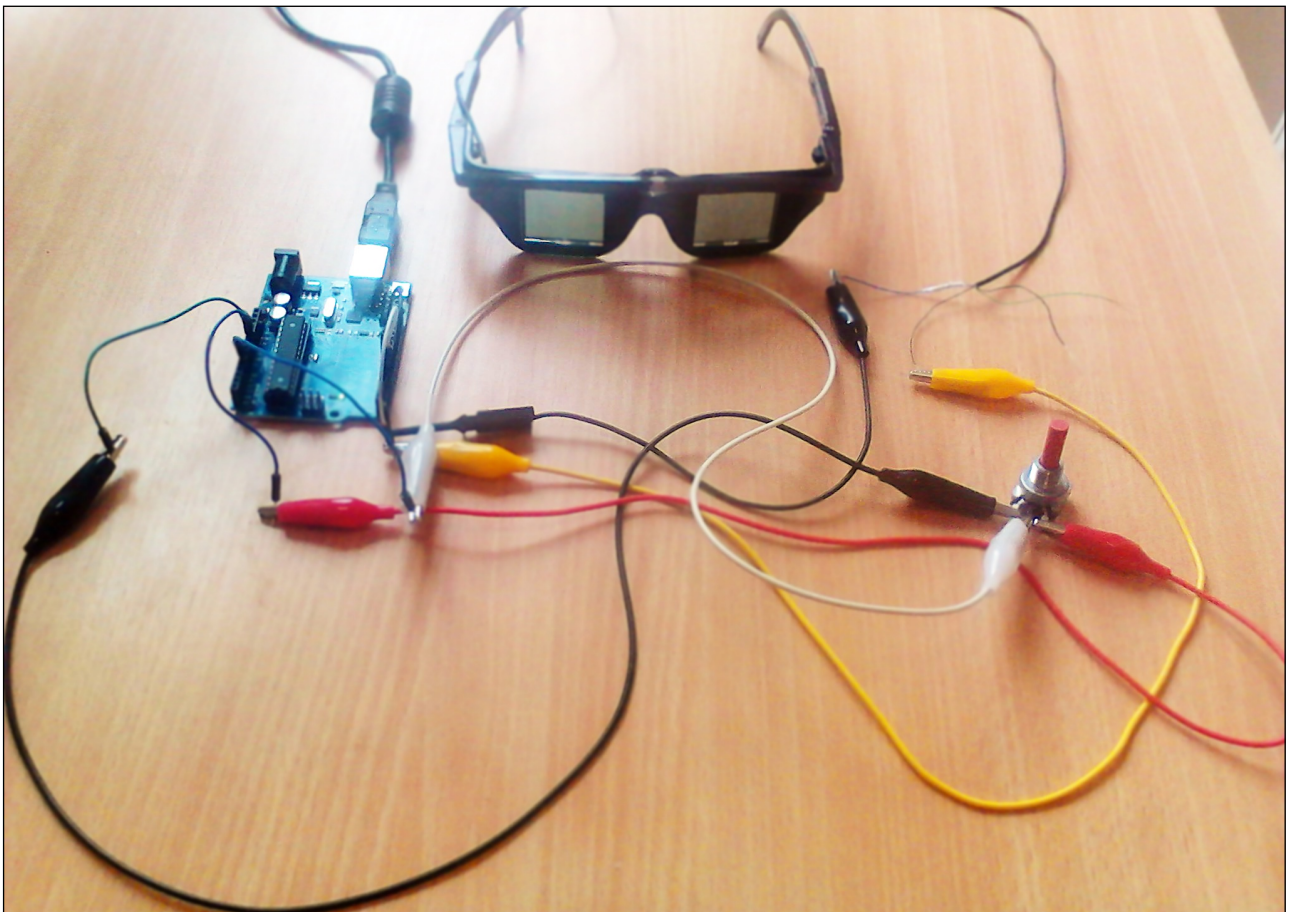


PORTABLE PHOSPHENE MACHINE

SUN AS LIGHT SOURCE FOR INDUCING HYPNAGOGIC STATES



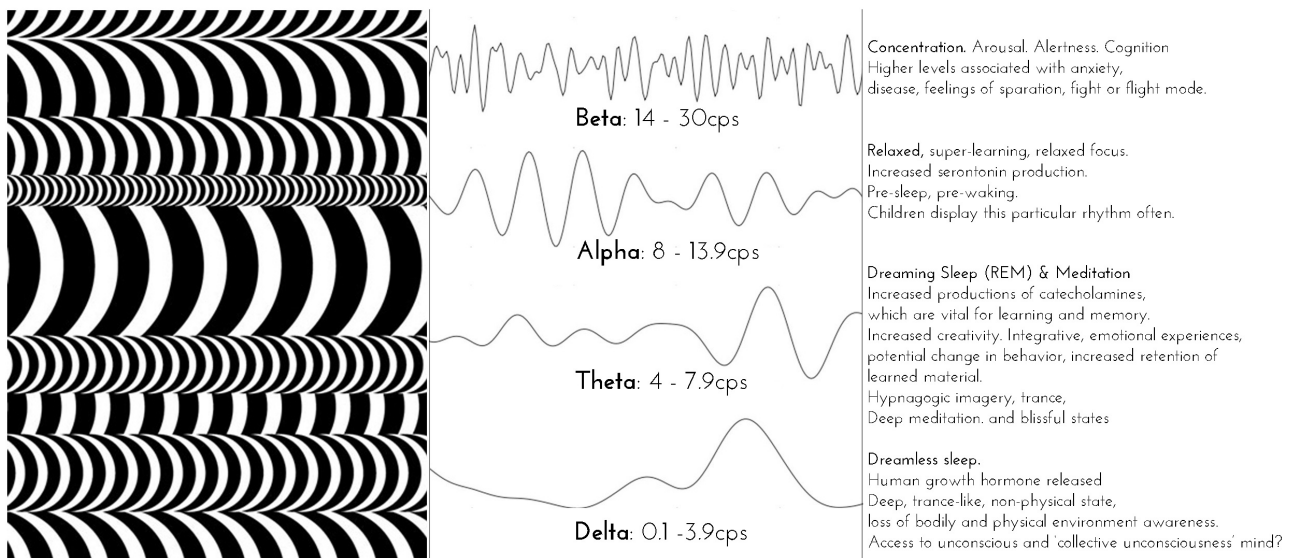
Introduction

While being inspired by the various flicker devices of the past (1) and present (2) and their effects on the mind, I wanted to induce the *Hypnagogic state* (3) from a portable flicker device which used the sun as the light source instead of artificial light.

Originally I considered analogue and mechanical approaches for generating a variable flicker, but then I heard about 'shutter glass' or 'smart glass' which changes its opacity when charged with an electrical current. So after consulting the Virtual Reality Department they very kindly supplied me with an old pair of shutter glasses that I could program for this project idea.

Theory

Electrical activity in the brain is rhythmic. The frequency of this rhythm depends on the state the mind one is in: an active, alert state correlates to rhythms in the Beta range of 14-30Hz. There is of course this view in 'brainwave entrainment' that one can induce different states of mind, by causing different brain wave frequencies to fall into step with external stimuli, in this case 'light on' - 'light off' sensory information.



Flicker: Light frequency

Brain wave range
Electrical rhythm of the brain's activity

State of mind
State of Consciousness

The intention is to enter a Hypnagogic state, or experience the associated mental imagery of moving geometric shapes and colours by utilizing our sun's light along with alternating the flicker frequency of the glasses with a potentiometer. Eyes are of course closed throughout this procedure. The effect 'Purkinje lights' is named after the founder of modern neuroscience Jan Purkje who thinks that this results from the visual circuit being short circuited by the changing frequencies. There is another theory which suggests that the varying frequencies of light are stimulating the pineal gland in the brain to produce DMT, which in turn can be responsible for the psychedelic imagery, since DMT is a Dimethyltryptamine(4).

The Hypnagogic state can be more deeply penetrated when one is able to relax the mind while maintaining awareness, which means not to fall asleep, and also not to judge ones experience of phenomena with thought, labeling, and categorizing, more commonly described as cognitive processes or as *conceptual awareness* as opposed to *non-conceptual awareness* where one is able to rest naturally in what is, dwelling in the naked awareness of the experiencer, simply being the perception itself, without being disturbed by thoughts, mixed feelings, expectations or sensory impressions. But in most cases, especially with new and interesting visual phenomena, one will habitually divide up ones experience with thoughts and other cognitive processes.

