a research work in the direction of Brain-Computer Interfaces. Combining technology advances – such as mobile EEG devices (*in particular, MindWave Neurosky*) and musical knowledge – such as pentatonic scales (*hang and tank drums tones*), it allows everyone to see, to hear his brain activity represented by set of sounds and to use brain waves as a brush for drawing, as parameters for image filtering, attention modulated color-overlay pictures flows and in a puzzle gathering and identical pictures recognition games. MindDrawPlay is much more than a neurofeedback app with sounds and visualizations, it provides with a unique experience of interactive immersion into flows of your mindspace.

Pic. 1 Mobile EEG (MindWave NeuroSky, http://neurosky.com), data acquisition device for brain waves.

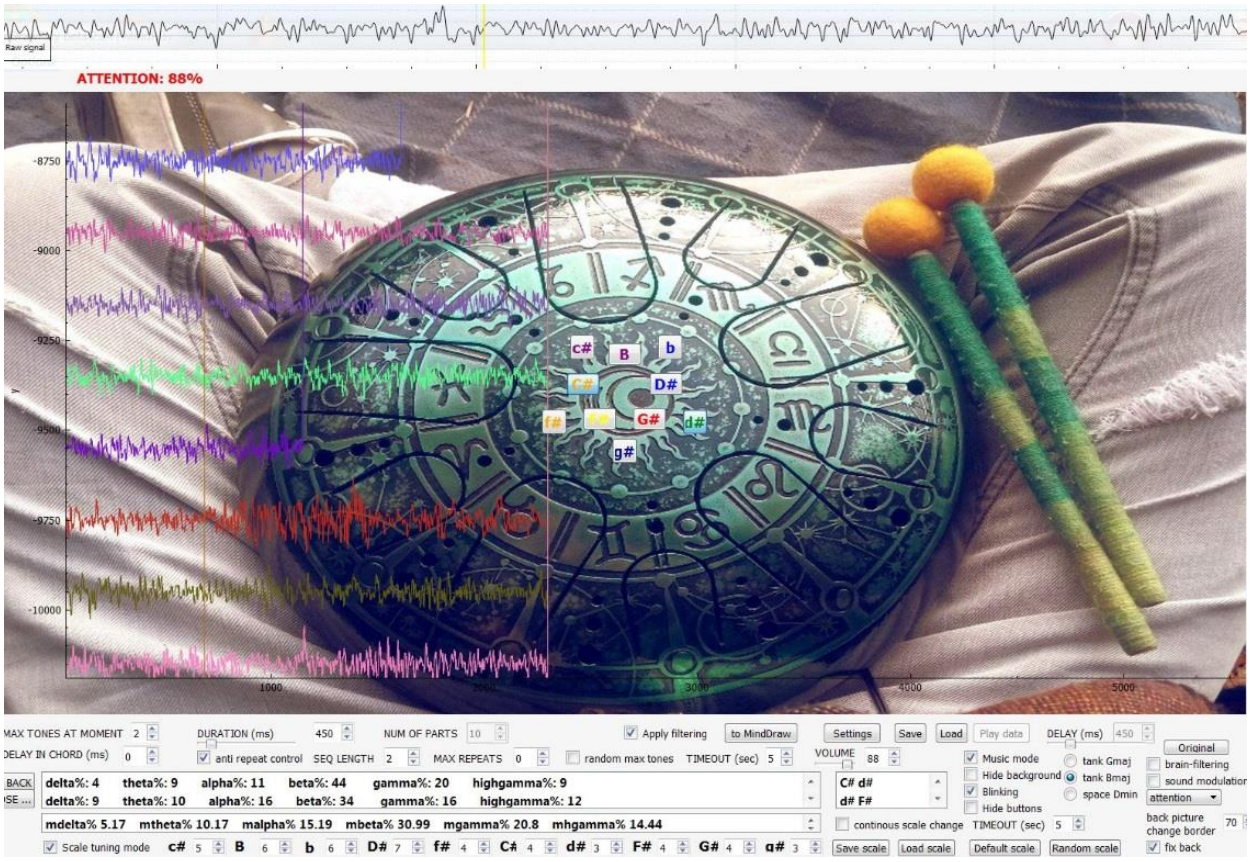


Pics 2-3. Screens of the application, promo video: https://vimeo.com/396706503

Thanks to mobile EEG, it is simple in usage, does not require any preparation procedures (like with traditional EEG devices), just wear, observe and play with your mindspace. Application allows user to control different parameters, for example, in case of music – duration of tones, number of tones in a moment and their distribution (how often which tones play), in case of drawing – different color modes of brush and amplitude of brain signals as a brush, in case of graphical space flow – how many pictures in a puzzle will change and how fast. You can observe in real-time dynamics of your brain waves on plots, your attention / meditation level changes and how actions in application or your mental activity states influence brain waves. Therefore, essentially, MindDrawPlay is form of an interactive art, neurofeedback application and a tool for exploring brain activity patterns.

