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Master's Thesis  
Academic Year 2020

Collective Memory Immersion: Increasing  
Intimacy among Elderly People with Immersive  
Memory Sharing Experience



Keio University  
Graduate School of Media Design

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A Master's Thesis  
submitted to Keio University Graduate School of Media Design  
in partial fulfillment of the requirements for the degree of  
Master of Media Design

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Abstract of Master's Thesis of Academic Year 2020

# Collective Memory Immersion: Increasing Intimacy among Elderly People with Immersive Memory Sharing Experience

Category: Design

## Summary

Social isolation problem is becoming a normal issue among the aging society. Keeping feeling lonely and away from social activities may increase the risk of both physical and mental health problems. These situations happened to elders after a family member's passed away, retirement, losing mobility, or staying at one place for too long. Reminiscence therapy has been proved that could be beneficial in reducing loneliness and social isolation in many studies. In this study, we analyzes the benefits of immersive technology used during the sharing session and provides a new concept of augmented reality and mixed reality collective memory sharing model for elderly groups. In this research, the proposed Collective Memory Immersion and the AR Dice map are the approaches of immersive sharing experience, which would help the older adults enhance their sharing process to make them know each other better. This research shows the possibility and effectiveness of applying immersive technologies on reminiscence therapy for helping elderly people getting rid of social isolation and increasing intimacy among them.

## Keywords:

social isolation, elderly people, reminiscence therapy, immersive experience, mixed reality, collective memory

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# Chapter 1

## Introduction

In this Chapter, the brief and the background of my research will be introduced and explained. First, the concept of the aging society and the social isolation problem the elderly people are facing. Secondly, my research purpose of this thesis will be discussed. The last part of this chapter will be the thesis contribution and the outline for the next several chapters.

### 1.1. Aging Society and Loneliness Problem

For all human beings on the earth, we have to face the same topic. We are getting older and older till the ends come. By the development of modern technology, people in Japan 2020 are having a life expectancy of 85.3 years [1] which means we are going to be facing at least two decades plus years after retirement from work. Among those populations, loneliness is a common issue especially for the people in older community-dwelling populations, its prevalence varies: about 20 percent to 40 percent of older people report feeling lonely, with 5 percent to 9 percent of these reporting feelings of intensive or pain loneliness. Researchers have suggested that people in institutional settings are more likely to feel lonely than those living in their own homes. [2]

### 1.2. Collective Memories and Aging Population

Many ways have been proved that could solve elderly loneliness. From my research, I would like to focus on a specific topic about how memory sharing could help elderly people find a way to break the wall of loneliness and depression caused by different kinds of reasons such as losing a life goal after retirement or keeping

losing families or friends by the increasing of ages. “ Collective memory refers to the shared pool of memories, knowledge, and information of a social group that is significantly associated with the group’s identity.” [3] From a series of studies in 2016 showed that older adults can be benefited from reminiscence therapy. The report of the study pointed out that: “The effects of reminiscence therapy may even go beyond loneliness, with another review finding that it can improve quality of life, cognition, communication, and mood in people with dementia by a small amount” [4] That actually inspired us for seeking new potential and possibilities to solve the loneliness problem. By understanding how collective memory sharing will be helpful to the older adults in groups, several methods and approaches will be provided in this thesis.

### **1.3. Motivation**

Though we have known that many tools or methods are already being used on helping elderly people to solve their loneliness problem, we believe that it could be a more efficient and universal way to be designed. For me, personally, I would like to dig more on this topic because I believe that someday when I became an old man, I may also need some help from age-friendly design. For elderly people nowadays, they definitely have the right to enjoy the latest technology. However, most of the latest technology designed for the younger generation has an Insurmountable barrier for elderly people. I believe we can design an approach for elderly people to enjoy the benefits of collective memory driven by the enhanced and embodied technology.

### **1.4. Research Purpose and Contribution**

We propose the Collective Memory Toolkit as a newly designed method for empowering memory sharing among elderly people. This research aims to help elderly people solve loneliness problems by the specific way of memory sharing. Others may already have many solutions to produce reminisce therapy, our research will focus more on the age-friendly design and the technology intervention such as the latest XR technology(“XR” is a far-reaching, inclusive, and flexible term. The

”X” represents a variable that defines a continuum that can also be expanded and extended in a multivariate sense (e.g. ”XYR” = XY Reality). [5] We will focus the research on how elderly people share the memory and how the design will help elderly people to use the collective memory toolkit easily. We started the research on observing the traditional type of memory sharing activities and based on the results of the analyst we design furthermore toolkit and workshop style. We would like to see if the design could have an improvement on helping elderly people sharing the memory.

## 1.5. Thesis Outline

The structure of the thesis will be introduced below.

### **Chapter1: Introduction**

This chapter will introduce the background of the research: the aging society, collective memory, and the loneliness problem. The motivation and the research purpose and the contributions will also be given. Also providing a clear structure of the whole thesis for people who would like to view this systematically.

### **Chapter2: Related Works**

In this chapter, we will introduce some basic knowledge and foundation keywords based on some related works explanation. People will have a quick understanding of public/ collective memory, successful aging, collective memory related service, the relationship between loneliness and collective memory, and the mixed reality services focusing on memory sharing and immersive storytelling. We will introduce and explain these keywords to help people get a further comprehension of the research purpose and the research goal in this chapter.

### **Chapter3: Design approach**

In this chapter, we will start to discuss how we approach our goal by showing some observations, interviews, and workshops we did with elderly people from different kinds of organizations in Japan. The process and concept of our design will also be introduced in this part. we will also explain the reason that we decided to choose XR technology as the Auxiliary tool to further develop our final prototype in the next chapter.

**Chapter 4 and Chapter 5: IM-project and The Collective Memory Toolkit** In these two chapters, we will mainly discuss the prototype making and user test. Chapter 4 will mainly focus on the research before the Covid-19 which is the project named IMproject and chapter 5, due to the Covid-19 situation, the validation of the second toolkit becomes very hard. We will explain the prototype making and user test based on the timeline order and point out the improvement and revision we did during the process. we will also discuss the feedback and acquisition from the participant of user study and design progress.

**Chapter6: The conclusion**

This chapter will be the last chapter of this thesis which includes the conclusion of this research, the limitation of the design approach, and what we need to improve in the future.

# Chapter 2

## Related Works

Regarding current works which are already used in daily life and some new inventions and design in the field of human computer interactions. There are many attempts and unique designs for applying high-end technology on elderly people to help them solve some daily problems such as reducing depression, loneliness or increasing the social ability for older adults. In this chapter, related work will be introduced by five sections, the first three sections will be the keywords explanation and the last two sections will introduce some services that already exist or similar to my hypothesis helping people solve this kind of problem.

### 2.1. Collective Memory

#### 2.1.1 Memory and collective memory

Let's start with the word that will appear a lot in the whole thesis, what is the collective memory. People must be familiar with the word: Memory. "Memory refers to the processes that are used to acquire, store, retain, and later retrieve information. There are three major processes involved in memory: encoding, storage, and retrieval." [6] The beginning of we started to have the feeling of memorizing things can be traced back to our childhood. Thus, we actually stocked many precious memory pieces in our minds. The word "Collective memory" can be described as the memory of a group of people. More accurately, "Collective memory asks how social groups remember, forget or re-appropriate knowledge of the social past" [7]. Sometimes these kinds of group memory can also be described as Public Memory. In the paper Matthew Houdek and Kendall R. Phillips wrote in 2017, they also defined that: "The term public memory refers to the circulation of recollections among members of a given community. These recollections are far

from being perfect records of the past; rather, they entail what we remember, the ways we frame it, and what aspects we forget.” [8]

### **2.1.2 Mandela Effect**

However, the collective memory(or public memory) does have some difference from the formal histories. Sometimes people will have collective false memories, you may have heard about a word of the Mandela Effect which refers to ”a situation in which a large mass of people believes that an event occurred when it did not.” [9] We believe this kind of effect may also happen during the sharing activities for elderly people so it could also be an interesting factor for us to seek some further results.

## **2.2. Loneliness and Reminiscence therapy**

As we mentioned in the first chapter, soical isolation has become a huge problem happening among the high percentage of older adults. The situation is even worse in institutional settings. A study was done in 2017 shows that “Of the residents in institutional settings, 9 percent suffered from loneliness often or always, and 26 percent sometimes. In these nursing homes and assisted living facilities in Helsinki, Finland, the loneliness associated with poor self-rated health, dependency in ADL and mobility, higher cognitive function, depression, and poor psychological well-being.” [2] The other study from Poland also pointed out that:40 percent of nursing home residents exhibit a sense of loneliness, while the greater loneliness and solitude, the lower the quality of life. [10] [11] Fortunately, more and more research has paid more attention to elderly people’s mental issues. Some studies show that reminiscence therapy could reduce depression among the elderly. Depression caused by loneliness or other reasons now have some effective ways for them to stop suffering from mental pain. A study describes the effect of reminiscence therapy as: “Reminiscing encourages older people to become actively involved in reliving and sharing their past with others. [12]. This study also gave the specific ways to process the therapy may use sound photos, copied documents, drama, and sensory gardens to stimulate debate and discussion for the participants.” [12].

## 2.3. Collective memory related with loneliness

One study from the UK in 2019 [13] proved that the community memory (the collective memory of a community) could bridge a link between the person and one of the communities the individual belongs to fight with the social isolation and the depression of loneliness. This study also focused on the community identity for people. This study believed that collective memory could be the key element of developing relationships between individuals and the community. So the basic structure of this finding could be individuals sharing the community memory with other members in the community which is supported by the staff like nurses in the nursing home. Bypassing the community memory together, individuals will find their social positions/chatters to play in the community and break the social isolation then relief from the depression caused by loneliness.

