

# An Installation to Increase Body Positivity and Convey Dilemma to Make People to Think of a Healthier Life

UNIVERSITY OF TWENTE

BSc Creative Technology

Faculty of Electrical Engineering, Mathematics, and Computer  
Science (EEMCS)

*Hyungju Nam S2032155*

*Bachelor Thesis Creative Technology*

*Supervisor: Femke Nijboer*

*Critical Observer: Anouk Middelweerd*

*Biomedical Signals and Systems, EEMCS, University of Twente*

# Abstract

Obesity is one of the biggest social and life-threatening problems we face today. This paper examines the use of speculative design to create public installation that aim to convey dilemmas to promote body positivity and encourage individuals to consider taking healthier actions. An interactive installation called "Love Yourself: An Interactive Mirror" was designed using brainstorming and the Creative Technology Design Process. When users positively reflect on themselves, they receive visual feedback that reinforces positive self-perception, while reflecting on themselves negatively has the effect of mirror cracking. To test the installation there was a use evaluation with 30 participants. Participants were mainly University students with age 20~30. 75% of people answered that their body positivity has been increased and willing to have a healthy lifestyle after using the installation. 60% of people answered that they have recognized the dilemma of body positivity. So, the results showed that the installation achieved the project goal: increasing people's body positivity conveying a dilemma, and encouraging participants to consider healthier lifestyle choices. The results of this study suggest that speculative public installations can be a powerful tool to tackle social issues, promote body positivity, and motivate health interventions.



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# Table of Contents

<b>Abstract</b>	<b>2</b>
<b>Acknowledgment</b>	<b>3</b>
<b>Table of Contents</b>	<b>4</b>
<b>Chapter 1. Introduction</b>	<b>7</b>
<b>Chapter 2 - Background research</b>	<b>8</b>
2.1 Literature Review	8
2.2 What is speculative design?	8
2.3 Requirements of Public Installation	13
2.4 Which factors push people to a lifestyle program or pull them away?	13
2.5 What is body positivity and how does it affect people?	15
2.6 State of arts	16
2.6.1 Speculative design for sedentary behavior: The Ivy project	16
2.6.2 Speculative design: If Not Now Then When	17
2.6.3 Speculative design: Disney movie Wall-E	18
2.6.4 Body positivity movement: Lady Gaga's "Body Revolution"	19
2.6.5 Body positivity movement: My Body Gallery	20
2.6.6 Body Positivity: Stop Hating Your Body	21
2.6.7 Conclusions of state of the art	21
<b>Chapter 3. Methods and Techniques</b>	<b>22</b>
3.1 Design Process	22
3.1.1 Ideation	24
3.1.2 Specification	24
3.1.3 Realization	24
3.1.4 Evaluation and Reflection	24
<b>Chapter 4. Ideation</b>	<b>25</b>
4.1 Stakeholder identification	25
4.1.1 Designer	25
4.1.2 Supervisor	26
4.1.2 User	26
4.1.2 The Public	26
4.1.2 Public Space Manager	26
4.2 Stakeholder Requirements	27
4.3 Initial Ideas	28
4.3.1 A talkable coffin	28
4.2.2 Comparing sports athlete's injuries	29
4.2.3 Subliminal apple	30
4.2.4 Imagine you are getting overweighted	31
4.2.5 Love Yourself: An Interactive Mirror	32
4.4 Final idea	32
<b>Chapter 5. Specification</b>	<b>34</b>
5.1 Lo-fi Prototype Requirements	34

5.2 Lo-fi Prototype	35
5.3 Lo-fi test	36
5.3.1 Test Results	37
5.3.2 Evaluation and Implication	38
5.4 Revised Final Prototype Requirements and Concept	39
5.4.1 Revisioned Final Prototype Concept	39
5.4.2 Revised Final Prototype Requirements	41
5.5 System Architecture	42
5.5.1 General System Architecture	42
5.5.2 Main System Architecture	43
5.5.3 Time Sequence Diagram	44
<b>Chapter 6. Realization</b>	<b>45</b>
6.1 Hardware	46
6.1.1 Display	46
6.1.2 Webcam	46
6.1.3 Laptop	47
6.2 Software	48
6.2.1 Python	48
6.2.2 Adobe After Effect	48
6.2.3 Houdini	49
6.2.4 Cakewalk	50
6.2.5 Autodesk 3D Maya	51
6.3 Hi-fi Prototype	52
6.3.1 Voice Recognition	52
6.3.2 Performance	54
6.4 Final Prototype Requirements Review	59
<b>Chapter 7. Evaluation</b>	<b>61</b>
7.1 Hi-fi Test	61
7.1.1 Setup	61
7.1.2 Procedure	62
7.2 Results	63
<b>Chapter 8. Discussion</b>	<b>65</b>
8.1 Discussion	65
8.2 Discussion Conclusion	67
<b>Chapter 9. Limitation and Future Work</b>	<b>67</b>
<b>Chapter 10. Conclusion</b>	<b>68</b>
<b>References</b>	<b>70</b>
<b>Appendix</b>	<b>73</b>
Appendix A Usage of generative AI	73
Appendix B Free model used for Final Concept Design	73
Appendix C Main code for hi-fi prototype user evaluation	73
Appendix D Code for voice recognition	79
Appendix E Subtitle Script Youtube Link	80
Appendix F Positive and Negative Effect Youtube Link	81

Appendix G Negative and Positive Sounc Effect Youtube Link  
Appendix H Information and Consent form

81  
81

# Chapter 1. Introduction

Obesity is one of the biggest societal and life-threatening problems we face today. In recent years, the number of obese people around the world has increased, and so has the societal burden [1]. According to a report published in March by the World Obesity Federation, World Obesity Atlas 2023, one in seven people worldwide are obese or overweight, and if appropriate measures are not taken to address the obesity issue, one in four will be obese and the overweight population will exceed half of the world's population by 2035 [1]. WOF forecasts that the overweight population with a BMI of 25 or higher will reach 4.05 billion accounting for 51% of the world's population, and the obese population with a BMI of 30 or higher will increase to 1.914 billion, representing 24% of the world's population.

There are a variety of interventions around the world, such as medical support, diet, medications, bariatric surgery, and other treatments [2]. However, despite these efforts, obesity rates are still increasing every year. Current weight control interventions are less successful due to the various complex characteristics [3]. Moreover, the complex characteristics of obesity make it difficult for obese individuals to achieve and maintain weight loss. Research indicates that only 11% of obese individuals maintain weight loss for at least one year [4]. The body's biological mechanisms make weight loss and maintenance difficult. Obesity is often associated with body dissatisfaction. Individuals may feel dissatisfied or unhappy with their appearance, leading to negative body-related emotions and behaviors [3]. Viewing appearance-focused content on social media can increase an individual's body dissatisfaction [5]. Media plays an important role in shaping societal beauty ideals and body standards. Individuals compare themselves to the idealized body image displayed in the media, which can lead to body dissatisfaction and harmful behaviors related to diet and body image management [5]. Recently, the body positivity movement has spread through social media to break through this. The body positivity movement aims to challenge dominant appearance standards and promote acceptance of diverse body types. Exposure to body-positive movement has been shown to improve physical satisfaction and emotional well-being [5]. The goal of the body-positive movement is to protect individuals from the consequences of negative body image, leading to better well-being and health interventions. However, the body positivity movement faces the dilemma that increased body satisfaction may lead to decreased health promotion behaviors. The biggest challenge is to increase the body satisfaction of individuals and ensure that it leads to health interventions.

Therefore, providing opportunities for individuals to think about themselves, and emerging body positivity ultimately encourages them to make changes. Speculative design is an applicable approach in this regard. Unlike traditional design methods, speculative design is an approach that utilizes creativity and critical thinking to address real-world problems [10]. While conventional designs focus on solving existing problems, speculative design imagines alternative futures and challenges assumptions about the present [10]. Designers encourage users to envision scenarios that do not yet exist and stimulate discussions about technology, society, and culture through unique works, projects, or stories [7]. This challenges conventional norms and triggers thinking beyond the current state [6].

There are diverse methods to use speculative design. For example, media, installations, books, etc. are used to influence people in a wide range of ways. Installation is one method

to utilize speculative design. They can be designed to educate and raise awareness about various topics, from art and culture to social issues and public health, memorably reaching a wide audience [11]. There is the potential to start conversations, provoke thought, and inspire action on important social issues, contributing to positive social change [12]. Additionally, they are accessible to a diverse range of people, regardless of background or socioeconomic status, in public spaces [11]. They can collect valuable data on user behavior, preferences, and interactions, which can be utilized for future research.

The aim of this research is to create a speculative public installation that can be used to make people think about body positivity and desirable future life interventions.

There will be a sub-questions followed.

1. What is speculative design?
2. What installations or interactions currently exist to make society think about lifestyle interventions?
3. What requirements does a public installation need?
4. Which factors push people to a lifestyle program or pull them away?
5. What is body positivity and how does it affect people?

## Chapter 2 - Background research

### 2.1 Literature Review

This section begins by exploring the literature that focuses on the definition and effects of speculative design through a variety of examples. Next, the potential impacts and requirements that installations may have on people will be discussed. Finally, by examining the reasons people participate in health programs and the reasons they drop out or do not participate, this section will provide an overview of the elements to make a life intervention project.

### 2.2 What is speculative design?

The phrase "future forecast" is used a lot these days when talking about the future. The word forecast is used to predict something like weather. But unlike the weather, the future depends on the choices made in the present. Therefore, it is more like designing the future than predicting it. Speculative design is a methodology that considers how it will affect future politics, society, economics, and so on, abstracting and concretizing potential futures, and communicating them to the public through scenarios. Speculative design began to take shape in the early 1990s by Anthony Dunne and Fiona Raby. They have compared traditional design with speculative design. They explained that traditional design attempts to solve problems, offers solutions, and provides clear answers. In contrast, speculative design is critical, discovering problems, asking questions, and inducing people to think about how the world could be. While traditional and speculative designs may seem opposed. Dunne and Raby explained that speculative design is a complementary concept to traditional design [8]. Additionally, speculative design is involved within design, art, and futurology, incorporating future and critical design functions. (**Fig 2**).

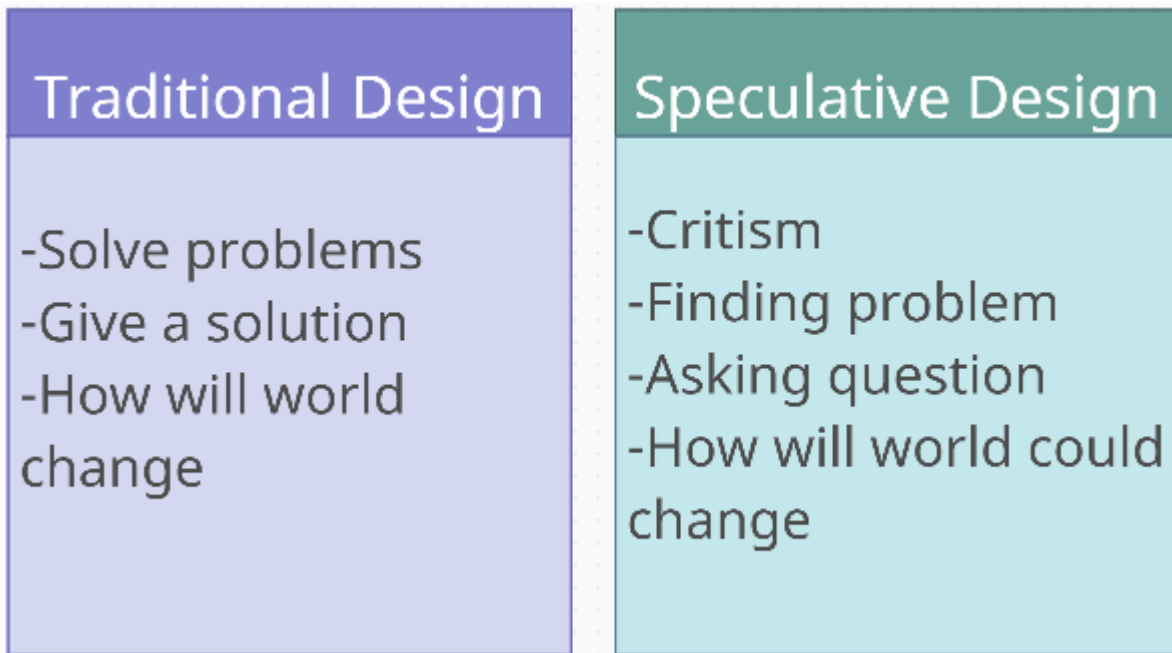


Fig 1. Made from creately.com

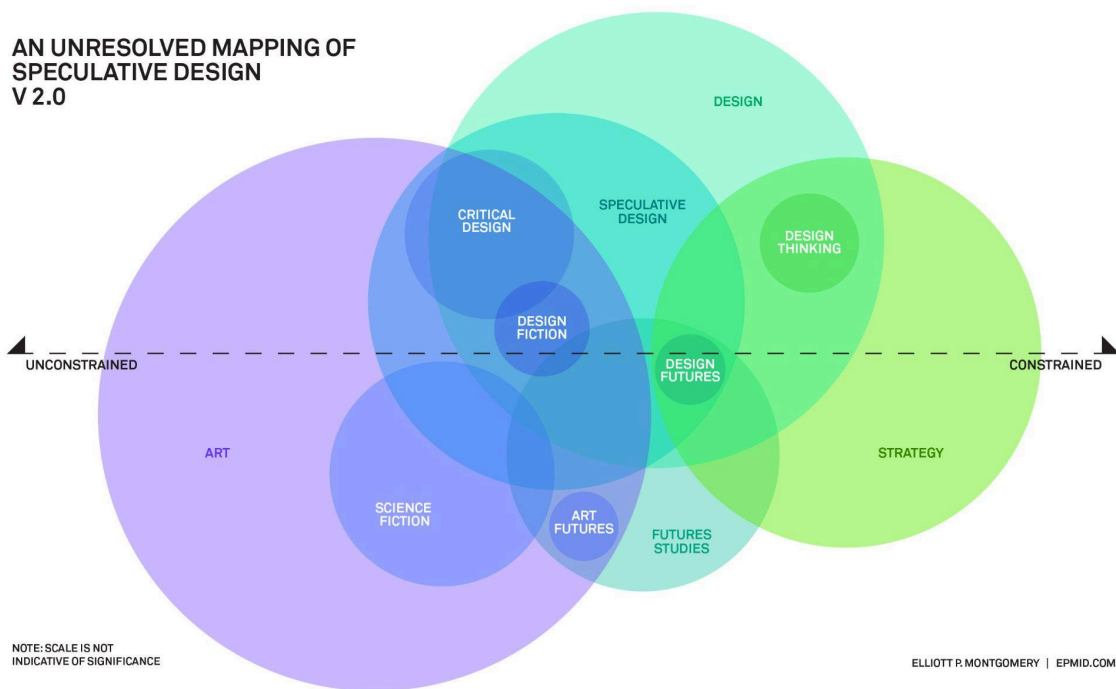


Fig 2. An unresolved mapping of speculative design. Adapted from [9]

Designers Dunn and Ravi, in their "Technological Dream Series: No1, Robots" (2007) [Fig 3, 4], created a familiar image by designing robots to harmonize with the modern home. To overcome the fear of robots, the project successfully presents a new beginning for domestic robots by designing for complex human emotions: needy and submissive robots, furniture that looks familiar but has been modified to accommodate new technology with advanced

features, and technological interactions that take place in a strange but familiar way. Although the robot's functions are explained in detail, the robots are harmonized with the residential environment allowing the public to imagine living with robots [10].



**Fig 3.** Dunne and Raby, Technological Dream Series: No. 1, Robots—Robot 3 (2007). In the future, a lot of data, including personal and confidential information, will be stored in digital databases. This robot uses retinal scanning technology to authorize access to the data. Users authenticate themselves by looking at the robot for a long time. Adapted from [10]



**Fig 4.** Dunne and Raby, Technological Dream Series: No. 1, Robots—Robot 4 (2007). This robot is very needy. This robot is intelligent, but its body is underdeveloped and it must rely on its owner's hands to move. Neediness is designed into smart products to maintain a



sense of control. This robot is made to speak human language, but over time it will evolve into its own language. You can still hear traces of humanity in its voice. Adapted from [10]

Speculative design can also tell a story about what would happen if a system in the present were taken to an extreme in the future. Black Mirror season 1 episode called Fifteen Million Merits centers around the hyper-commoditized relationships, interactions, dreams, and aspirations of today's free-market capitalist system when taken to the extreme. The drama introduces the technologies that tech companies are currently developing and shows how this turns into a nightmare with unpleasant consequences for humans [8] [Fig 3].



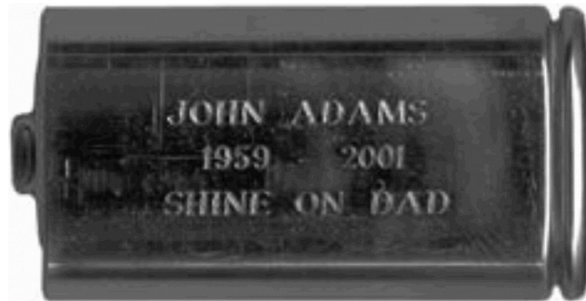
**Fig 5.** Black Mirror Season 1. Adapted from [8]

While video media can tell a powerful story and provide immersion. It is limited in requiring passivity to viewers as viewers can only rely on visual cues. As a designer, it is important to provide visual cues carefully that allow the audience to imagine the world and its politics, social relations, and ideology.

To encourage active participation it is crucial to capture the public's attention. It can be helpful to provoke assumptions to get the public more engaged and thinking. If the design is too familiar, it may be easily unnoticed and absorbed into the normal progression of the product. Therefore, the design solution should be both provocative and familiar simultaneously. Using sensitive topics such as sex or death can easily provoke the audience but uncanniness can cause disgust. If a project deals with sensitive topics, careful uncanny management is required. In the horror genre, it's desirable to utilize the uncanny for maximum psychological impact, but speculative design requires a more cautious approach. For example, the project 'Afterlife' directly addresses the sensitive issues surrounding the topic of human death. It uses microbial fuel cells to charge batteries while the body decomposes [Fig 7, 8]. By capturing life as energy in batteries [Fig 7], the project makes us think about life after death.



**Fig 6.** Auger–Loizeau (2008), Afterlife coffin with microbial fuel cell. Adapted from [10]



**Fig 7.** Auger–Loizeau (2001), engraved Afterlife battery. Adapted from [10]

Unfortunately, visitors to the exhibit ignored the zen aspect of the project and focused on the unsavory aspects: the process of dying, the death of loved ones, and the material activity of the human body while the fuel cell was working. This led to simple rejection as the benefits were ignored. The audience felt the proposal was too uncanny.

Speculative design invites the public to imagine the future through exhibitions. Every speculative design project is unique, and the diversity of topics, contexts, technologies, perspectives, and audiences makes it difficult to provide a clear "how to." As new technologies continue to evolve and practices mature, past methods are becoming more sophisticated, further complicating the situation. Thus, the examples described suggest how the project should be approached, managed, and created to connect with the general attitude, and approach to the topic, especially with the perception of the real world. This approach involves creating realistic and practical demos, or more specifically, virtually transforming disruptive technological innovations into future products. The key advantage of this approach is that it removes creative processes constrained by commercial limitations. This separation allows setting goals based on questions, discourse, virtual possibilities, and actual products, focusing on utopian concepts and dystopian counterproducts. Through this, audiences can be inspired to think not only about what they desire for their future selves but also what they do not desire [10].

## 2.3 Requirements of Public Installation

The public installation has a variety of objects and it is utilized in various ways. Traditional art installations were installed to reflect the history, and value of a place and to express the cultural elements. With the development of design methods and technology, public installations have evolved from static monuments to dynamic, interactive experiences that deeply engage the community. This encourages the public's active participation and interaction with the content on display [6]. Interactive installations are effective at engaging the public's involvement and interest. Participants become part of the installation, rather than observing, and their actions and input affect the outcome of the installation [11]. Sensors, touch screens, and motion tracking enable the user to have an interactive experience. These installations enhance social interaction and community participation by connecting users with technology [11]. Moreover, inspires creativity, novelty, and motivation in the public and encourages conversation and connection among participants. The installation allows the designers to express political, social, and environmental messages. Designing an effective public installation requires careful consideration of a variety of factors. According to Müller et al. (2010), he highlighted the importance of connecting participants with the installation. He explained that this will reinforce user experience by stimulating creativity, encouraging participation, and increasing motivation [12]. To connect participants in public places it is crucial to capture the attention of pedestrians so visibility and attractiveness are important factors. By inducing public curiosity, it is possible to increase the attractiveness of the installations. Curiosity stimulates the cognitive structures of the public and induces individuals to explore and search for explanations. By giving the user choices reinforces intrinsic motivation and allows the user to take control of the interaction and immerse themselves more deeply in the installation [12]. It is important to avoid overwhelming the user with too many choices and to maintain a balance between novelty and ease of use.

