Hint

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Design for Aging
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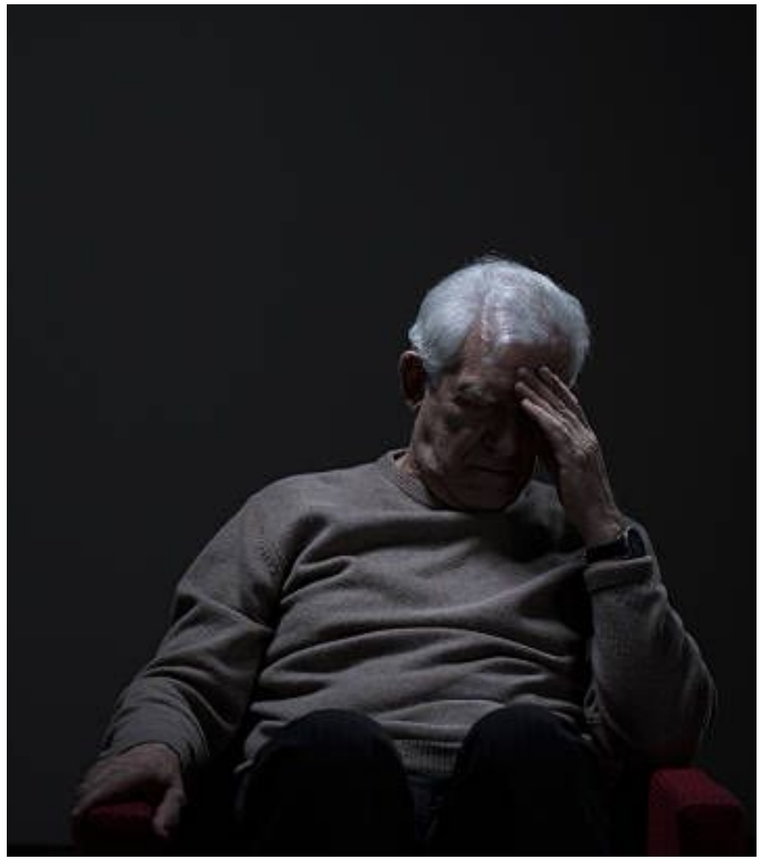
Professor Ignacio Urbina Polo

Introduction

The Spring 2021 capstone studio Design and Aging, taught by Professor Ignacio Urbina Polo, explored opportunities at the intersection of health and design for the aging and elderly population in a way that is accepting of their challenges and considerate to their needs.



Topic Research

Overview

One of the first noticeable signs of aging is sensory loss, which greatly impacts the way the elderly experience and interact with the world. Despite being a shared natural experience, sensory loss is a common source of isolation, depression, and anxiety. Sight, touch and hearing are the three senses that directly impact communication and when diminished can disrupt established routines, lifestyles, activities and relationships. Each of these three senses are affected in different ways, of which sight and hearing are the most severe.[1]

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[1] Aging changes in the senses. (n.d.). Retrieved May 10, 2021, from https://medlineplus.gov/ency/article/004013.htm#:~:text=As%20you%20age%2C%20the%20way,for%20you%20to%20notice%20details.

Sight

The cornea and lens are the structures within the eye that are primarily responsible for vision. The cornea and lens work together in the eye to focus the light reflected from the environment onto the retina by being relaxed or constricted in a process called accomodation. Objects that are closer reflect more light and the eye must flex more to allow all of the light in.[2] Aging causes the structures and muscles within and around the eye to change, becoming less sensitive, flexible, and responsive to light. These changes lead to a series of visual deficiencies.[3]

A decline in visual acuity is known as presbyopia, or aging eyes. It is a natural condition in which the eyes gradually lose their ability to focus and develop nearsightedness, becoming noticeable to the elderly starting in their mid-forties and continuing to worsen until their late-sixties. Presbyopia occurs when the lens hardens due to old age. This prevents the lens from being able to curve and allow in enough light to view close objects clearly.

Aging also changes the eye's perception of color contrast, losing sensitivity to differences in cool shades, specifically blue and green. This phenomenon is a result of the yellowing and clouding of the lens over time, gradually giving the effect of constantly wearing a yellow filter. As this change occurs slowly, it becomes difficult for the mind to determine the true hue of colors and mainly affects blue-yellow vision. In a study conducted by the Smith-Kettlewell Eye Research Institute, it was shown that blue-yellow spectrum color vision issues were present in 45% of people in their mid-70s and over 67% of those in their mid-90s. However, although the color perception of cool shades was disrupted, the perception of warm shades by elderly does not seem to be affected. Instead, it has been shown that warm red to yellow lighting is able to increase contrast perception for the elderly, especially in low light scenarios.[4] In addition to visual acuity and color perception, aging further decreases the visual field by reducing peripheral vision and decreases the acceptable tolerance of light making the elderly more sensitive to glare and have difficulty seeing in low light.

[2] Okpe, O. (2020, August 31). Accommodation. Retrieved May 10, 2021, from https://www.kenhub.com/en/library/anatomy/accommodation

[3] Common Age-Related Eye Problems. (n.d.). Retrieved May 10, 2021, from https://my.clevelandclinic.org/health/articles/8567-common-age-related-eye-problems

[4] Dotinga, R. (2014, March 18). Color Vision Tends to Fade With Age: Study. Retrieved May 10, 2021, from https://www.webmd.com/healthy-aging/news/20140318/color-vision-tends-to-fade-with-age-study#1

Hearing

Nearly half of all those over 65 years old and over two thirds of those over the age of 70 have some degree of hearing loss.[5] Similar to the eye, as aging occurs, structures within the ear begin to change. Hearing occurs when sound waves enter the ear and reach the eardrum. Sound waves cause the eardrum to vibrate setting off a chain reaction of rippling in the middle ear. As the ear ripples, small hair cells inside the ear follow this movement and bend, creating an electric signal sent to the brain and is interpreted as sound. Natural hearing loss is typically a combination of noise-induced hearing loss and age-related hearing loss.