Basically, there are three windows in the application, additionally on the top of all - there is a plot with real-time raw brain signals from EEG device.

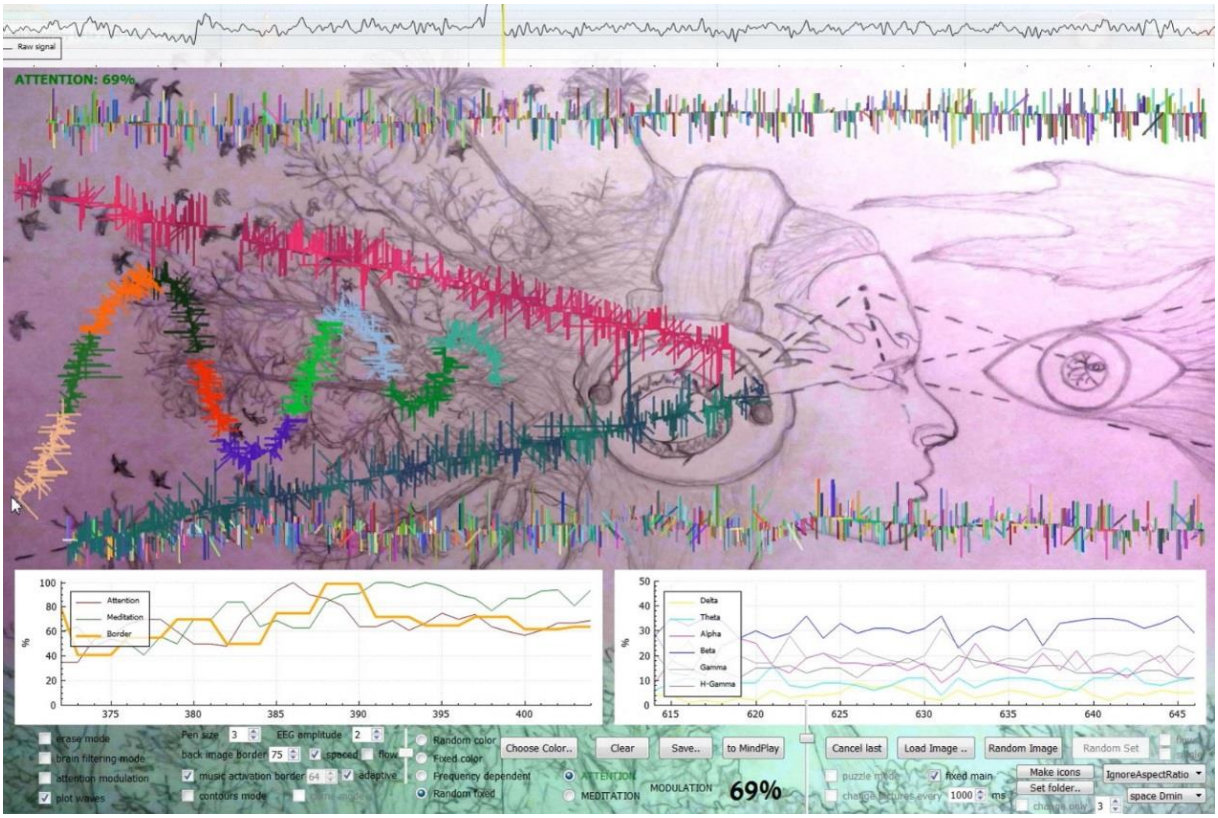
1st window is “MindPlay”, allowing translation of brain waves to music by playing samples of tones from 2 tank drums and 1 hang drum with any background image (.jpg). The image can be filtered at the same time with effects – blurring and change of colors by HSL (hue) filter, blurring depends on the brain activity: higher attention/meditation level gives less blurred image. Music by brain waves can be combined with usual playing of samples by user.



Pic. 4 Screen of “MindPlay” window with brain waves flow,
video: https://vimeo.com/363065676, https://vimeo.com/373804169, https://vimeo.com/341203496

How does it work?

In short – it gets brain signals (electrical activity in microvolts) from 1 electrode (on frontal lobe area, Pic.1) and transmits it via bluetooth to the application, where it is processed in a short intervals (1, ½ sec or less) and frequency distribution for every interval is analyzed. Different musical tones are linked to different brain waves (delta, theta, alpha, beta, gamma, high gamma), depending on which of them are more expressed in relation to deviation from its average value – particular corresponded tones will play. Thanks to pentatonic scale (which is used in hang or tank drums), the sounds are always in harmony. Your attention / meditation levels, which are estimated by build-in algorithm in EEG device (or by Fourier transform values from raw signal) are related with volume control: when you are more focused – sounds play louder, and optionally with tones duration, where with a higher level of attention/meditation – tones play longer. Brain waves are visualized by these short intervals in a flow, which you can scale and move.



