

Memory Lab

By

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Memory Lab

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Abstract

Memory Lab is a small lab that allows individuals to create their own scents from their earliest memories. Proust Phenomenon, a well-known theory, which proposes that distinctive smells have more power than any other sensation to help us to recall distant memories. *Memory Lab* takes the inverse approach; it transforms one's early memories into a scent, and save it. Life starts the moment we have a memory, which is the source of our life. Memory defines who we are and the experiences we have had. Our earliest memories are very important to us. Although it happened a long time ago, it symbolizes the new birth of our spiritual life. This project will help people to remember deeply their earliest memories by the scents they create.

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A special thanks to my family. Words can not express how grateful I am to my mother, and father for all of the sacrifices that they've made on my behalf. Thank them for supporting me for everything, and especially I can't thank them enough for encouraging me throughout this project.

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CHAPTER 1

INTRODUCTION

We shall have to wait and see if our life ends with memory loss; what is certain is that it starts with it.(Draaisma,15)

Our memory has a will of its own. We can not choose what we want to forget. If only we had never seen something, experienced something, and heard something. Our memories take notice of it. From the moment we are born, we have memory, and we start to have a life. “Memory is like a dog that lies down where it pleases” (Draaisma,1). It can retrieve what we have and find where we started.

When I consider how to define myself, it is usually through experiences that I have had. It shapes my personality, and what is in my life. It includes obvious things like my gender, my nationality, my culture and my beliefs. All of these characteristics are the building blocks of my memories, and helps me to construct my ‘self’. The self is created from a combination of every type of memory. I would not be myself without the facts I know, the things I know how to do, and the events I can recall. They are all me. Maybe I can still have a personality, if some of my memories are missing, but I still have those experiences I have had, even if I have forgotten them. Those memories have been deeply inserted in my body and blood. I am only what my memories have retained.

As we grow up, we will lose some memories, but we will retain our earliest memories. We will often recall them without any reason. Most people date their first memories back to somewhere between the ages of two and four. These are snatches of independent and disconnected images. Not only are they not preceded

by anything, often nothing follows them for a long time either. We do not know why we still remember them or why we did not lose them. However, smell can help us recall our involuntary memory. It can trigger memory effectively.

Smell and taste are now understood to be common priming sources of involuntary memory, bringing us back to the original event. It was in *In Search of Lost Time* that Proust described his childhood pleasure of eating the small French cookie dipped in linden tea:

And as soon as I had recognized the taste of the piece of Madeleine soaked in her decoction of lime-blossom which my aunt used to give me (although I did not yet know and must long postpone the discovery of why this memory made me so happy) immediately the old grey house upon the street, where her room was, rose up like a stage set to attach itself to the little pavilion opening on to the garden which had been built out behind it for my parents (the isolated segment which until that moment had been all that I could see); and with the house the town, from morning to night and in all weathers, the Square where I used to be sent before lunch, the streets along which I used to run errands, the country roads we took when it was fine. (Proust, 64)

Marcel Proust, one of the greatest novelists of all time, is also known for his extraordinary skills in analyzing the forms and psychological mechanisms of memory. His main novel, *In Search of Lost Time*, emphasizes the importance of what

he called “involuntary memory,” which is deeply associated with emotions. He describes a character who vividly recalls long-forgotten memories from his childhood after smelling a tea-soaked biscuit. This suggests that distinctive smells have more power than any other sensation to help us recall distant memories. Moreover, some psychologists (M. J. de Brujin of Tilburg University and John J. Downes of The University of Liverpool) have argued that the special impact of odors on our memory could be related to the proximity of our olfactory bulb, which helps us process smells, to the amygdala and hippocampus brain regions, which control our emotions and memories.

CHAPTER 2

INFLUENCES AND RESEARCH

Taste My Memories (2017)



Figure 1: Xinyan Wang, Taste My Memories, 2017

In my artistic practice, I often find inspiration from my inner feeling, my life and my perception of the world. The body of my thesis project *Memory Lab* is strongly influence by the life I experienced in US (2017-2018), which was recorded in my diary.

Taste My Memory (fig.1) is a project in which I transfer my sad memories into sour flavors. It is based on the writings in my diaries over 30 months, beginning in 2015. When I am experiencing strong feelings or have questions about myself, I would write down my thoughts. Most of the days I wrote in my diary, I was depressed

and sad, so the writings are my secret and deep inner thoughts: a recording of all of my unhappy emotions.

For this project, I transferred my memories into flavors that the participants are allowed to drink. By analyzing the amount of days I wrote in my diary per month during a year, I made enough juice for the 2016 diary using the same percentage breakdown. The water represents how many days there are in each month, and the juice represents how many days I actually wrote in the diary. The total is 200 grams. How sour the flavor is depends on the amount of days I wrote in my diary that month. It fluctuates.