## 2.4. Solutions, Designs from different field

In this section, We will introduce some similar existing solutions for solving the problems above, some are still in the experimental phases and some of them are already in the mass market.

### 2.4.1 A real-world case Rendeever

This is a service present by Rendeever company [14] in the United States. From their description, the service gives old adults a window to the parts of the world that they are missing. The service mainly uses VR (virtual reality) technology to help elderly people experience some novel contents or old memories in the virtual environment. They provide customized services as community-based for elderly people to re-experience some scenes they lived before for helping them overcome social isolation. This is a really good example for us, from their experience we could figure that possibility for elderly people does have the ability to use head-mounted displays to interact with some immersive content. However, in present, more common VR contents are presented, such as traveling to someplace or experiencing some activities. Based on that, we can imagine the use of technology to help elderly people solve isolation problems.



Figure 2.1 An older adult is experiencing the Rendever

### 2.4.2 Combat loneliness by sharing memories

Several studies in 2016 [15] [16] presents that:” As shown in previous studies, talking about accomplishments, reliving happy times and sharing experiences promotes self-esteem and a sense of fulfillment and comfort while helping people connect the past with the present” The study compared five programs may help elderly people reduce the depression from the loneliness and found out the memory sharing actives(or reminiscence therapy) was the most successful one. The study also pointed out that spending time with people could be a choice to defend from the despair and loneliness caused by aging and loss.

### 2.4.3 Social Virtual reality experience with older adults.

This workshop and social VR study [17] is aiming to teach elderly people to play and creating with virtual reality by grouping them to make new interactions in a virtual environment. In this study, older adults divide into different groups and present social VR scenarios in a group unit. From figure 2.2 we could know how this study formed the group in three different phases of the study, which could help us to design the workshop later on. The study also pointed out social VR as



a means of challenging aging stereotypes which proves that VR can play a positive role in rapidly aging societies. From the study, we could believe that immersive technology could become a tool for elderly people to collaborate when doing the reminisces social interaction.

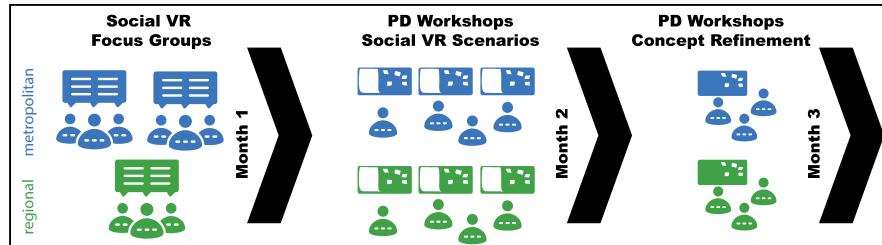


Figure 2.2 The Social VR workshop flow

## 2.5. Immersive technology

From the last subsection, we found out that now many researchers and companies are more willing to use novel technologies like virtual reality or augmented reality to help elderly people fighting with loneliness. In this section, we will focus more on the specific application for immersive technologies from the academic field to our daily life.

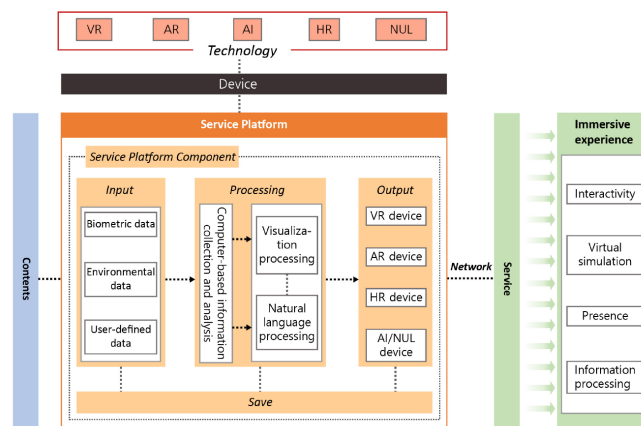


Figure 2.3 Framework of the immersive experience service

Figure above is from a study in 2020 [18] which gives us a clear framework about how the immersive experience service formed from contents to service. Author introduced an idea of successful aging based on the previous research. The figure 2.4

<b>Successful aging</b>	<b>Definition</b>
Disease prevention	Prevention of disease-related hazards, knowledge of health, and awareness of one's health condition
Physical and cognitive function	High physical and mental functions, high learning ability and short-term memory, proper exercise, and physical fitness training
Psychological characteristics	Emotional stability, attachment to experiences and memories, absence of depression and loneliness, high degree of self-respect and satisfaction with life
Productive activities	Continuing educational and self-development, motivation for life, social activities, and an active attitude to learning
Social interaction	Close relationships with others, forming social bonds, adaptability to the environment, and social support

Figure 2.4 Detailed information of Successful aging

shows the detailed information and this standard will affect the whole study a lot. From the 20 services identified in this study, we could learn about how social interaction type of immersive experience services performed with the help of Mixed reality. The study then explained the immersive experience service model based on one welfare center by making a table (figure 2.5) which could also be helpful for us to understand the workflow clearly. The good thing is that the author listed the technology applied and shows the function categories, input, and output which is easy for us to compare which kind of activities has the most affinity to immersive technology. From this research, we noticed that there still some limitations on immersive experience service for elderly people due to the currently developed technology, more research, and exploration in this field is needed, which provided us a chance to dig more into this thesis.

Successful aging		Immersive experience service	Input	Processing	Output
Disease prevention	S.1	Remote virtual medical service	User-definition, Environment	HR graphic	HR
	S.2	Immersive medical note service based on the health conditions	User-definition, Biometric	HR graphic	HR
	S.3	Diet proposal and food information provision based on the health condition	Biometric, User-definition	AR graphic	AR
	S.4	Identification of those at risk of falls and injuries, and undertaking preventive measures by learning various postures	Biometric, Environment, User-definition	AI program, NLU program	AI, NLU
Physical and recognitive functionality	S.5	Step-by-step AI-based virtual training contents	Biometric, User-definition	VR graphic	VR
	S.6	Step-by-step virtual training contents based on the physical capability	Biometric, User-definition	VR graphic	VR
	S.7	Real-time route detection and AR navigation service based on the program	User-definition, Environment	AR graphic	AR
Psychological characteristics	S.8	Providing scattering of light, sunshine, and virtual sky through illumination	User-definition	AR graphic	AR
	S.9	Virtual travel contents for natural resorts or tourist attractions	User-definition	VR graphic	VR
	S.10	Virtual nature environment factor (indoor garden, aquarium, etc.) service in space	User-definition	AR graphic, HR graphic	AR, HR
	S.11	Customized indoor environment (lighting, sunlight, sound, etc.) service based on the physical/emotional status	Biometric, Environment, User-definition	AI program, NLU program	AI
	S.12	Virtual memory remembrance contents based on the experience	User-definition	VR graphic	VR
Productive activity	S.13	Customized job information service through analyzing data on training and learning	User-definition	AI program, NLU program	AI
	S.14	Virtual job experience and education contents	User-definition	VR graphic	VR
	S.15	Customized virtual environment contents associated with hobbies/education programs	User-definition	VR graphic, AR graphic	VR, AR
	S.16	Sharing hobbies and education outcomes with the elderly from other regional communities	User-definition, Environment	AR graphic, HR graphic	AR, HR
Social interaction	S.17	Realistic 3D virtual object (bird, dolphin, etc.) service	User-definition, Environment	HR graphic	HR
	S.18	Social robot service that recognizes and expresses natural language	Biometric, User-definition	AI program, NLU program	AI, NLU
	S.19	Immersive space service that allows to remotely communicate with friends and family	Environment, User-definition	AR graphic, HR graphic	AR, HR
	S.20	Multimodal participation virtual environment and game contents based on social VR	User-definition	VR graphic	VR

Figure 2.5 20 immersive experience service lineup and their categories

# Chapter 3

## Concept Design

In this chapter, we will introduce the vision of this study, the observation and interview plan and how they went, the fieldwork and workshop design, and the takeaways from the workshop. At the end of the chapter, we will talk about how prototypes will be made in chapter four and chapter five.

### 3.1. Design approach

#### 3.1.1 Vision

To start with, I would like to discuss the vision of the whole study first. Due to the highly increased aging population, we could expect we will face more and more elderly loneliness in the next ten years. That inspired me and made me think about what we should hand on to solve or at least reduce the risk of being like that. As we already know from the previous chapter, the loneliness problem could hugely affect the quality of retired life in both mental and physical ways. Another concern from some studies I read and from my personal experience is that in the modern digital society, we are leaving the elderly people behind. [19]With the development and digitization in many fields of daily life, more technology becomes indispensable for basic living. Elderly people who don't know how to use smartphones or the internet may be shut out from society in the next ten years. Elderly people do have the right to enjoy the benefits of the internet, online community, or even IoT(Internet of Things), but the learning cost seems too high for them makes them at a loss when facing the new stuff born from the advanced technology. Thus, I would like to also focus on the elderly people-friendly design by combining the newly developed technology besides solving their

loneliness problems. Also in Japan, there is a social phenomenon called Hikikomori and it happens a lot among the younger generation. However, these days, this phenomenon also happening to mid age people. It is encapsulated by the so-called “8050 problems,” in which elderly parents in their 80s are forced to take care of their grown unmarried children in their 50s in one household, leading both to social isolation. [20] Government and area communities already notice this problem and how serious the problem is. Recently, a murderer case in which an 80 years old father killed his Hikikomori son just because he is worrying and being unsatisfied about his son who stayed at home all day lasted for at least 30 years and also became mentally unstable. This is a typical 80-50 problem. Though older parents could make sure their mid-age kids have enough money to live after they pass away, the kids may have worse mental status at the time. This could be a threat to society. On the other side, research showed that: Retirement may increase depressive symptoms among Japanese older adults, particularly men from lower occupational class backgrounds. Encouraging recreational social participation may mitigate the adverse effects of retirement on the mental health of Japanese older men. [21]

### **What will the elderly people’s life be like in the Future?**

Since life expectancy is growing higher and higher, we can imagine in the next ten years, elderly people over their 80’s interacting with their smart devices as a new normal. They don’t even need to feel the new technology, it will be so smooth to use with zero cost of learning them. That is the goal I would like to achieve in my study and design of making tool kits with technology to let elderly people feel more intimacy with others and willing to break their social barrier to become more positive about their surroundings.