Hair cells are damaged due to long term noise exposure, leading to noise-induced hearing loss. Hair cells are unable to repair or grow back after being damaged, so the loss of working hair cells greatly impacts hearing. Age-related hearing loss is called presbycusis and occurs due to a combination of circumstances. Aging causes changes in the structures of the inner ear, slows blood flow to the ear, impairs nerves, changes the way the brain processes speech and sound, and damages the hair cells. When hearing loss occurs, the ability to pick up frequencies diminishes, lowering the range of perceptible sounds, hear at lower volumes, and differentiate between different sounds.[6]

In addition to hearing sound, the inner ear is also responsible for balance. Balance is greatly affected by the ability to process auditory information as it reveals important information about the environment. A joint study by Mount Sinai and New York University's Steinhardt School of Culture found that hearing static background noise was essential to maintaining balance. Poor balance due to the lack of hearing is also often replicated in the deaf and by those wearing noise-cancelling headphones. Having poor balance from hearing loss puts the elderly at greater risk of falling.[7] Falling is the leading cause of death in the elderly. One in four of those 65 or older fall each year, with one in five falls causing serious injury. Major falls are dangerous and often fatal for the elderly. 12% of falls resulting in the need for hip replacement are the cause of death within the following year.[8]

[5] Aging changes in the senses. (n.d.)

[6] Age-Related Hearing Loss. (2020, December 14). Retrieved May 10, 2021, from https://www.nidcd.nih.gov/health/age-related-hearing-loss

[7] The Mount Sinai Hospital / Mount Sinai School of Medicine. (2020, March 12). Sound can directly affect balance and lead to risk of falling. Retrieved May 10, 2021, from https://www.sciencedaily.com/releases/2020/03/200312142303.htm

[8] Important facts about falls. (2017, February 10). Retrieved May 10, 2021, from https://www.cdc.gov/homeandrecreationalsafety/falls/adultfalls.html

Touch

70% of Americans over the age of 65 suffer from an impaired sense of touch. Nerve endings in the skin, muscles, tendons, joints, and organs are responsible for the sensations of pain, temperature, vibration, and position. The receptors in nerve endings transmit signals to the spinal cord that then is interpreted by the brain to process sensory information. Aging causes the threshold of sensitivity to decrease as a reduced blood flow disrupts the signal between receptors and the spinal cord. Other health factors like diabetes, nutrient deficiencies, and nerve damage can also affect sensation perception. Overall, the aging process reduces the feelings of pain, temperature, and pressure. However, as the skin thins due to old age, the elderly are simultaneously more sensitive to other sensations like light touch and vibration.[9]

[9] Aging changes in the senses. (n.d.)

Social Effects

Often undetected by caretakers, social workers, and the elderly themselves, vision loss is a leading cause of elderly depression. The loss of vision is positively proven to be linked to depression overall. For adults over the age of 20, a positive correlation was found between vision impairment and feelings of mild depressive symptoms. Those with visual acuity impairment were almost twice as likely to develop depressive symptoms as their counterparts without.[10] A study on monovision contacts also revealed that participants with normal vision reported a higher quality of life than those with presbyopia. The correction of presbyopia through monovision correction showed some improvements for those with presbyopia in their quality of life, however, this improvement was still significantly less than the base quality of life for those with normal vision.[11] Many of those with presbyopia leave their condition untreated or incorrectly treated. Some of the most common reasons people with presbyopia leave their condition uncorrected even when they have the means to get help are underestimating the impact of decreased vision on daily activity and the lack of motivation to improve quality of life.[12] The current development of the economy and society further puts emphasis on activities that require near vision that is difficult for those with presbyopia, making it easier for them to feel out of touch with society and more difficult to feel useful or productive.[13] This loss of autonomy is a constant reminder of their advancing age, giving rise to feelings of becoming a burden to loved ones and being left behind in the times, further reinforced by the difficulty in functioning without help and may feel isolated as they have difficulty recognizing faces and environments.

The loss of hearing is a large factor of elderly isolation. In addition to presenting a barrier to verbal communication, age-related hearing loss is positively associated with Alzheimer's and a general cognitive decline.[14] This mental atrophy contributes to social aversion that makes the elderly more at risk of developing dementia as well. According to a study by The National Council on the Aging, those with untreated hearing loss reported high levels of depression, anxiety, and paranoia.[15] They were less likely to participate in social events compared to counterparts wearing hearing aids. Compared to hearing aid users, those with untreated hearing loss were 8% more likely to have depression for more than two weeks, 22% more likely to find others get mad at them for no reason, and 10% less likely to participate in regular social activity. While hearing aids are a common solution recommended for the elderly with proven benefits, studies show only one in seven Americans that need hearing aids actually use one with the most common reason being they did not think they needed one.[16]

The gradual loss of sight and hearing make the elderly rely on touch more heavily for communication. However, many elders suffer from social isolation. This makes the elderly at greater risk of developing touch deprivation. Research by the National Institutes of Health has found touch is an important communictor of emotions and is an integral part of maintaining relationships.[17] It activates the orbitofrontal cortex that is associated with emotions, social behavior, and learning and releases oxytocin, a hormone that reduces stress.[18] As touch is an important factor of emotional wellbeing, touch deprivation could result in mental health risks like depression, anxiety, and feelings of loneliness.

[10] Zhang, X., Bullard, K. M., Cotch, M. F., Wilson, M. R., Rovner, B. W., McGwin, G., Jr, Owsley, C., Barker, L., Crews, J. E., & Saaddine, J. B. (2013). Association between depression and functional vision loss in persons 20 years of age or older in the United States, NHANES 2005-2008. JAMA ophthalmology, 131(5), 573–581. https://doi.org/10.1001/jamaophthalmol.2013.2597.