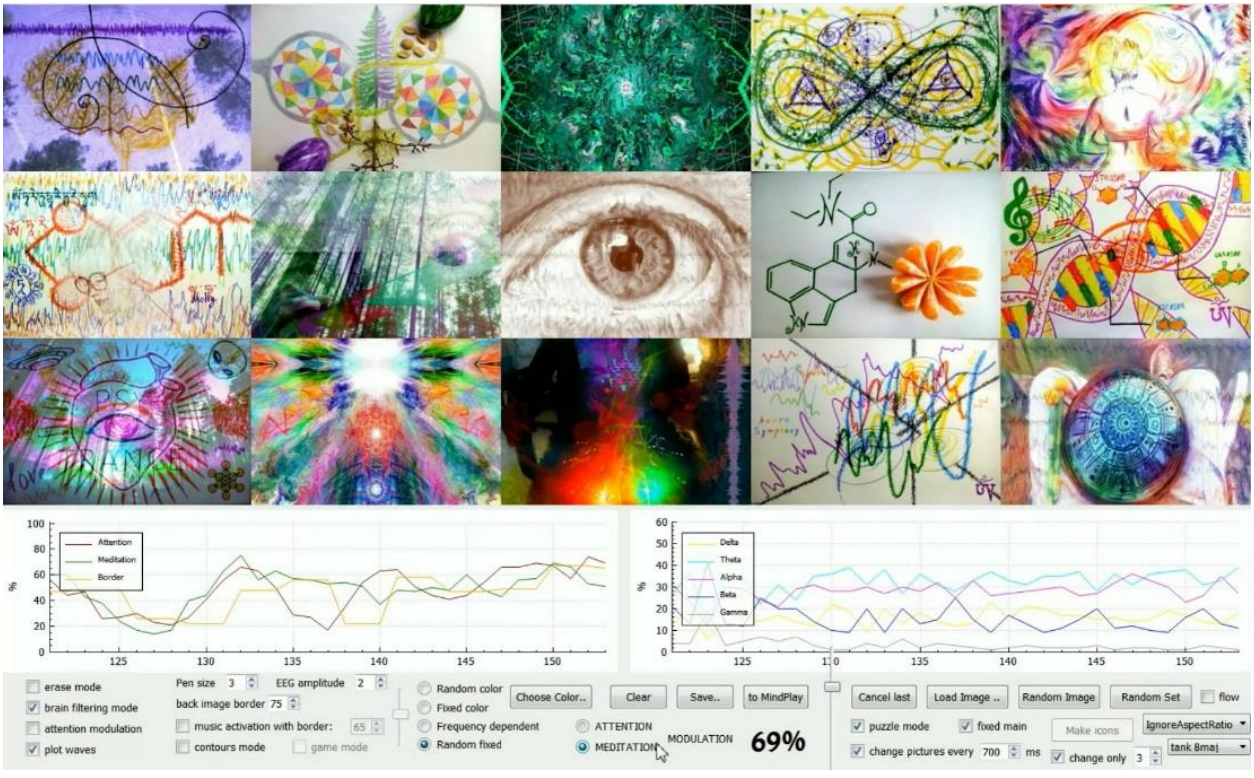
Pic. 5 Screen of “MindDraw” window in “drawing mode”,
video: https://vimeo.com/374172719, https://vimeo.com/331878650, https://vimeo.com/363152405

2nd window is “MindDraw” with 4 different modes representing various graphical spaces and controls of them. In all modes there is an option to show in real time brain waves and attention / meditation levels on the plots. It represents your brain activity patterns, when you simply look on the application window or do something there (or wherever within limits of bluetooth connection). Therefore, you can see how your interactions influence your brain activity, for example, when you start

drawing a line – your attention and beta waves usually increase, when you are closing eyes or relaxing – alpha waves usually get higher. Moreover, there is an option for combining drawing with music – when your attention/meditation level is higher than some value (like 80% or adaptively computed value) – musical space is activating and you hear sounds from "MindPlay" window.

1st mode – drawing with brain waves as a brush, the idea is that when you press and move the mouse – signal from your brain (amplitude of brain oscillations from EEG device) is projecting on a plot with direction always orthogonal (90°) to mouse movement. There are several options and parameters, such as color control (brain frequency dependent, random, fixed), amplitude (fixed, attention/meditation modulated), modes for instant drawing and drawing by contours. As in “MindPlay” window, you can use any image as a background layer also with a filtering option.