### **Why Observation and Interview is needed?**

As a part of the young generation, all the information and feelings I received about elderly people are very limited. I don’t have a chance to talk with someone in their retired life in Japan. That could make me think narrowly and fail to have a clear insight of what are the real needs of older adults. Observation and Interview could be the most intuitive way and many studies have already proven that [22]. I will introduce my observation and interview plan and what we did in Fieldwork from the next section.

## 3.2. Fieldwork Plan

To understand more about the specific situation elderly people face in Japan, I decided to start from observation, interview, and fieldwork to meet the real elderly people in Japan in person. These will be slightly introduced in timeline order and I will provide more details in the next sections. To begin with, I decided to find a good example: a good formed elderly people community. Luckily, with the help of my professor Minamizawa and the partnership of the Mediva company, I had a chance to join the community of Azamino Hilltop to observe some of their activities and had a chance to interview the host. After observing the “good” model of how elderly people community, I attended a workshop in a nursing home. For this time, I participated in the event with the staff who take care of the elder people and had a chance to understand how older adults in institutional settings live every day and what is the aspect from another side. For the next step, I participated in a challenge event in Shibuya QWS, worked as a team with classmates from my graduate school to make some progress on helping old adults live in the Shibuya area. We designed the workshop together and then I personally designed a prototype based on the feedback of elderly people. My goal from this series of fieldwork is to identify old adults’ current situation and what their needs are regarding mental health and how they feel about loneliness.

## 3.3. Observation and Interview

### 3.3.1 Azamino experience

I did several fieldwork studies and interviews with elderly people in the Azamino Area. They are formed into a regular older adults club(salon) held by Azamino Hilltop nursing facility. On the first time fieldwork, I tested how accepting people over 65 years old about the new technologies and inventions. We bought some new prototypes from Embodied Media Lab and made a demo showcase at the Azamino Hilltop to let people attending the salon there try the new technologies. This is shown below in Figure.

From this study, people from Azamino Hilltop salon had a very high acceptance and good feedback of the experience. In the discussion session after the demo,



Figure 3.1 An older lady is experiencing the Liquid VR from our lab.

some of the elderly people said they were very enjoying the VR experience. Although most of them are the first time knowing VR and haptics technologies, they didn't show any fear or uncomfortable sickness in and after the experience. I guess another reason is that people in this salon are well educated and they keep updating themselves from daily life.

After the first demo showcase, I decided to interview some people from the last event. With the help of the Azamino Hilltop nursing facility, I successfully got a chance to do a group interview with 8 members from the salon and also attended the last activity. (Figures 3.2).

People from the interview are all from different backgrounds. Some of them are still working after 65 years old, some of them are fully housewives, some of them are doing some part-time jobs just for killing the time. The reason and





Figure 3.2 Group interview with People from the Azamino Salon

motivation they keep attending the salon and came to the interviews are also different. From the interview, I noticed that some of the interviewees had a lot of interest in focusing on social problems such as the 80-50 problem I mentioned above. Although most of them are already retired, their social connections are as strong as the time they were a working force. They read the news, watch TV, and some even surf online to get the latest information trying to keep pace with the fast-developing society. This group of people is the leading active elderly group now and I think I can learn more from them in the future if I would like to take them as a positive example. I also gave them three topics for a discussion which are 3 topics: 1. About Daily Life and one day life timeline 2. People and Relationship: ask them about Social network, family formation. 3. Technology related: About what kind of technology they are using and how do they see about VR and immersive experience

From the interview, they mentioned two interesting points. First is they don't



want future limitations to be seen or be thought of as negative. A female said that through seeing her mother with dementia she learned that dementia is not necessarily so terrible as people can still hold onto memories deep down. And another female felt positive that technology would make it so physical limitations don't stop people from enjoying experiences (for example, she mentioned she likes to travel) Second point they mentioned is that they want to strengthen community ties to prevent "lost" people (hikikomori). One interviewee mentioned concerns about helping people who live alone during times of disaster (the idea of creating a community map)

I also attended a regular salon from Azamino Hilltop and I got some ideas from the observation. The topic is WAKA (a Japanese poem style) and I noticed that people who attend the salon are not very interested in the topic, after the lecture, the atmosphere changed, maybe the contents are too hard for most of them. However, they started to share their own stories from the topics. And some of them are first time attending the events and they become a part of the community. From the first interview and observation that I figured out that the needs of elderly people are kind of the key in this research, gathering information and data from databases or other research is a good start and now I could focus more on the listening of the real-world voices from the elderly people I met and interviewed.

So I started to interview one specific person from the salon to figure out if my hypothesis is suitable for the elderly people in Japan and start building my prototype ideas. The male I interviewed is 86 years old, who is still working as an owner of two companies. I made an appointment after the last group interview. The reason I choose him as the main interviewee is because his thoughts and response fit my ideas a lot. He talked about the Hikikomori problem during the group discussion and he also mentioned his own sharing memory experience. This series of activities still have many limitations such as elderly people who attend the event are all outgoing and willing to participate in the social interactions. As a good model of showing how a standard elderly community should form, I got a very good reference in my next phases of research.



Figure 3.3 Group workshop in a high end nursing home with the staff

### 3.3.2 Nursing home experience

As We talked about in chapter two, the elderly people who live in institutional settings such as nursing homes will have more chance to fall into loneliness because of away from the familiar home environment and hard to get new social relations. We had a chance to cooperate with a nursing home located in the core Yokohama area. The workshop was held by Embodied Media lab and Company Mediva. The attendees were not the elderly people living there, instead, we invited the staff from this nursing home to attend since another aspect is always needed and it is really useful to get information from the people who are dealing with older adults every day. The workshop was held in two parts, the experience part, and the hands-on part. First, we let the staff experience the same demo settings from the last one in Azamino, and then we got into the hands-on part which is letting them play with a toolkit that makes vibrations between two ends. By using clay and other creative tools like whiteboards, let them imagine what kinds of technology will be useful for elderly people and easy to plugin into the nursing home. We found out many good ideas such as a fully immersive theater

with AR equipment and haptics feedback which could provide elderly people a better experience on viewing movies, dramas, or even having a virtual traveling in the room. From this workshop, we not only gathered ideas from the nursing home staff but also figuring out that designing elderly people's user-friendly technology approach is very necessary and achievable in the present.

### 3.3.3 Elderly learning group experience



Figure 3.4 The first meeting with Novel-Elderly association

To demonstrate my idea better, we had a chance to cooperate with a group of older adults (The Novel-Elderly association in English as known as civil diplomacy group) who are from different backgrounds gathering to learn English together and their goal is to promote Japanese culture in English and help the foreigners who traveling in Japan. The reason I decided to start the prototype design with them as I had a chance to attend a challenge in Shibuya and our topic was extremely close to the thesis, it will be explained more in the next chapter. We did several workshops with this group of older adults and designed a prototype based on the feedback of the workshops. The workshop design results and prototype will also be introduced in the next chapter. Overall, It was a very good relationship with the English learning group, due to the COVID-19 situation happening in

present(2020), the activities with them stopped in the middle of 2020, we are keeping in touch and will have further cooperation in the future.

### **3.4. Design Concept**

From the fieldwork, observation, and interview, I propose to design a prototype to prove my idea of using collective memory as the core idea, plus the newly developed technology as the enhancement tool to increase the intimacy between elderly people for helping them to reduce loneliness and get out from the social isolation. Two main prototypes will be explained in the next two chapters and they are all important for proving my idea. They both use the concept of shared memory, the difference between them is how we present the memory in contents. The first AR(augmented Reality) involved memory sharing map will be introduced in Chapter four which comes with the progress with IM-project(The one we did with the Novel-Elderly association). And the second prototype with Mixed Reality involved which is named The Collective Memory Toolkit will be introduced in Chapter five. Both of the two prototypes are important to the hypothesis since it could bring us two different angles of feedback and the interaction approach could be compared. Also, both prototypes share the same core idea, people need to collaborate during the activities to finish the task or viewing the contents together. It has been proved that collaboration enhances later individual memory for emotional material [23] From both activities we expect people especially elderly people could become closer to each other whether they know them before or for the first time meet.

#### **3.4.1 Immersive experience and storytelling applying on elderly.**

Let's start with the immersive experience. As we mentioned in chapter two, more and more services that are designed for elderly users start putting their attention on providing immersive experience and applying new head mount displays on their services. Many services in the market are having great success by just applying simple VR content to older adults. However, for the most important part of the

whole experience, the storytelling and system design needs to be highly rated, we will discuss how to make good storytelling under the MR environment first.