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[13] Holden BA, Fricke TR, Ho SM, et al. (2008) Global Vision Impairment Due to Uncorrected Presbyopia. Arch Ophthalmol;126(12):1731–1739. doi:10.1001/archopht.126.12.1731.

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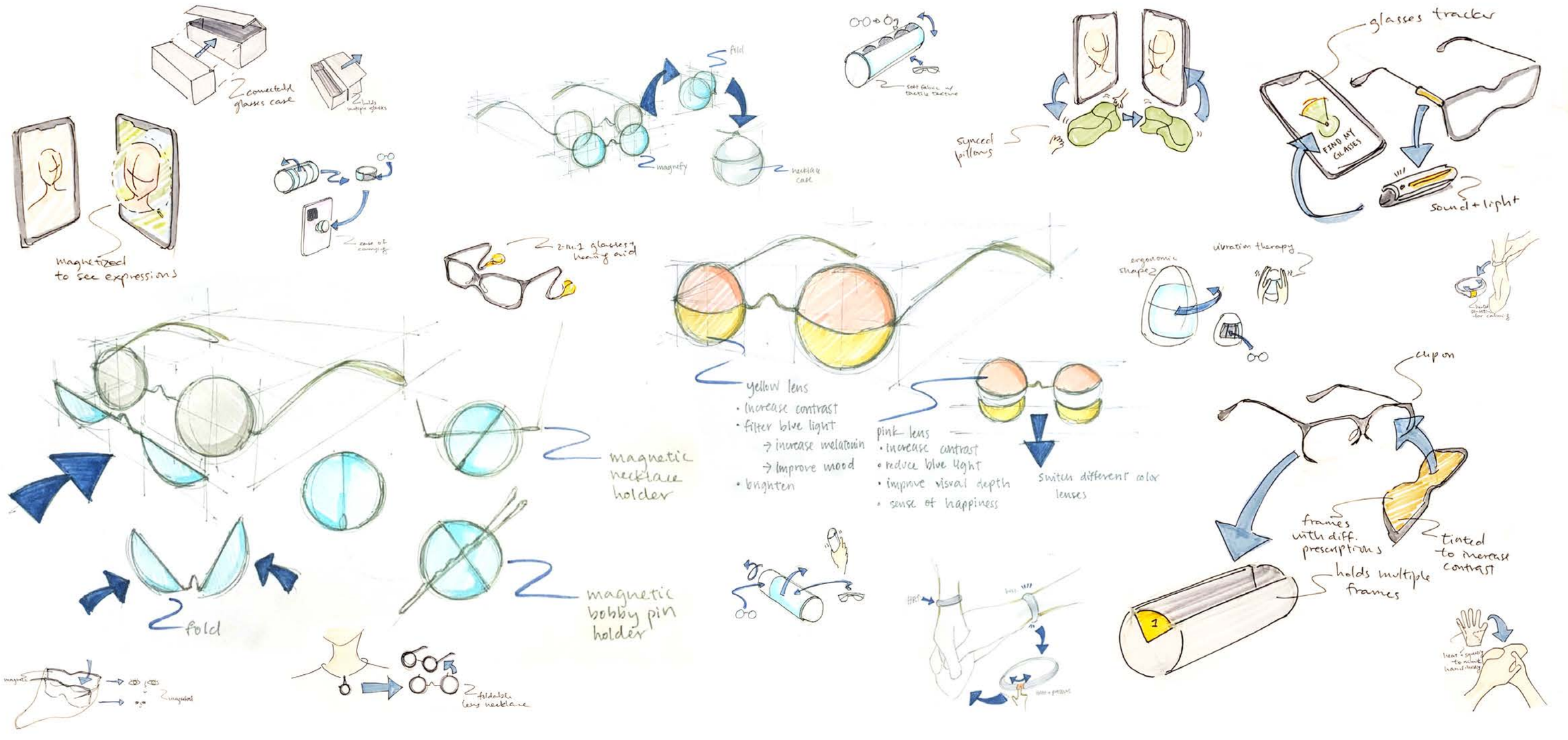
[17] Morales-Brown, L. (2021, January 19). What does it mean to be 'touch starved'? Retrieved May 10, 2021, from https://www.medicalnewstoday.com/articles/touch-starved#what-it-means

[18] The Power of Touch and What It Means for the Elderly. (2014, April 4). Retrieved May 10, 2021, from https://www.comfortkeepers.com/info-center/category/senior-care/article/the-power-of-touch-and-what-it-means-for-the-elderly

Ideation

Sketching

Preliminary ideation explored various elderly concerns surrounding the sensory loss of the three main communicating senses and a multitude of solutions. In consideration of the shared reluctance to integrate new or additional technology into their lifestyles by many elderly, most ideas focused on developing or adding onto existing aids. The solutions looked to combine various solutions to address multiple sensory loss concerns to maximize the use of a single product.



Prototyping

Several preliminary ideations were combined to generate the concept developed further through prototyping. The general concept will include a rose tinted lens that can attach to custom prescription glasses. They will come with a case that has a soothing exterior texture and will vibrate to the rhythm of a heartbeat.

Conceptual Research

Red Tinted Lenses

The concept addresses each of three communicating senses, and applies a solution to alleviate some of the mental and physical effects that arise from sensory loss.