Context

Stroboscopic flicker devices of the past and present:



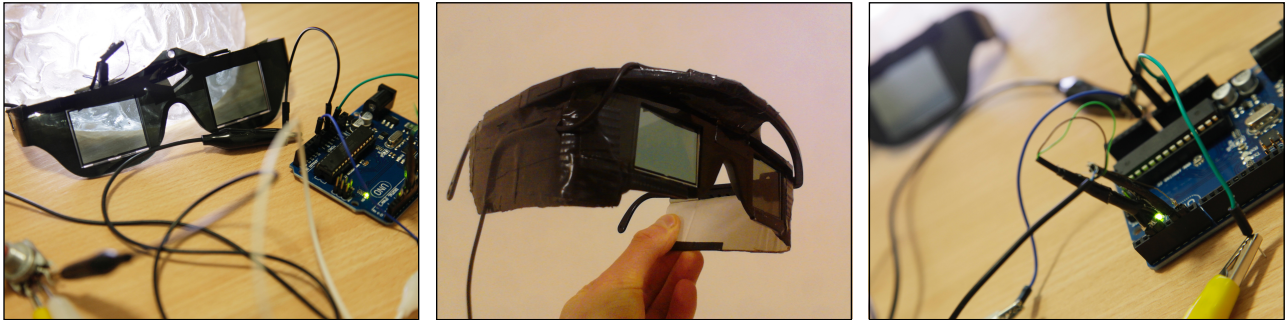
Fig. 3. *Dreamachine* 1958 Brion Gysin and Ian Sommerville. Pictured William Burroughs.



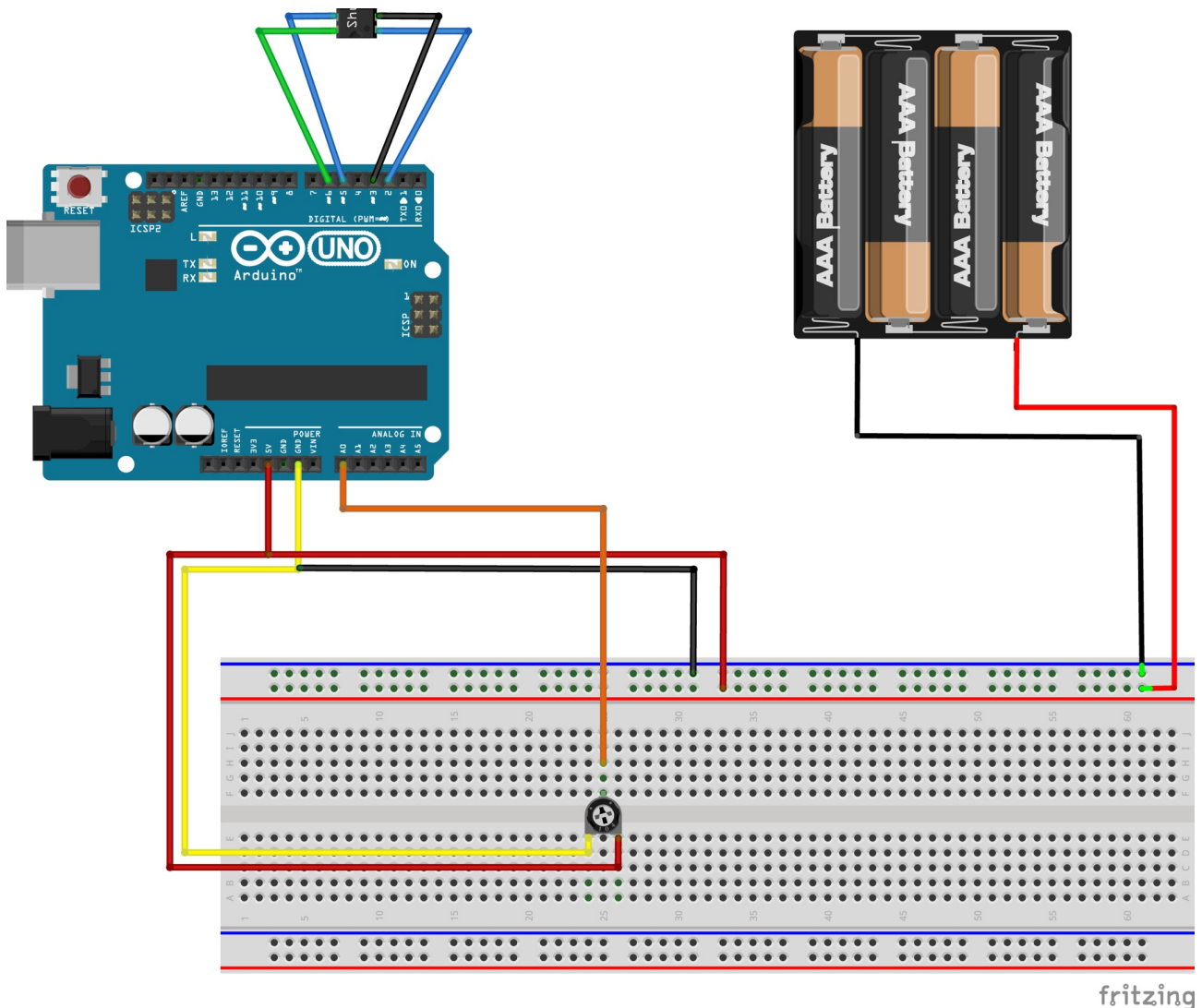
Fig. 4. *Lucia N°03* 2013 Dr. Dirk Proeckl & Dr. Engelbert Winkler. Pictured Sebastian Geato