Thus, interactive public installations have great potential to enhance public participation and social interaction. By meeting the above requirements, designers can create installations that engage audiences, promote conversation, and eventually increase public awareness.

## 2.4 Which factors push people to a lifestyle program or pull them away?

People participate in lifestyle programs to improve their health or appearance [13]. People at

higher risk of cardiovascular disease or with higher blood pressure and cholesterol were more likely to participate in the program [13]. Older people are more likely to have chronic illnesses, and they are more concerned about their health than younger people [13]. So they are more likely to participate in the program [13]. On the other hand, young people joined the program for aesthetic reasons rather than health [13]. Participants over 50 years of age were less likely to drop out of the program, while younger participants under 35 years of age had higher dropout rates. Older age had higher motivation rates between program participation and success [14, 15]. Younger participants had higher dropout rates than older participants due to extrinsic and intrinsic factors.

Full-time jobs, time management, family responsibilities, and meal planning were common extrinsic barriers to the program, and holiday and time constraints interrupted regular exercise routines [13, 14, 16]. Creating a regular lifestyle such as a planned diet and regular exercise are important factors in maintaining weight loss but these extrinsic barriers interrupt regular lifestyle [13]. Some individuals stated that after experiencing a rebound, they were likely to give up on the change and return to their previous lifestyle [13]. In addition, the possibility of dropout rate increases when the interventionist changes during the program [14, 15]. Intrinsic barriers include lack of motivation, psychological effects, and sleep disturbances. Dropouts and non-participants have been shown to discontinue often or not participate in programs due to a lack of motivation [14, 15, 16]. Obesity has psychological effects on participants, including depression, anxiety, and frustration. These emotional difficulties interrupt individuals from actively participating in the program and increase the possibility of dropping out [15]. Emotional difficulties lead to sleep disturbances, which decrease participant's energy and negatively affect maintenance and success in program participation [15]. Additionally, some individuals didn't participate in the program because they felt they were healthy enough [14].

Understanding adherence predictors is crucial to increase program success and participation rates. Predictors of adherence include early weight loss, lower initial BMI, and better mood [16]. Setting realistic weight goals strengthens internal motivation because participants experienced early weight loss and lowering BMI [17]. Lifestyle interventions customized for participants reduced the dropout rate [15].

In conclusion, understanding the various factors that influence participation and maintenance of a lifestyle program is critical for success. People with chronic illness or motivated to improve their personal health and appearance were found to be more likely to participate in and maintain the program. Regular lifestyle habits, such as a planned diet and regular exercise, are essential for maintaining weight loss. Compared to older participants, younger participants tend to experience more difficulties in participating and maintaining the program due to extrinsic and intrinsic factors. Identifying and addressing these factors is essential to improving program participation and dropout rates. Setting realistic goal weights and providing personalized lifestyle interventions for participants can strengthen internal motivation to succeed in the program. Lifestyle programs that focus on these elements are more effective in helping individuals achieve and maintain health interventions.

## 2.5 What is body positivity and how does it affect people?

Body image is closely related to obesity-related problems [18]. Body image means a person's perceptions of their body, resulting in thoughts and feelings. A positive body image is a protective factor against both obesity [19]. Factors such as self-efficacy, media influence, and psychological factors influence body image formation.

Self-efficacy is crucial in obesity treatment because it influences individual's belief that they can successfully manage their weight [20]. People with high self-efficacy are more likely to have a positive body image, whereas those with low self-efficacy may suffer from body dissatisfaction and negative self-perceptions.

Social media platforms such as Instagram are associated with negative body image issues among people. People often compare their bodies to ideal images displayed in the media and realize that there is a large gap between their appearance and social standards of beauty, leading to body dissatisfaction [19]. People facing body dissatisfaction are more vulnerable to psychological distress and eating disorders [18].

Several years ago, a body positivity movement was active online to improve psychological well-being and body image. Body positivity is a social movement that encourages acceptance of all body types, regardless of size, shape, or appearance [21]. The movement challenges social standards of beauty by asserting that all bodies are intrinsically valuable and deserve respect [22]. This can increase social acceptance and reduce stigma against individuals who do not meet traditional standards of beauty. The movement encourages individuals to evaluate their bodies regarding their health, not appearance. Promoting self-love and acceptance through body positivity helps reduce individual's dissatisfaction with their bodies [22].

Positive attitudes toward the body have a variety of beneficial effects on individuals. Promoting self-acceptance can greatly enhance self-esteem and help people perceive their unique physical characteristics as positive rather than problematic [19]. This acceptance can decrease anxiety and depression and improve mental health [19]. Studies have shown that exposure to body-positive content improves mood and reduces symptoms of mental health problems [19]. It has also been shown that people with a positive body image are better at handling stress and negative emotions [19]. Furthermore, a positive view of the body can encourage healthier lifestyle choices by focusing on health and wellness rather than focusing on weight loss and aesthetic goals. This motivates individuals to participate in regular physical activity and a balanced diet [19].

In addition to body positivity exercises, psychological interventions such as mirror exposure therapy have been shown to be effective in reducing body dissatisfaction [18, 28]. Mirror exposure therapy is a treatment that helps individuals observe and describe their reflection in the mirror [18, 28]. This technique encourages individuals to separate their appearance from their self-esteem and helps them develop a more realistic and positive perception of their body [18, 28].

There are some criticisms of body positivity. First, body positivity still focuses on appearance [19], and by encouraging body acceptance and positive body image, may unintentionally

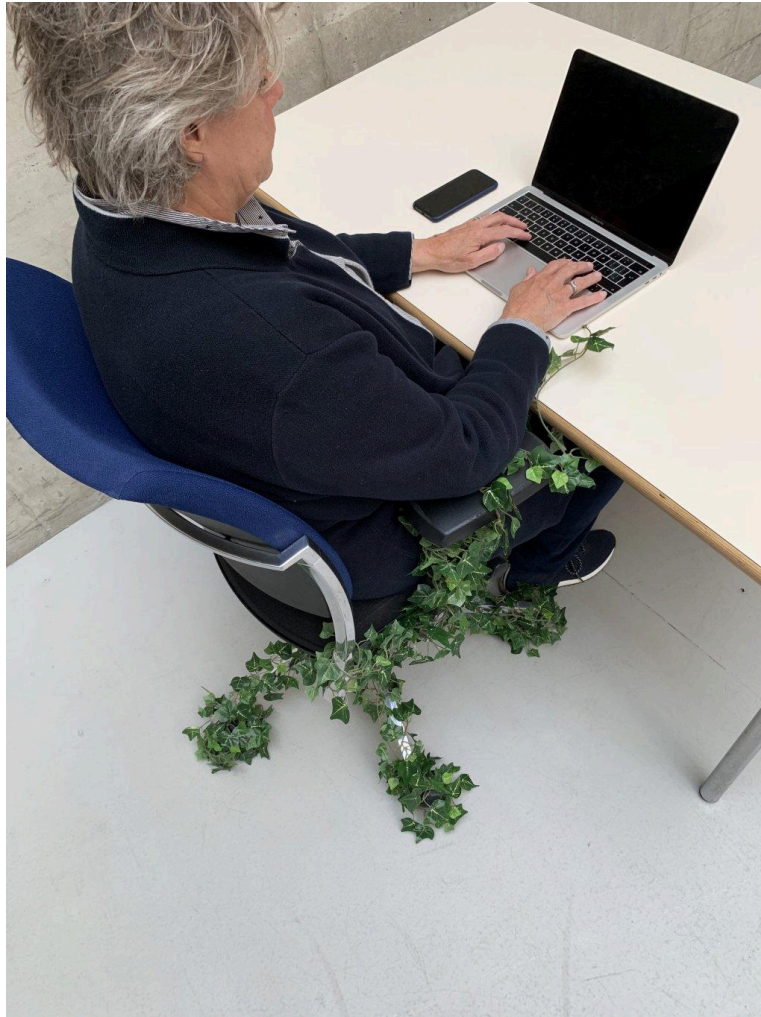
reinforce the idea that appearance is most important [19]. There is concern that body positivism normalizes larger body sizes and may promote obesity [19]. This exercise promotes self-acceptance but may unintentionally normalize unhealthy weight status and undermine efforts to address obesity-related health risks [19]. In other words, the dilemma is that people may accept their obesity and not make efforts to improve their health.

In conclusion, understanding body image and its effects is critical to creating a healthier society. Body positivity helps to reduce body dissatisfaction and encourage healthy lifestyle choices by strengthening acceptance of all body types. Body positivity faces the dilemma of promoting acceptance and psychological well-being while at the same time not unintentionally interrupting health interventions. The challenge is to balance between accepting different body types and encouraging healthy lifestyles.

## 2.6 State of arts

### 2.6.1 Speculative design for sedentary behavior: The Ivy project

A project called Ivy uses speculative design for workers to think about healthy behavior in the office. The project argued that inactive lifestyles are the fourth leading cause of death worldwide and workers sit and work for several hours without thinking about health. Deviating from the current trend of digitization and quantification of health interventions, the Ivy project created an office chair that uses ivy growing on office chairs to measure and visualize the time spent sitting, to raise awareness of sedentary behavior among office workers [Fig 8]. The longer one sits, the more ivy grows on the chair handles and legs, and after two hours of sitting, the chair becomes immobile. They chose ivy because ivy grows by staying in one place for a long time. Some types of ivy are toxic, and the audience can recognize that the act of sitting is toxic.



**Fig 8.** The Ivy office chair. Adapted from [23]

### 2.6.2 Speculative design: If Not Now Then When

John Isaacs represented the fat man through his sculpture. John Isaacs explained that the work did not simply describe obesity, but as a landscape of the physical memory of the body as a place of inner emotional conflict. He stated that the sculpture is like a sponge, absorbing all the misdeeds of its owner. He said that the sculpture's heroic pose contrasts with the misdeeds. The sculpture is a monument and a mirror reflecting the moment when the public is faced daily with the side effects of overconsumption, waste, and pollution, but have no power to change reality. Through this installation, the public can reflect on indifference and hidden guilt.





**Fig 9.** Art installation: IF NOT NOW THEN WHEN. Adapted from [24]

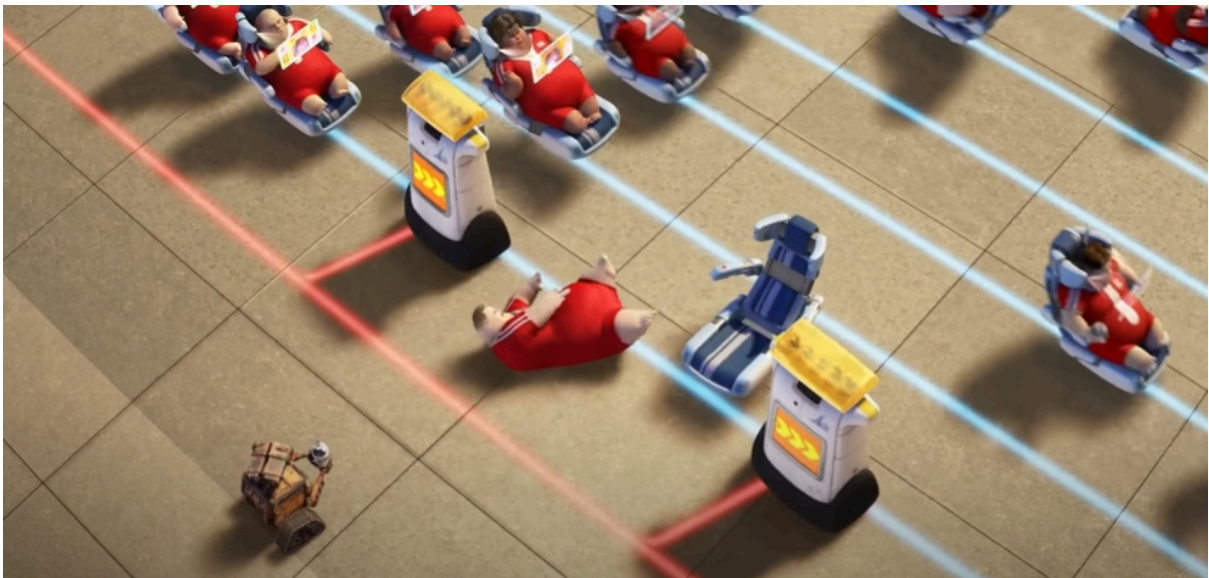
### 2.6.3 Speculative design: Disney movie Wall-E

The movie "Wall-E" tells the story of a cleaning robot left alone on a devastated Earth to clean up trash. In the film, humans originally lived on Earth, but due to the execution of a space migration program caused by the massive amount of garbage, they moved to a spaceship to live. In the beginning, humans were in normal shape, but due to the developed technology, they became highly obese just by eating and playing without moving in space for a long time **[Fig 10]**. In one scene, a man falls off from the device that assists his body. He is shown unable to get up on his own, showing the powerlessness of the human race caused by serious obesity **[Fig 11]**. This movie is an example of a speculative design that shows the devastated earth and the obese condition of all humans, making the audience think about the importance of environmental protection and the seriousness of obesity.





**Fig 10.** Obese people in Wall-E. copyright by Disney



**Fig 11.** Man falls from an assist device. copyright by Disney

#### 2.6.4 Body positivity movement: Lady Gaga's "Body Revolution"

In 2012, Lady Gaga launched a campaign called "Body Revolution" on her website. She posted images of herself in yellow underwear, discussing her struggles with bulimia and anorexia [Fig 12]. The campaign's goal is to encourage the public's bravery and self-acceptance by revealing her flaws [22]. People were encouraged to share personal images and stories that reflect Gaga's own confessional posts [22]. The focus is on revealing and celebrating one's body flaws.

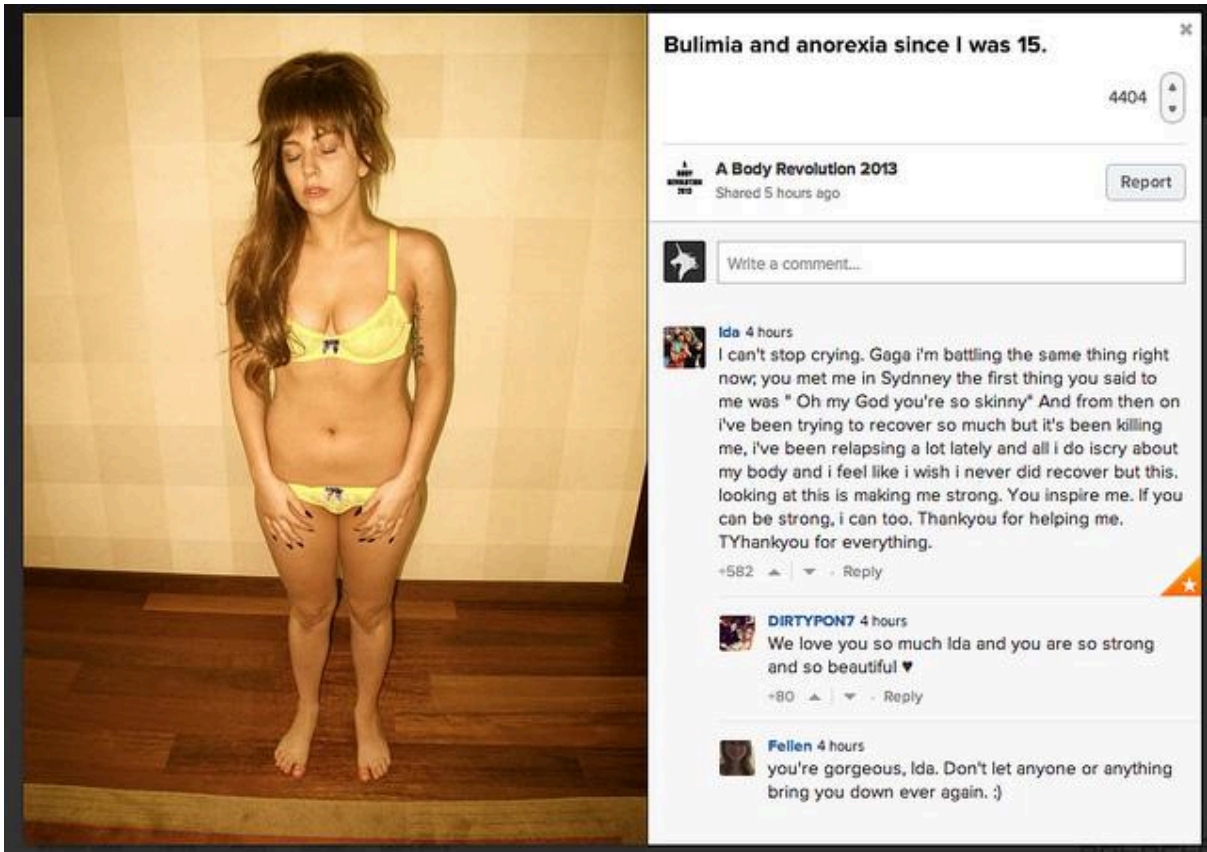


Fig 12. Body Revolution Post by Lady Gaga. Adapted from [25]

### 2.6.5 Body positivity movement: My Body Gallery

The website was founded in 2009 and aims to help women see themselves more clearly by displaying a collection of photos showcasing diverse body types. Users can upload and search for images based on height, weight, and body type to find others who share their measurements, promoting the idea that all body types are normal and acceptable [Fig 13].

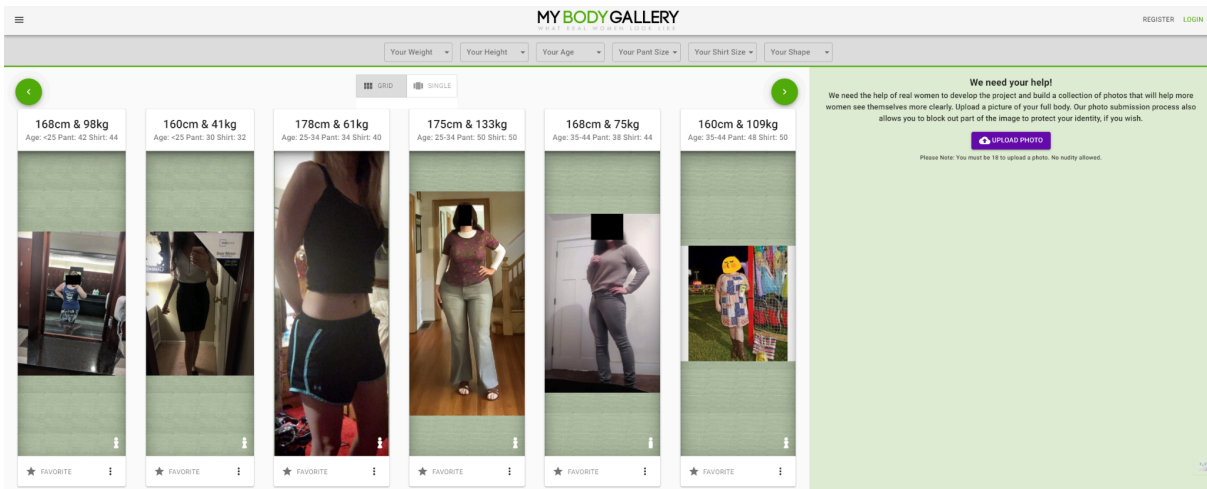


Fig 13. My Body Gallery website. Adapted from [26]

## 2.6.6 Body Positivity: Stop Hating Your Body

The movement was started by Annie Segarra in October 2010, after body-positive content she posted on her personal blog went viral. The site encourages users to share personal stories and images related to body acceptance and body image difficulties. Users share positive messages from their personal stories to help support others and build positive self-efficacy.