Tinted lenses are able address several of the concerns faced by the elderly. In general, tinted lenses reduce glare and are able to block the blue light from electronics that suppress melatonin.[19] This decreases eye strain and damage, slowing the deterioration of the eyes during aging. Tinted lenses also minimize the appearance of fine lines and wrinkles around the eyes, giving the elderly a more youthful look. In particular, red lens tints are the most beneficial to the elderly. Red tinted lenses are able to increase the color contrast of blue and green hues, making it easier for the elderly that have difficulty with blue yellow vision to be able to see under low light conditions and have better color perception.[20] In addition to the physical benefits, wearing red tinted lenses is further good for mental health. The saying "looking through rose tinted glasses" is scientifically accurate, making wearers happier subconsciously. Color can have profound effects on mood. A study on the effects of various color tinted lenses showed that red tinted lenses produced the same effect as looking at positive images. Participants with red tinted lenses felt a boost in happiness and excitement that improved their mood and activity level.[21]

Embodied Cogntion

For touch, in addition to evoking emotions, textiles and haptics can influence the way people perceive the environment around them. This concept, embodied cognition, describes the phenomenon in which perception and behavior can be affected by objects and products in their environment. An example of embodied cognition at play in daily life was proven through a study examining the transferable effects of holding a hot drink. Participants of the study holding the drink were more likely to view strangers as warmer people, having more caring and generous first impressions than participants holding a cold drink.[22] In addition to embodied cognition, tactile feedback is significant to mental health as studies have shown that tactile sensation, rather than visual, is more effective to people when in a negative mood.[23] In particular, soft and smooth textures are comforting and can give a more positive attitude when being touched. In a study of thirteen varying materials, velvet and silk were shown to evoke the strongest sense of happiness.[24]

Heartbeat Vibration

While hearing loss prevents the transfer of sound to vibration in the ear canal, artificial vibrations can be felt to the touch outside of the ear and provide therapeutic effects to those suffering from hearing loss. Deaf individuals often describe how they are able to feel sound through vibrations. Although not as effective as a healthy ear canal, external vibrations are able to capture some of the benefits lost by reduced hearing. Whole body vibrational therapy has been proved to be able to improve balance for those who have reduced hearing capabilities and has achieved success in training deaf children to be able to walk. Haptic wearables are able to bring vibrational therapy to the daily life of those with impairments, helping patients get the necessary sensory information to be able to correct balance and posture.[25] In addition to physical therapy, vibrations are also used to boost mental health. Heartbeat-like vibrations during stressful situations are able to significantly calm heart rate and lower blood pressure.[26]

[19] Eldridge, M. (2017, November 09). How do you choose the best lens tint? Retrieved May 10, 2021, from https://blog.safetyglassesusa.com/how-do-you-choose-the-best-lens-tint/

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[22] Chillot, R. (2013, March 11). Surface impact. Retrieved May 10, 2021, from https://www.psychologytoday.com/gb/articles/201303/surface-impact

[23] Animal instincts: Why do unhappy consumers prefer tactile sensations? (2011, June 16). Retrieved May 10, 2021, from https://www.sciencedaily.com/releases/2011/06/110615120250.htm

[24] Iosifyan, M., & Korolkova, O. A. (2019, April). Emotions associated with different textures during touch. Retrieved May 10, 2021, from https://www.researchgate.net/publication/332564189_Emotions_associated_with_different_textures_during_touch