Taste My Memories is a very personal project. It is the source of inspiration for my thesis project, *Memory Lab*. Because *Taste My Memories* is a record of my private feelings and emotions, I would like thesis project to be public so that as many people as possible can interact with my work and generate their own symbols.

The Smell of Fear (2005)



Figure 2: Sissel Tolaas, The Smell of Fear-01, 2005



Figure 3: Sissel Tolaas, The Smell of Fear-02, 2005

The Smell of Fear (2005) by Sissel Tolaas (fig.2 and fig.3) collects the bodily smells of 9 men when they are afraid: mostly their sweat. Artists and scientists have worked for more than five years carefully collecting the samples, and chemically mimicking and accurately testing them. In the exhibition space, the walls are covered with vertical stripes of slightly tinted paints that have been impregnated with the aromas of the respective men. There are more variations of fragrances than

one might expect. One man smells of salted and buttered popcorn, another man thinks it is baby powder and musk. To some people the body smells like sweet fruit, cilantro, or dusty meat (Thomas, par.4). In her statement about her work, Tolaas refers to the “aesthetic” of smells as pleasant or unpleasant. Each person produces the visceral displeasure one might psychologically associate with their body odor.

Animals can smell fear, which is primal. It is an involuntarily expression of altering body chemistry. We as humans may no longer be able to smell fear, but the colloquialism remains because our body odors are a means of invisible and inaudible communication. Despite the blank white walls, Tolaas’ installation implicates a kind of intimate relation between the participants and these unknown body odors. Participation requires a kind of sensual engagement: rubbing the walls, pressing one’s nose up to the wall’s surface, activating our haptic sense. The walls become patinated with the collected connection of the public. The sensory experience is more subtle and visceral than any kind of visual experience because the scent is a permeable neurotransmission of the human body. And so the abstraction of fear and others’ bodies are no longer such an abstraction, as we take in this disembodied body of scent and imagine the other through our senses.

This project inspired me the relationship between smell and emotion. Then I started to search some theories that can connect smell and memories. Finally, I fund the Proust Phenomenon.

CHAPTER 3

ISSUES OF CONTENT

What is *Memory Lab*?

Memory lab is a place where individuals are allowed to create their own scents from their earliest memories. At first, the lab technician will help the participant to equip a MindWave headset and a earphone. An audio guide with 6 Hz (Theta wave) background music in their earphones will help the participant recall their earliest memory peacefully. The participant will follow the audio guide and recall their earliest memory within two minutes. Meanwhile, the MindWave headset is reading eight frequency range brainwaves data streams from the participant. The eight frequency range brainwave data stream will activate eight dosing pumps (fig. 4). The eight frequency range brainwave data stream are mapped to the speed of eight dosing pumps. One frequency range brainwave data stream controls one dosing pump. Depending on the brainwaves data of the participant, eight liquid-based pre-made scents will flow out via the 8 pumps in different doses. Finally the eight pre-made scents are mixed together and flow into a beaker. The lab technician will separate the scent the participant has created into two perfume bottles. One is for the Memory Lab Library, and the other is for the participant.



Figure 4: Dosing Pump

Brainwave and emotions

A brainwave is how we describe the various states of electrical activity known as a brainwave pattern. Depending on what we may be doing or experiencing, our brainwaves will vary. For example, the waves are different when we are awake compared to when we are sleeping and when we are exciting. Sensitive equipment called an EEG is used to measure brainwave activity. For my thesis project, I used NeuroSky's MindWave (fig.5 and fig.6) to detect the brainwave data. MindWave is a Brain-Computer Interface (BCI) device, which turns your brainwaves into activity, and unlocks new worlds of interactivity. The MindWave reports the wearer's mental state in the form of NeuroSky's proprietary Attention and Meditation eSenseTM algorithms, along with raw wave and information about the brainwave frequency bands (NeuroSky,3).