Development of the portable flicker device

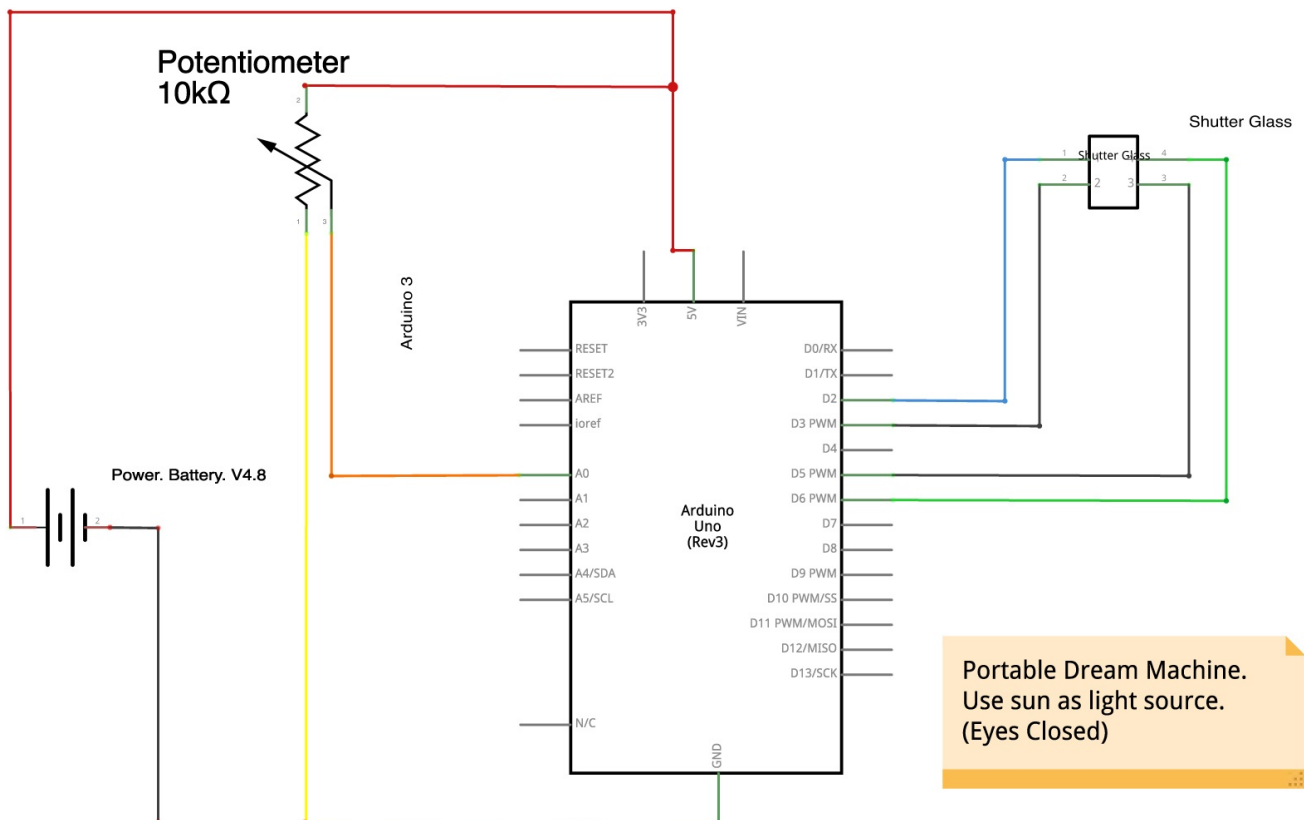
I used a pair of shutter glasses from the VR department, which I rewired, and connected to an Arduino micro controller with a potentiometer for adjusting the delay in the programs code. Soldering connections and wire cutting were needed to strengthen the wires connections and to resolve a faulty wire, as originally the right frame was not working.