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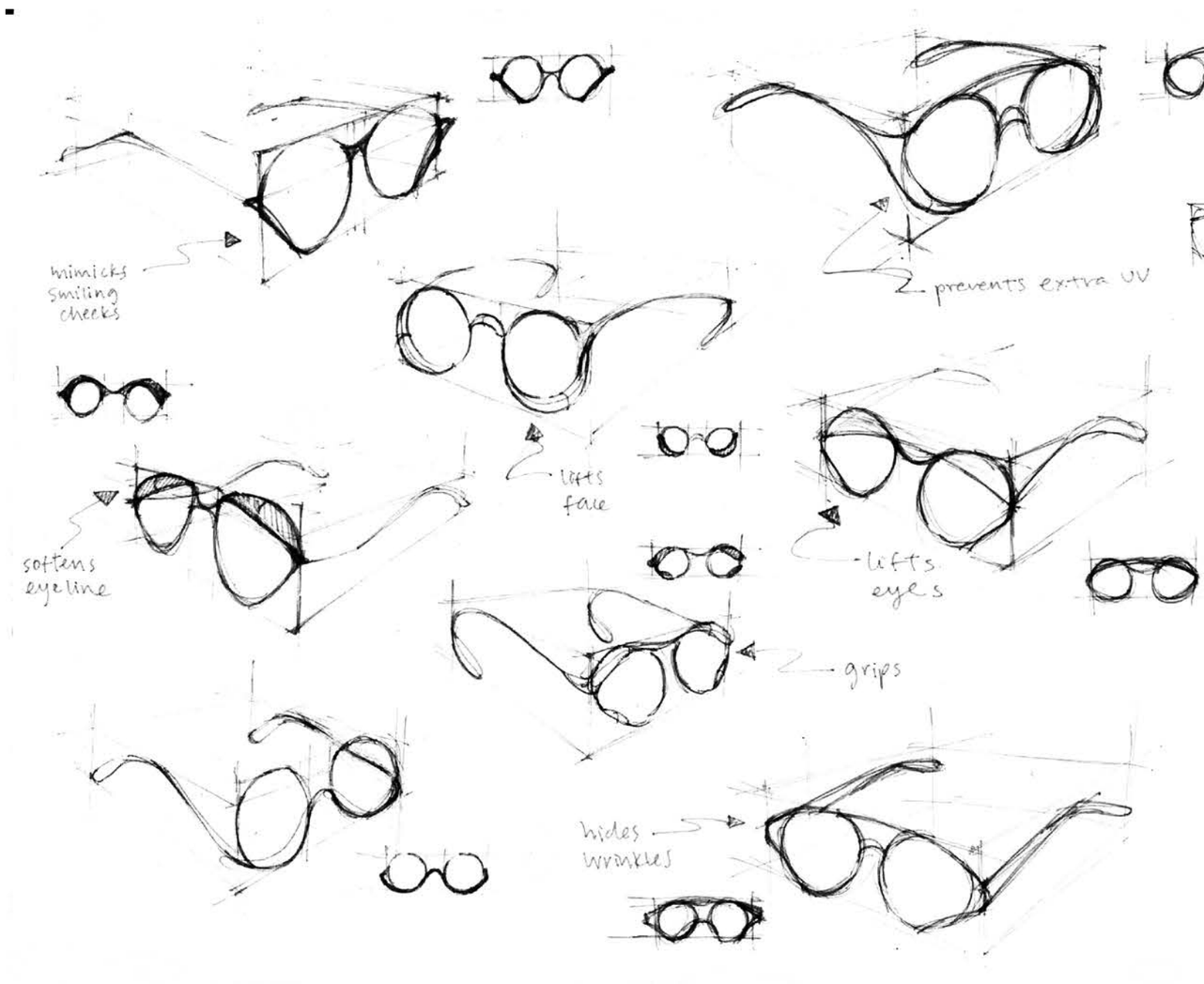
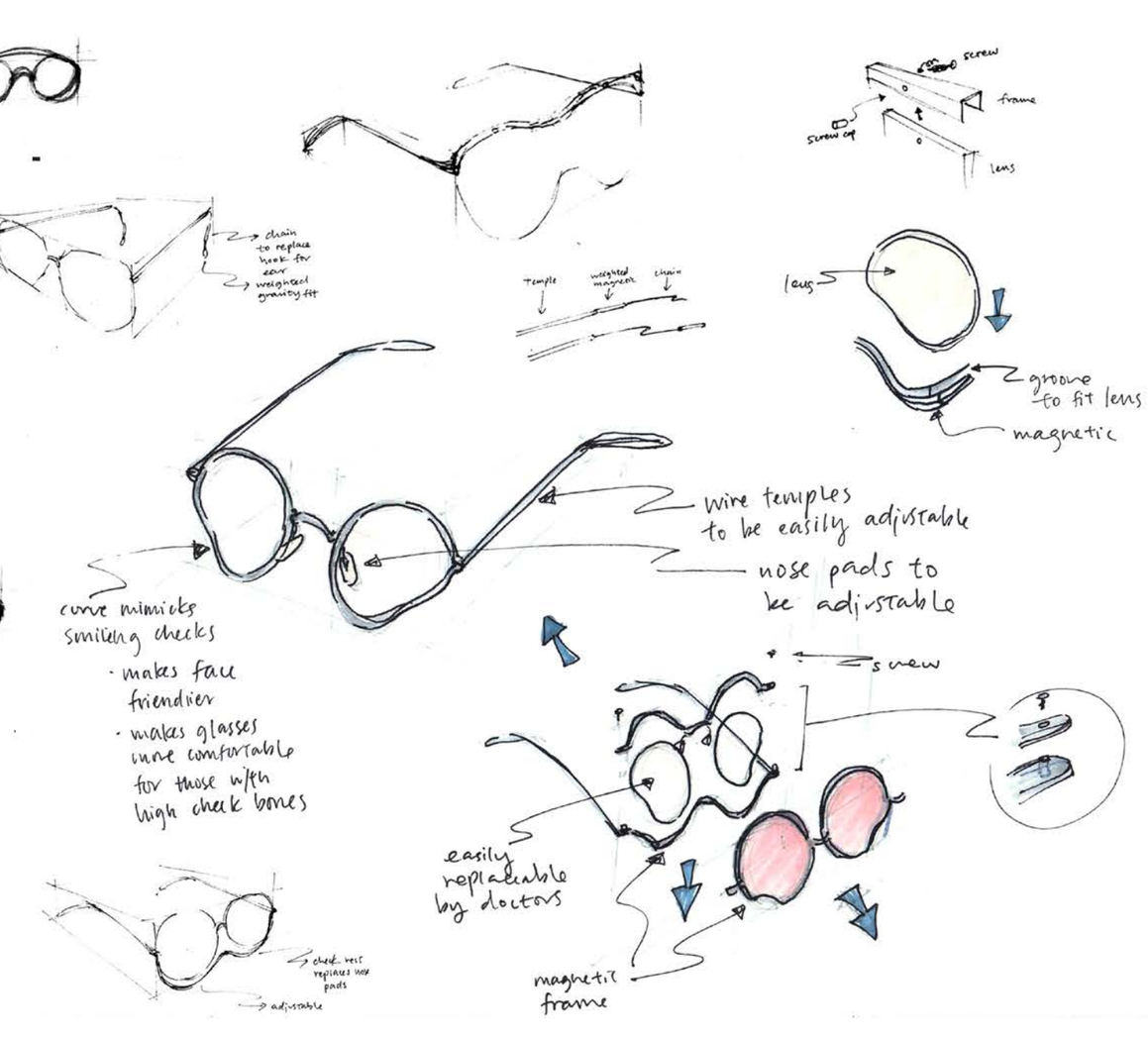
[26] Azevedo, R. T., Bennett, N., Bilicki, A., Hooper, J., Markopoulou, F., & Tsakiris, M. (2017, May 23). The calming effect of a new wearable device during the anticipation of public speech. Retrieved May 10, 2021, from https://www.nature.com/articles/s41598-017-02274-2