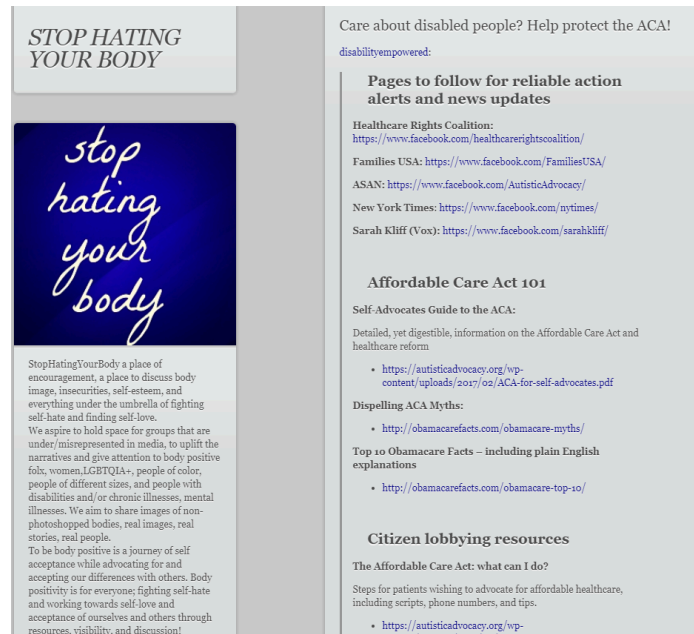


Fig 14. Stop Hating Your Body Tumblr Blog. Adapted from [27]

## 2.6.7 Conclusions of state of the art

The state of art section presented three speculative design examples and three examples of the body positivity movement. Each of the speculative design examples addresses different topics in different ways. Through media, installations, and scenarios, each example stimulates thoughts about the future and the dilemmas that accompany it. These works aim to engage the public in critical reflection on potential futures and the consequences of current behaviors.

All body positivity examples aim to elevate body positivity. They encourage self-acceptance and challenge societal beauty standards through various platforms. Each example tries to enhance people's self-acceptance and body positivity in various ways.

In conclusion, by researching the current state of the art regarding speculative design and body positivity movement, insights into how speculative design approaches are utilized and how the movement increases body positivity were collected. There is no assigned method for speculative design all of the examples used speculative design in their own way. Furthermore, the all-body positivity movement example utilizes an online platform to increase body positivity by allowing people to accept their flaws by revealing and sharing their flaws.

## Chapter 3. Methods and Techniques

This chapter describes the design methodology and techniques used for this project. The selected design methodology will be explained and how the project complies with the design phase.

### 3.1 Design Process

The project will use a Creative Technology Design Process which is developed by Mader and Eggink [29]. This design process contains four phases ideation, specification, realization, and evaluation. In the ideation phase, stakeholders and requirements will be analyzed and product ideas will be generated based on the problem statement and requirements [**Fig 15**]. In this phase, suitable technology will be identified with product ideas. In the second specification phase, a lo-fi prototype will produced to analyze how the product will harmonize with the project goal and how it will affect the user experience. In the third realization phase, a final prototype will be produced based on user feedback. Finally, in the evaluation and reflection phase, an evaluation and personal reflection will conducted to determine if the requirements from the ideation phase have been met and if problems have been resolved.

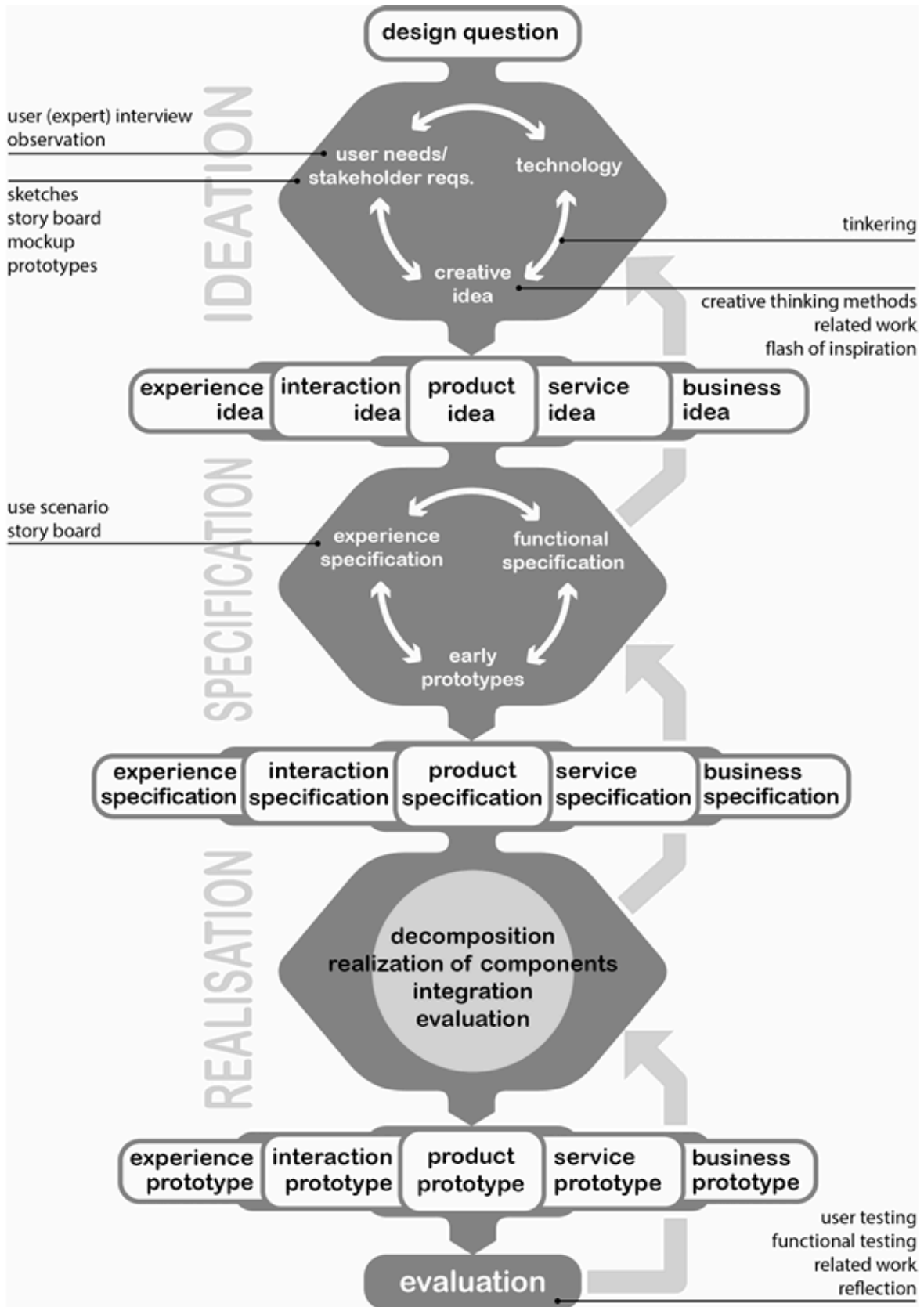


Fig 15. Creative Technology Design Process Adopted from [29]

### 3.1.1 Ideation

Stakeholder identification and analysis will be processed in this phase. For the stakeholder identification and analysis power/interest matrix will be utilized[30]. After this identification and analysis, installation requirements will be identified using MoSCoW analysis [31]. Multiple prototype ideas will be generated through short brainstorming sessions. Next, suitable technologies will be discussed in each idea.

### 3.1.2 Specification

One final will be selected from the previous phase the requirements of the product will be identified and lo-fi prototypes will be created. This phase involves detailing the requirements, constraints, and specifications necessary for the actual implementation of the proposed ideas. The first user test will be conducted, this is where users are evaluated to determine whether they were not offended and whether the intended information was successfully delivered. Based on user feedback, the final idea will be selected that works best.

### 3.1.3 Realization

The final idea will be selected during the specification phase and developed as a hi-fi prototype. The prototype will be enhanced based on feedback collected during the specification phase. The system architecture of the hi-fi prototype will be explained first and the hardware and software elements used in the prototype will be followed. The final prototype will then be discussed with photos and functional requirements will be reviewed.

### 3.1.4 Evaluation and Reflection

In the final phase, another user test will be conducted to evaluate the effectiveness and usability of the prototype. At this stage, data can be collected on how participants and the general public were affected by the prototype. This will allow identification of whether participants were inspired to think about healthy life intervention through the installation.



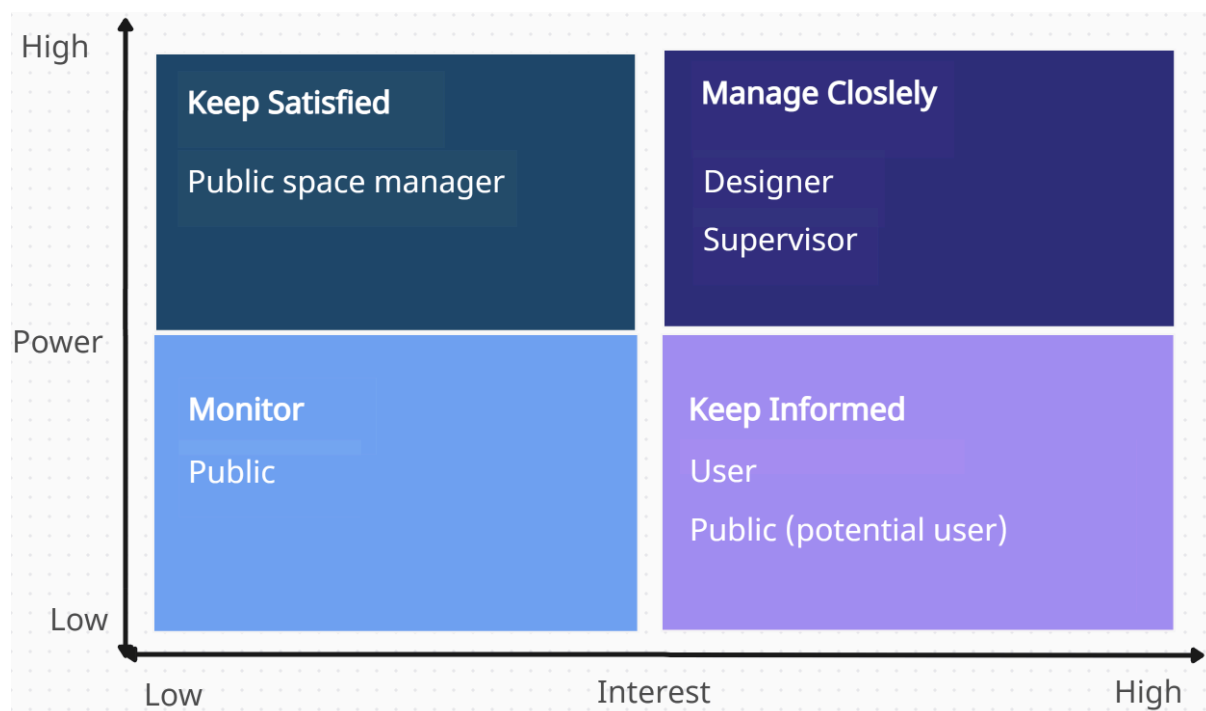
# Chapter 4. Ideation

## 4.1 Stakeholder identification

**Table 1** shows stakeholder identification and their roles. After the identification, the power/impact matrix [**Fig 16**] is utilized to analyze stakeholders. Each stakeholder will be sorted into four categories Manage Closely (high power, interest), Keep Informed (low power, high interest), Keep Satisfied (high power, low interest), and Monitor (low power, interest).

Stakeholder	Role
Designer	Who creates public installation
User	Who uses installation
Public	Walking around the installation could be a potential user
Public space manager	Who decides whether the installation can be displayed in the public area

**Table 1.** Stakeholder identification and role



**Fig 16.** Stakeholder analysis Power/Impact matrix. Made from creately.com

### 4.1.1 Designer

Patrick Nam as a creator of the project has a significant influence on the design process and has a great interest in the success of the project. Responsible for designing the installation

to satisfy system requirements. Feedback from the supervisor and user will be collected and applied during the design process. Patrick Nam falls in the high power/interest category.

#### 4.1.2 Supervisor

Femke Nijboer and Anouk Middelweerd are supervisors of this project. They will provide guidance, suggestions, and feedback during the project to ensure that the project follows on track and meets the academic requirements. Supervisors play a key role in guiding the project in the right direction. Their feedback and guidance are critical to the success of the project. They fall in the high power/interest category.

#### 4.1.2 User

Target users, who are interested in a healthier life, and the installation. The installation will be installed in a public space so anyone can use the installation. But the project goal is to increase body positivity and convey dilemma to make people think better future. So main target group will be the ones who are willing to have a better future and the ones who with low body positivity. Understanding the needs, preferences, and feedback of users is essential to creating a user-friendly and impactful installation that aligns with project goals. So during lo-fi and hi-fi testing user feedback and insights will be asked and collected. A positive impact on the general public through the installation is very important, and the ultimate goal is to improve awareness about obesity and make them think about a healthy future. Users have a high interest in the installation but they don't have the power to influence the project directly. Users will sorted into high-interest and low-power categories.

#### 4.1.2 The Public

There will be pedestrians around the installation walking by. Some of them will be a potential user and others will just walk away. It is crucial to make the installation attractive to capture the attention and make them users. Considering the interests and perceptions of the general public, especially potential users, is critical for the installation to resonate with the target and generate positive engagement. Potential users will fall into high-interest low power same as users and pedestrians will fall into low interest and power.

#### 4.1.2 Public Space Manager

Public space managers have a high power in the project by determining if an installation can be displayed in a public space and if it is appropriate. Their authority can affect the success of public access and community participation. Understanding the standards and requirements set by the public space manager is essential to ensuring compliance and obtaining approval to display the installation in the assigned public space. They have high power but low interest in the project since they have the authority to approve installation but they don't have any power to influence the project.



## 4.2 Stakeholder Requirements

**Table 2** shows the stakeholder requirements. These requirements are selected and categorized using the MoSCoW technique mentioned in section 3.1.1.

<b>Category</b>	<b>Explanation</b>	<b>Stakeholder</b>
<b>Must</b>	Installation must be engaging and easy to use.	User, Public
	Must have a positive experience that raises awareness about body positivity and health.	User
	The installation must adhere to safety regulations inform users of any ethical issues that may arise and ask for their consent.	Designer, User
<b>Should</b>	Should be able to interact with the installation in multiple ways to enhance engagement.	User
	Should feel motivated to think about and potentially change their lifestyle choices.	User
	Should be curious and motivated to interact with the installation	User, Public
<b>Could</b>	Could participate in surveys or feedback sessions to improve the installation	User
<b>Won't</b>	Won't experience any technical issues or difficulties during the interaction	User
	Won't feel offended by the content or design of the installation	User, Public
	Won't find the installation disruptive or intrusive in the public space	Public, Public space manager
	Won't be excluded from the experience due to language or accessibility barriers	User, Public

**Table 2.** MoSCoW analysis for stakeholder requirements

## 4.3 Initial Ideas

In previous chapters, stakeholder analysis and requirements have been analyzed. In this chapter, initial ideas will be generated and the one that best meets the stakeholder requirements will be selected as the final idea. To generate initial ideas for the prototype, a personal brainstorming session was conducted [Fig 17]. The goal was to develop a creative and effective concept that could make people think about healthy lifestyle intervention through a public installation.

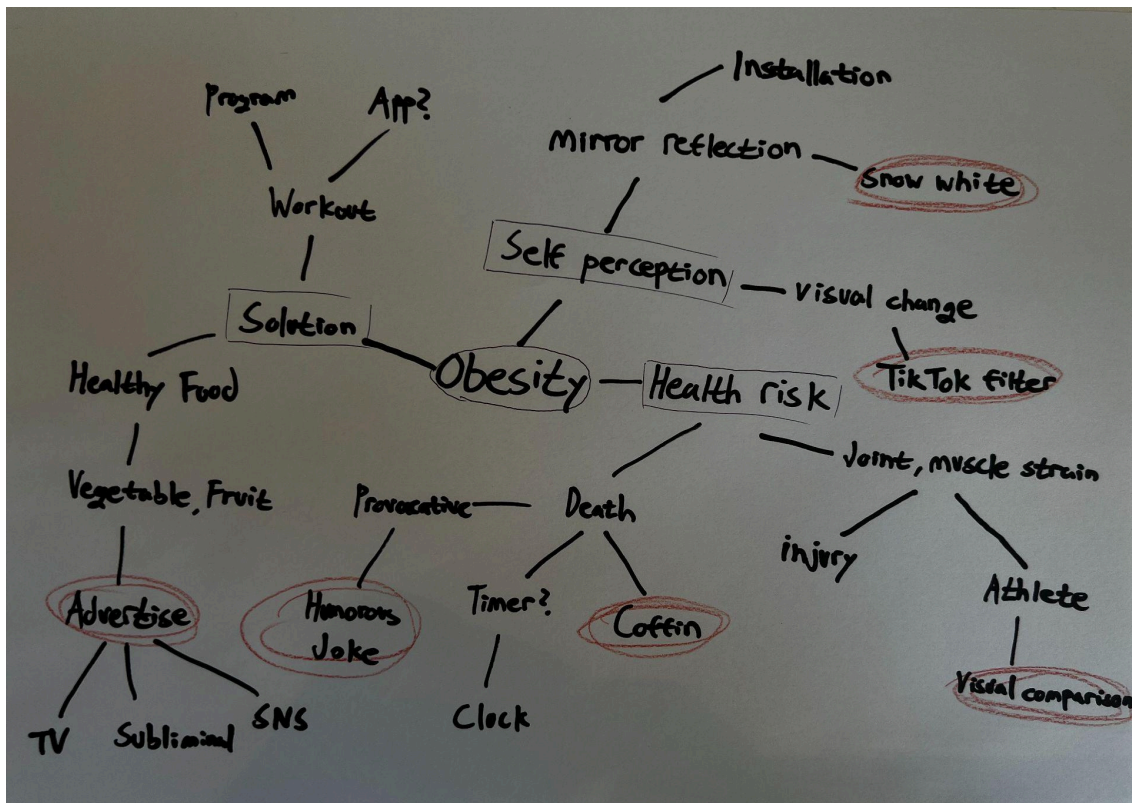


Fig 17. Brainstorming Session Paper

### 4.3.1 A talkable coffin

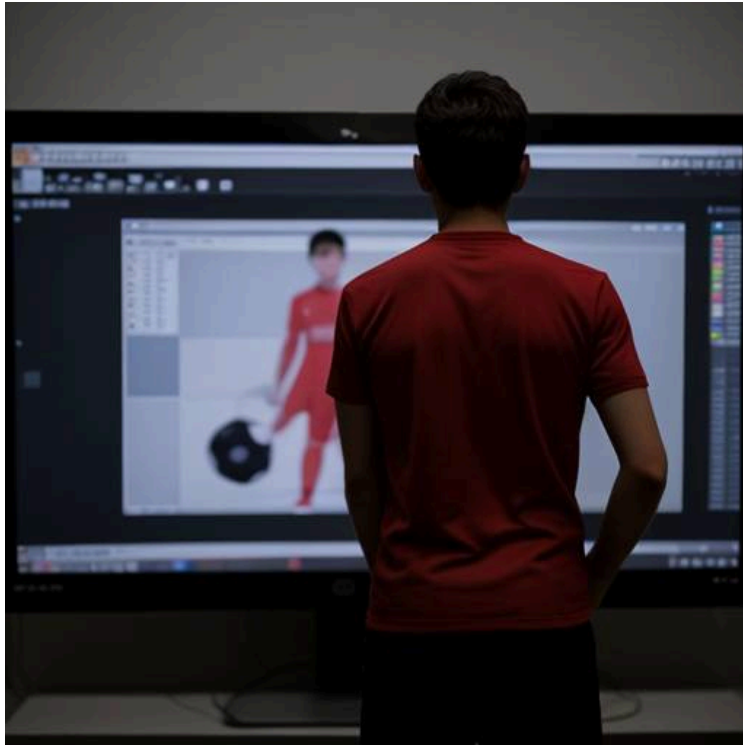
There will be a coffin with a weight, height sensor, and speaker installed. When people go inside of the coffin the sensor will measure the user's body information [Fig 18]. Based on the weight and height BMI will be calculated. If the user has a high BMI then the coffin will tell the user a joke like "You will break the coffin because you are too fat" or "You can't buried inside the coffin because you are too fat". If the user has a low BMI " You are too light and the coffin will fly away with you." This project is a provocative design so that there will be a possibility to harm or offend users. Also, there is a limitation that provocative jokes don't apply to users having normal weights.



**Fig 18.** AI-generated concept art.

#### 4.2.2 Comparing sports athlete's injuries

There will be a display, a camera, and a weight sensor in this installation [Fig 19]. When the user steps on a weight sensor then it will measure people's weight and take a picture of their body. Then It will visualize the impact of their body weight on their knees and compare it to the knee injuries of famous soccer players. By showing a potential risk of injury overweight users will recognize their health status and think about health interventions. This idea has a limitation in that the installation only can be applied to users who are overweight.



**Fig 19.** AI-generated concept art.

#### 4.2.3 Subliminal apple

This idea was inspired by an experiment conducted by James Vicary of New Jersey, USA, in 1958. He inserted the subtitle "Drink Coke, Eat popcorn" into every single cut of a movie film. The inserted frames were so short that the eye could not notice them, and as a result, the audience bought more Coke and popcorn than usual (Cite). This idea is to encourage healthy eating habits by utilizing subconscious advertising, which can increase the user's consumption of certain products, and integrate this into fruits and vegetables. When a user uses a phone or computer, the program's image changes to an apple or utilizes some other method that exposes the user to fruits and vegetables in a situation that the user does not recognize [Fig 20] (In the picture one icon have been changed to apple image).