Figure 5: The front of MindWave

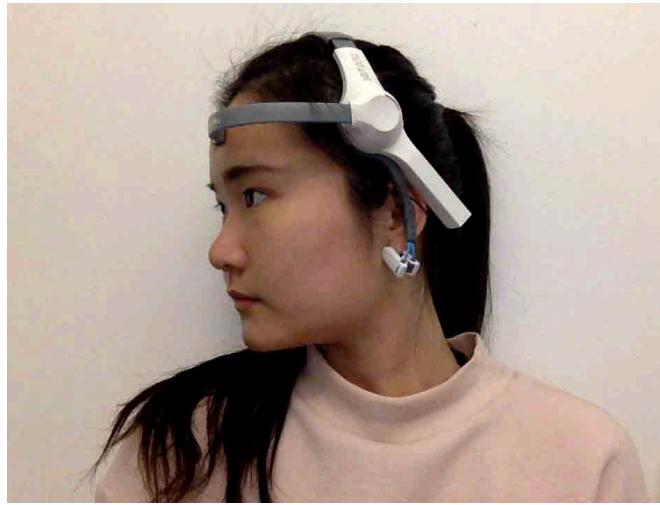


Figure 6: The side of MindWave

Hz is the abbreviation for hertz. This is the unit used to measure frequency. It is defined as one cycle per second — the higher the Hz the faster the brainwave activity. The table (table 1) gives a general synopsis of some of the commonly-recognized frequencies (NeuroSky, 13) that tend to be generated by different types of activity in the brain:

Brainwave Type	Frequency range	Mental states and conditions
Delta	0.1Hz to 3Hz	Deep, dreamless sleep, non-REM sleep, unconscious
Theta	4Hz to 7Hz	Intuitive, creative, recall, fantasy, imaginary, dream
Alpha	8Hz to 12Hz	Relaxed, but not drowsy, tranquil, conscious
Low Beta	12Hz to 15Hz	Formerly SMR, relaxed yet focused, integrated
Midrange Beta	16Hz to 20Hz	Thinking, aware of self and surroundings
High Beta	21Hz to 30Hz	Alertness, agitation
Gamma	30Hz to 90Hz	formation of new ideas, learning something new, processing large amounts of information

Table 1: Brainwave type and mental states (NeuroSky, 13)

In the *Memory Lab*, I collected 8 frequency ranges of brainwave data of the participant: Delta, Theta, Low alpha, High alpha, Low beta, High Beta, Low gamma, High gamma. This covers all frequency ranges of the brainwaves in order to analyze as many details of how the participant felt as I could.

Emotions play an important role in everyone's life. "The term 'emotion' has been derived from the Latin word 'emovere' which -means 'to move', 'to excite', 'to stirrup', or 'to agitate'(Ashtaputre, 1)." The brainwaves can tell us the difference in the emotions the person is going through. "Through energy signal estimation of EEG on Delta, Theta, Alpha, Beta, and Gamma wave with parameter extraction given with time features it can then use on emotion parameters, including voice, facial expression, body movement and other parameter integration, thus effectively enhancing the accuracy of emotion differentiation. (Tsai, 5)" Therefore, by analyzing the 8 frequency range brainwaves data of participant, *Memory Lab* knows what basic status participants have when they are recalling.

The pre-made scents

An odor, odour or fragrance is caused by one or more volatilized chemical compounds, generally at a very low concentration, that humans or other animals perceive by the sense of olfaction. Odors are also commonly called scents, which can refer to both pleasant and unpleasant odors. The terms fragrance and aroma are used primarily by the food and cosmetic industry to describe a pleasant odor, and are sometimes used to refer to perfumes, and to describe floral scent. (Spectrum)

The pre-made scents of *Memory Lab* are very close to those we experience in our daily life, but few people notice. I collected the ingredients (fig.7) from things in my life, then distilled them to create the respective scents. The ingredients I collected are lemon, mint, lavender, ocean, earth, regular leaves, unknown flower petals, tree branches, roots, rain, snow, glass, print ink, pen ink, toilet paper, and so on. There are 56 scents in total (Table. 2). The exhibition will last 7 days; eight different scents will be presented each day. Each day, the participants will produce their own unique scents. Finally the Memory Lab Library will collect the various scents.

	Delta	Theta	Low Alpha	High Alpha	Low Beta	High Beta	Low Gamma	High Gamma
Day1	lemon	mint	lavendar	orange	petals1	branches	roots	rain
Day2	snow	earth	leaves1	petals2	print ink	lemonglass	paper	clothes
Day3	peanut	seed1	petals3	hair	ocean	toilet paper	sand	pen ink
Day4	shampoo	ink	seed2	leaves2	glass	petals4	tea tree	green tea
Day5	hibiscus	rose	leaves3	rock	petals5	black tea	skin	apple
Day6	ginger	onion	petals6	garlic	carror	leaves4	dusk	chotolate
Day7	petals7	suger	pear	leaves5	chamomile	chrysanthemum	coffee	metal

Table 2: The ingredients of scents for 7 days



Figure 7: The ingredients of scents

Our earliest memories are the source of our life. They symbolize the new birth of our spiritual life, so I started to consider what scents could represent “the beginning” and “the source.” I try to find the answer in the place I live. When we recall our earliest memories, a scent or an image appears in our mind that is familiar

to us. What are the things that are familia? We are familiar with the smell of print ink when we are reading. We are familiar with our home when we smell the odor of our clothes and quilt. We are familiar with the street, the smell the trees on our block. I began to collect objects and different things with smell around me. We often do not notice them because they are already a part of us. It is like our earliest memories. We do not remember what they are unless we recall them on purpose. Our earliest memories have already seeped in our blood.