Form Development

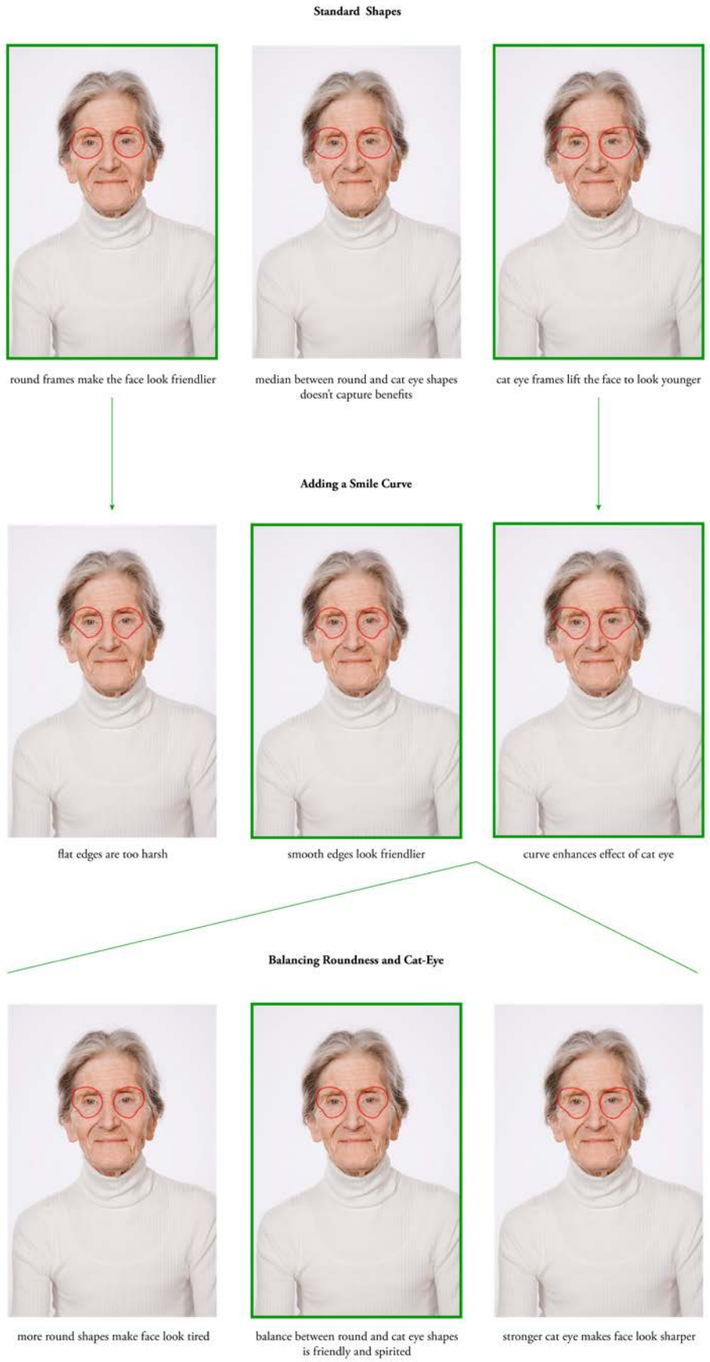
Frames

The concept was explored further by looking into the specific form the glasses, tinted lenses attachment, and case would take. When designing the frames, it was important to reflect the goals of the project and evoke a sense of happiness, friendliness, and approachability. Several rounds of ideation and prototyping were conducted to refine the final form. Ideation explored several aspects of frames that could appeal to the elderly and achieve the aforementioned effects. Further research into the effect of frames on elderly faces revealed that cat eye frames are able to lift the face while round frames soften the appearance of harsh lines formed through aging. For the elderly, it was important that the size of lenses be large vertically to accommodate presbyopic lenses.

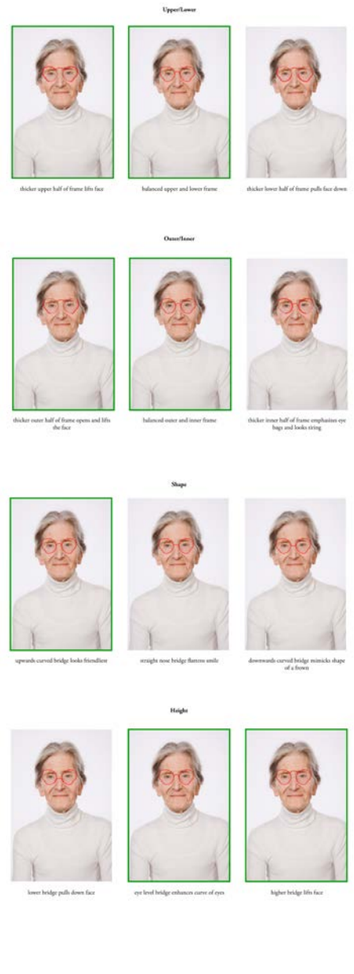




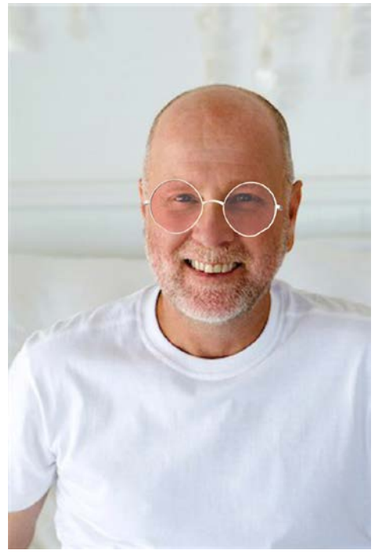
An idea generated through the preliminary form ideation featured a mostly circular shape but included a concave curve at the lower outer edge to mimic smiling cheeks. This curve was hypothesized to make the face seem more friendly but also add the lifting effect to circular frames without giving a sharp look.



To verify this proposal, the frames were rendered graphically on an image of an elderly woman in iterations starting from round and cat eye frames and ending with the most effective version of the new frame. Considerations of frame thickness, and bridge shape and height were considered in addition to frame shape.