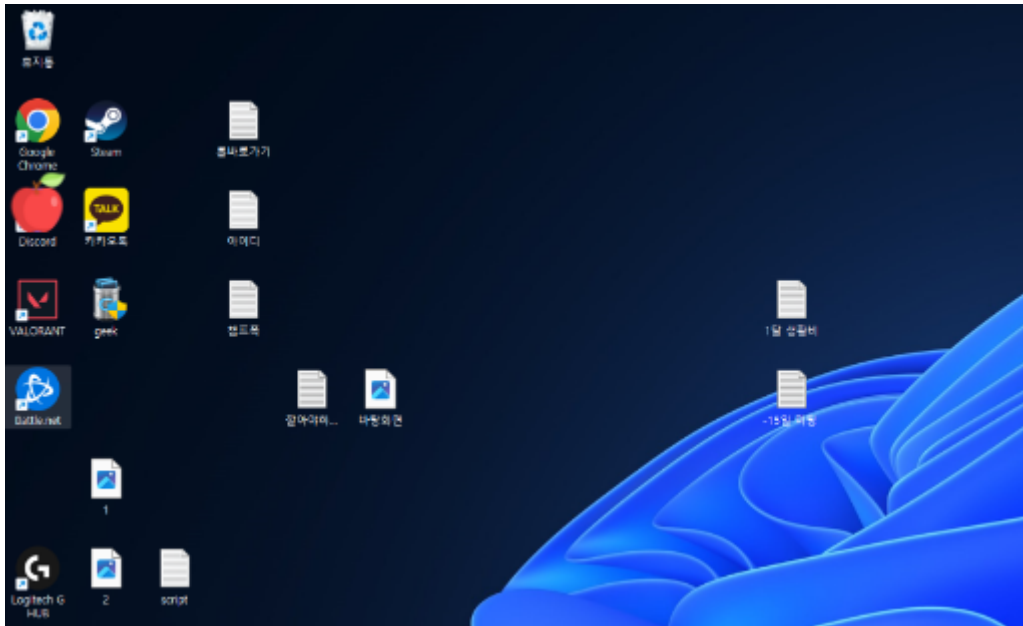


Fig 20. Subliminal apple concept.

#### 4.2.4 Imagine you are getting overweight

There will be a display and camera in the installation. First, the user will take a selfie then there will be an indicator that the user can modify. The left side of the indicator is HEALTHY and the right side is FAT. If the user moves the indicator to the right, it will show the user's selfie getting fatter [Fig 21]. If the user moves the indicator to the left, it will show the selfie getting healthier, more handsome, and more beautiful. The advantage of this idea is that installation can show both a fat and healthy appearance, regardless of the user's weight.



Fig 21. TikTok Fat Filter. Adapted from Viral Kingdom Youtube [32]



#### 4.2.5 Love Yourself: An Interactive Mirror

The concept is inspired by the magic mirror in the snow white fairytale [Fig 22]. In the book, the evil queen asks the mirror who is the fairest in the land. The mirror responds it is snow white. Evil queen seems she doesn't have confidence in herself. If she liked herself she wouldn't have asked to the mirror.

People who are obese usually avoid the mirror to look at themselves. This project aims to increase body positivity and self-confidence by making people tell what they love about themselves in the mirror. There will be a display showing users like a mirror. If the user says something positive about themselves the display will instantly give feedback to the user showing the user's reflection in the mirror smiling or gradually getting a healthier appearance. In contrast, if they say something negative about themselves the mirror will crack progressively.



**Fig 22.** Scene from Snow White and the Seven Dwarfs (1937). copyright by Disney

#### 4.4 Final idea

Considering stakeholder requirements in Chapter 4.2 and initial ideas in Chapter 4.3, the final idea will be the 4.2.5 Love Your Self: An Interactive Mirror. This decision was made

because idea 4.2.5 meets most of the stakeholder requirements and it has the potential to promote body positivity and its dilemma effectively.

The “Love Yourself” interactive mirror aims to enhance the user’s self-efficacy and body positivity by inducing a user to engage in a positive self-reflection experience. The concept will utilize mirror exposure therapy explained in Chapter 2.5.

The idea is that people look in the mirror and are asked to describe themselves. They can describe themselves both externally and internally. Real-time feedback will be provided based on the user’s answer. If the user describes themselves positively, a halo will gradually appear on their reflection in the mirror. This suggests that the user is using the installation in the right direction. In contrast, if the user describes their reflection in the mirror negatively, the mirror will gradually crack. This indicates to the user that they need to describe themselves positively.

27-inch display will act as a mirror it will be decorated like a mirror with laser-cut wood. One webcam will be used to capture the user and show through the display. One laptop will be used to run the program [Fig 23]. The final concept design was made with Autodesk 3D Maya all of the models are free which can be found in **Appendix A**.



**Fig 23.** Final concept design made with Autodesk 3D Maya.

# Chapter 5. Specification

## 5.1 Lo-fi Prototype Requirements

**Table 2** shows the requirements for the lo-fi prototype. These requirements are selected and categorized using the MoSCoW technique mentioned in **section 3.1.1**.

Category	Requirement
<b>Must</b>	It must have the capability to user response for future research and improvements
	The prototype must be easy to use
	The prototype must provide the concept of the final prototype and easy to understand
<b>Should</b>	The prototype should promote body positivity, ultimately leading users to think about a healthier future
	The prototype should show the dilemma of whether body positivity leads users to think about a healthy future or to be satisfied with users current status
	It should provide real-time feedback to users based on their interactions to keep them engaged and informed
<b>Could</b>	Ensuring it can be easily installed and relocated if needed
	The prototype could allow participants to suggest ideas
<b>Won't</b>	The installation won't have a complex setup process that requires specialized skills or equipment.
	The installation won't promote discrimination and blame against users by expressing them ridiculously
	The installation won't store personal data to ensure user privacy and comply with data protection regulations.



**Table 2.** MoSCoW analysis of lo-fi prototype requirements

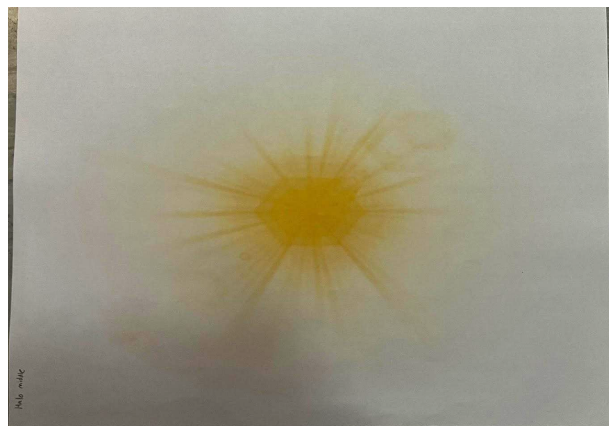
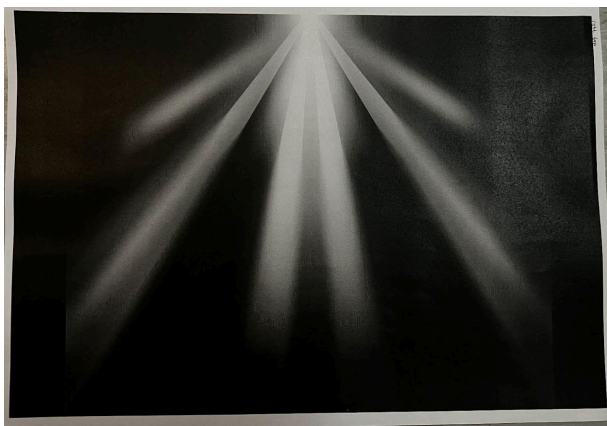
## 5.2 Lo-fi Prototype

To test the concept of the Hi-fi prototype, lo-fi prototypes were made physically. The purpose of the lo-fi prototype is to get an insight into the user experience of the installation concept. With the data collected, the final concept will be revised. This prototype showcases the concept of the installation by providing images to users. It consists of one mirror, two light images for positive feedback, and three crack-effect images for negative feedback.

Participants will be asked to look into the mirror and describe their reflection in the glass. Depending on the participant's answers, the instructor will provide the feedback images. If the participant describes himself/herself positively, a positive feedback image will be displayed as shown in **Fig 25**. There are two positive feedback images in total. One is a spotlight coming down from above, and the other is a halo created from behind the user. If a participant talks negatively about himself/herself. In that case, the negative feedback image will be provided as shown in **Fig 26**. There are also two types of negative feedback images, one that breaks from the user's back and one that breaks from the edge of the mirror. The source image link can be found in **Appendix A**.



**Fig 24.** Lo-fi Prototype Mirror



**Fig 25.** Positive Feedback Images



**Fig 26.** Negative Feedback Images

### 5.3 Lo-fi test

During the lo-fi test session, participants will be randomly recruited around the Xior Student Building, Enschede. The user testing will target the 20~50 age group with no other limitations. In the lo-fi test, five participants will be recruited to test the lo-fi prototype. The testing of the prototype will take 5~10 minutes.

Before the test, participants will receive an information letter and consent form [**Appendix G**]. Then participants will be asked to test the prototype. During the interaction, all of the input will be recorded by the researcher. After the testing session, the interview session will be started and the following questions will be asked to participants. The interview session will take 15 minutes.

#### Questionnaires

1. How would you describe your overall experience using the prototype?
2. What did you like about the prototype and why?
3. What did you don't like about the prototype and why?
4. Which do you feel more positive about, Spotlight or Halo?
5. Which is more negative, an effect that breaks at the end or an effect that breaks in the middle?
6. Did the prototype increase or decrease your body positivity and why?
7. After testing the prototype do you think you want to improve your health or appearance?

8. Did you recognize the dilemma of whether body positivity leads you to participate in health interventions or to be satisfied with your current status and avoid participating?
9. Were there any parts of the prototype that you found unclear or challenging?
10. Do you have any opinion or recommendation for the lo-fi prototype?

### 5.3.1 Test Results

The results of the test are written in **Table 3**. Evaluation and implication of user test will be discussed in the next section based on the answers in **Table 3**.

	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
Q1	By using this prototype, I realized that I think negatively about myself	Now I've gained weight, so I said negative about myself, and the mirror broke. Instead of saying something positive, I thought, I should make no reason for the glass to break. I wanted to try the prototype again the next time after I lost weight	I just explained my appearance neutrally and nothing really happened	By describing myself I found my strength and weakness	I've always used mirrors to look at my appearance, but never to reflect on myself, but this prototype allowed me to analyze myself.
Q2	I like the idea that the mirror gives real-time feedback based on my input. People often feel negative about themselves in general, and the project seems to improve that	It was good to see myself objectively, and the negative feedback from the mirror crack was motivating to lose weight	It was nice to see how I think of myself	It was nice to know how I feel about myself	I like the idea of using mirrors
Q3	There could be a possibility that the project might have too much confidence for the individual	I didn't know when the installation would end	I found no reason to use this installation	The prototype couldn't directly impact my life.	I was embarrassed to explain myself in front of others
Q4	I prefer the spotlight, it makes me more special	Spotlight felt more positive	I like both spotlight and halo	I like spotlight	I like spotlight
Q5	A crack from the middle gives me more shock	Crack from the edge made me more motivated	A crack from the middle felt more negative	I prefer crack from the edge	I think it's more realistic to see it breaking down from the outside.
Q6	Yes, also hi-fi prototype would be more effective	No, but there is a potential	No, I got no feedback	Yes, my describing myself positively it helped me to increase body positivity	Yes, I think body positivity will increase by describing myself positively and seeing feedback
Q7	Yes, I gained a	Yes, of course	No	Yes, I want to	Yes

	mindset to love myself I want to learn more about how to love myself			improve my strength and work on my weaknesses	
Q8	Yes	Yes, body positivity can improve self-efficacy but it could interrupt self-objectification.	-	Yes	No, I am always positive and try to make progress so there was no dilemma for me
Q9	No	Yes, I didn't know when the installation would end	I described myself as neutral, so it was unclear because I didn't get any feedback from the prototype	If someone who has low self-efficacy and speaks negatively about themselves, it can actually worsen their self-efficacy. The challenge is to address this.	No
Q10	To solve the dilemma, if an unhealthy participant uses the installation make the mirror red to show that the participant is in an unhealthy status	Maybe add an end button where the user can end the interaction	I wish there were more specific questions at the beginning rather than asking me to describe myself	No	If the installation is going to be in a public place, it should be attractive (You can use LED). It would be nice to have more detailed questions at the beginning. For example, describe something you don't like or weakness about yourself and something you like or strength about yourself for 30 seconds each. If the user only talks about their disadvantages, it would be nice to comfort the user

**Table 3.** Lo-fi test interview result

### 5.3.2 Evaluation and Implication

Before testing the lo-fi, all participants were expected to describe their external appearance. But during the test, they utilized the installation in unique way. All of the participants started by describing their external appearance. **Participant 1** explained his psychological status by linking with his eyes. He explained that his clear eyes make him look trustworthy and it represents his healthy personality. Unlike other participants **Participant 2** approached the prototype negatively due to his current weight status, he explained that negative feedback makes him motivated and he wanted to remove negative aspects of him. He added he wanted to use the installation once again after losing weight. Additionally, **participant 2** was confused about when to stop using the installation. He suggested the need for a clear endpoint in the interaction. **Participant 3** described himself neutrally, which did not trigger

any feedback from the prototype. The installation requires positive or negative input to give feedback to the user. He understood the concept of the prototype but could not have full experience. He wanted detailed questions at the beginning rather than “Describe yourself reflected in the mirror”. **Participant 4** emphasized his strengths and weaknesses, using the prototype to gain a balanced perspective of himself. **Participant 5** felt the prototype was not attractive enough. He highlighted that the installation needs to be attractive if it's going to be displayed in public. Moreover, **participant 5** also recommended starting a detailed question to guide users.

Overall, Through lo-fi testing, it was proven that the prototype increases people's body positivity and successfully conveys the dilemma that can arise when body positivity is increased. The real-time feedback mechanism was appreciated for immediately reflecting the user's input and inducing self-analysis and potential behavioral change. The spotlight feedback was particularly favored, as it made participants feel special and positive. Most of the participants preferred a crack from the edge as a negative effect. A detailed description will be provided for the user to prevent situations where the prototype is unable to provide feedback by describing themselves neutrally. Moreover, an empowering phrase will be displayed at the end to let the user know when they finished using the prototype. One participant gave feedback that the prototype was not attractive enough when using a small mirror, so a large monitor will be utilized as a mirror, and to give users hardware-based feedback and to make it more attractive installing LED-like lighting will be considered.

## 5.4 Revised Final Prototype Requirements and Concept

By analyzing the results of lo-fi tests, I was able to gain insights and more understanding of the prototype requirements. The final requirement and concept will be re-created based on the feedback. In this section, the revised final prototype requirement and concept will be discussed.

### 5.4.1 Revisioned Final Prototype Concept

**Fig 27** shows the sketching of the final prototype concept. The prototype will consist of one big monitor and a webcam to make it like a mirror. A big monitor will give the user the feeling it is a big mirror and a webcam will be utilized to capture the user and display it on the monitor. The webcam contains a microphone so the prototype could capture the user's voice as input. The LED strip will be installed at the back of the monitor to make the prototype attractive and to give hardware feedback to the user. The prototype will consist of 4 stages: Startup Description, Negative Feedback, Positive Feedback, Ending

#### **Startup Description**

In the description stage, a two-faced head model will be displayed on the screen and it will give a description of the installation and ask the user to describe themselves.

Script: Welcome to Magic Mirror. Look inside the mirror and describe yourself

#### **Negative Feedback**

The two-faced model will ask the user to describe the user's weakness or what they don't like about themselves. When the user starts to describe themselves negatively, a mirror crack effect will appear on the screen.

Script: Tell me, what is your weakness or what you don't like about yourself

### Positive Feedback

After the screen is completely cracked, the two-faced mode will appear again and ask the user to explain their strength or what they like about themselves. When the user starts to describe themselves in a positive way, the mirror crack effect disappears and a spotlight effect gradually appears from above. As a result, the broken glass effect disappears completely and only the spotlight effect will remain on the screen.

Script: Then tell me about your strengths or what you like about yourself

### Ending

After the positive feedback stage, to increase body positivity and to let the user know that the installation is finished empowering phrase will be displayed on the screen.

Script: You are beautiful as you are always Love Yourself

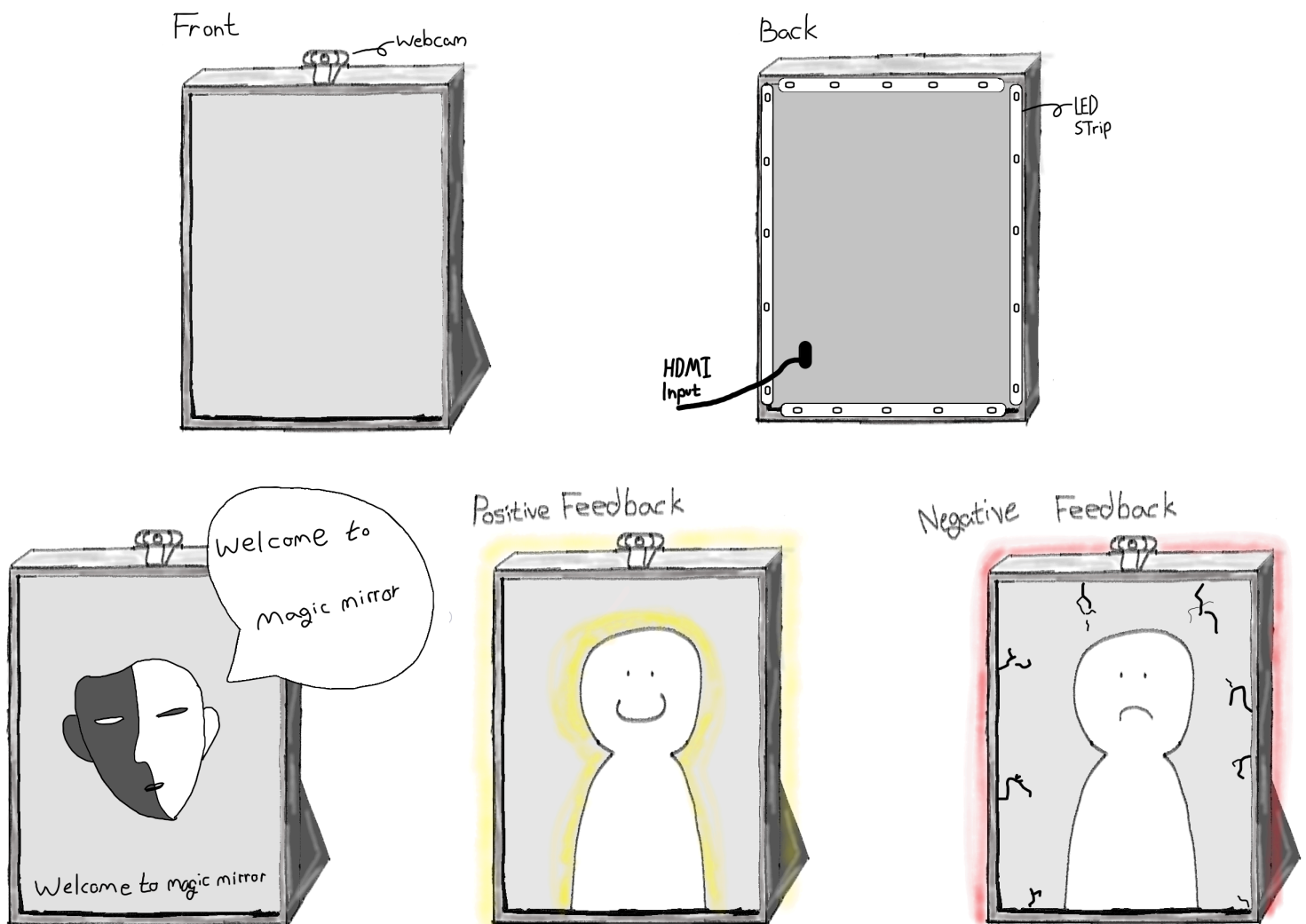


Fig 27. Sketching of Final Prototype Concept

## 5.4.2 Revised Final Prototype Requirements

**Table 2** shows the requirements for installation. Based on the feedback from the lo-fi user test in **section 5.2.2**, requirements are selected and categorized using the MoSCoW technique mentioned in **section 3.1.1**.