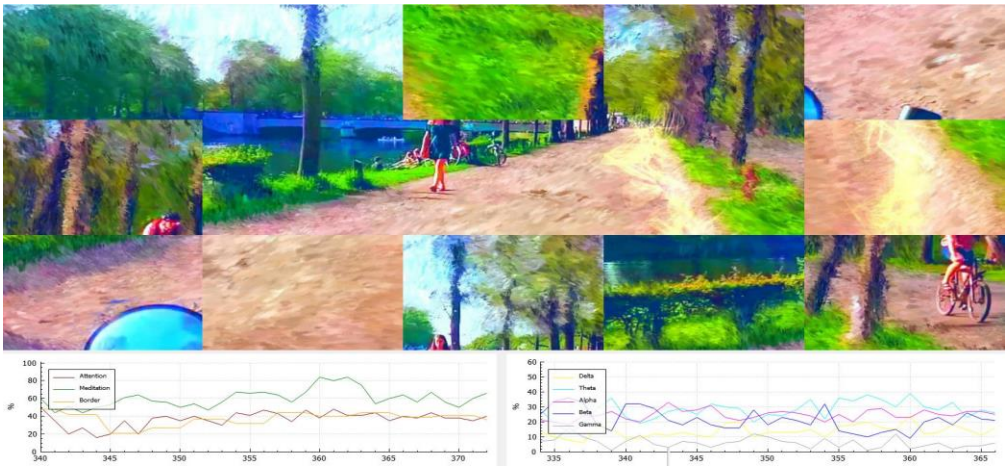
2nd mode – puzzle flow representation of any images set. Here the idea is that you have 15 small puzzles with images and you can control with your attention/meditation levels how many of them and how fast will change, when you are focusing – less puzzles are changing and slowly.



Pic. 6 Screen of “MindDraw” window in “puzzle mode”,
video: https://vimeo.com/374183779

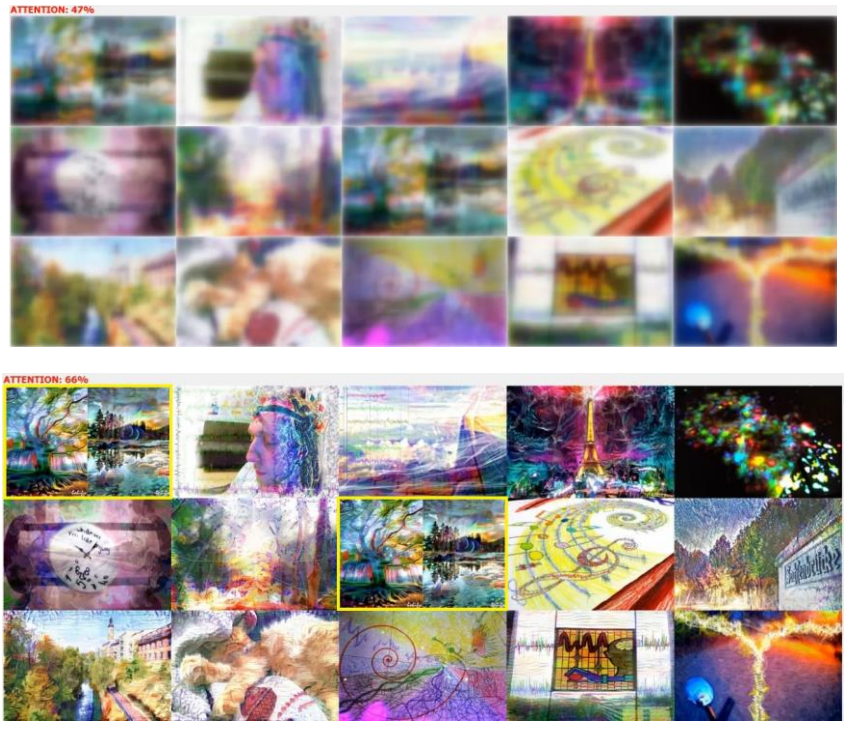
"Draw" and "Play" windows can be switched and used with the same picture and all options available in two windows, so you can observe pictures from a set, choose the one you like and go for drawing or playing, then go back to the set, choose another one or just observe the flow. (video: https://vimeo.com/332093098)

3rd mode – simple puzzle gathering game, where with your attention/meditation level you need to complete the picture from 15 randomly shuffling fragments. There are 2 options in this mode, when puzzle has fragments only of the one picture or when it is represented by the background picture and a set of small randomly changing overlapping images. The idea is that, when you are more focused / relaxed – the puzzle is more complete, less fragments are in the wrong positions (or less overlaps with background picture) and changing slowly.



Pic. 7 Screen of "MindDraw" window in "puzzle gathering" mode,
video: https://vimeo.com/362443658

4th mode – an identical pictures recognition game, where you need to find two the same pictures among 15, when all of them are blurring depending on attention, when you are more focused – pictures are more clean and it's usually easy to find the same.