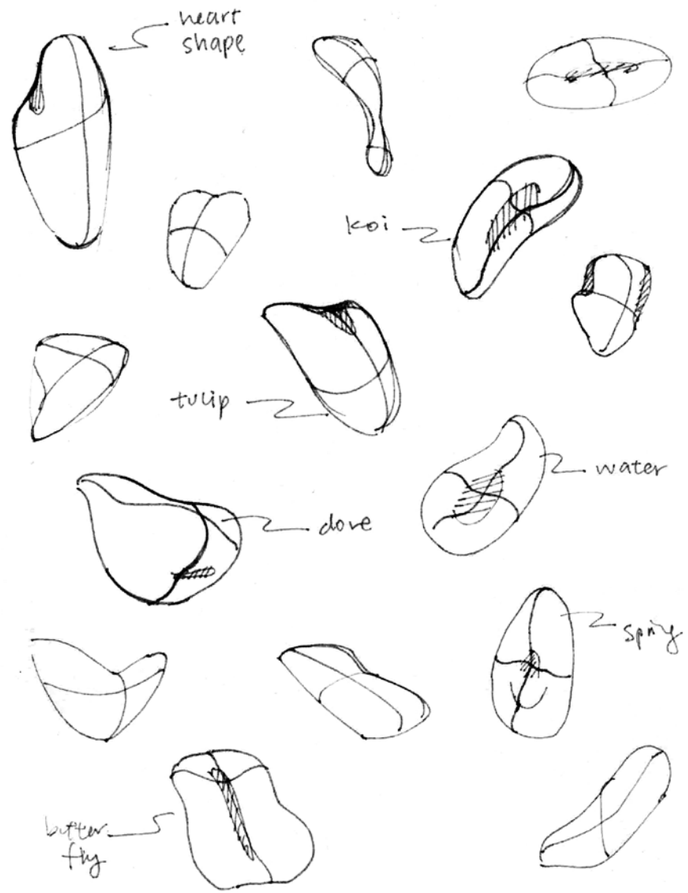
The finalized shape was then 3D modelled and rendered on the image of the elderly woman and a man to better verify the effectiveness when using accurate materials regardless of gender.



Physical wireframe prototypes of the frames were then crafted to further analyze the added smiling curve and minute changes to the curve were made to be more aesthetically pleasing.

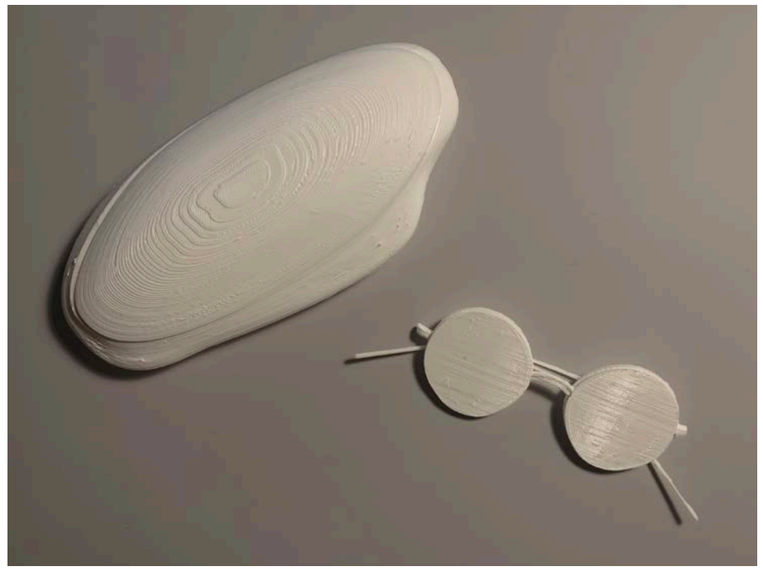
Case

As the case is meant to be carried and be a constant presence in the user's lifestyle, the form of the case was designed to be an artifact that would add extra personal meaning. Several soothing and happy symbols were explored during ideation, including hearts, tulips, fish, water, butterflies, and etc. Sketches of the most interesting forms were made using clay to visualize the forms in 3D. The heart inspired shape was chosen as it best reflected the purpose of the case giving heartbeat-like vibrations.