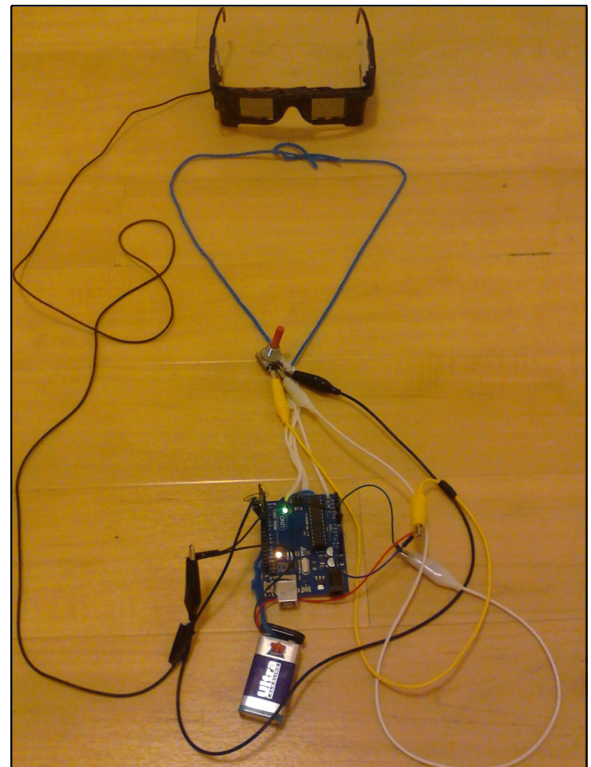
With programming, I tried using two potentiometers to change the flicker rate and duration of each. this worked well, but later I will use two, one for individual control of each frame. The current pair are controlled together with one potentiometer and an Arduino micro controller.



Schematic



fritzing



The Programming

I was informed that I would need an H-bridge to alternate the positive and negative flow of electricity through the shutter glasses, because without this, the shutter glass will degrade faster due to positive charge build up. I learnt that H- Bridges are normally used to control Motors. After some reading, I noticed that I could just program the current to alternate, without using an H-Bridge. So this you can see below in the code. The flicker rate is altered by changing the delay of the digital write.