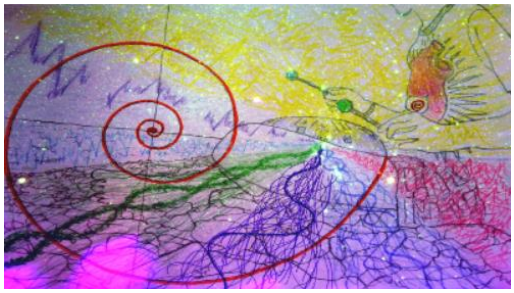
Pic. 8 Screen of "MindDraw" window in "puzzle game" mode,
video: https://vimeo.com/372210884

3rd window of the application is “MindOCV” (based on OpenCV library) with the left and the right panels to choose the main and the overlay pictures from a set.

Basically, there are 3 modes in this window, 2 of them are flows:

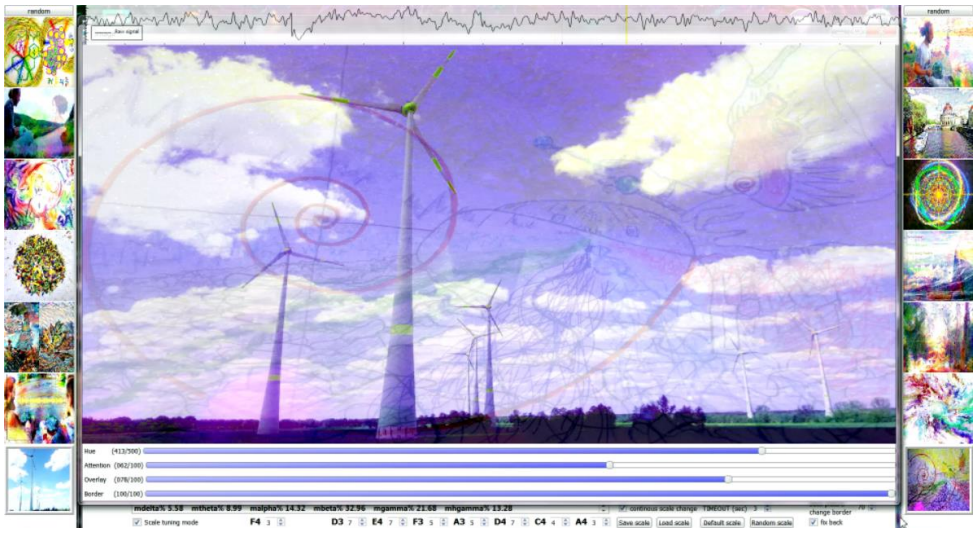
1) color-overlay flow – where attention modulates rate (how fast) overlay and color changes are applied for a chosen couple of pictures, attention also controls the transparency of the main pic (more focused – more solid), at the same time the main pic is changing colors with HSV (hue) filter.