CHAPTER 4

AESTHETIC ISSUES

Audio Guide

According to meditation principle, the audio guide uses sound to depict a scene of the participant's earliest memory. This allows the participant to travel through time and space to arrive at their earliest memories. The audio guide helps the participant to focus their mind on a particular object, thought or activity to achieve a mentally clear and emotionally calm state. The earphone I use for the audio guide is a Bose Noise Canceling Earphone (fig.8). It decreases the outside noise as much as possible and the level of noise canceling can be controlled by APP QC30 (fig.9). The QC30s let you dial in how much of the outside world you want to hear. By creating a quiet and isolated environment, this earphone allow participants to focus on what they are recalling effectively.



Figure 8: Bose noise cancelling headphones

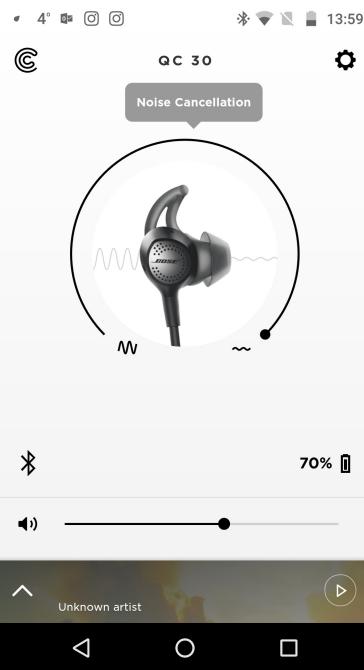


Figure 9: Bose noise control

On the audio, there is a soft female voice saying, “Welcome to *Memory Lab*. This is a lab where you can transfer your earliest memory to a scent. Now close your eyes. Breath deeply and relax. Breath in. Breath out. Recall your earliest memory. Imagine you are moving through time and space. You are traveling to your earliest memory. Here comes a scene. Where are you? What does the scene look like? How old are you? What are you doing? Who are you with? How do you feel? Are you happy or sad? Keep breathing. Breath in. Breath out. Slowly open your eyes and come back to reality. Thank you for your participation.”

The background music (*Magnetic Minds*) consists of Binaural Beats. It contains 6 Hz (Theta), which is associated with long-term memory stimulation. Base frequencies of the left channel is 144 Hz and the right channel is 138 Hz. "Binaural Beats" is a term used when one plays one sound frequency in one ear, and another

sound frequency in the opposite ear, creating a two-tone effect in the mid-brain that is actually perceived as one tone. This causes an "entrainment" effect in the brain that has a variety of results depending on the frequency.

Memory Lab Appearance



Figure 10: Memory Lab table



Figure 11: Memory Lab Library

Memory Lab really builds a lab in the gallery. It is set in a corner and consists of two parts: the Memory Lab table (fig.10) and the Memory Lab Library (fig.11). The Memory Lab table is an operating area where the lab technician stays and helps participants to collect the scents they have created from their earliest memories. The Memory Lab Library is a collection of all the participants' scents, which are hung on the window. The scents are placed in order of the date and time the participants recalled their memories. Every single scent is placed in a plastic bag with an

information label inside (fig.12). The label has three basic information about the participants: name, date of first memory, and date recalled. When the participants finish their recollection, they write their information on these labels. With the information on the label, no matter who the scent is for - the participants or the Memory Lab Library - it is saved and collected for a long time. That is what I really hope the participants will do.



Figure 12: The front and back of information label

The Memory Lab table is at the front wall of corner and Memory Lab Library is at the side of corner, which is also a window display and open to public street. When pedestrians cross the road, they can see the Memory Lab Library from outside gallery. There are 8 transparent liquid-base scents hanged from the ceiling. Every scent is attached with the ingredients of the scents and its name (fig.13). In the middle of the table, there is a long tube from the ceiling, which goes into a beaker. This is the way all of the scents come together. The beaker is finally where the

scents are contained. The tube is mounted on a lab stand, which can stabilize the long tube without it wiggling (fig.14). This makes the participants feel as if they are really doing an experiment.

In addition, a transparent drawer with 300 brown perfume bottles inside, and a tray with plastic bags and information labels are placed on the table (fig.15). They are placed orderly; most of them transparent. The *Memory Lab* should be a clean and quiet place. In order to avoid the visual color being too pale, some small objects are colored brown and gold. For example, the perfume bottles, the Memory Lab table, and the stool are all brown. While the information labels, the label with the names of the ingredients and the pen for writing the basic information are golden.