By doing some search on how to tell a story in a VR or MR environment, we found some useful references and some interest in “checkpoint” design by the support of the performance from staff during the experience. Research from Sweden provides us a method to increase the immersive level by adding live performance when users receiving the MR-experience with the HMD( Head Mount Display) [24] Author introduced several frictions between realities by combining 360-degree videos and the live performance made by the staff. Users will feel themselves as a character in the show and will be touched by staff during the video playing. The friction between physical and virtual presence will enhance the immersion. Also, another research provided a mixed reality space to allow users to upload their memories to the platform and present them as some platters in the MR space. [25] This paper discussed how to keep the audience simultaneously interested in individual level as well as engaged with a group of others. That is the point I would also like to figure out. How can we keep the users along in the experience and group them when needed? This study gave users the authority to upload the memories picture to the public mixed-reality room which is a physical space. That also brings me ideas like the if the memory pieces are offered by elderly people themselves, they may feel more involved and become more positive to communicate with others. Another research [26]also relate the physical objects in the immersive environment, which users can interact with the bottle and “drink’ it during the experience, that makes the users more feeling like being in the real story, not just an audience just following the instructor. Also, for some elderly people who cannot get used to the HMD, augmented reality could become another resolution. Comparing with the VR or MR [27], we are expecting the AR application may bring a closer distance to the users since they can see each other with their own eyes, not from the displays.

### 3.4.2 AR approach- IM-project

As I mentioned above, to prove my concept, I need to make some prototypes. I had a good chance to enter the QWS challenge which provides us with many resources in Shibuya. I was planning to make a prototype at the end of the first

phase of the project(QWS challenge) [28]. The prototype will have a chance to be on a showcase after several user tests and revision and It is good timing for me to test my concept in the public that I can not only doing user test with the exact older adults member but also receiving comments from the mass during the demo showcase. As the target user, the elderly from the Novel-Elderly association have different backgrounds and most of them don't know each other well since they mostly group up together just learning English. This also could be an advantage since my purpose is to figure out if the memory sharing process could increase their intimacy and reduce social isolation. The prototype will be made on smartphones in which elderly people can scan some specific objects to trigger the memory sharing process. About this prototype, We will provide more detailed information in chapter four for proving my purpose.

### **3.4.3 MR approach - The collective Memory Toolkit**

We will have another try in chapter5 which is making an immersive experience in the Mixed reality environment. An MR environment may bring the elderly people a different feeling of their familiar memory contents and we would like to figure out if the fully immersive experience could or could not enhance the effect of the memory sharing process and the reminiscence therapy. The prototype will combine the real-world objects as the trigger of storytelling. Different from the AR experience which users need to scan on some objects to start the experience, we are expecting a more smooth flow of memory sharing in MR. With the help and lead from the group staff, users could naturally just “look” at the real-world objects and start to experience the memory in the HMD. We believe that will make the whole experience process more friendly to elderly people since it is simple and doesn't require too much interaction on their own. They could just sit down with other participants and share their memories simply and smoothly. We will discuss more detailed information such as the design and function revision in chapter five.

## **3.5. Overview of prototypes**

Both projects are needed in my thesis because I would like to figure out if AR and MR have a different effect on the memory sharing process. And by observing

the workshop we did, more elderly people are having the interested in the head mount display setting. However, AR technology is very mature and has been already applied to senior services. [29] I believe both technologies may have an impact on helping elderly people to improve the memory sharing process. The advantage of AR is easy to access, no guide is needed, will have a lower chance to hurt the seniors, and content making can be very simple. The advantage of MR is a fully immersive experience, smooth interactions and more types of content can be presented. What is AR bad for, people have to operate the scan phase, and it may make some elderly confused about what they are doing? The MR also has some problems such as more complicated equipment is required, needs more time to generate the contents and some older adults may feel dizzy and scared in this new kind of space. Overall, we will have different ways to build the prototypes and my goal is not to compare which one is better. In my vision, both prototypes could be helpful to improve the experience of memory sharing among seniors. Elderly people could choose the ways they like and feel no pressure to use these tools to solve social isolation and increase their contact with other people at their same ages. In next chapters four and five, we will talk about how we made the prototypes and how the user test went.

# Chapter 4

## IM-project

In this chapter, we will mainly introduce the IM-project and AR Map of Shibuya which is the prototype we made to try out the Augmented reality on memory sharing process.

### 4.1. Summary of IM-project

The IM-project is a project I participated in as the initiator member focusing on realizing the concept of positive aging by creating a society where people of all ages and backgrounds can create limitless connections. In short, we would like to give new value to the lived experiences of older adults such as help them explore the place they have known for a long time again. To start with the project, we built the partnership with the Novel-Elderly association and invited them as the target user during this project. The project has been accepted as a candidate of the first QWS challenge [28] and the activity area was the Shibuya area. So the Novel-Elderly association became the perfect partner since they are also located in the Shibuya district and most of them are from this area.

### 4.2. Workshop design

Based on the project schedule and the meeting plan with the Novel-Elderly association, we decided to do two different workshops and make a prototype to enhance the effect of the workshop. [figure 4a] In the first workshop, our goal was to gather emotion-linked memories and connect those with general events and context (we decided to use the topic, Shibuya ). This will give us an emotional bridge point as well as a “collective” bridge point. We then use these points as design opportuni-



ties. The worksheet design was the first milestone we would like to achieve, from the figure4.1 to figure 4.2 we designed several versions of the worksheet aiming to help elderly people to categorize their memories during interviews and expect to lead them into more specific memories. We improve them from different angles such as make it more readable for elderly people and much easier for us to collect the information. We first designed the sheet based on the specific age range but we found out the for different people the age range may not fit everyone so we divide their growth trajectory into Childhood, young adulthood, adulthood, and older adulthood which could help the users blur the age boundaries and easier for them to recall their stories. Then We tested these interview worksheets among our members and we figured out the best one is figure 4.3. In the final edition, we cut the paper into 12 parts which are three categories include milestones, places, and people they interacted with, plus four zones of life timeline. Figure 4.3 is a real memory worksheet record from a female elderly from the first interview during the first interview. It is recorded by us since the elderly female was focusing on talking and we wrote it down for her. We also collected the high-frequency keywords from the interview and then started making the materials and structures for the first workshop.

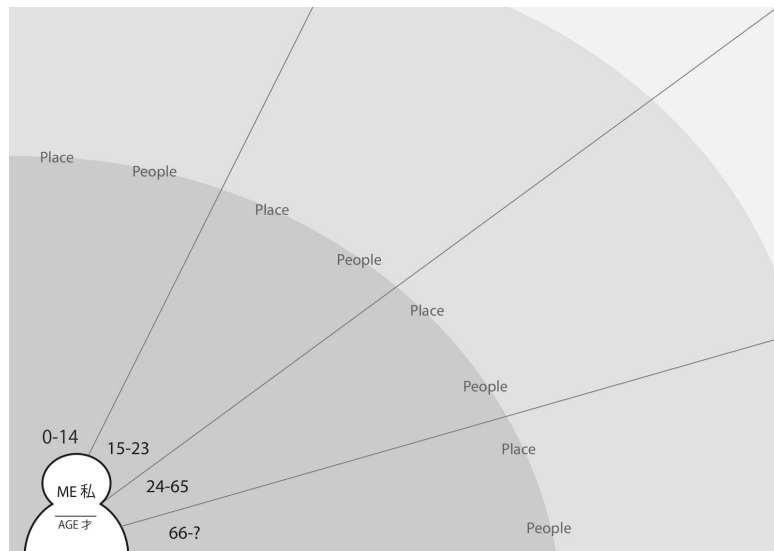


Figure 4.1 The first version of worksheet design.

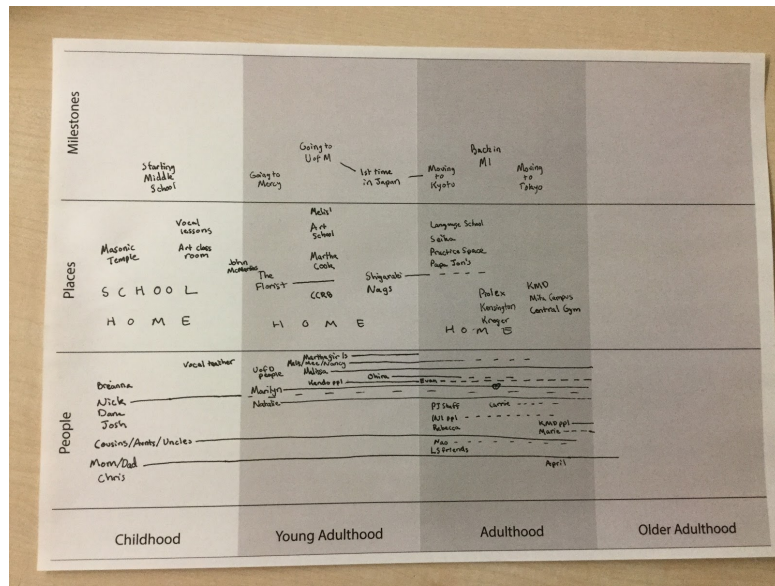


Figure 4.2 Another revision of worksheet.

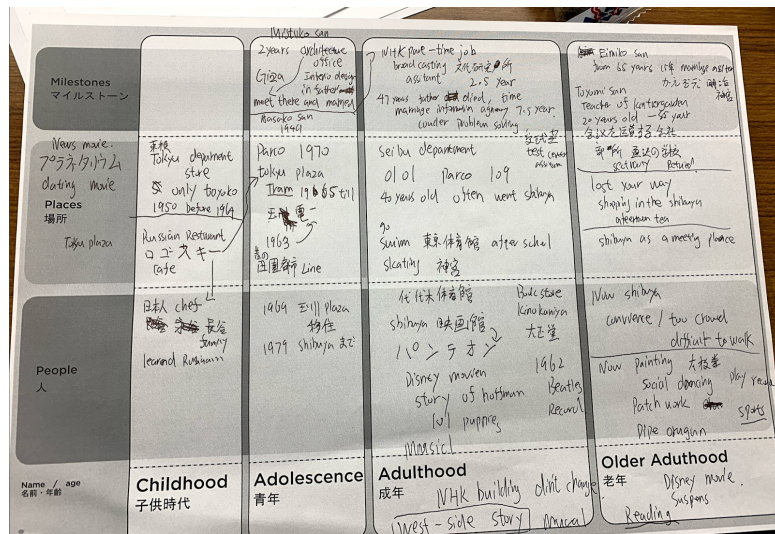


Figure 4.3 The final edition of worksheet.