Code

```
// Setting Digital pin inputs for shutter glasses:
const int glassR1 = 2;
const int glassR2 = 3;
const int glassL1 = 5;
const int glassL2 = 6;
// Setting Analogue pin inputs for Potentiometer
int valueOfAnalogPin0;
int valueOfAnalogPin2;

void setup() {
  // initialize the digital pin as an output.
  pinMode(glassR1, OUTPUT);
  pinMode(glassR2, OUTPUT);
  pinMode(glassL1, OUTPUT);
  pinMode(glassL2, OUTPUT);

  pinMode(A0, OUTPUT);
  pinMode(A2, OUTPUT);
  Serial.begin(9600);
}

void loop() {

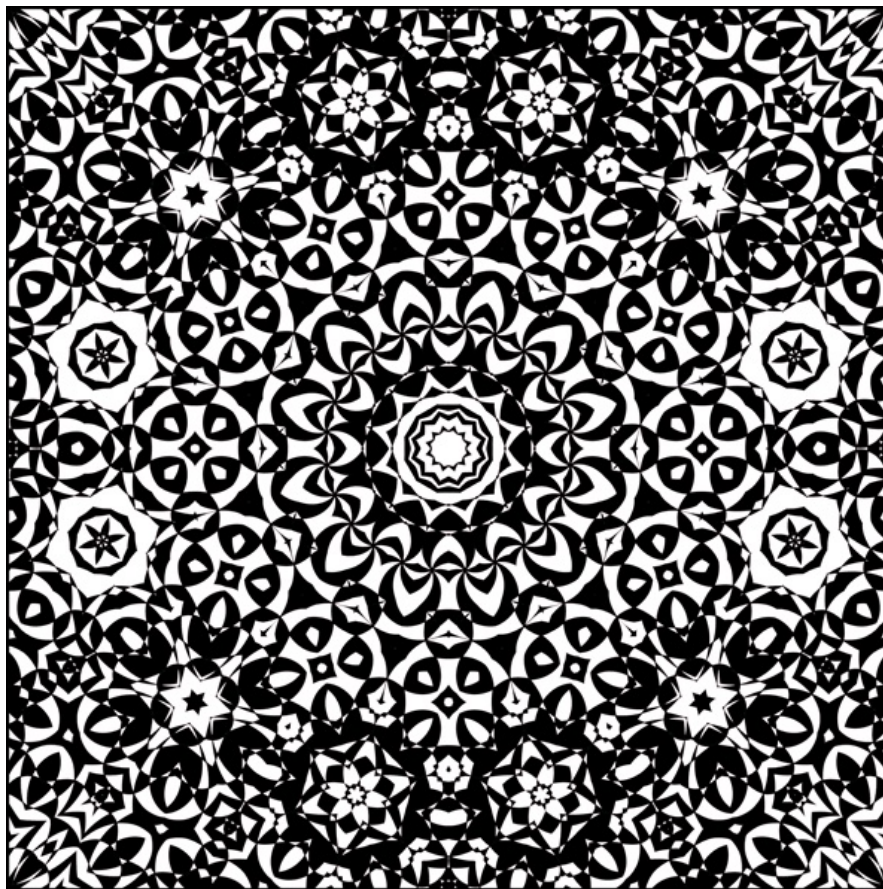
  valueOfAnalogPin0 = analogRead(A0);    // for the 1st Potentiometer input
  valueOfAnalogPin2 = analogRead(A2);    // for the 2nd Potentiometer input

  Serial.println(valueOfAnalogPin0);  // just to see the value change of the Potentiometer
  // Right frame
  digitalWrite(glassR1, HIGH);
  digitalWrite(glassR2, LOW);
  delay(5);
  digitalWrite(glassR1, LOW);
  digitalWrite(glassR2, HIGH);
  delay(5);
```

```
// Left frame
digitalWrite(glassL1, HIGH);
digitalWrite(glassL2, LOW);
delay(5);
digitalWrite(glassL1, LOW);
digitalWrite(glassL2, HIGH);
delay(5);

// Right and Left frame HIGH HIGH
digitalWrite(glassR1, HIGH);
digitalWrite(glassR2, HIGH);
delay(5);
digitalWrite(glassL1, HIGH);
digitalWrite(glassL2, HIGH);
delay(valueOfAnalogPin0); // this is where the flicker rate is changed by the
Potentiometer

}
```



A black and white example of the type of geometric imagery experienced. Or 'flicker phosphenes'.

Testing with the Sun, Outside

Rodrigo in Theatre Platz, Weimar



Next steps

It works as expected, but definitely not as intense as Lucia N°03. The Sun is always needed, and touch or computer screen lights are just not bright enough. Changing the flicker rate is fun, but one doesn't know exactly which frequencies are chosen. So it can be difficult to judge if one has found the much sought after Alpha rhythm.