Figure 13: Ingredients of the scents and its name



Figure 14: Tube and beaker



Figure 15: Transparent stuffs on the Memory Lab table

Participants will sit in front of the scents to recall their earliest memories. When they are doing so, the 8 pumps will be activated in pairs based on the question from the audio guide given. More specifically, the nth question will activate the nth and the $(n+1)$ -th pumps. For example, the first question will activate the first and second pumps. The second question will activate the second and third pumps. At the beginning, there are only a few drops from the tube. The more questions appear, the drops will become a flow. When the audio end, they will become drops again.

The logo of *Memory Lab*

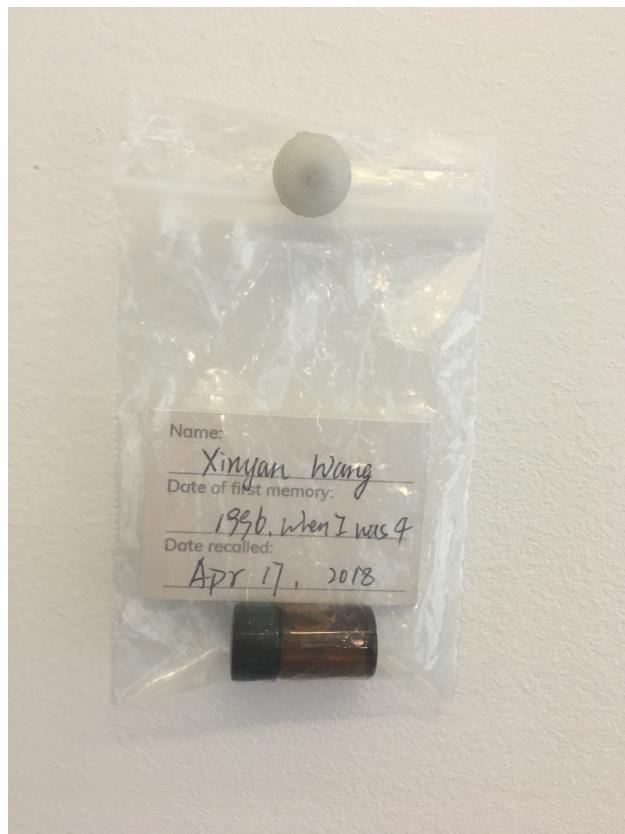


Figure 16: Perfume bottle

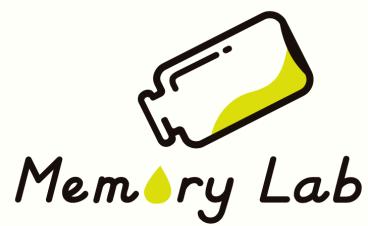


Figure 17: Memory Lab logo

From an aesthetic perspective, the most impressive thing in Memory Lab is the bottle that both participants and *Memory Lab* will collect, so I decided to use a perfume bottle (fig. 16) as the logo of the *Memory Lab* (fig.17). The perfume bottle is above the letter “Memory Lab.” It has liquid-based scents inside. One drop of scent is obliquely flowing from the bottle. The drop replaces the “o” in the word “Memory,” which symbolizes the bottle is storing our memories. The logo is drawn by strokes and font is handwriting style. I hope it is a elegant, light and handy graphic. The color of the bottle lines is brown, which matches the color of a real perfume bottle. While the color of the liquid is golden. It matches the color of the label. Visually, all of the logo elements are refined based on the look of the *Memory Lab*.

CHAPTER 4

TECHNICAL ISSUES

Distillation

Distillation is used to separate mixtures of liquids by exploiting differences in the boiling points of the different components. Distillation may result in essentially complete separation (nearly pure components), or it may be a partial separation that increases the concentration of selected components of the mixture. The technique is widely used in the industry; for example in the manufacture and purification of nitrogen, oxygen and rare gases.

For *Memory Lab*, I distill plants to create essential oils in order to derive scents. Essential Oils are not made, but instead, they are extracted from plant materials. Extractions are used to obtain a plant's active botanical constituents that function as its "life force." The idea of distilling oils and the invention of steam distillation was started by Arabian alchemist, Ibn Sina. I am greatly indebted to his innovation because it allowed me to distill essential oils on my own.

There are three primary components (fig.18) that make up an essential oil distiller:

1. Steam Generator: This provides the heat source, which helps to boil the water one uses, and produces the steam needed to release the volatile oils from the plant. It comes with a chamber that holds the plant material, and where the steam makes its way and builds an oil-steam mixture.