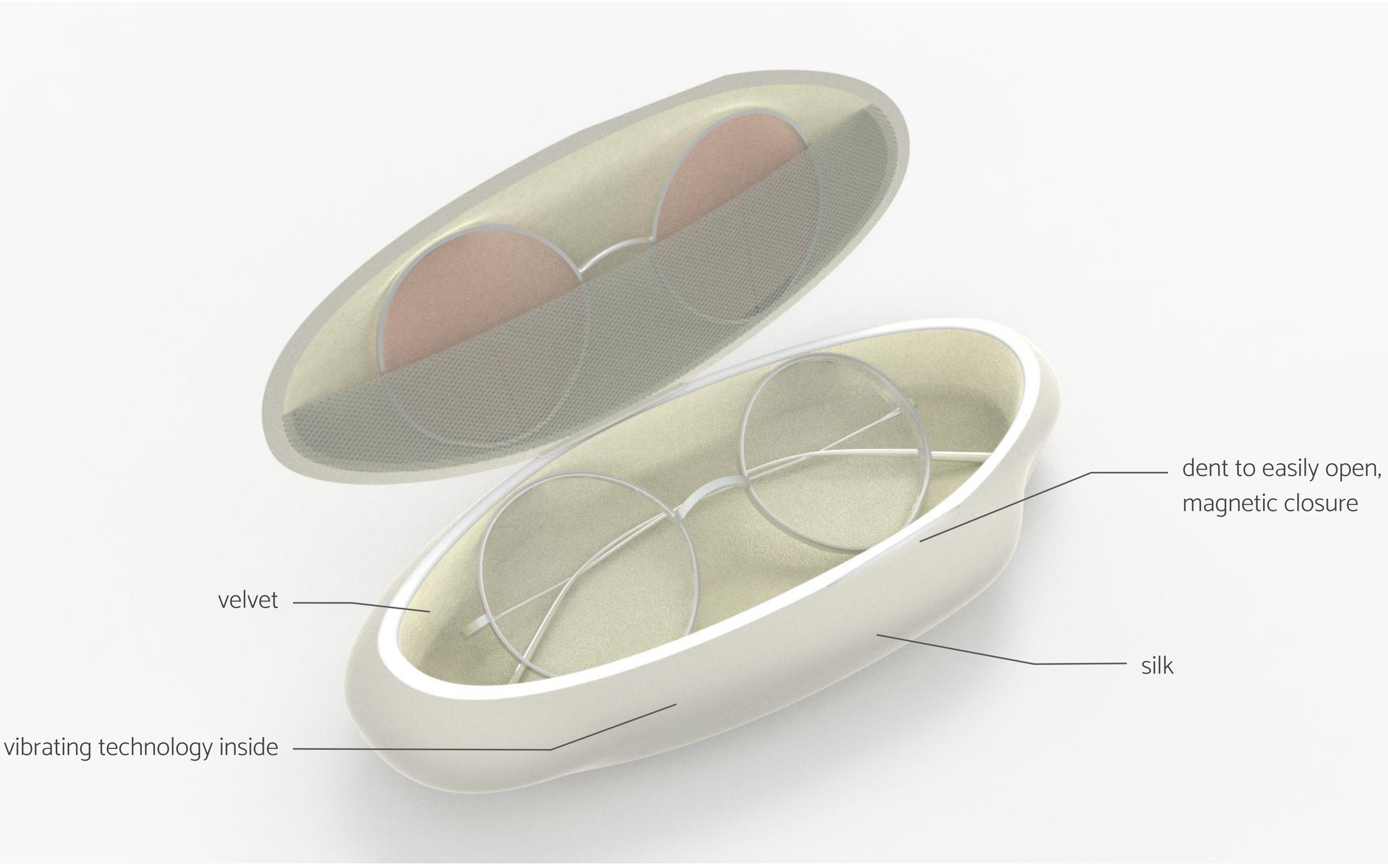


In consideration of the comfort holding the case, materials were sourced to find the best fit. Various silky and velvety fabrics were considered for the tactile feel. Having a velvet interior would further serve to protect the glasses while a smoother exterior surface would be easier to clean. A layer of thin foam would line the case exterior under the fabric to make the case more soft and a layer of plastic underneath would give the case structure.

White Model



Renderings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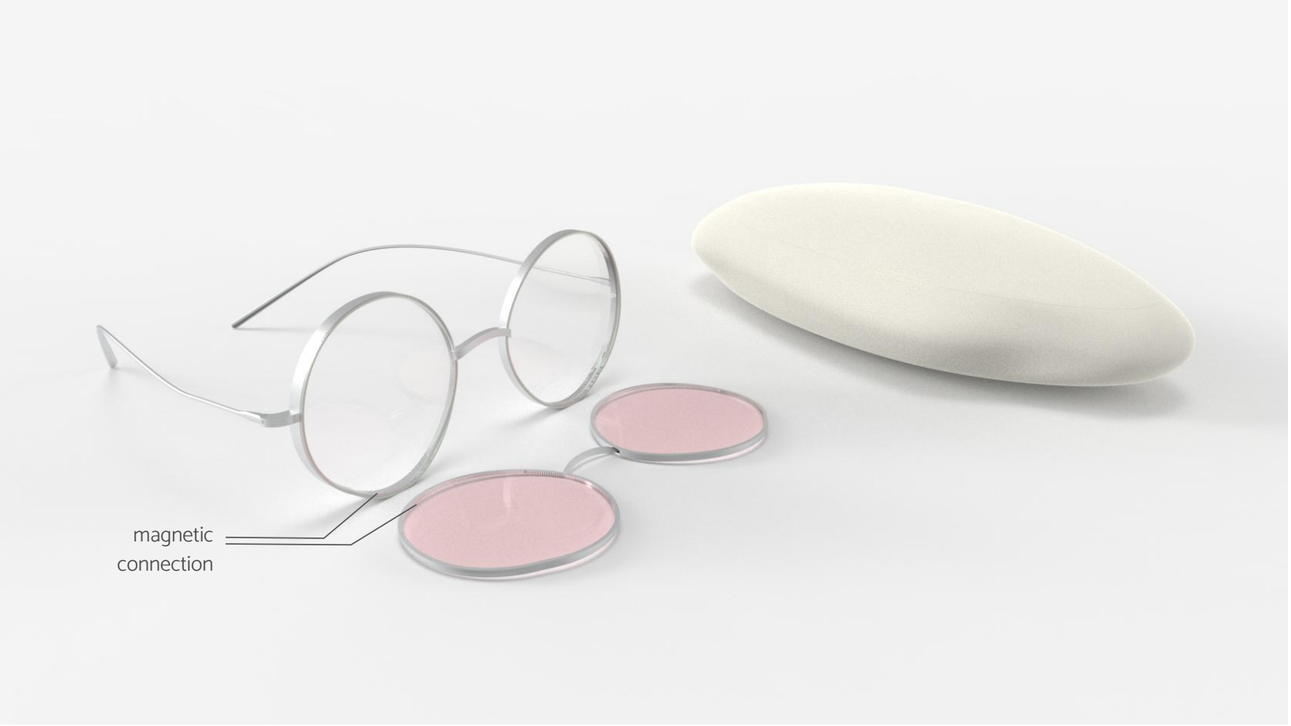
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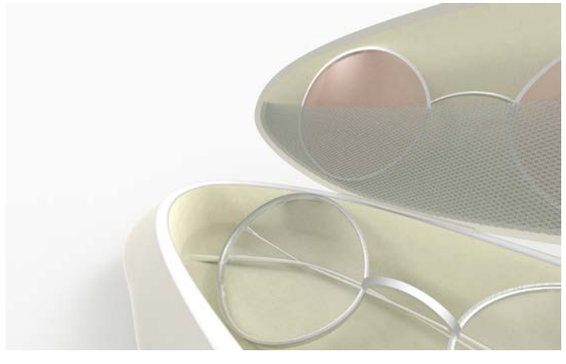


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