Category	Requirement
<b>Must</b>	The installation must include interactive elements such as sensors, and motion tracking to engage users actively and enhance their experience.
	The installation must be visually appealing and noticeable in public spaces to capture the attention of the public and encourage participation
	The installation must be durable and easy to maintain to withstand public use and environmental factors
<b>Should</b>	The installation should support multiple languages to be accessible to a diverse audience.
	It should offer a customizable experience based on the user's input, allowing for a more personalized interaction
	The installation should promote body positivity, ultimately leading users to think about a healthier future
	The installation should show the dilemma of whether body positivity leads users to think about a healthy future or to be satisfied with users current status
	It should provide real-time feedback to users based on their interactions to keep them engaged and informed
<b>Could</b>	The installation could include lighting elements to make the prototype more attractive and engaging
	It could integrate with social media platforms to allow users to share their experiences and spread experience about the installation and its message



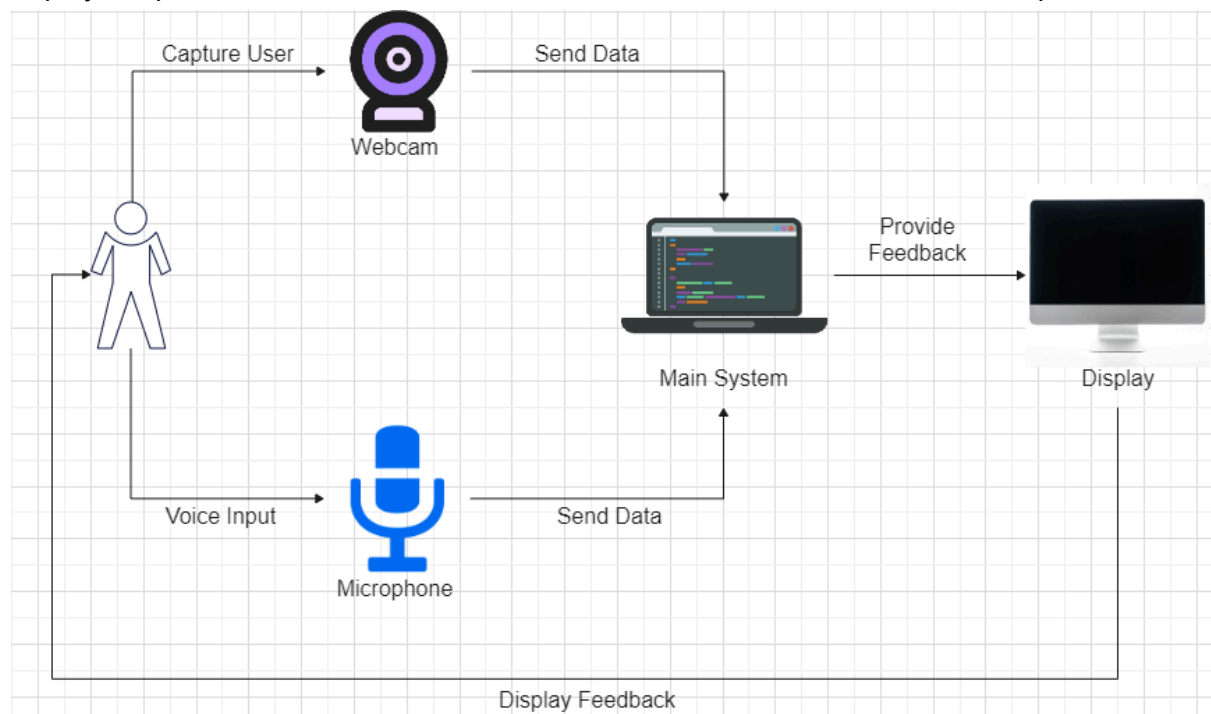
	There could be a companion mobile application that extends the experience beyond the physical installation
<b>Won't</b>	The installation won't have a complex setup process that requires specialized skills or equipment, ensuring it can be easily installed and relocated if needed
	The installation won't promote discrimination and blame against users by expressing them ridiculously
	The installation won't store personal data to ensure user privacy and comply with data protection regulations.

**Table 2.** MoSCoW analysis for requirements for installation

## 5.5 System Architecture

### 5.5.1 General System Architecture

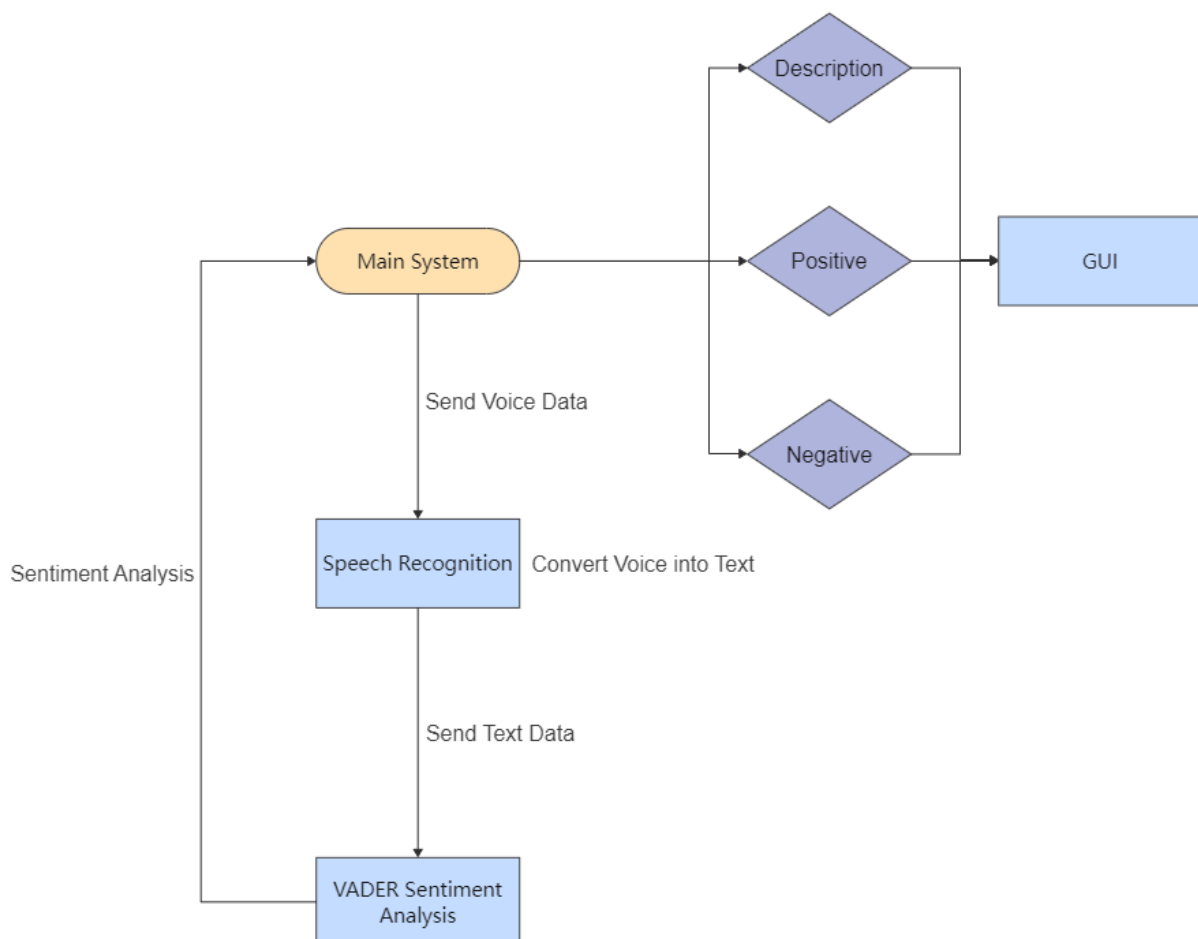
**Fig 28** shows the system architecture of the prototype. The webcam and microphone will capture the user (appearance) and the user's input (voice) and send it to the main system. The main system will be Python and a sub-system for analysis. The main system will analyze whether the user says positively or negatively and send feedback to display. The display will provide real-time instant feedback to the user based on the user's input.



**Fig 28.** System Architecture

## 5.5.2 Main System Architecture

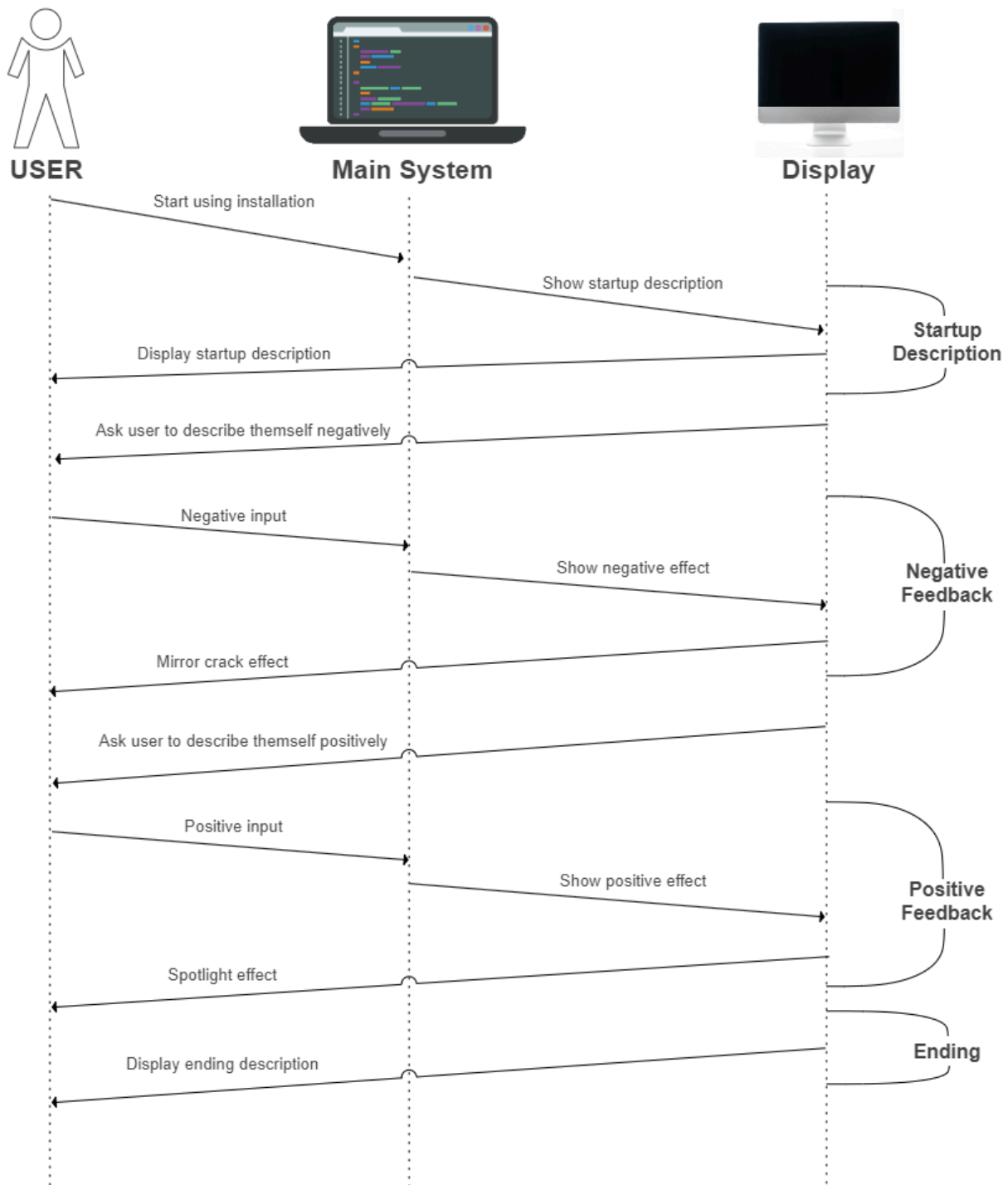
**Fig 29** illustrates the main system architecture, this section explains how the user's input is analyzed. First, the user's voice input will be sent to the Speech Recognition interpreter. This will convert voice into text and send it to VADER Sentiment Analysis. VADER uses a dictionary that includes emotion scores for specific words and phrases. This dictionary contains approximately 7,500 words and phrases, and each word is assigned a score that indicates the strength of the emotion. For example, "happy" has a positive score, while "sad" has a negative score. The input text is converted to lowercase and pre-processed to take into account punctuation, capitalization, exclamation points, etc. VADER detects elements in the text that intensify or weaken the emotion. Capital letters are considered to increase the intensity of emotion, so "HAPPY" is evaluated as a stronger positive emotion than "happy". Punctuation marks especially exclamation marks are used to increase the intensity of emotion. "Happy!!!" is evaluated as a stronger positive emotion than "happy". The total emotional score (compound score) is calculated by adding up the emotional scores of each word and phrase in the text. A compound score greater than 0.05 is considered positive, a score less than -0.05 is considered negative, and anything else is considered neutral. Based on the VADER Sentiment Analysis, the main system will display the effect on the GUI.



**Fig 29.** Main System Architecture

### 5.5.3 Time Sequence Diagram

**Fig 30** displays the interactions and flow of events between the User, Main System, and Display explained in **section 5.4.1**. When the user starts using the installation the main system command to display the startup description and asks the user to describe themselves negatively. Then the user will describe their weakness or what they don't like about themselves. Then the main system(Speech Recognition, VADER Sentiment Analysis) will analyze the user's voice input. If the user describes negatively display will show a mirror crack effect on the screen. Then display will show a description asking the user to describe themselves positively. Then the user will describe their strength or what they like about themselves. The user's input will be analyzed again and the spotlight effect will be displayed based on the input. Lastly, the empowering phase will be displayed to let the user know that the installation is finished.



**Fig 30.** Time Sequence Diagram

## Chapter 6. Realization

In this chapter, the realization of the project will be explained. Hardware and software materials are used based on the final concept in **section 5.4.1**. First hardware will be explained, and then software will be followed.

## 6.1 Hardware

Hardware is a crucial component of the project in order to capture the user's appearance and input and display the user and the feedback. This section will explain what hardware was utilized.

### 6.1.1 Display

At first, the 14.5-inch monitor was used which is built into laptop computers [Fig 31]. As a result, it felt more like a laptop monitor than a mirror. Normally, mirrors are longer vertically than horizontally, so a large monitor is decided to use vertically to give users the feeling of a mirror. Therefore, the Crossover 279Q7 monitor was used. This monitor has a 27-inch display with a resolution of 2560x1440.



**Fig 31.** Crossover 279Q7 Monitor

### 6.1.2 Webcam

To capture the user, the Taxon Trust QHD Webcam in Fig 32 will be used. Since a 27-inch 2560x1440 monitor is used, the webcam should support 2560x1440 resolution for a clear screen. This webcam provides QHD 2560x1440 / 30 fps video with a diagonal 80-degree field of view. Moreover, there are two built-in microphones, and a webcam will capture the user's voice input.



**Fig 32.** Taxon Trust QHD Webcam

### 6.1.3 Laptop

The laptop shown in **Fig 33** is used to operate and utilize Python. This program requires powerful specifications in order to overlay photos, effects, and videos on top of a webcam screen. The Yoga Pro 7i has good specifications for its size, so it meets the requirements.



**Fig 33.** LENOVO Yoga Pro 7 14IRH8

## 6.2 Software

### 6.2.1 Python

All programs of the prototype will be built with Python utilizing OpenCV (**Fig 34**). The written code in Python is attached in **Appendix B, C**. The utilized Python Interpreter will be explained below (**Table 5**).

Python Interpreter	Explanation
OpenCV	Vision library that captures webcam stream handle images and is utilized to overlay.
Pygame	To play sound effects and voice-over
PIL	It is used to open, convert, and convert to NumPy arrays
ffpyplayer	Used for playing video and audio
Tkinter	Used to create GUI(Graphical User Interface)
SpeechRecognition	Recognizes and converts audio to text
VADER Sentiment Analysis	Analyze text to evaluate emotions

**Table 5.** Used Python Interpreter



**Fig 34.** Python and OpenCV

### 6.2.2 Adobe After Effect

To make subtitles with a particle effect Adobe After Effect was used [**Fig 35**]. All subtitles appear from left to right, and when they disappear, a particle effect is used to give a feeling like smoke or sand [**Fig 36**]. The subtitle video can be viewed with the Youtube link in **Appendix D**.



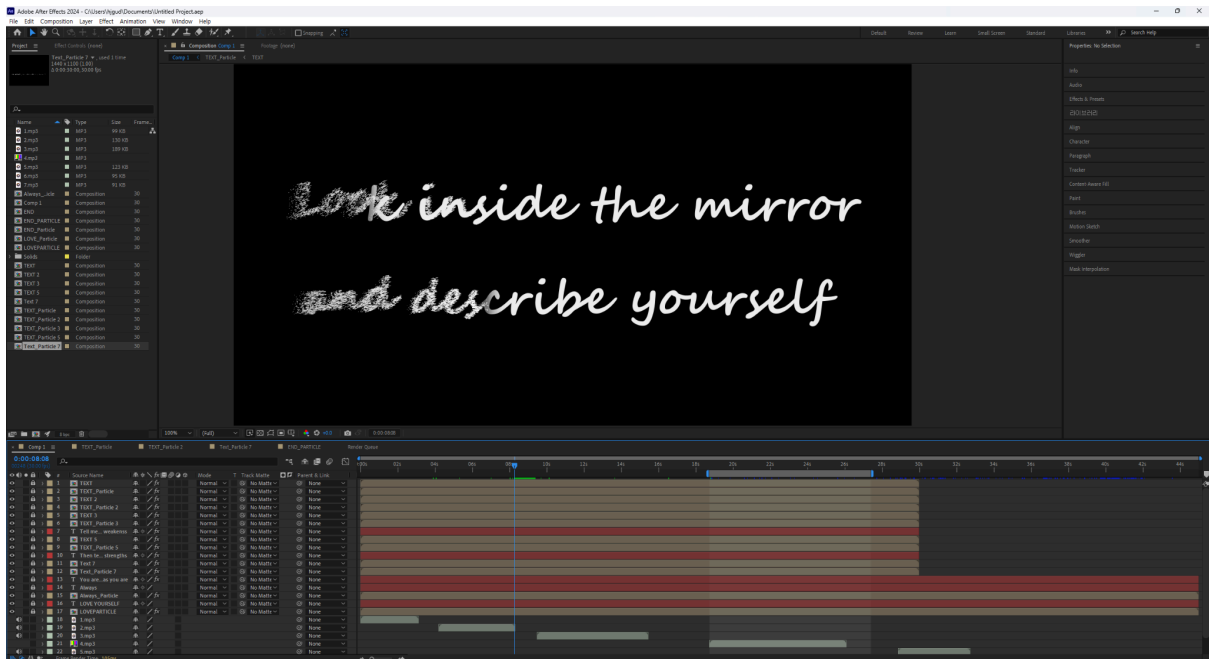


Fig 35. Adobe After Effect

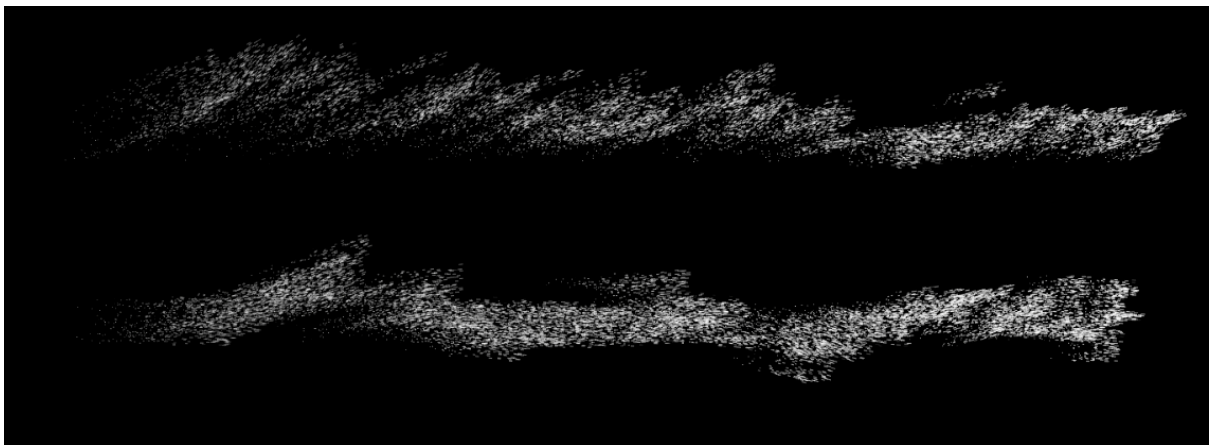
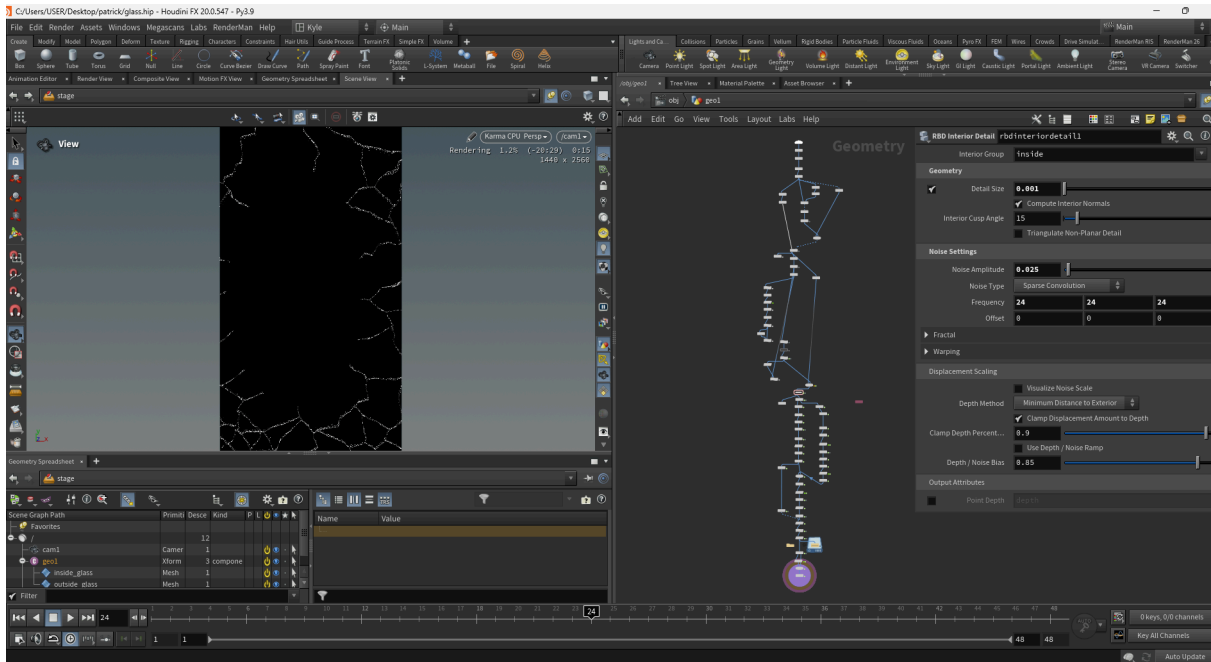