2. Condenser: Once an oil-steam mixture is produced, it passes into the condenser where it can be turned into a liquid substance, creating an oil-water mixture this time out.
3. Separator (fig.19): This is the final step during the distillation of essential oils. Since oil is much denser than water, separating them should be really easy. The oils will rise above the steam water in the Separator (Theresa, 3).

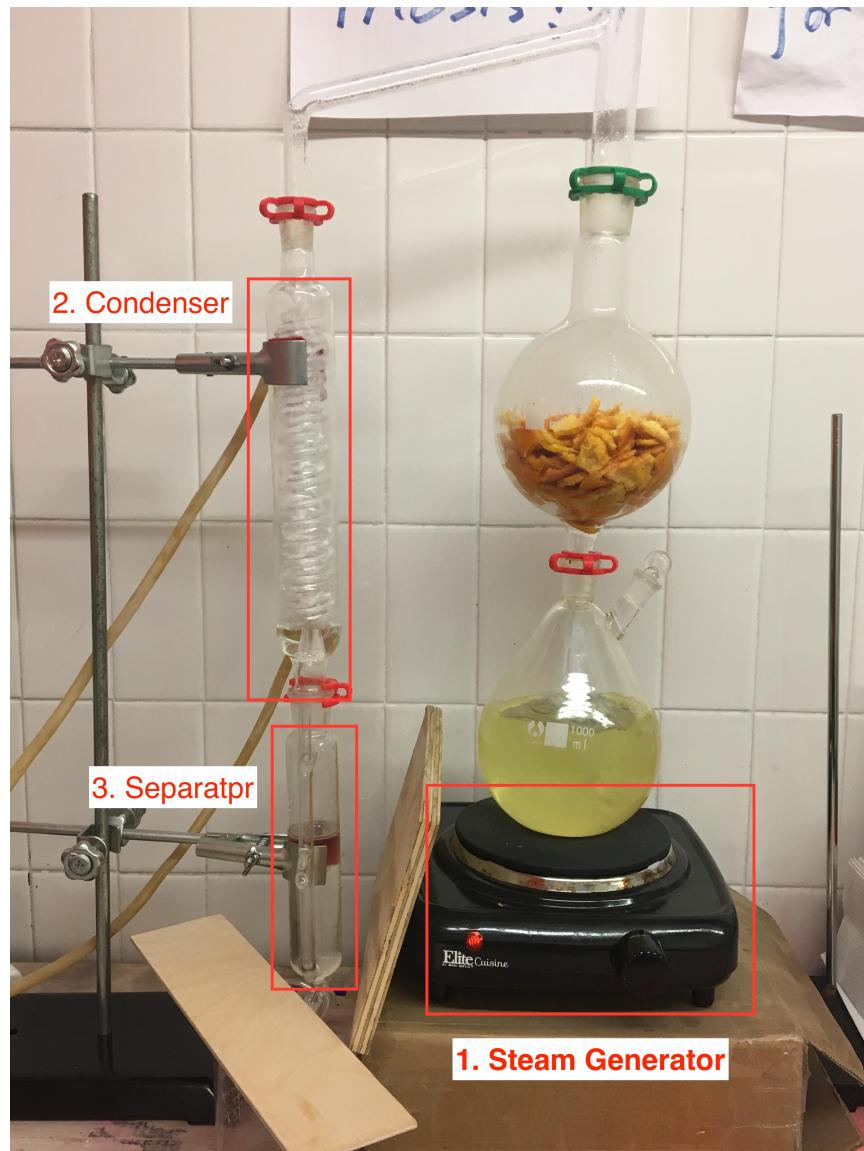


Figure 18: Essential oil distiller



Figure 19: Separator

The method works with the use of steam. Begin by putting the plant material in a still and placing it on top of a heat source. As the heat builds up and the temperature increases, it will eventually produce steam and increase the pressure inside the still. These elements help in forcing the molecules of the plant to open up and be released in vapor form. Soon after the steam is produced, it will move into the condenser. This part of the steam distillation process helps the vapor to return to liquid form. At this point, the liquid substance is the essential oil produced from the plant material.

Because some of my ingredients are not plants, they do not have any oil inside. However, the distillation still collect scents from the steam water, so some of the scents are not oil based, but liquid based.

Programming Flow chart

I used Processing, Arduino and Max/MSP/Jitter to do the programming. The library I used for Processing is MindSet Processing version 0.1.2 (2) created by Jorge C. S. Cardoso, which allows users to use the NeuroSky Mindset brainwave sensing headset with Processing. It gives one access to the raw wave values, to the eSense meters (Attention and Meditation), and to the EEG values (fig. 20). This library was implemented using the Think Gear Communications driver J2ME implementation provided in the Mindset Development Tools 2.1 (Cardoso, par.2).