### 4.3. Implementation

The workshop has been arranged into 4 parts which were held in 4 different weeks and the first week was the group interview using the timeline design worksheet to

give us an initial grasp about the group such as where were they born and grow or how was their life going so far. The second and third parts are the two parts of the workshop which we planned to collect and create the collective memory for them. The last but not the least part was the demo showcase which we made the collective memory into an installation and showed to the public at the QWS event. We will directly start to talk about two workshop parts and the feedback we got. The prototype will be more detailed in the next section.

### 4.3.1 Workshop Part one

The first part of the workshop is one on one experience which means one elderly people will have one instructor to help them recall their memories and made into a form [figure w5 the form example] We designed this form and cards [figure 4.5]

The image shows a 'Storytelling Worksheet' form with handwritten entries. The form is divided into several sections:

- LANDMARK:** 'Movie theater' and '映画館' (Eiga-kan).
- MESSAGE:** 'I hope before Justice will be better.'
- STORY:** 'When Japanese was high school student, people were about wearing more of that time. It was also popular in high school. Some of the classmate escaped from school and went movie in the afternoon. She liked french cinema and she found french in college later. Shibuya is very enchanted to younger people though they are lacking of money for shopping. High school student's felt excited to go to Shibuya for movie.'
- OTHERS (FACT/HISTORY, ETC.):** 'High school 2 steps from Shibuya from 1920s, Shibuya had already open many theaters. Two cinema'.
- Curiosity cards:** 'ENCHANTED' and 'CURIOUSITY'.

Figure 4.4 An example from the workshop part one.

Our purpose was to let the older adults list the location, moment, and the message of their personal memories and we collect them to make a list of keywords for workshop 2's use. Since workshop 1 is one on one with our members, the workshop went very smoothly and they were all willing to share their memories about the Shibuya.



Figure 4.5 Card from workshop toolkit designed by member *Yurike Chandra*

### 4.3.2 Workshop Part two

In the second part of the workshop, we had the 20 participants work in groups of 5 with 2 facilitators to dissect the personal stories and then create as a team a new collective story.[figure4.6] Elderly people were divided into groups and they



Figure 4.6 Group work with facilitators

were using the worksheet and the toolkit to create their collective memory stories together and presented as a group to others during the workshop[figure 4.7]. Our feedback revealed that the toolkit was helpful for stimulating memory recall and helped the seniors be more creative. And despite speaking different languages and



Figure 4.7 Creative part

coming from different culture backgrounds, we were able to successfully collaborate.

### 4.3.3 Feedback and summary of the workshops

Here is some feedback from the interview after these two parts of the workshop, one female said: I was very confused when I talked about the story because the memories are too far away from me now. So I contact some friends to make sure my memory is correct. After the second workshop, When everyone agreed with my story, I felt relaxed and satisfied with the workshop, I want to do it again. Another male talked: “I love Shibuya but it is a young person’s town. I want a place to go, but not a place just for old people. One for diversity. I liked joining this project because we got to work with a diverse group.” From their words, we could know that the workshop went effective and we did collect many memories which is a good start for me to start my prototype.

### 4.3.4 Collecting memories from the two workshops

For the memory collection process of both workshops, we designed the workshop sheet and during the group interview, the facilitators(Members of the IM-project)



made memos to record the details of discussions for the groups he or she belongs to. After the first part of the personal workshop, we had group meetings to share what kind of memories may be collected and what keywords could trigger their public memory. We also searched the data and history online from the Shibuya area to find some interesting stories that happen around the 1960s. We always got books from the Shibuya library and we also mark out the key contents. For the second part of the workshop, we made a keyword list and let the elders form groups by the keywords they interesting in. After the second workshop, we mainly focused on the six creative stories we made with them during the workshops, and based on these contents, I started my first prototype making.



Figure 4.8 The "reform of memory" showing in the workshop

## 4.4. The Memory Dice of Shibuya

In this section, I will introduce how I made this prototype and the feedback from users by showing interviews and photos.

### 4.4.1 Design concept

After collecting the data(memories) from the workshop we held, I decided to make a collective memory map for this group of elderly people and also for all other people who had or want to have some experience in the Shibuya area. The six well-defined stories have been chosen to show on the Dice. I decided to use a Dice cube[figure 4.9] as the trigger of AR contents. The core idea is when people scan the dice, the stories will pop out on the screen with one elderly member sharing in her/his voice. And as we all know, the dice have six sides and 4 to 5 stories will be provided at the same time if people are sitting around the table and scanning the dice at the same time. Another function is the map plus dice, when the dice were placed on the Shibuya map, users can fit the dice into 6 different locations [30][figure4.10] based on the color indicator and may help to understand the contents better.



Figure 4.9 Dice Cube

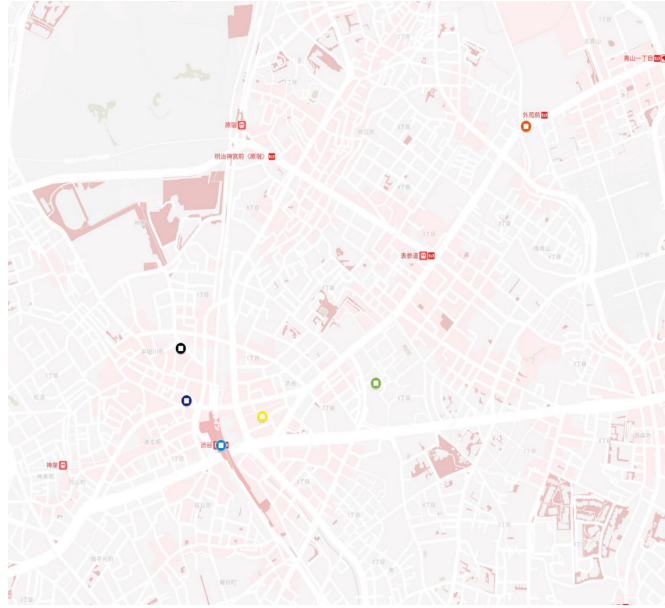


Figure 4.10 Locations of Shibuya made from Google Map

#### 4.4.2 Function design

The application of the Augmented reality part was developed in a Unity 3D environment. To realize the AR function, I used the package of vuforia SDK from PTC [31]. By importing the images representing the memories into Unity, and then checking the stability of tracking, I inputted the memories on the image target objects. Each image is fitting the keywords from the six collective stories. The application was designed to run on an Android Device(required OS-level higher than 7.0) and since the app is really easy to use, just grab scan and share, it was also elder-friendly. I designed the application with a larger font size and to be unified, the User interface of the stories kept the same as the previous workshops to help elderly people understand the stories better.



### 4.4.3 Showcase and User test

The first user test and showcase were during the QWS events, people from different backgrounds gathered to celebrate the success of the first QWS challenge. I demoed this prototype during the session. People of all ages had a chance to hand in this installation. The user ages were from teenagers to older adults in their 80s. From the feedback of them, some findings are really interesting, one male user in his 50s told that he was doing the same kind of memory collecting works specifically for focusing on families. He helped families to rebuild their family albums and he thought applying augmented reality in-memory sharing could definitely be helpful for posterity to understand their grandparents. Another user in his 80s told that he was really impressed by the Augmented reality experience and it was his first time trying. He thought the process is easy and understandable which is



Figure 4.11 The contents pop out at the demo showcase

good for the new elderly users like him to learn and play with. He also shared his ideas and memories after viewing stories from the prototype. We did another User

test among the Novel-Elderly association. The elderly people from the association gave us very positive feedback and they were willing to do another round by using different themes. They discussed topics like gourmet, travel memories, the best food of your family, and more. However, due to the Covid-19 situation, the next workshop was postponed and the regular meeting with them was canceled.



Figure 4.12 Elderly people try out with the AR experience

## 4.5. Summary

In this chapter, we mainly discussed the workshop design and the AR prototype: The memory Dice of Shibuya. We showed the whole process about why we made a workshop and the results of the workshop. Then the prototype making process has been introduced through the concept design, function design to the user demo, and feedback. The AR technology approach is a very good start and shows the possibility of elderly people using new techs in their daily life. From the series of events, elderly people in this association became more willing to share about themselves. At the very beginning of the workshop, they are kind of shy and refuse to talk about their families or personal stories. By the leading and the inspiring of the toolkit, they started to talk more and at the end of the whole session, they became knowing each other better, some of them figuring out some same traits and hobbies. We could believe they will have more interactions privately.

# Chapter 5

## The Collective Memory Immersion

In this chapter, we will discuss another version of the prototype, a mixed-reality based immersive experience. We will introduce the system design, how to input the contents, user scenario, and prototype user test. We will discuss different revisions and updates and provide some feedback from the user test under the Covid-19 situation.

### 5.1. Design concept

To begin with, as we talked about above, the main reason we have another prototype is that We believe that both AR interaction and MR interaction can provide an immersive experience. However, only providing AR interaction is not enough, to get further, the Mixed-Reality will play an important role in the prototype making. The basic idea of the second prototype is to provide the re-experience process in a more personal and deep way. Besides the AR map style, wearing HMD may help elderly people get into the reminiscence process and that has been tested in a study from 2020 [32]Overall, the HMD is just a better solution we can have now, still many limitations need to be solved, such as dizzy, fear or other side effects caused by the immersive environment. By upgrading the workshop with the MR scenes performance, we expect elderly people may be more focused on the sharing process and it could reduce the interference outside from the group such as other groups' chatting.