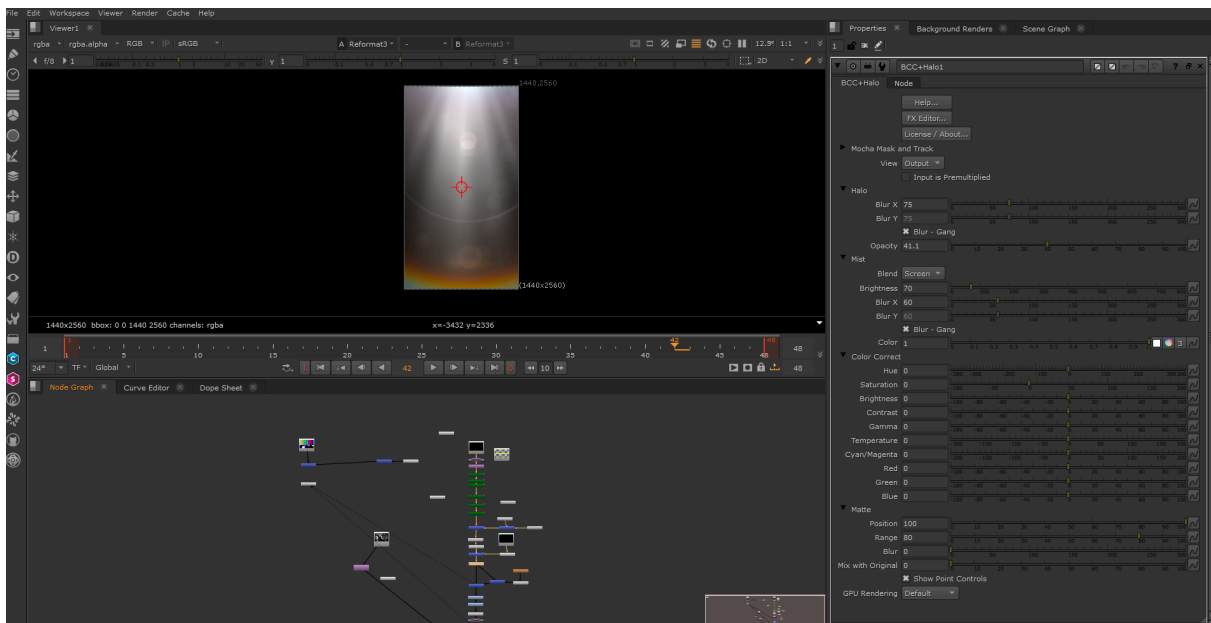
Fig 36. Disappearing Effect

### 6.2.3 Houdini

Mirror crack effects and spotlight sound effects were made with Houdini. The mirror cracking effect gradually breaks the glass from the edge of the screen towards the center [Fig 37]. The spotlight effect descends from the top to the bottom of the screen. The intensity of the light increases the more positive words the user says [Fig 38]. To maximize the positive effect, a lens flare effect is displayed together. All effects are rendered as 48 PNG files to display them in 4 stages. Using the PIL library in Python, the PNG files are played sequentially in groups of 12. All of the effects can be viewed with the link YouTube link in Appendix E.



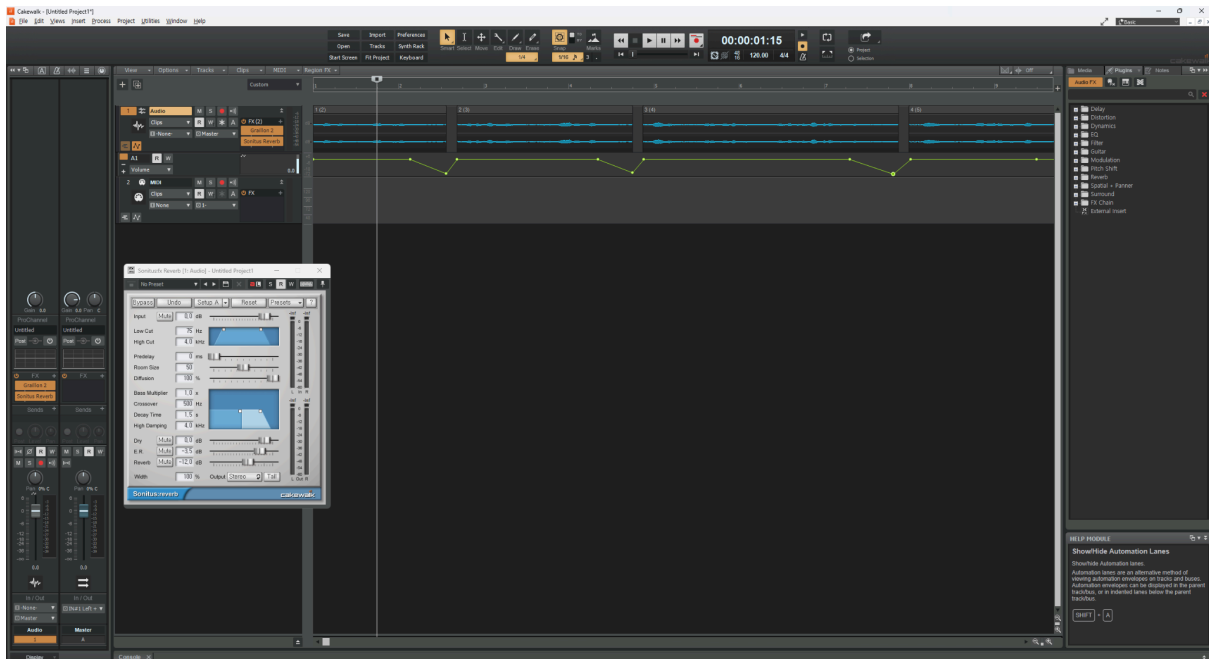
**Fig 37.** Mirror cracking Effect made with Houdini(Negative Effect)



**Fig 38.** Spotlight Effect made with Houdini(Positive Effect)

## 6.2.4 Cakewalk

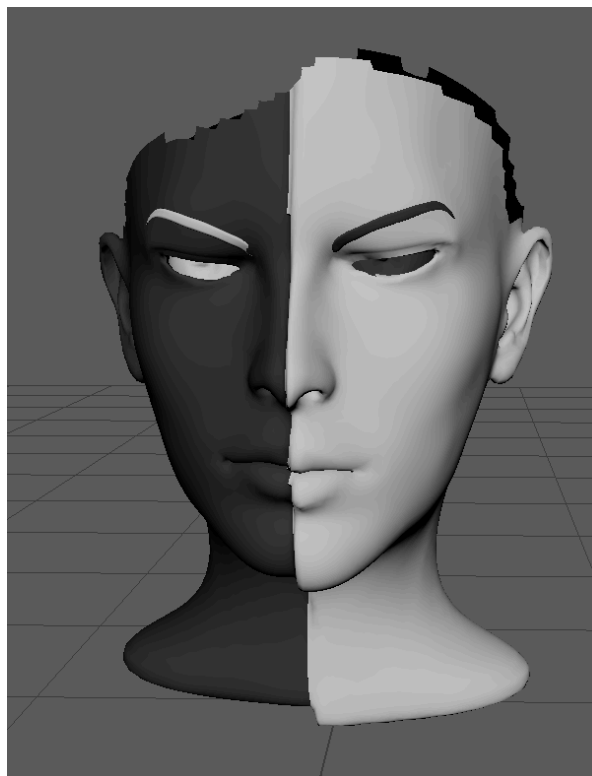
To make a voice overlay for the subtitle and sound effects for the mirror crack and spotlight Cakewalk was used [Fig 39]. For the voiceover Sonitus Reverb and Grallion 2 plugin were utilized to make the voice mysterious. Fade-in and out effects were applied for all of the sounds. Voiceover was recorded by myself and the source of the negative and positive sound effects can be checked in **Appendix F**.



**Fig 39.** Sound effects and voiceover made with Cakewalk

### 6.2.5 Autodesk 3D Maya

A two-faced model was made with Autodesk 3D Maya [Fig 40]. A mouth-moving animation was created and the model's mouth was in sync with the voice-over.



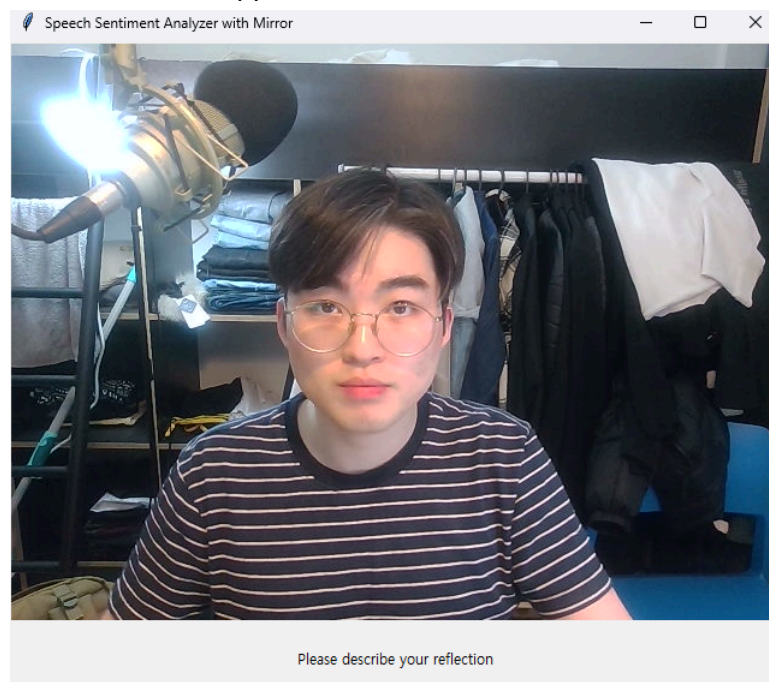
**Fig 40.** Two-faced model created with Autodesk 3D Maya

## 6.3 Hi-fi Prototype

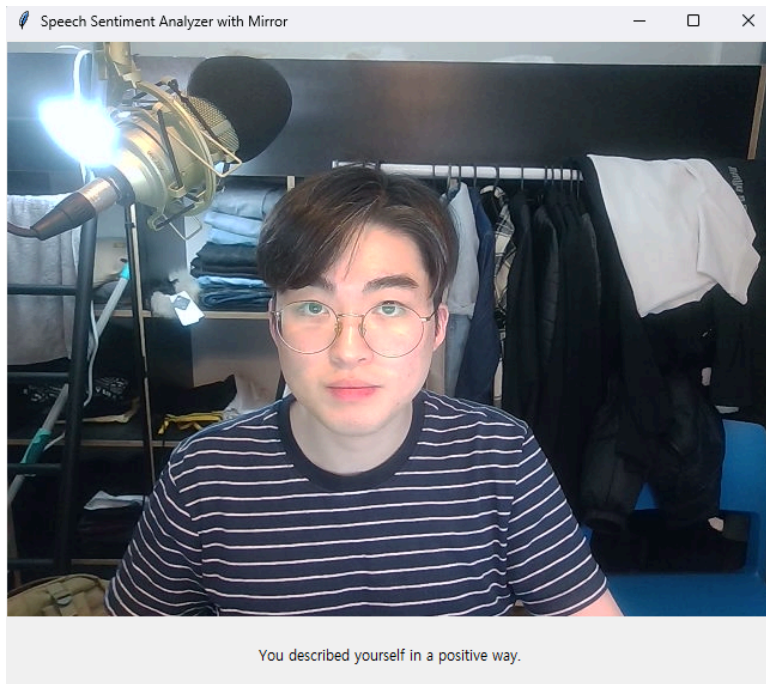
All of the materials were integrated into one program. However there were two practical problems First, because of overlaying multiple images and videos on the webcam at the same time, there was a performance problem with the processing video in Python. Python was not enough to handle multiple heavy events at once so it caused a freezing screen with the two-faced model animation. So with the hi-fi prototype two-faced model animation will be deleted. To address this problem using Unity as a program seems a better solution than Python. Unity is often used to make a game so it will be more capable of handling videos and images. The second problem was with voice recognition. The program requires time to analyze the user's voice input so it can't provide instant real-time feedback to the user. So voice recognition will be excluded from the hi-fi prototype evaluation. To give real-time feedback on the Wizard of Oz technique will be used. The Wizard of Oz technique allows designers to prototype and evaluate interfaces without having a fully functional system [33]. By manually controlling the system's response to user input, it is possible to make the system appear automated [33]. Mouse left click will display a negative effect and right click will display a positive effect.

### 6.3.1 Voice Recognition

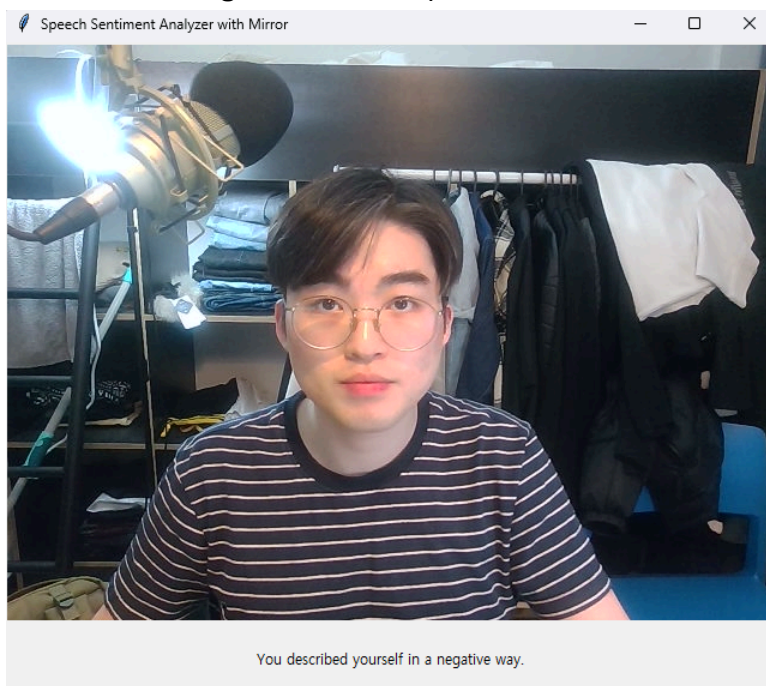
**Fig 41** shows the start screen of the voice recognition it detects the user's voice input and analyzes it. **Fig 42** shows that users have said positively and **Fig 43** shows that users have said negatively. This method will applied to the main code.



**Fig 41.** Voice Recognition



**Fig 42. Positive input detected**



**Fig 43. Negative input detected**



### 6.3.2 Performance

#### Startup Description

**Fig 44** shows the startup description explained in **section 5.4.1** it gives a welcome message to the user and explaining the user that they need to describe themselves. All of the description is displayed at the bottom of the screen with a voiceover.



**Figure 44.** Startup Description

## Negative Feedback

**Fig 45** shows a subtitle asking the user to describe the user's weakness or what they don't like about themselves explained in **section 5.4.1**.



**Fig 45.** Asking Negative Input

After the user makes a negative comment about themselves, the screen will break [**Fig 46**]. There are a total of four stages of mirror cracking effects, and each time the user makes a negative comment, an effect will be displayed.

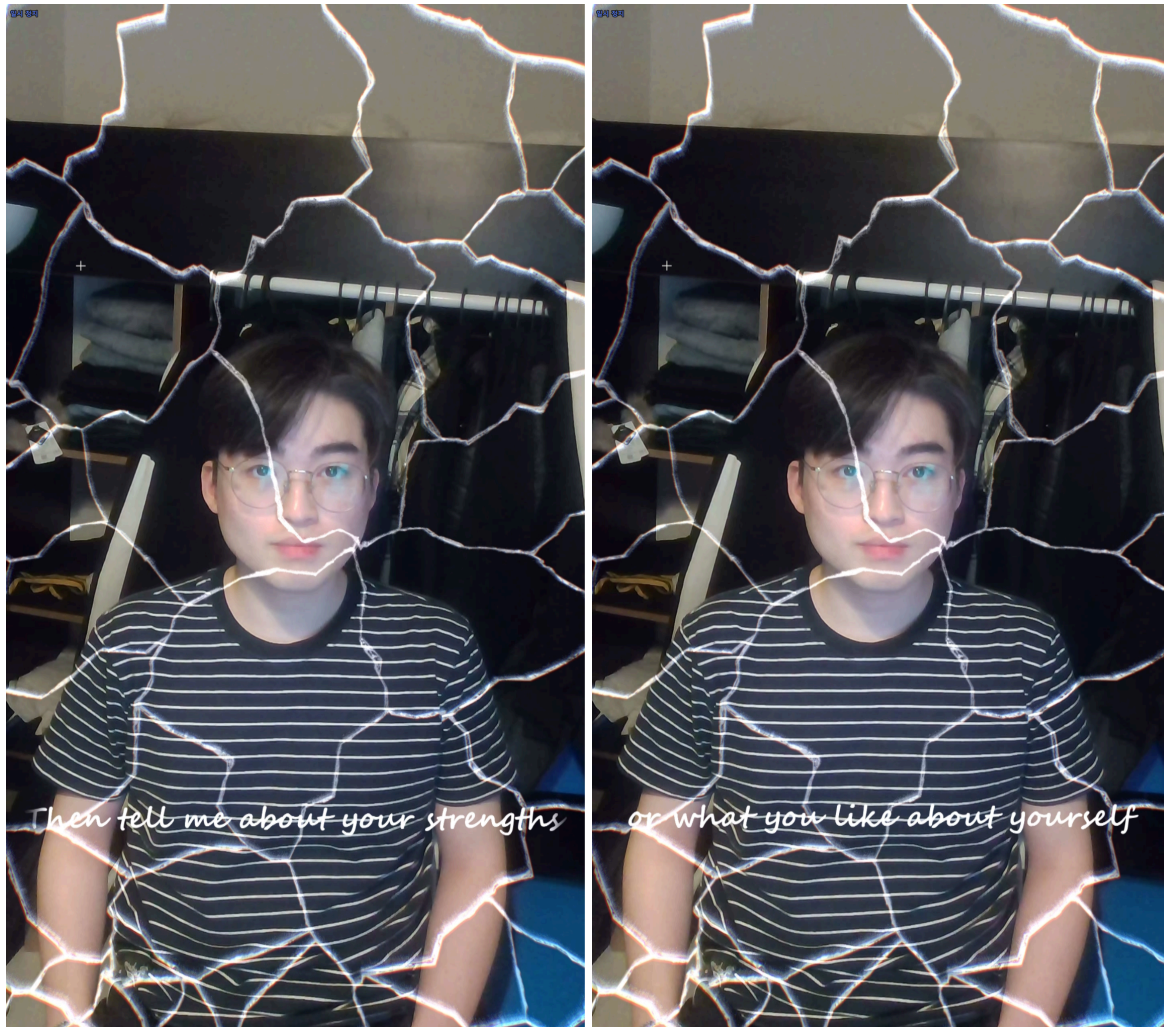




**Fig 46.** Mirror Cracking Effect

### Positive effect

After the screen is completely cracked, the positive effect stage will begin. **Fig 45** shows a subtitle asking the user to describe the user's strengths or what they like about themselves explained in **section 5.4.1**.