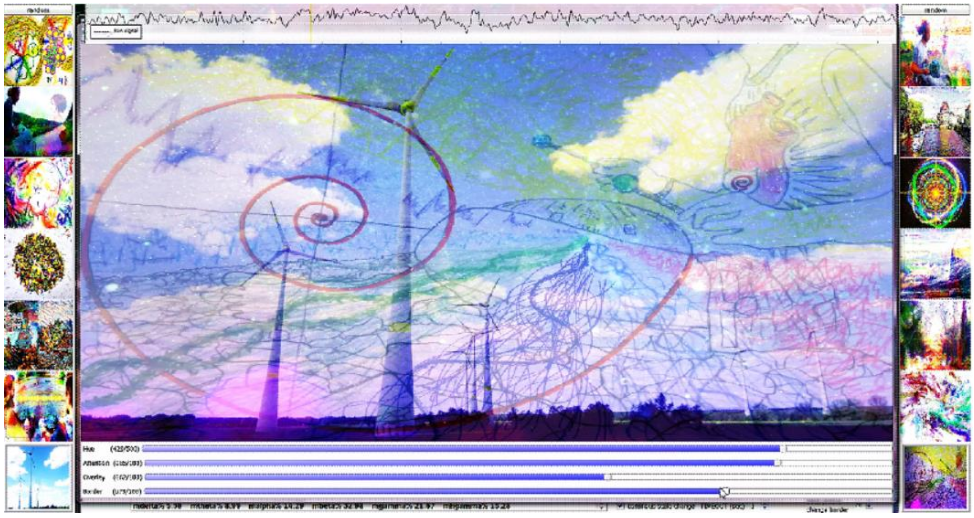
main pic



overlay pic

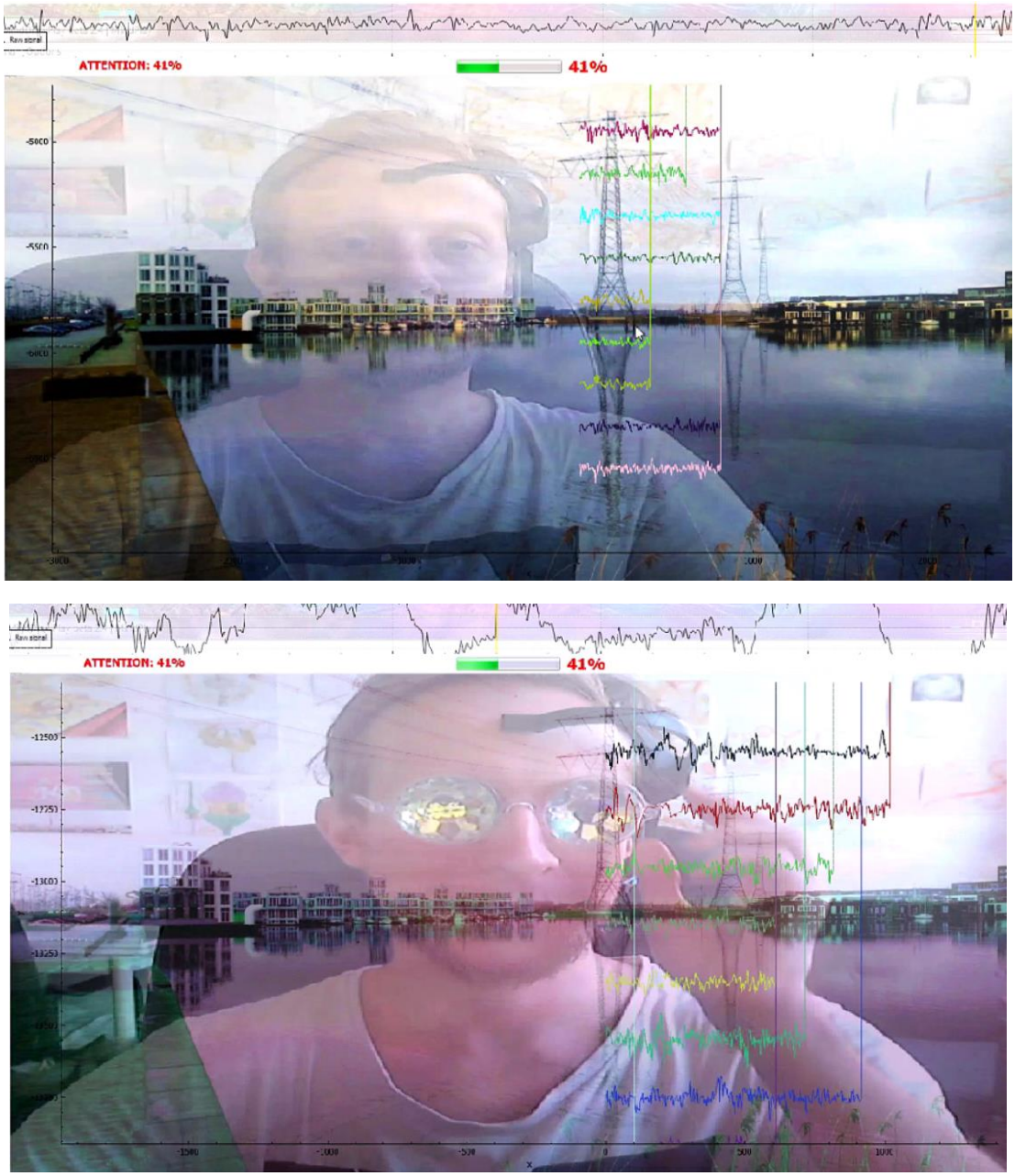
pics from resulting flow:





Pic. 9 “MindOCV” window with color-overlay flow, video: https://vimeo.com/387225095

Besides, there is an option to use camera input as a source for overlay pictures, which provides with an amazing experience of being inside the flow, while observing and interacting with it (both by your attention and usual controls). Streaming of the flow to “MindPlay” and “MindDraw” windows – allows to watch yourself or space from camera with overlay of your brain waves and attention / meditation levels.