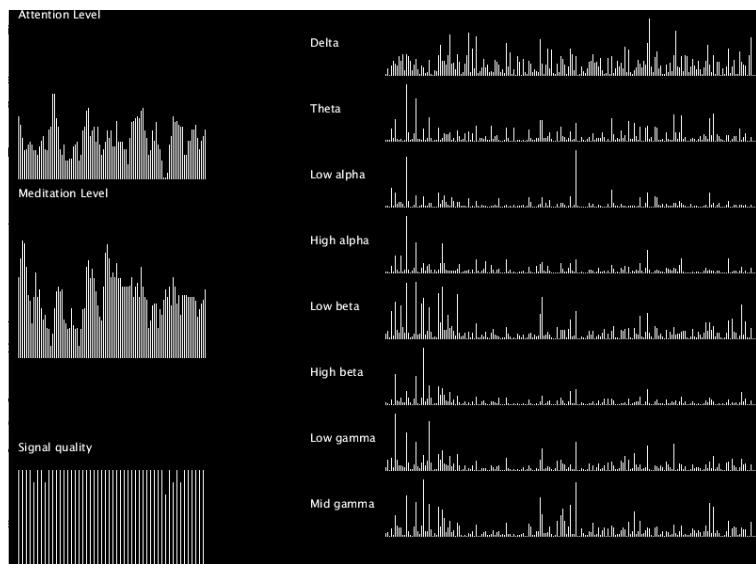


Figure 20: Brainwave data in Processing

This picture (fig.21) shows the programming process. The MindWave headset first reads and sends the participant's brainwave signal to Processing, which encodes the signal to OSC-standard data. These OSC data are then streamed into the Maxuino module to program the Arduino board. The programmed Arduino board

controls the voltage of the L2N98 H-bridge, and in turn controls the extent to which the pumps are pushed.

The OSC data (fig.22) are represented by a string of numbers in the Maxuino, and the mapping between the numbers and the L2N98 H-bridge voltages is prescribed by the artist in such a way that the more frequently a piece of brainwave appears, the less pushed the corresponding pump is.