**Fig 47.** Asking Positive Input

After the user makes a positive comment about themselves, the mirror crack effect disappears and a spotlight effect gradually appears from above [**Fig 48**]. Each time the user makes a positive comment, the intensity of the light will increase in four stages, and the mirror crack effect will disappear. Consequently, the broken glass effect disappears completely and only the spotlight effect will remain on the screen.





Fig 48. Spotlight Effect

### Ending

Finally, when the mirror crack effect disappears and the intensity of the spotlight effect reaches its maximum value, an empowering phrase appears on the screen to inform the user that the installation is over and to increase body positivity explained in **section 5.4.1**. [Fig 49].

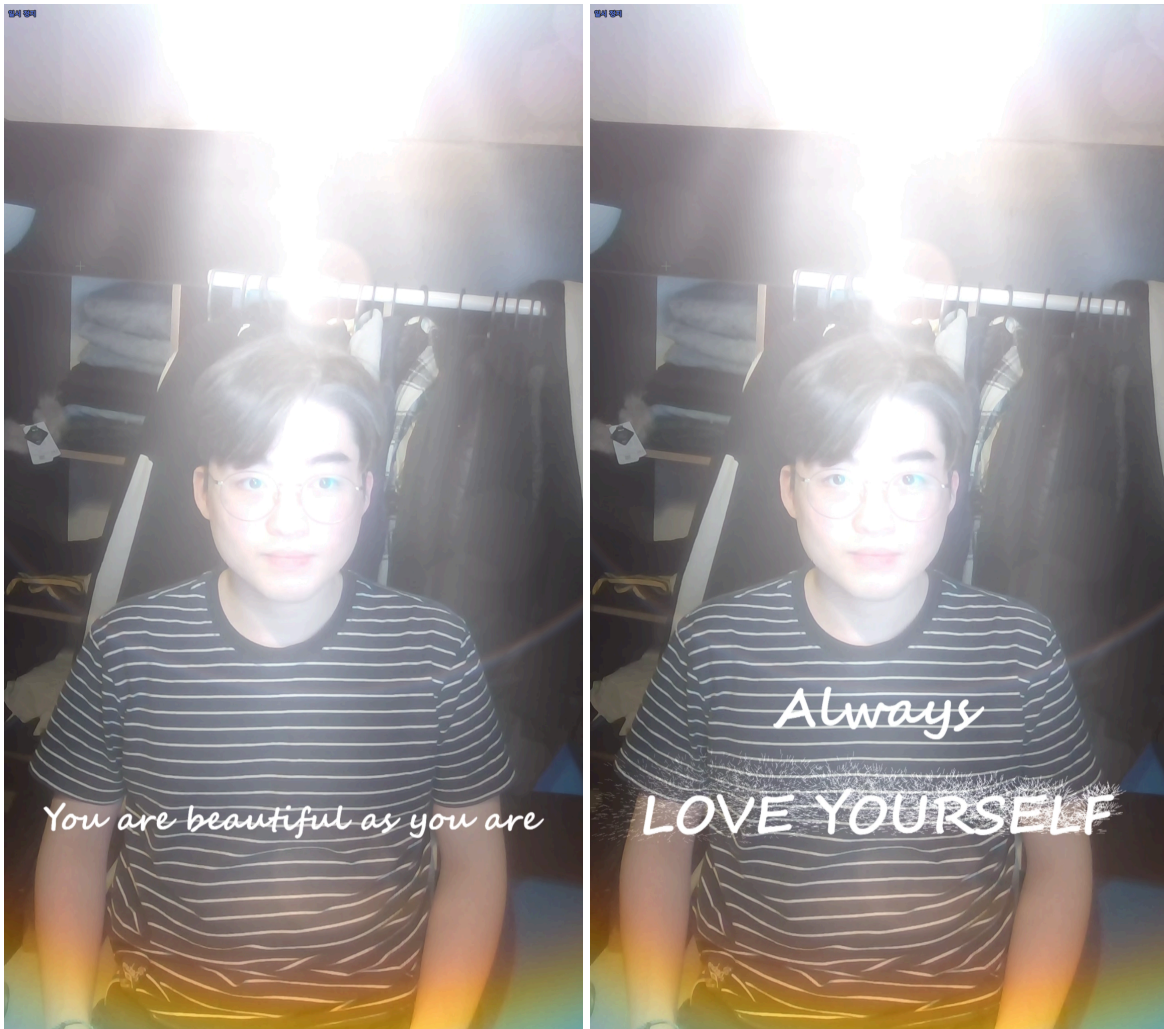


Fig 49. Empowering Phase

## 6.4 Final Prototype Requirements Review

**Table 6** evaluates whether the created hi-fi prototype meets the final prototype requirements in **Section 5.4.2**. '○' means the prototype met the requirements, '△' partially met, and '×' did not meet the requirements. This table not only evaluates whether the pre-created requirements were met but also evaluates what is currently lacking in this prototype to access future improvements.

Category	Requirement	Result

<b>Must</b>	The installation must include interactive elements such as sensors, and motion tracking to engage users actively and enhance their experience.	○
	The installation must be visually appealing and noticeable in public spaces to capture the attention of the public and encourage participation	△
	The installation must be durable and easy to maintain to withstand public use and environmental factors	○
<b>Should</b>	The installation should support multiple languages to be accessible to a diverse audience.	×
	It should offer a customizable experience based on the user's input, allowing for a more personalized interaction	△
	The installation should promote body positivity, ultimately leading users to think about a healthier future	○
	The installation should show the dilemma of whether body positivity leads users to think about a healthy future or to be satisfied with users current status	○
	It should provide real-time feedback to users based on their interactions to keep them engaged and informed	○
<b>Could</b>	The installation could include lighting elements to make the prototype more attractive and engaging	×
	It could integrate with social media platforms to allow users to share their experiences and spread experience about the installation and its message	×
	There could be a companion mobile application that extends the experience beyond the physical installation	×
<b>Won't</b>	The installation won't have a complex setup process that requires specialized skills or equipment, ensuring it can be easily installed and relocated if needed	○
	The installation won't promote discrimination and blame against users by expressing them ridiculously	○
	The installation won't store personal data to ensure user privacy and comply with data protection regulations.	○

**Table 6.** Final Prototype Requirements Review

## Chapter 7. Evaluation

In this chapter, the evaluation of this project will be discussed. The goal of the evaluation is to investigate whether the high-fi prototype achieved the goals of this project through user testing. Evaluation will focus on whether the prototype increases people's body positivity, addresses dilemmas related to body positivity, and checks whether the user feedback received during the lo-fi prototype test in **section 5.3** has been reflected.

### 7.1 Hi-fi Test

#### 7.1.1 Setup

As the prototype will ultimately be created in the form of an installation that anyone in a public place can use, the main target group was set as students passing through during lunch break (12:30~13:30). In addition, due to the characteristic of public places, many users will use the installation in a short period of time, so approximately 30 participants will be recruited for user testing. The test will be conducted over 5 days, with 6 people tested each day. First, the researcher will explain the project goals and the prototype. Then, participants will be asked to test the prototype. The testing of the prototype will take about 5~10 minutes. After the testing session, the researcher will conduct a short interview to ask participants questions. The interview session will take 5~10 minutes. Following interview questions were generated to gain feedback and insight from various perspectives of the participants.

#### Questionnaires

1. How would you describe your overall experience using the prototype?
2. What did you like about the prototype?
3. What did you don't like about the prototype or found challenging?
4. While using the prototype, did you feel offended or find any discrimination?
5. Did the prototype increase or decrease your body positivity and why?
6. After testing the prototype do you think you want to improve yourself?
7. Did you recognize the dilemma of whether body positivity leads you to participate in health interventions or to be satisfied with your current status and avoid participating?
8. Were there any parts of the prototype that you found unclear?

**Q1** is designed to identify the overall user experience by asking users to explain their participation. **Q2** and **Q3** are aimed at getting detailed opinions of users. By identifying what users like and dislike, this data can be used for future prototype improvement. The prototype asks users to look at the mirror and describe themselves. This task could be an easy task for some people, but some people can feel very difficult, offended, or discriminated. Therefore, **Q4** is checking whether it had a negative impact on users. **Q5** is related to the main goal of the prototype. **Q5** aims to find out whether the prototype increased the user's body positivity. **Q6** makes the connection between body positivity and healthy life. Through this question, it is possible to check whether body positivity leads people to have healthier lives, as discussed in **section 2.5**. **Q7** is a question to check whether the prototype conveyed the



dilemma of body positivity to the user. Q8 can be used to analyze future work by asking whether users find it unclear or challenging.

### Venue

The University of Twente, Smart XP has been selected as the installation location. This location is where many students pass through during lunchtime and has a free atmosphere. The prototype will be installed on a desk on the second floor of Smart XP [Fig 50], and students passing through will be asked to participate in user testing.



**Fig 50.** Hi-fi Prototype Testing Setup in Smart XP

### 7.1.2 Procedure

Before starting the test participants received an information letter consent form. Then, the researcher informed about the project goal, prototype, and test procedure. Participants were informed that this prototype was designed to be installed in public places and be used by people casually. The researcher informed participants that the number of obese people is increasing and people's general health is deteriorating. So the project aimed to increase people's body positivity to improve self-efficacy and promote self-love, ultimately encouraging people to have healthier lives.

Then, participants are informed that the prototype will ask users to explain themselves through a mirror-like display device. When explaining themselves, users are allowed to



explain their appearance, personality, and inner characteristics. Participants were explained that they would first be asked to give a negative description of themselves, and then a positive description. Since negative and positive effects have three stages, participants were requested to describe their three negative aspects and three positive aspects.

During the testing session, the Wizard of Oz technique will be utilized to control the feedback. It will be used because voice recognition does not have 100 percent accuracy in detecting and it takes time to analyze the user's input so it is not capable to give instant feedback to the user. Without the participants knowing, the researcher will control the feedback effect by using the mouse-click method.

Lastly, the researcher informed participants there would be a short interview session. The procedure for evaluating the Hi-Fi prototype is as follows.

1. Providing information letter and consent form to participant
2. Explain the project goal, the hi-fi prototype, and the test procedure
3. Participant start testing
4. Participants describe as negative (negative feedback displayed)
5. Participants describe as positive (positive feedback displayed)
6. Finish the test
7. Interview session

## 7.2 Results

The hi-fi prototype user testing was conducted with a total of 30 participants, primarily university students aged 20~30 [Fig 51]. 75% of the participants were male and 25% were female. Only two of the 30 participants were overweight. It was not easy to find overweight participants, so there was a lack of data on the overweight population. There were no other restrictions. The main findings from this group are summarized below:

### **Overall Experience:**

Approximately 80% of participants reported a positive overall experience using the prototype. Mainly they described it as an **“idea was impressive”, “the prototype was fun to use”, “well made”, and “easy to use”**. Most of them liked that the prototype made them think about their strengths and weaknesses.

### **Positive Aspects:**

Participants appreciated various elements of the prototype. The visual effects and instant feedback system were particularly favored, with comments like **“The instructions were clear, I like the mirror idea. I like the effects,”** and **“The sound effects, mystery voice, and camera were good quality, and the animations and text effects were really cool.”**

### **Challenges and Negative Aspects:**

Participants tested the prototype in a public space. So the researcher was watching them testing the prototype and there were pedestrians. Some participants found it difficult to describe themselves in front of others. They also said it was difficult because they don't usually think deeply about themselves. This was noted with comments such as **"It was hard to describe myself in front of other people."**, **"It was hard to look at myself and describe"** and **"It was hard to describe myself because I usually don't think about myself."** A few also mentioned issues with the color contrast between subtitles and effects, making the text hard to read.

### **Offended or find any discrimination**

All of the participants answered they were not offended or found any discrimination. Some of the participants had difficulty using the prototype in public space but did not get emotionally harmed.

### **Increasing Body Positivity and Desire for Self-Improvement:**

The prototype was successful in increasing body positivity among the participants.

Approximately 75% of people said their body positivity has increased and they want to improve themselves after using the prototype, with comments like **"It increased my body positivity, and the real-time feedback made me immersive"**, **"Yes, by saying my strength, it increased my body positivity."** and **"I would like to improve my weakness."**

25% of people said there was no difference in using the prototype just once, but most of them gave feedback that if they use this regularly like a diary, then they think their body positivity will increase.

### **Recognition of Dilemma:**

Approximately 60% of participants answered that they had realized the dilemma of body positivity and health interventions. Most of them highlighted that body positivity is essential and should lead to healthier lifestyle choices.

### **Suggestions for Improvement:**

There was minor feedback from participants suggesting improvements. First, there was feedback about visibility. Currently, the description text color and negative feedback effect are both white as seen in **sections 6.2.2 and 6.2.3**. Some participants said that the subtitles were difficult to see because of the overlap of these two effects. Moreover, there was a situation when participants wore white colored cloth makes hard to read the description. Therefore, it is necessary to modify these two colors to improve readability. Second, adding more effects. Most of the participants liked the effects of positive and negative but some participants wanted more engaging effects. They didn't ask for specific effects but wanted more effects. Lastly, one participant suggested, **"It will be great if the prototype gives me a solution to improve myself"**.

Overall, the results of testing indicate that the hi-fi prototype promoted a positive positivity and most participants expressed a desire to improve themselves. It also encouraged people to think about their strengths and weaknesses, creating a new point of discussion for those who don't usually think about themselves. However, the challenges and suggestions for improvement suggest areas that need to be improved in future work.



**Fig 51.** Hi-fi testing in Smart XP

## Chapter 8. Discussion

### 8.1 Discussion

The Hi-Fi prototype was evaluated to assess its effectiveness in promoting body positivity and determine whether it successfully conveyed the dilemma which is the project's goal. The overall evaluation results showed that the participants were very satisfied with the prototype experience. The majority of participants reported a positive experience, appreciating the interactive elements, real-time feedback, and impressive concepts. The most important element of the prototype, real-time feedback based on participant input, was highly rated, indicating that the prototype worked as designed.

Using the prototype, most people (around 75%) said that their body positivity has been increased. They also said that they wanted to improve themselves after using the prototype. This confirmed that body positivity improves users and encourages them to live a healthier life. 25% of people reported that the prototype did not increase their body positivity. These people can be divided into two groups. One group already had a high body positivity and did not benefit from the installation. The other group said that there was no difference in using the prototype once. They added that the installation would be more effective if it were used more frequently in everyday life, like a diary.

Ozkaramanli and Desmet focus on whether a product design causes a dilemma that allows for self-reflection when evaluating a product [34]. They explained that conveying dilemmas can challenge existing ideas, enable self-reflection, and stimulate discussion among people [34]. By using this evaluation method Q6 was asked to participants. This question was designed to find out whether this prototype conveys dilemmas in which body positivity could

occur. This prototype differs from conventional obesity treatments and adopts a method that promotes body positivity and encourages people to make changes themselves. At the same time, there is a dilemma that body positivity may interfere with health interventions.

Approximately 60% of participants recognized the dilemma between body positivity and health interventions, acknowledging that not only increasing body positivity is important but also needs to lead to healthier lifestyle choices. Some participants emphasized that the current prototype promotes body positivity and conveys the dilemma, but does not guide people on how to make healthy lifestyle choices. The prototype was made to improve people's body positivity and convey the dilemma of making people think they have to change themselves. It was not designed to directly change people, so it does not need to provide a direct solution.

The prototype had a challenge in that it might pose a risk to the user. During the user experience, the prototype asks the user to look at themselves in the mirror and reflect on their appearance or personality in public space. This task might be easy but some people could find it very difficult or offended. Despite these concerns, all participants responded that they did not feel offended or discriminated against. This indicates that the prototype does not have any potential emotional problems.

During the testing, several areas for improvement were identified. First, the Wizard of Oz method was used and the participants were not informed to not distort the test result. Due to technical limitations, the researcher controlled the process of analyzing the user's input and displaying the feedback effect. Therefore, the researcher had to be present around the installation to use it. In the future, improve the accuracy and speed of speech recognition so that users can use the installation without any restrictions in public places. Secondly, there was a problem with the negative feedback effect impairing the legibility of the subtitles. This problem occurred because both the feedback effect and the color of the subtitles were white, so it is a problem that can be solved by changing the color.

Finally, it is expected that this installation can be developed as a mobile app to help users who have difficulty explaining themselves and users who have not experienced an increase in body positivity. By making a mobile app, that can be used in a private space, regular use of the app will also be effective in increasing body positivity.

This project takes a similar approach to mirror exposure therapy, but unlike this method, no interventionist is managing the patient, which frees it from the limitations described in **section 2.4**, which is that the patient's dropout rate increases when the interventionist changes during the program [14, 15, 18, 28]. It also has the strength that it differs from traditional methods for curing obesity. During the testing of the hi-fi prototype, people said that they had a hard time describing themselves because they don't usually think about themselves, and the installation made them think about this idea. Beyond the project's goals, it started a new discussion and gave people time to think about themselves. People who have low self-esteem or are dissatisfied with their bodies are less likely to look in the mirror [35, 36]. This installation had a positive impact on people by encouraging them to look at themselves in the mirror, objectify, and accept themselves.

## 8.2 Discussion Conclusion

The hi-fi prototype demonstrated the potential to increase body positivity and convey dilemmas to promote a healthier life. Key findings from the use evaluation indicate high levels of satisfaction with the interactive and innovative design and significant improvements in body positivity for many participants. The prototype effectively engaged users by providing real-time visual feedback based on their input. The recognition of the body positivity dilemma among participants also highlights the importance of balancing acceptance with health interventions. There were several areas for improvement, and these should be improved in the future for a better user experience.

In conclusion, the hi-fi prototype successfully achieved its goals of promoting body positivity and addressing dilemmas, demonstrating its value as a speculative design installation. The next section will organize and discuss the limitations and improvements of the current prototype.

## Chapter 9. Limitation and Future Work

During designing, building, and testing the prototype there were limitations identified. First, the study showed success in achieving the project's goal of increasing body positivity and conveying a dilemma to make people think about a healthier life. However, the project does not provide any guidance on how to live a healthy life. It only starts a discussion to think about a better future. The project was not intended to provide guidance but the guidance could be a solution to solve the obesity problem which the current project lacks. Secondly, the use evaluation was tested with only with university students, so it may not be representative of a wider audience. In addition, there is a lack of test data from people who suffer from obesity or being overweight. So the prototype couldn't be accurately tested whether is useful for people experiencing health problems. In the future, it will be necessary to test the prototype with participants from various groups, including those of different ages, cultural backgrounds, languages, and physical characteristics. This will provide more extensive feedback and discover unknown improvements that were not identified in this project. It will also provide accurate data on whether the current prototype is useful for people experiencing health problems. Moreover, the prototype only supports English, so non-English speaking users cannot use the installation due to a lack of multilingual support. there are people around the world who speak a variety of languages. To make installation more accessible to a wider range of people, it is necessary to support multiple languages. By changing subtitles and audio files with multiple languages, it would become more accessible to a wider range of people. Third, there was a limitation in user usage, some participants pointed out that using the prototype just once was not enough to have a significant impact on body positivity, and suggested that to achieve long-term results, it is necessary to participate regularly, like writing a diary. Furthermore, the use evaluation was conducted in public places, some participants had difficulty explaining themselves. Users said they had difficulty explaining their weaknesses or strengths in front of others. Installations in public places do not provide the privacy necessary for users to participate in the installation comfortably. To solve these limitations the mobile app version can provide a private space for users to reflect on themselves regularly. Using this app, users can take a photo of their smile every day to

create a visual diary, helping them to maintain a positive attitude over time. Regular use of the app can overcome the limitations of a single-use installation and improve long-term effectiveness. Fourth, there were technical limitations. The speech recognition system had problems processing user input accurately and quickly. As a result, the Oz Wizard method had to be used, and researchers had to manually intervene to provide real-time feedback. This is not practical for public installations where automated operation is essential. So it is necessary to optimize the speech recognition system in the future version. In addition, when implementing the two-faced model animation in **section 6.3**, performance issues occurred, causing the screen to freeze and lag, so it had to be removed. This performance issue occurred due to the systemic limitations of Python. There are problems with displaying multiple visual effects on the screen, so the software needs to be switched to a more powerful platform such as Unity can solve this problem. Fifth, the color of the negative feedback effect was similar to the color of the instructions provided to users in subtitle format, which reduced the legibility of the description. In addition, if the user had white clothing, the legibility of the subtitles was reduced due to the color overlap. For this reason, some participants had difficulty reading the instructions. To solve the problem, it is necessary to modify the color of the subtitles. Changing the color of the negative feedback effect may cause the glass-breaking effect to become unnatural, so this can be solved by positioning the subtitles above the negative feedback effect and then adding a border color. Lastly, currently hi-fi prototype is just a monitor with a webcam. The installation will be installed in a public space so it is crucial to capture visibility and attractiveness from pedestrians. These external factors can be improved using LED and decorating monitors like a mirror. With LED physical real-time visual feedback can be given to the user. This will increase not only the visibility and attractiveness of the installation but also enable users to deeply interact with the installation more than before.