## 5.2. User experience scenario

In this section, we will discuss how the Collective memory immersion application runs and what kind of immersive experience, users will experience in the ideal condition. The experience will become a part of the workshop we did with the Novel-Elderly association. The main process is shown in figure 5.1, it is designed as a loop that could be re-used and reform as a collective memory among the same batch of people. The activity will be held with one instructor and three elderly people, each session is expected to finish in ten minutes for each topic. To begin with, we have to collect the memory owned by most people from the group at the workshop (Chapter4). By picking up the representative objects from each memory, we set these objects as the memory trigger and we will use them in the developing part and bring them to life during the sharing activities. The memory object is formed by a real-world object such as a baseball in the 1960s, a banana in the 1950s, or a book in the 1960s. Of Course, we cannot have a banana from the 1950s, that is the reason we use mixed-reality systems as a support to help us rebuild their memory objects in the virtual world and show them on the table through the HMD.

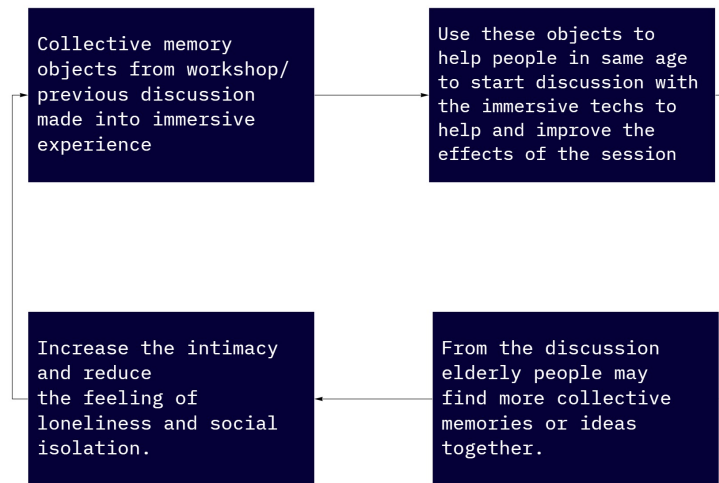


Figure 5.1 The workflow of the memory-sharing process

To make the sharing process more interesting and having more memorable points, three different keywords will be provided to elderly participants with the original

memory object, since it is only showing on their HMD, they will need to talk to other two participants and we believe that may help them to increase the feeling of belonging to the society and become more creative during the activity.[29][30] After they expressed their ideas and personal memories they will go into the next experience which is the virtual environment of memory, in this world they will be able to view the memory rebuilt in three-dimension and by the lead of the voice and video contents, they may have more call back about this collective memory. After viewing the VR contents, they will put down the HMD and have a short talk with others in the same group. The instructor needs to observe their talks and record the keywords, ideas, or even some newly found collective memories for the next round of content building. By reconstructing the new collective memories into a new MR immersive experience, that makes a close loop and we are ready for another sharing session.

### 5.3. System design of MR prototype

In this section we will discuss several prototype attempts, due to the COVID-19 situation, the cooperation with the Novel-Elderly association has been forced to suspend. All the contents making are based on the data before the COVID-19 and the user tests are limited and followed the instruction of Keio University's response measures to COVID-19.

#### 5.3.1 The system design of MR prototype

As we mentioned in the user experience scenario, the prototype itself is a mixed reality environment based application. As same as the AR version, the MR prototype was also developed in Unity3d and mainly fitting for all android 7.0+ smartphones with cameras. A big reason why we using smartphones as the device is that during the workshop session, we found more and more elderly people are starting using smartphones and we are expecting them to use this application not only during the session but also be used in the daily life if they want to share some collective memories by themselves. The easy setting of smartphones made this operable even for elderly people. In this prototype, we took a story presented by the memory of one female from the Novel-Elderly association and made it into

an immersive experience. Here is her story about bananas in the 1950s: After 1945, her father was a civil servant working in the Tokyo area. Her father always bought the bananas Shibuya's fruits shop on his way home. The banana was super expensive due to the rarity. Because he was very busy and he wanted to keep good relationships with children, he brought bananas back home twice a month. The female felt very warmhearted and very grateful to her father. When she grew up, she liked to eat some fruits, cake, and ice in that shop. From the story, the

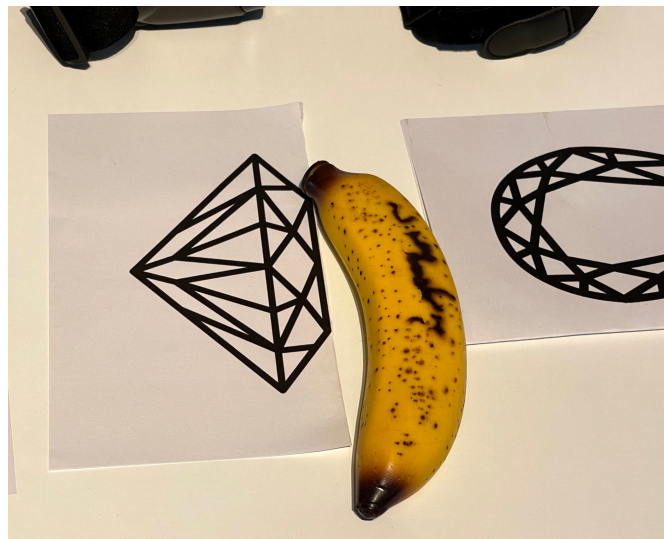


Figure 5.2 The memory object for prototype: a fake banana

key memory objects will be the banana (figure 5.2) in the 1950s (which is a precious gift at that time) then I picked up three keywords that may resonate with other elderly people who also lived in those moments. They are location-Shibuya, precious -the High price and the family member-parents. They will be presented in the MR in different ways.

The whole immersive experience has divided into basically two phases. The first phase will be the MR experience where the users look at the objects with the HMD (figure 5.3) on and view the keywords while seeing others and the instructor in person (figure 5.4). After they finish these, they can take off the HMD and get into the discussion.

When the discussion is timed up, experiences get into the second part. They will need to put on the HMD again and when this time they look at the memory object,



Figure 5.3 The HMD(head mount display) form by smartphones

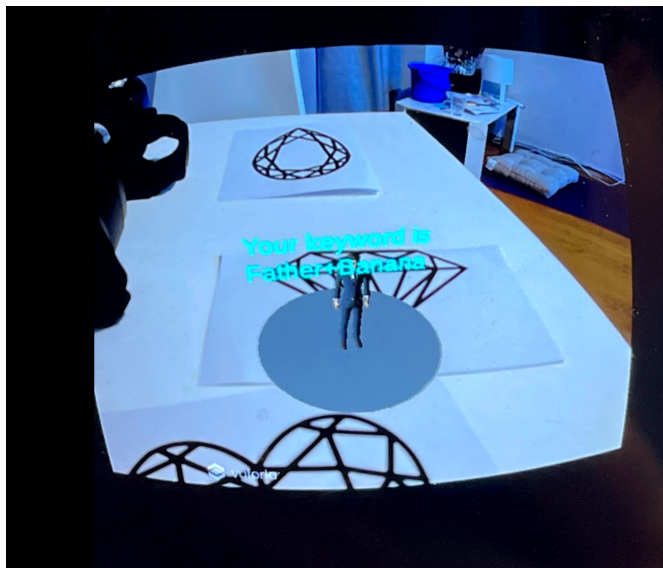


Figure 5.4 Shot on phone screen showing the keyword for first phase

the VR scenes(figure 5.5) are going to play. In this demo, I build a virtual Shibuya and the users will be at the front of the fruit shop, they are expecting to view the original memories from the female in the virtual environment mode. They will have another discussion time after finishing the contents, we are expecting them to generate more collective memories by the stimulate of these two phases.





Figure 5.5 Screenshot of second VR scene in developing mode

## 5.4. Function adjustment

During the design of the prototype, I got many ideas from the workshops, so for making the user interactions more natural and easy to operate, I revised the function several times, we will introduce some failure versions and analyze why they are not fitting into this application. Since we cannot take elderly people as out test users, all the tests were based on feedback and advice from a professor, lab members, and user test.

The first problem I faced was how to interact with the scene when elderly people put on their HMD. The first idea generated in my mind was the very usual function that always applies in the Virtual environment: Eye gazing [33]. It is very common to use the eye gaze function when you are in a fully immersive environment without a controller or other interactive devices like a mouse or keyboard. So I firstly included this function in my design. (figure 5.6)

However, during the in group discussion, I found that for people who have not played VR apps before, it was hard to let them focus on the interactive buttons or objects using gazing functions. When it comes to the seniors, they may feel uncomfortable rotating their heads to focus on the buttons. And also, "pressing" the next steps button will disrupt the experience and may confuse the seniors and increase their fear during the activities. So I decided to remove the function and I had to find the other way for elderly people to go through from the MR scene to the VR immersive experience. By doing some research online and reading the documents of Vuforia AR I found that the vuforia AR target could trigger



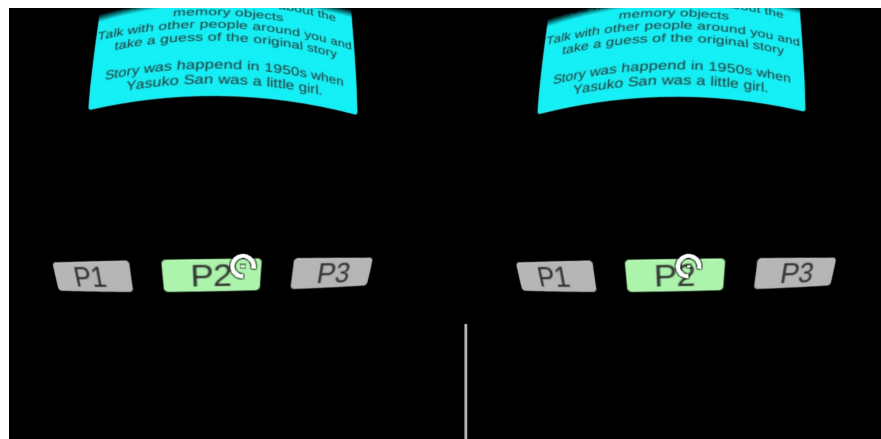


Figure 5.6 The screenshot of eye gazing function

the next scene in the unity. Since the three participants will need to check three different hints on their own, they need different triggers. So I decided to print some markers on the paper and when they are in the activity looking at the maker, the hints will appear on their head mount display. Since we have many themes, finding common marks could be one of the choices. I finally chose the gemstone shapes as the marker because I think the memory pieces are as precious as the jewelers. (figure5.7)