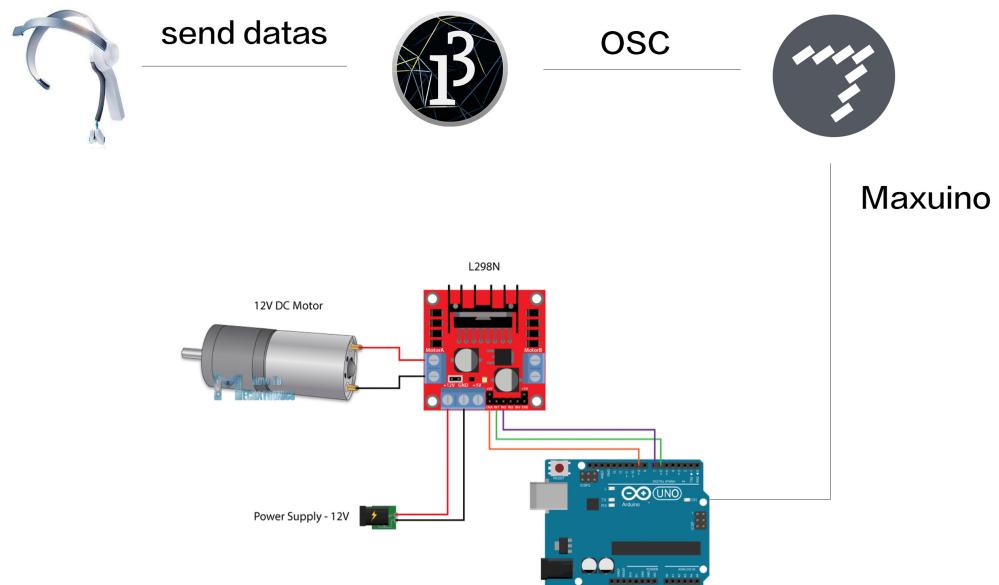


Figure 21: Programming flow chart

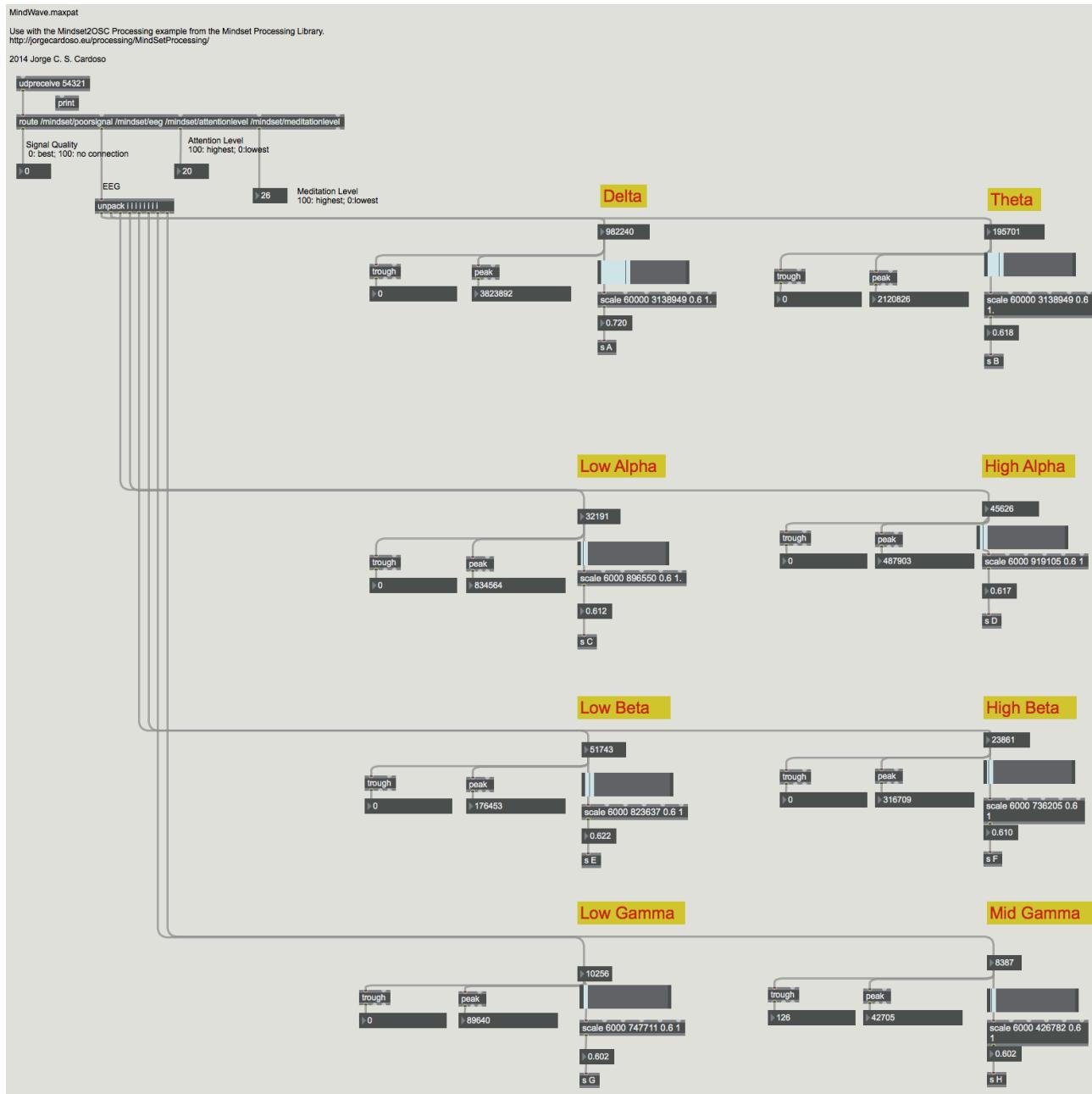


Figure 22: MindWave data in Max/MSP

CHAPTER 5

CONCLUSION

With the creation of *Memory Lab*, I hoped to address the idea of saving one's earliest memories through scents. According to the Proust Phenomenon, scents can trigger distant memories. I want to enable people to create their own scents and use them to trigger their earliest memories.

Instead of thinking of *Memory Lab* as a piece of interactive artwork, it would be fairer to say that it is a station that collects and reproduces our earliest memories. Currently, few artworks use the sense of smell as a medium for expressing ideas. As a graduate student in interactive arts, I wanted to do something to break the common practice.

Interactive art can access all of human senses: hearing, seeing, touching, tasting and smelling. *Memory Lab* involved smell to create an artwork. It was a challenge to use scent as a medium, because smell is the least sensitive of our five senses. Another challenge was that the interaction with the participants was not physical, but mental.

How the user experience is designed, and what action triggers the interaction play an important role in interactive art. I consider the interaction as connection with the world. People need a connection with the world, and the strongest connection is emotional connection, which can touch one's deep inner feelings powerfully. However, memories are the gifts that the world gives us. Recalling our memories is the closest connection one has with the past. Therefore, when people interact with my artwork, they are actually communicating with themselves in the past. The

interaction has a psychological connection and emotional resonance with the participants, so they will really save the scent for a long time.

I believe *Memory Lab* will expand people's horizons, and present more possibilities of interaction to the public. I hope *Memory Lab* is not an artwork that is only shown in a gallery, but also can be presented in a variety of public and commercial spaces.

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