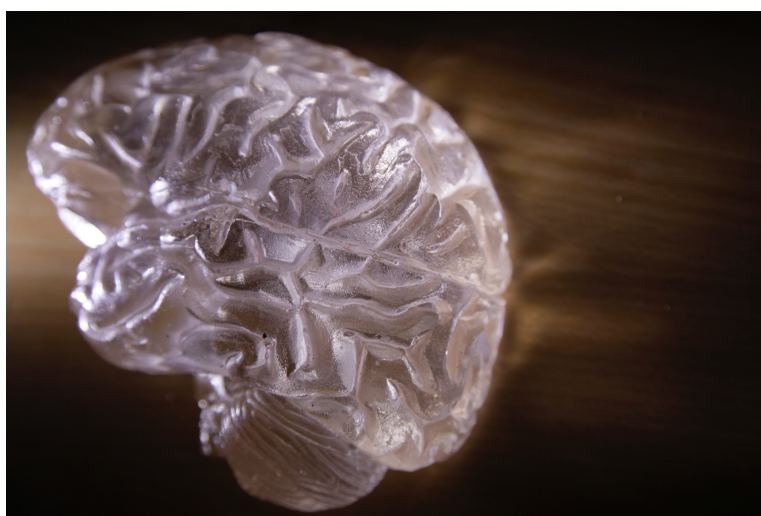
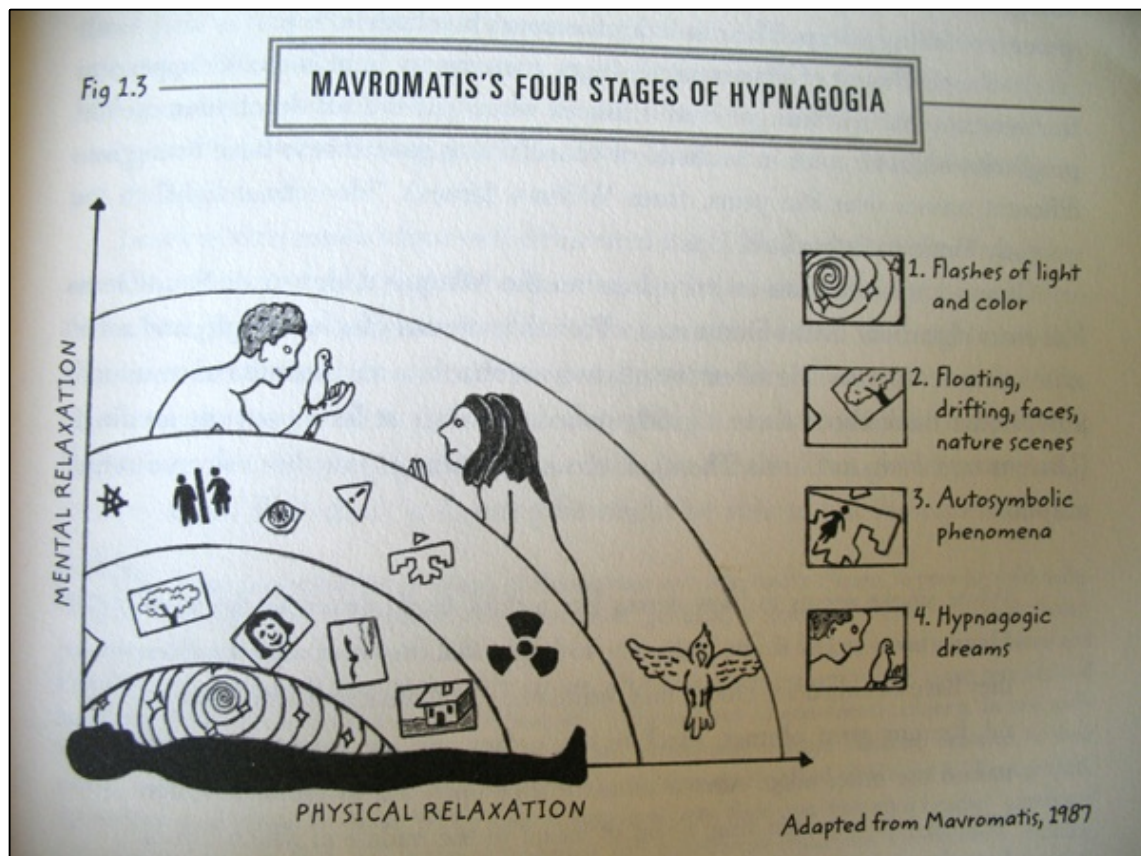
My next steps will be: to add a second potentiometer to control the frames individually, to use a strap to secure the glasses onto the head so they don't fall off, to find a slider potentiometer instead of the current knob type one so that the slider can be attached to the side panels which I added to the glasses frame, and eventually to solder components into one complete product, which one can simply place onto ones head, without all the wires. This would mean getting a board made to replace the Arduino, finding a good place to hang the battery and designing a physical interface on the glasses themselves. I envision sliders on the side to change frequency and a micro controller board attached to the strap at the rear of the wearers head, along with the battery. Will also next try adding artificial light to the glasses (E.g Bright LEDS)

Video Documentation: <http://youtu.be/bmfWK6aJ0ro>



NOTES

1. Past: '*Chapel of Extreme Experiences*' - A Short History of Stroboscopic light and the Dream Machine. John Geiger. (2003) Soft skull Press
2. Present: Lucia N°03 website: www.gesund-im-licht.at
3. '*Hypnagogia*' - The unique states of consciousness between wakefulness and sleep. Andreas Mavromatis. (1987) Routledge & Kegan Paul Ltd
4. www.en.wikipedia.org/wiki/Dimethyltryptamine



Transparent Resin Brain Hemisphere. (2012) Sebastian Kaye