Unfortunately, these processes did not go well. By testing the marker and the memory objects, the accuracy of the AR tracker went down a lot. Sometimes the smartphone devices cannot recognize the marker and this will affect the activities. I tried changing the image target, though it became more stable than before, I figured out that the process became more complicated and the experience was not so smooth. After considering the whole experience again, I think the application needs to be simplified. My goal is to let seniors don't feel the intervention of VR and MR. They can just put on the HMD, see through the memory objects, discuss and enjoy the immersive contents. Look at the memory objects and wait for the "magic" to happen is the ideal condition. To achieve this kind of effect, I removed the complicated marker system. Instead, when users put on the HMD, the hint will automatically appear and when they are ready to get into the VR scene, they just need to put on the HMD again and look at the memory objects. It will become a seamless experience by the indication of the instructor. In this activity,



Figure 5.7 Mark matching the HMD

the instructor also plays an important role, since most of the seniors haven't experienced VR and MR before, a real-world guide man will be way better than the cold text instructions on their HMD.

## 5.5. Evaluation

It is kind of hard to measure the effect if the users feel more intimacy with others after doing this activity. The subjective response on the survey will directly point out their feelings and may show how do they feel about knowing better each other. [34]It is very difficult to measure someone's loneliness level by doing a small scales test or questionnaire [35]. So besides proving the effect of reducing the isolation feeling, directly ask them if they feel more connected and know more about others will be the goal of the activity. Designing a questionnaire could be an efficient way of collecting their feedback. The questionnaire to evaluate the intimacy between the test users consists of 7 questions and the question also has been designed into an easy answering type since we are expecting the elderly people to answer them. Questions included simple personal information like ages.

And we also put some Yes or No questions like asking them if they experienced this kind of sharing process before or if they could understand what we did with them. We also let them rate how the intimacy level is after the activity( from 1-not so much to 5-feel more connected) Other questions include letting them rate the immersion experience in mixed reality. Last but not least was asking about the topics they are interested in memory sharing, it is subject to response and we actually expect them to give some interesting feedback. After acquiring the data from the participants, we will analyze the results with the observation data(video of the activity and photos) together since the response of their first time putting on the HMD is also a point needed to be noticed.

### 5.5.1 Plan under COVID-19

As we mentioned above, doing a user test is very hard under the COVID-19 situation, gathering may cause a cluster and it is especially dangerous for seniors to infect. Under the consideration, only the younger generation will be the test users and we will keep in contact with the seniors online and phone to get advice and feedback from them by showing the progress with them. Since It is also kind of unsafe to gather a large group of people, the plan was to test 6 participants in 2 groups of people. Though the test sample may be too less to prove the concept, safety should be considered as the first. The test is in a rented meeting room and we checked the participants' body temperature to make sure nobody is under the infected condition. We also prepared the alcohol pad for cleaning hands and devices after use. The instructor will wear a mask for the whole activity and the participants need to wear a mask when they are not using the HMD device. During the discussion session, everyone needs to keep a social distance and always wear a mask.

### 5.5.2 User test

6 participants undertook the user test, between the ages of 22 to 26. They were divided into 2 groups of three people and most of them don't know each other before the user test. The user test lasts for twenty minutes and the specific time slot is divided into 5 parts which are the first opening introduction(4min), AR

hint experience(3min), discussion one(5min), immersive storytelling(3min), and the discussion two(5min).

**Step1: Opening introduction**

Before the experience starts, the instructor will introduce the story background, the head mount display, and the memory objects. The instructor will distribute three HMD with different contents to the users and help them adjust the device.

**Step 2: AR hint experience**

Users will put on the HMD and after the application starts and define the ground plane automatically, the hint will be displayed in 3D and participants will also be able to see through the real world.

**Step 3: Discussion one**

Participants will be asked to talk about the hints they saw and talk about their memories with the objects and hints one by one.

**Step 4: Immersive storytelling in VR**

After putting on the HMD again and looking at the memory object on the table, they will automatically enter the virtual environment and start to experience the story in the first-person angle.



Figure 5.8 User experience the Virtual environment on their own

**Step 5: Discussion two and wrapping up**

Participants will be asked to talk about their feelings about the original story and they need to give some ideas of their collective memory together. After all the steps down, participants are asked to fill the quick questionnaire and the user test will end after all the questionnaire has been done.

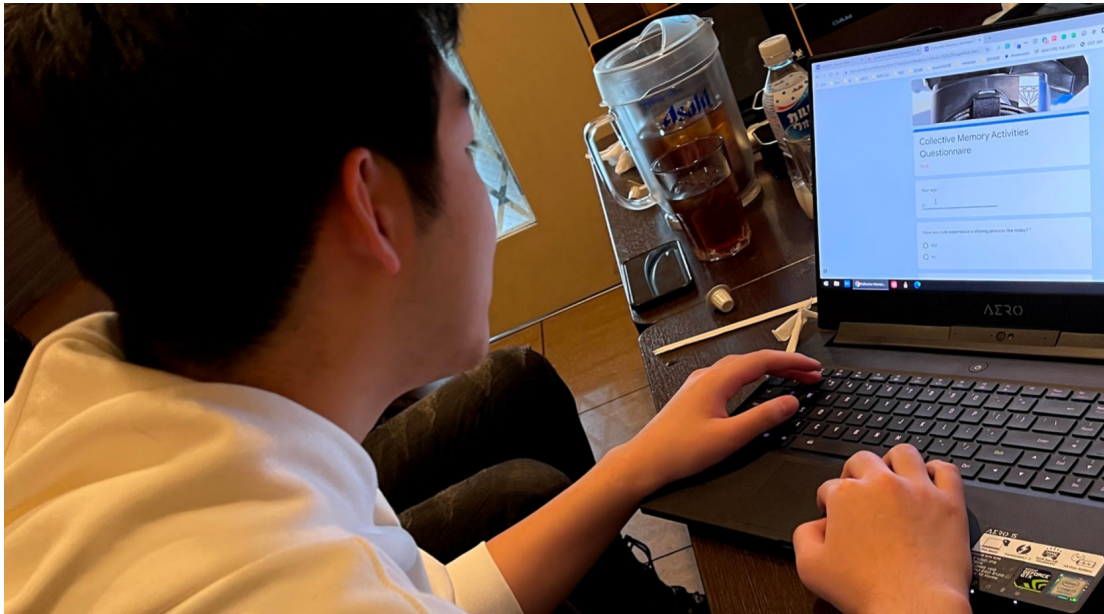


Figure 5.9 User filling the questionnaire on the laptop

### 5.5.3 User feedback and results

We will discuss the feedback from users during the activity. From the questionnaire, we found 66 percent of participants are first time experiencing the immersive sharing process with Mixed-reality. Almost all of them showed huge interest when they started looking through the HMD. During the AR hint section, some of them cannot find their hints in the video see-through setting, it is because the area they faced does not have a plain ground to generate the hints, most of them can see the hints with the help of the indicator. All of the participants could understand the purpose of the memory sharing activity and be willing to participate again in this. When it comes to the kinds of topics they would like to share with others, many participants wrote their ideas such as gaming, childhood memory(the 1990s), and working experience. [figure 5.10] The following chart(figure 5.11) shows the results of the rating of immersion of the sharing process. The average rate is 9 of 10 which is quite high. These results indicate that the immersive storytelling was very impressive by most of the participants and this kind of interactive way is largely accepted by them.

What kind of topics will you want to share with people the same age as you / the people of different ages.

(6 条回复)

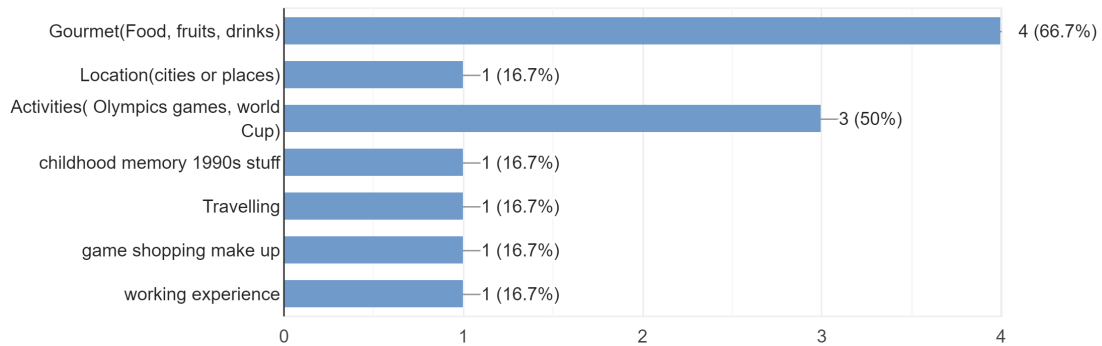


Figure 5.10 Categories of memory users want to share in the next activity

How do you rate the immersion experience in mixed reality?