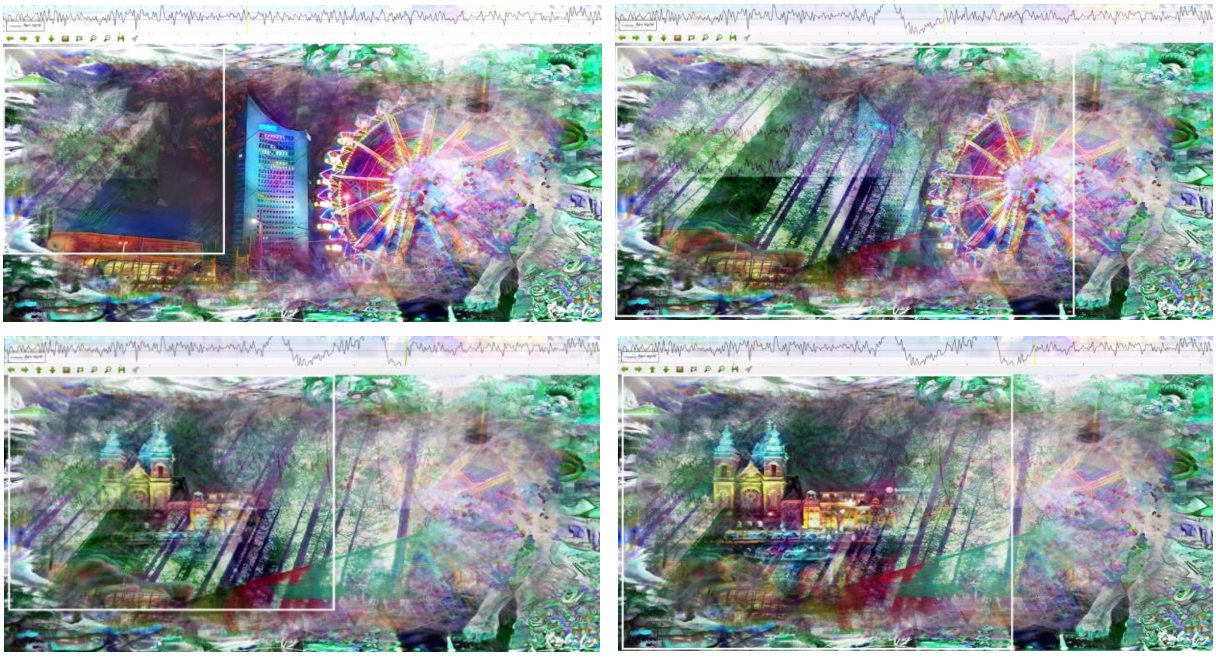


Pic. 10 “MindOCV” window with color-overlay flow and camera input,
video: https://vimeo.com/398709793

2) dreamflow – allows smoothly filling visual space with parts of different pictures, either in a fully / partially user controlled way or in autonomous – when attention can modulate how fast fragments appear, area, transparency of fragments and number of points in polygons for fragments (if polygon option is chosen, otherwise – fragments appear as circles of different sizes).

Pic. 11 “MindOCV” dreamflow,
video: https://vimeo.com/396094596, https://vimeo.com/396226013, https://vimeo.com/396294651

Additionally, especially interesting and immersive is the “drops” mode – where fragments of pictures appear in a growing windows (drops), the rate of their area increase can be modulated by attention, such as with a higher focusing – drops grow faster, new drops appear either at random position or at a current mouse position.



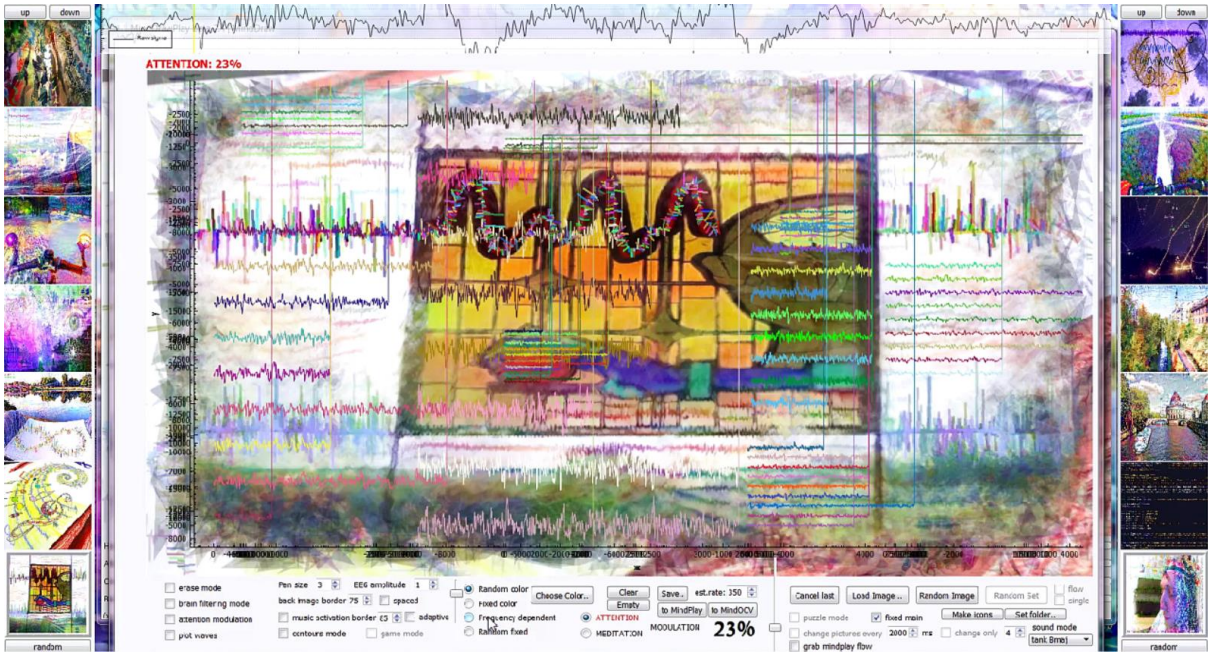
Pic. 12 “MindOCV” dreamflow, drops mode,
video: https://vimeo.com/397576948, https://vimeo.com/397859469, https://vimeo.com/399557745