## Chapter 10. Conclusion

This project aimed to increase body positivity and make people think about healthy lifestyle choices by conveying the dilemma. A public interactive installation was created using a speculative design approach. The prototype, "Love Yourself: An Interactive Mirror", aims to encourage positive self-reflection by providing real-time visual feedback effect based on the user's input.

The prototype was tested with 30 university students and proved its effectiveness in improving body positivity and conveying the dilemma. Approximately 75% of participants reported their body positivity has increased and increased motivation for self-improvement after using the prototype, and 60% of participants reported they recognized the dilemma of body positivity. This indicates that the installation was successful in achieving the project's goal and encouraging them to think about healthier lifestyle choices. The installation also highlighted the potential of speculative design in dealing with social problems such as obesity. In addition, this project demonstrates the potential of speculative design in the field of public health. In public health, to solve the social problem of obesity, obesity is defined as a disease and treated. Unlike the traditional method, this project attempted to solve social problems by making people change themselves by stimulating thought and discussion with an interactive installation. This approach differs from traditional public health treatment and presents a new way of obesity.

There were some limitations, challenges, and areas for improvements such as single use limitation, public space challenges, limited engagement with diverse audiences, and technical limitation. By addressing these identified limitations and integrating feedback from various use evaluations, future development will improve the effectiveness and accessibility of the installation. This research contributes to the speculative design field and the application of public health interventions, opening the way for innovative approaches to social issues.

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# Appendix

## A. Usage of generative AI

During the preparation of this work, Patrick Nam used **ChatGPT** in order to summarize data about obesity. After using this tool, Patrick Nam reviewed and edited the content as needed and took full responsibility for the content of the work.

During the preparation of this work, Patrick Nam used **ChatGPT** in order to ideate and summarize his own thesis to write an abstract, introduction, and conclusion. After using this tool, Patrick Nam reviewed and edited the content as needed and took full responsibility for the content of the work.

During the preparation of this work, Patrick Nam used **ChatGPT** in order to explain VADER Sentiment Analysis in section 5.5.2 VADER Sentiment Analysis is a Python library it was hard to find the mechanism of the library so to gather information and explanation GPT was used. After using this tool, Patrick Nam reviewed and edited the content as needed and took full responsibility for the content of the work.

During the preparation of this work, Patrick Nam used **DeepL** in order to translate Korean to English. Most of the contents were written in Korean first translated into English and rewritten. After using this tool, Patrick Nam reviewed and edited the content as needed and took full responsibility for the content of the work.

During the preparation of this work, Patrick Nam used **Grammarly** in order to check grammar and edit the paper. After using this tool, Patrick Nam reviewed and edited the content as needed and took full responsibility for the content of the work.

## B. Free model used for Final Concept Design

Human model:

<https://free3d.com/3d-model/nathan-animated-003-walking-644277.html>

Laptop model:

<https://www.cgtrader.com/free-3d-models/electronics/computer/3d-laptop-16-inch-silver-color-3d-model>

Mirror model:

<https://www.cgtrader.com/free-3d-models/architectural/decoration/mirror-low-poly>

Desk model:

<https://www.cgtrader.com/free-3d-models/furniture/furniture-set/low-poly-uv-mapped-desktable>

## C. Main code for hi-fi prototype user evaluation

```
import cv2
import os
import numpy as np
from PIL import Image
import threading
```

```

import pygame
from fpyplayer.player import MediaPlayer

# Global variables
current_frame_positive = 1
current_frame_negative = 1
max_frame_negative = 48
max_frame_positive = 48
path_positive = r"C:\Users\hjud\PycharmProjects\mirror\png"
path_negative = r"C:\Users\hjud\PycharmProjects\mirror\negative"
path_sound = r"C:\Users\hjud\PycharmProjects\mirror\png\Sound"
path_video = r"C:\Users\hjud\PycharmProjects\mirror\video"
video_files = ["Sub1.mp4", "Sub2.mp4", "Sub3.mp4"]
overlay_image_positive = None
overlay_image_negative = None
overlay_image_ending = None
loading_images = False
negative_loaded = False
frames_loaded_negative = 0
frames_loaded_positive = 0
sound_click_count = 0
video_click_count = 0
current_video = None
play_video = False
sound_playing = False
current_volume = 0.1
click_count = 0

# Initialize pygame mixer
pygame.mixer.init()

# Thread lock for synchronization
overlay_lock = threading.Lock()

def load_images(path, start_frame, end_frame, reverse=False):
    global overlay_image_positive, overlay_image_negative, loading_images,
    negative_loaded

    loading_images = True
    for frame_num in (range(start_frame, end_frame) if not reverse else range(start_frame,
    end_frame, -1)):
        file_name = f"Effect_{'Positive' if path == path_positive else
'Negative'}.{frame_num:04d}.png"
        file_path = os.path.join(path, file_name)
        if os.path.exists(file_path):
            pil_image = Image.open(file_path).convert("RGBA")
            new_overlay_image = cv2.cvtColor(np.array(pil_image),
cv2.COLOR_RGBA2BGRA)
            print(f"Loaded image: {file_path}")
            with overlay_lock:
                if path == path_positive:
                    overlay_image_positive = new_overlay_image
                else:
                    overlay_image_negative = new_overlay_image

```

```

else:
    print(f"File {file_path} does not exist")
    break
loading_images = False

def play_sound(index):
    global sound_playing, current_volume
    sound_file = os.path.join(path_sound, f"Sound.{index:04d}.mp3")
    if os.path.exists(sound_file):
        if not sound_playing:
            pygame.mixer.music.load(sound_file)
            pygame.mixer.music.set_volume(current_volume)
            pygame.mixer.music.play(-1) # Play sound in a loop
            sound_playing = True
            print(f"Playing sound: {sound_file} at volume: {current_volume}")
        else:
            pygame.mixer.music.set_volume(current_volume)
            print(f"Adjusting volume: {current_volume}")
    else:
        print(f"Sound file {sound_file} does not exist")

def play_click_sound(index):
    sound_file = os.path.join(path_sound, f"Sound.{index:04d}.mp3")
    if os.path.exists(sound_file):
        pygame.mixer.music.load(sound_file)
        pygame.mixer.music.play()
        print(f"Playing sound: {sound_file}")
    else:
        print(f"Sound file {sound_file} does not exist")

def update_image(event, x, y, flags, param):
    global current_frame_positive, current_frame_negative, frames_loaded_negative,
    frames_loaded_positive, negative_loaded, sound_click_count, loading_images,
    play_video, current_video, video_click_count, current_volume, video_cap, video_playing,
    audio_player, click_count, overlay_image_ending

    if event == cv2.EVENT_MBUTTONDOWN:
        if video_click_count < len(video_files):
            current_video = os.path.join(path_video, video_files[video_click_count])
            video_click_count += 1
            play_video = True
        else:
            video_click_count = 0 # Reset click count to replay videos from the start

    elif event == cv2.EVENT_RBUTTONDOWN and not loading_images and
frames_loaded_negative == 4:
        click_count += 1
        if click_count == 5:
            ending_image_path = os.path.join(path_positive, "Ending.png")
            if os.path.exists(ending_image_path):
                pil_image = Image.open(ending_image_path).convert("RGBA")
                overlay_image_ending = cv2.cvtColor(np.array(pil_image),
cv2.COLOR_RGBA2BGRA)
                print(f"Loaded ending image: {ending_image_path}")

```

```

else:
    print(f"Ending image {ending_image_path} does not exist")

if play_video:
    play_video = False
    video_playing = False
    if video_cap:
        video_cap.release()
        video_cap = None
    if audio_player:
        audio_player = None

if frames_loaded_positive < 4:
    start_frame_negative = max_frame_negative - frames_loaded_positive * 12
    end_frame_negative = start_frame_negative - 12
    start_frame_positive = frames_loaded_positive * 12 + 1
    end_frame_positive = start_frame_positive + 12
    frames_loaded_positive += 1
    threading.Thread(target=load_images,
                    args=(path_negative, start_frame_negative, end_frame_negative,
True)).start()
    threading.Thread(target=load_images,
                    args=(path_positive, start_frame_positive, end_frame_positive,
False)).start()

# Increase the volume on each right-click and play the sound if not already playing
if current_volume < 0.7:
    current_volume = min(current_volume + 0.2, 0.7)
    play_sound(5)

elif event == cv2.EVENT_LBUTTONDOWN and not loading_images:
    if frames_loaded_negative < 4:
        sound_click_count += 1
        play_click_sound(sound_click_count) # Play click sound on left-click
        start_frame = frames_loaded_negative * 12 + 1
        end_frame = start_frame + 12
        frames_loaded_negative += 1
        threading.Thread(target=load_images, args=(path_negative, start_frame,
end_frame, False)).start()

def overlay_transparent(background, overlay, x, y, alpha=0.5):
    bg_h, bg_w = background.shape[:2]
    ol_h, ol_w = overlay.shape[:2]

    # Resize the overlay image to match the background size
    overlay = cv2.resize(overlay, (bg_w, bg_h), interpolation=cv2.INTER_AREA)

    if x >= bg_w or y >= bg_h:
        return background

    if x + ol_w > bg_w:
        ol_w = bg_w - x
        overlay = overlay[:, :ol_w]

```

```

if y + ol_h > bg_h:
    ol_h = bg_h - y
    overlay = overlay[:ol_h]

# Extract the alpha mask of the overlay
alpha_mask = overlay[..., 3] / 255.0

# Ensure the alpha mask has the same number of channels as the background
alpha_mask = np.stack([alpha_mask] * 3, axis=-1)

# Blend the overlay with the background using cv2.addWeighted
background_part = background[y:y + ol_h, x:x + ol_w]
overlay_part = overlay[..., :3]

blended_part = cv2.addWeighted(background_part, 1 - alpha, overlay_part, 1, 0) #
Different weights for blending

# Combine the blended part with the original background
background[y:y + ol_h, x:x + ol_w] = blended_part

return background

def overlay_video(background, video_frame, y_position):
    bg_h, bg_w = background.shape[:2]
    vf_h, vf_w = video_frame.shape[:2]

    if vf_w > bg_w:
        video_frame = cv2.resize(video_frame, (bg_w, int(vf_h * bg_w / vf_w)))

    vf_h, vf_w = video_frame.shape[:2]
    y_start = y_position
    y_end = y_start + vf_h

    if y_end > bg_h:
        video_frame = video_frame[:bg_h - y_start, :]

    if len(video_frame.shape) == 3 and video_frame.shape[2] == 3:
        alpha_mask = np.ones((vf_h, vf_w, 3))
    else:
        alpha_mask = video_frame[..., 3] / 255.0
        video_frame = video_frame[..., :3]

    background[y_start:y_end, :vf_w] = cv2.addWeighted(background[y_start:y_end, :vf_w],
1, video_frame, 1, 0)
    return background

def start_webcam():
    global overlay_image_positive, overlay_image_negative, play_video, current_video,
video_cap, video_playing, audio_player, overlay_image_ending

    cap = cv2.VideoCapture(0)
    if not cap.isOpened():
        print("Cannot open camera")
    return

```



```

# Set the webcam resolution
cap.set(cv2.CAP_PROP_FRAME_WIDTH, 2560)
cap.set(cv2.CAP_PROP_FRAME_HEIGHT, 1440)

cv2.namedWindow('Webcam', cv2.WND_PROP_FULLSCREEN)
cv2.setWindowProperty('Webcam', cv2.WND_PROP_FULLSCREEN,
cv2.WINDOW_FULLSCREEN)
cv2.setMouseCallback('Webcam', update_image)

video_cap = None
video_playing = False
audio_player = None

while True:
    ret, frame = cap.read()
    if not ret:
        print("Can't receive frame (stream end?). Exiting ...")
        break

    # Rotate the frame 90 degrees clockwise
    frame = cv2.rotate(frame, cv2.ROTATE_90_CLOCKWISE)

    # Flip the frame horizontally
    frame = cv2.flip(frame, 1)

    with overlay_lock:
        if overlay_image_positive is not None:
            frame = overlay_transparent(frame, overlay_image_positive, 0, 0, alpha=0.5)
        if overlay_image_negative is not None:
            frame = overlay_transparent(frame, overlay_image_negative, 0, 0, alpha=0)
        if overlay_image_ending is not None:
            frame = overlay_transparent(frame, overlay_image_ending, 0, 0, alpha=0)

    if play_video:
        if not video_playing and current_video:
            video_cap = cv2.VideoCapture(current_video)
            video_playing = True
            audio_player = MediaPlayer(current_video)
            ret, video_frame = video_cap.read()
            audio_frame, val = audio_player.get_frame()
            if ret:
                frame = overlay_video(frame, video_frame, frame.shape[0] -
video_frame.shape[0])
            else:
                play_video = False
                video_playing = False
                if audio_player:
                    audio_player = None

    cv2.imshow('Webcam', frame)
    if cv2.waitKey(1) == 27: # Esc key to exit
        break

```

```

cap.release()
if video_cap:
    video_cap.release()
if audio_player:
    audio_player = None
cv2.destroyAllWindows()

if __name__ == "__main__":
    start_webcam()

```

#### D. Code for voice recognition

```

import cv2
import numpy as np
import tkinter as tk
from tkinter import Label
from PIL import Image, ImageTk
import speech_recognition as sr
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
import threading

class SpeechSentimentApp:
    def __init__(self, root):
        self.root = root
        self.root.title("Speech Sentiment Analyzer with Mirror")

        self.video_label = Label(root)
        self.video_label.pack()

        self.result_label = Label(root, text="Please describe your reflection", wraplength=400)
        self.result_label.pack(pady=20)

        self.cap = cv2.VideoCapture(0)
        self.update_video()

        self.recognize_speech_thread = threading.Thread(target=self.recognize_speech)
        self.recognize_speech_thread.start()

    def update_video(self):
        try:
            ret, frame = self.cap.read()
            if ret:
                frame = cv2.flip(frame, 1) # Flip the frame horizontally
                img = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
                img = Image.fromarray(img)
                imgtk = ImageTk.PhotoImage(image=img)
                self.video_label.imgtk = imgtk
                self.video_label.configure(image=imgtk)

```

```

        self.video_label.after(10, self.update_video)
    except Exception as e:
        print(f"Exception in update_video: {e}")

def recognize_speech(self):
    recognizer = sr.Recognizer()
    microphone = sr.Microphone()

    while True:
        with microphone as source:
            recognizer.adjust_for_ambient_noise(source)
            audio = recognizer.listen(source)

            try:
                text = recognizer.recognize_google(audio, language='en-US')
                self.result_label.config(text=f"You said: {text}")
                self.analyze_sentiment(text)
            except sr.UnknownValueError:
                self.result_label.config(text="Could not understand audio")
            except sr.RequestError as e:
                self.result_label.config(text=f"Could not request results; {e}")

def analyze_sentiment(self, text):
    analyzer = SentimentIntensityAnalyzer()
    sentiment = analyzer.polarity_scores(text)

    if sentiment['compound'] > 0.05:
        result = "You described yourself in a positive way."
    elif sentiment['compound'] < -0.05:
        result = "You described yourself in a negative way."
    else:
        result = "Your description is neutral."

    self.result_label.config(text=result)

def main():
    root = tk.Tk()
    app = SpeechSentimentApp(root)
    root.mainloop()

if __name__ == "__main__":
    main()

```

#### E. Subtitle Script Youtube Link

<https://youtu.be/ctx9F9xMk60>

F. Positive and Negative Effect Youtube Link

**Negative Effect**

<https://www.youtube.com/shorts/dJVjaKdSHQk>

**Positive Effect**

<https://www.youtube.com/shorts/mhS5FeYAb9Q>

Kayle Kim taught tutorial how to make effects in Houdini

<https://www.linkedin.com/in/kylekim98/>

G. Negative and Positive Sounc Effect Youtube Link

**Negative Sound Effect**

<https://www.soundofitaly.it/product/cracks/>

**Positive Sound Effect**

<https://www.youtube.com/watch?v=9ixP0NiGZnw>

H. Information and Consent form

## Information letter for graduation project

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Thank you for participating in this research. The purpose of this document is to explain the study that you may choose to participate in as a subject. please read this document carefully, and do not hesitate to ask any questions.

### Project Title

Better Future: an installation to make think of themselves to change their lifestyle to become healthier

### Researchers

Main researcher: **Patrick Nam** ([h.nam@student.utwente.nl](mailto:h.nam@student.utwente.nl))

Supervisor: **Femke Nijboer** ([femke.nijboer@utwente.nl](mailto:femke.nijboer@utwente.nl))

## **Purpose of the research:**

Obesity is one of the biggest societal and life-threatening problems we face today. In recent years, the number of obese people around the world has increased. There are a variety of interventions around the world. However, obesity rates are still increasing every year. Obesity is often associated with body dissatisfaction. Individuals may feel dissatisfied or unhappy with their appearance, leading to negative body-related emotions and behaviors. Therefore, providing opportunities for individuals to think about better futures and increasing their body positivity will lead them to think of healthier futures.

Speculative design emerges as an applicable approach in this regard. The speculative design allows the audience to imagine various possible futures and to think about the idea of those futures through stories and scenarios. To use speculative design public interactive installation prototype was made. The mirror asks the user to describe their reflection in the mirror. Depending on the user's answer, the mirror provides real-time feedback to the user. Positive explanations induce a spotlight effect on the user, while negative explanations cause the mirror to crack. This conveys to users a message that they need to think themselves positively. The purpose of this research is to test the prototype and collect insights from participants.

During the sessions:

You will test the prototype for 5 minutes. The prototype will ask you to describe yourself. First, you will be asked to describe negatively, and then positively. You can describe your appearance, personality whatever you prefer. Next survey questions will be given to you which will take 5~10 minutes.

## **Benefits and risk of participation**

This experiment might pose a risk for you. Read this carefully. During the experiment, we ask you to look at yourself in the mirror and reflect on your physical appearance. Although for some people this may be an easy task, we know that some people find this very difficult. Please consider carefully if you think this experiment is okay for you. We would fully understand if you opt out. However, the main message of the mirror is to show you you are good the way you are. The Ethics Committee Information and Computer Science has reviewed this research.

## **Procedure for withdrawal from the study**

You have the right to withdraw from the study at any time. If you want to withdraw, please inform the researcher. No reason will be asked.

## **Collection and processes of the personal data**

Your anonymity is ensured as much as possible during the session. All information provided by you will be treated with full confidentiality. Only a minimal amount of personal data will be collected from you including age, and gender. All data will be stored and processed under the General Data Protection Regulation (GDPR).

## **Data Usage, Dissemination, and Archiving**

The data collected in this study will be used for research purposes only. The demographic data can't identify you in any way. The data will be safely stored. The collected data might be used in publications or presentations but personal information will be anonymized before the use. The data will be only accessible to the researcher. The collected information will be deleted once they are no longer needed.

### Contact information

If you have any questions or complaints about the research project and wish to talk with the researcher, you may contact:

Patrick Nam [h.nam@student.utwente.nl](mailto:h.nam@student.utwente.nl)

If you have questions about your rights as a research participant or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science: [ethicscommittee-CIS@utwente.nl](mailto:ethicscommittee-CIS@utwente.nl)

## Consent Form for Prototype Evaluation

YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

*Please tick the appropriate boxes*

Yes No

### Taking part in the study

I have read and understood the study information dated [07/05/2024], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves testing the prototype and providing the insights

### Use of the information in the study

I understand that the information I provide will be used for research, publications, and presentations

I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared beyond the study team.

I agree that my information can be quoted in research outputs

**Signatures**

\_\_\_\_\_  
Name of participant

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands what they are freely consenting.

\_\_\_\_\_  
Researcher name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date