(6 条回复)

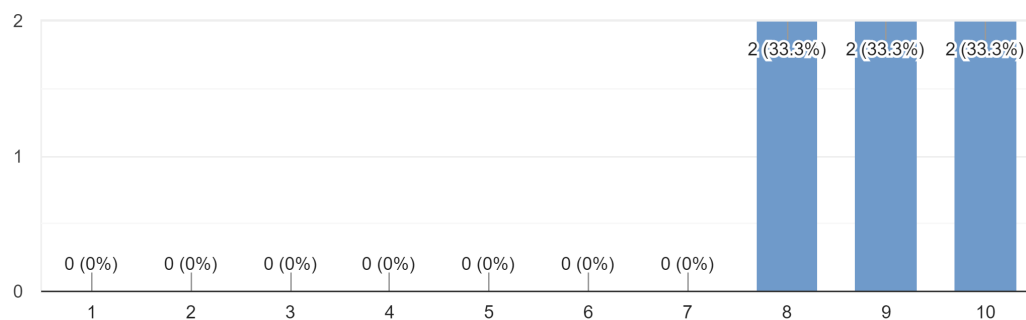


Figure 5.11 Immersion rating from the users

The following chart (figure 5.12) indicates how the participants feel about each other after the sharing activity. The result of the average rating is around 4.3 out of 5. By analyzing the performance from the observation, we could find out the gender difference may affect their choice.

How do you feel about the other two participants in the group, do you feeling knowing them better?

(6 条回复)

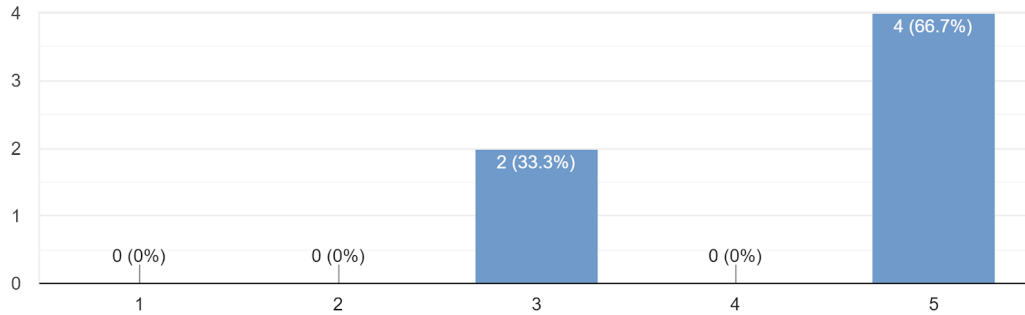


Figure 5.12 Showing the intimacy rating of users

## 5.6. Discussion

Overall, the results of the user test support the hypothesis, and we found something interesting and some places that still need to be improved that we will discuss in this section. First, since our users are younger generations, before the test, we told them this is an activity designed for seniors and hope they to experience it from an elderly perspective. From their feedback during the activities, some of them thought differently about the hints. One example is that one of the participants cannot understand the relationship between the keyword” high price” and the memory object: Banana since nowadays the banana is really cheap for purchasing. It shows they are lacking the knowledge of the 1950s. This brings us to some thinking about how to improve the relevance of keywords and the story. Another finding during the activity is that the hints sometimes will be misunderstood. The example was a foreign user viewing the hint keyword” Shibuya” which shows a 3D modeling of the Hachiko statue on the screen. He recognized it as a simple dog and mislead the discussion into feeding a banana to a dog. This reminds me about the accuracy of the hint, we need to improve the quality of the hint objects and consider the cultural difference. One finding from the questionnaire is that we should put gender as a value when considering the intimacy

among the test users. From the observation, we could find out that different gender may affect the results of the question. Two groups form in one female plus two male and one male plus two female types. And the only female and male from the groups have a lower affinity with the other two. These remind us of the gender factor needed to be considered in the prototype design. The user test still has more conditions that need to be considered and we are looking forward to doing this memory sharing activity with seniors after the COVID-19 situation.

## 5.7. The value of MR and AR for memory sharing activity among elderly people

Though it could be better if we had a user test of the MR prototype with the elderly people, I would like to discuss the value of making an immersive experience for elderly people as the conclusion of both prototypes. Firstly, implement new technologies with elder service is necessary, from the observation and experience events, they can get used to the new interactive ways easily. The immersive experience could not only help them to re-live a precious memory piece, but also could help them discover the old memories from a different aspect. For example, they can experience a familiar story from a third-person angle and viewing more details besides the story itself. Secondly, recording the old memorize in immersive experience is also important for us, nobody can escape from the aging process, designing a better way to encourage elders communication may also help the younger generations understand their elder family member better. One value we would like to realize in the IM-project is to break the barriers between older adults and the younger generations and build a limitless connection society for all ages. During the activities with the Novel-elderly association, many members expressed that they are willing to have more interactions with younger generations and experience some newly developed pop culture with them. Keep a better relationship among elderly people themselves is a good start, to reduce the social isolation from all ages will be the next direction we may focus on.



# Chapter 6

## Conclusion

In this thesis, from the prospect of our research on solving the social isolation for elderly people by applying memory sharing activities with the improvement of immersive technology, we designed the augmented reality-based memory map experience and the mixed reality-based memory sharing toolkit. The seniors' social isolation problems caused by the aging society bring us to think about how we might create an experience to help the older adults increase their intimacy by sharing the collective memory in an immersive way. By doing the related works we found out that reminiscence therapy is an efficient way to help elderly people rejoin society and improve their life qualities by sharing memories. And we also found out that newly developed immersive technology like virtual reality and mixed-reality are widely applying to developing the elderly user-based experience such as VR traveling for elderly people in the nursing home and AR apps to help seniors with their mental training. Then I started my fieldwork and interview. I firstly took a successful elderly community as my example. By attending their events and holding tech salons with them, we found out the acceptance of new techs for senior people is quite high. I also interviewed the leader of the community to figure out the know-how about how to form a successful community and keep a high participation initiative with the members who are from different backgrounds. From the fieldwork, observation, and interview, I propose to design the prototype to prove my idea of taking reminiscence therapy as the core method, add on the newly developed technology as the enhancement tool to increase the intimacy between elderly people for helping them to reduce loneliness and get out from the social isolation. To realize my idea, I decided to design two approaches from the same starting point. I need to test both AR and MR to check how their performance and affinity with the memory building and sharing process. I firstly designed a workshop to help seniors start their willingness to talk and we went

further to encourage and inspire them to share their personal experiences with others in the group discussion. We had a great collaboration with the Novel-Elderly association. By observing and recording the process of the workshop, we based on the data and keywords created a package of stories with elderly people. The prototype makes needed two phases, the AR-based experience, and the MR based experience. We designed the AR application with the location data and we made a memory map of the Shibuya area which elderly people can scan on the map to enjoy the immersive stories present by the others' collective memory and resonate with them. I tested our AR map prototype with the Novel-Elderly association and we also had a demo showcase to present with the public who were of different ages gathering in Shibuya. I got much positive feedback on recalling their own memories and the user experience proves that operating AR apps on a smartphone is not so hard for elderly people even with zero experience before. After proving my concept with the AR approach, I started to design the mixed reality experience with the Novel-Elderly association. However, due to the COVID-19 situation, the meetings and workshops were forced to stop. So I designed the experience with the data we collected in the workshop we did before and we kept in touch with the seniors online to ask their opinions about the stories' contents and their expectations about the prototypes. I made some revisions and improvements based on the advice of them and held a small batch of user tests among younger generations. The feedback was based on the questionnaire and interview and the results showed even for the younger generation, they could feel more connected to each other. Finally, The two prototypes both proved that using immersive technology does have effects on helping seniors improve their experience during the memory sharing process. The two different approaches both showed us the possibilities for elderly people's hands on the newly developed immersion technology. We presented a toolkit with two solutions on sharing and collecting memories with people gathering from the same ages. We describe the method to design and generate the contents for collective memory sharing. The process follows the concept of as simple as possible and our design is aiming to lower the violation and the discomfort feelings caused by the technology intervention.

The limitation of this research could be in two aspects: The target user need more samples, we focused on one group of elderly people as our target users,

though they are not so familiar with each other before (they just group up together and learning English twice a month), they are the positive-aging type of seniors who are willing to connect to the society. Our focus in the future should be on elderly people in institutional settings and not willing to talk to others. Our prototype is still not mature enough for testing on this type of seniors and we think the design and method needed to be improved to care more about their mental level when doing the activities to make sure it won't be harmful to the elderly people who are really struggling with social isolation. Another limitation was the story contents and the user age group. From the keywords and stories we gathered, we could figure out most of them happened around the 1950s and 1960s which may be limited. For further development in the future, several places could be improved, and based on the development of the new technology we could imagine the new immersive experience as below. Firstly, the workshop experience will be redesigned based on the feedback of the users, and we will combine more useful tools in the workshop such as designing an application that could show the detailed information (Photos, sounds, and videos) of a piece of memory rapidly during the memory sharing parts to inspire elderly people more for generates new collective memory. Also, we could update our card game like toolkit from the paperwork to the digital version by designing an elder-friendly application on smartphones or tablets to reflect the memory sharing process intuitively and reduce the process of ordering the data after the workshop. Secondly, by the development of the MR head mount device, they could be based on the Naked-eye-3D technology not from the video see-through. The benefit of applying that is to reduce the possible claustrophobia and dizziness when seniors put on a fully immersive device. However, the VR experience should not be affected and should provide two versions of VR or MR to let elderly people choose which immersive service they prefer. Finally, more sense feedback could be added in the memory sharing process, such as haptics smell and thermal feedback. Since we have already seen some VR devices with that kind of sensors and actuators, further research could test if the elderly people could accept the stimulation of other senses and could these feelings enhance the effect of the memory sharing process.

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