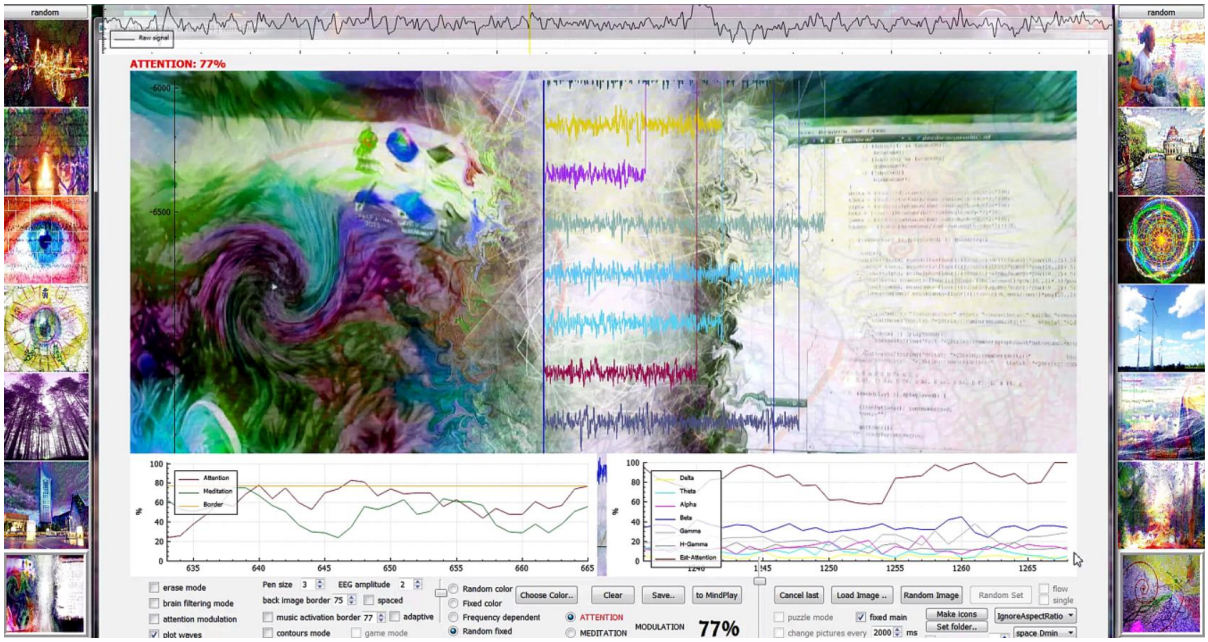
In both flows pictures can be changed by user action, time interval or condition: when attention > border value (for example, 80%) in hue-overlay flow – the main pic becomes overlaying pic and a new main pic is randomly chosen; in usual (full space) dreamflow with this condition – new picture for filling space is randomly chosen, with “drops” mode – new picture is also chosen, when the current drop area fills full screen. There is also an option instead of a random choice for next picture, to set the direction of the flow – to similar or opposite in relation to a current picture, the similarity is based on color histogram analysis of pictures.

3) static mode, kind of a simple graphical editor – currently with 5 filters (Dilate, Waves, Cartoon, ORB features, Mixer), this mode is more for exploring OpenCV filters and other image transforms, but also can be used during dreamflow mode or when one of the flows is stopped. The brush size for applying filter can be attention modulated.

Additionally, MindOCV flows and pictures can be streamed to “MindPlay” and “MindDraw” as well as back from there to “MindOCV”. Such transfers allow to observe and create various combinations of drawing and filtering with pictures, flows and brain waves.

MindDrawPlay is a part-time hobby project written in C++/Qt and currently tuned for MindWave EEG device. However, it can be adapted for other mobile or full EEG systems. There are a lot of ideas and ways for development and improvement. Author is interested and opened for any potential collaborations, especially, with mobile and VR applications developers.





More examples of drawings and pictures made with the app:
https://www.artstation.com/neur0forest/albums/1338653
Screen recordings demonstrating work of the app:
https://www.artstation.com/neur0forest/albums/1425498