UNIVERSITY OF TWENTE.

Interaction Technology
EEMCS
University of Twente
Master Thesis

Exploring Possibilities to Improve Distant Dining Experience for Young Expats with their Loved Ones over Time and Space Gap Issues

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July 2021

Abstract

Dining is a social activity performed among humans usually in groups of two or more around a dining table. It is the act of performing social activities while eating food. Through dining, humans get an opportunity to connect while sitting at the same table and eating the same meal (breakfast, lunch, or dinner), which usually acts as one of the social lubricants (common interaction point). In families, dining is one of the ways to build a stronger bong among each other by getting to know each other well and for parents to impart knowledge to their kids and to discuss their issues. The act of dining brings everyone together over the same meal at the same table to eat and bond. This act of dining is mostly absent between expats and their loved ones (family and friends) for a long period because of the time difference and the physical distance. In this master thesis, we first learn about the two issues expats face when they distant dine with their loved ones through existing literature and personal interviews. Second, we ideate possible solutions using different technologies with the help of our target group in a co-design session. Third, we conceptualise the most voted idea followed by another design session to discuss the details of the concept and keep the target group a part of the research throughout. And lastly, compare the difference in the experience of distant dining for our target group between the concept and video call.

Acknowledgements

First and foremost, I would like to thank my professors for their constant support in providing their opinions about my writing, for pointing me in the right direction and for all the effort they have put in to read my material multiple times in short time windows. I would also like to extend my acknowledgements to my family for their constant support financially and mentally. Their regular motivations allowed me to keep going during this dark time of Covid-19. My pet Tann the Labrador, constantly supported me during the long nights I have worked on my thesis by staying beside me and providing me comfort at all times.

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Chapter 1

Introduction

In today's time, students search for the best education to acquire even if they have to travel abroad and leave their families and friends behind for a few years. The same goes for adults who look for better job opportunities outside their home country. Statistics show, that there has been a growth in the number of international students from 2 million to 5.3 million between the years 2000 and 2019 according to data provided by UNESCO 2019 [2]. Another research report published by Finacord, forecast that an increase of 65.71% i.e. from 52.8 million to 87.5 million, in the number of adults taking jobs abroad from 2013 till 2021 will happen [3]. During this time, these expats short for expatriates[1] stay abroad and away from their loved ones[2], connecting with them using smartphones over voice calls, video calls and through social media. These virtual interactions usually take place during one's free time or when someone is dining.

1.1 Distant Communication

Dealing with time zones can be tricky and connecting with your loved ones is a constant struggle [4]. There are two types of communications, namely, asynchronous and synchronous, which are possible between people who live away from their loved ones. The asynchronous method consists of text messages or emails or chats and is not time-sensitive, whereas the synchronous method consists of live audio or video calls and is time-sensitive. Most of the time asynchronous methods are used to decide on a free time, also known as "Communication Window" for synchronous methods of communication which is also the largely preferred kind of communication method [4, 5]. Moreover, the communication window is usually longer during the weekends. During these communications, people usually talk about one day, ask about whether they had a meal or talk about the ongoing day.

1.2 Distant Dining

"Family that eats together stays together" [6, p. 1].

In an ideal situation, interactions between families and friends take place under one roof (home or a restaurant) around a dining table while dining [7]. Dining around a table along with friends or family is more than just about eating food, it is a social activity consisting of conversations also known as "Table Talk" with other diners and connecting with them not just at a physical level but also psychologically [7]. These "Table Talks" usually consist of discussing one's day or experiences, an upcoming event, a common topic like an event happened during the day or talking

[1] collective word for people residing in a country other than their native country
[2] families and friends

about a memory. Within a family, parents ask questions to their children to create an open environment to discuss their problems which is considered healthy for kids and teenagers [7, 8]. Apart from verbal communications, many non-verbal and visual communications also take place. Non-verbal communications like passing of dishes, serving food as seen in Figure 1-1, asking for dishes by pointing at them or praying before starting the meal and many more. Visual communication usually occurs when one diner is using their smartphone while dining to show an image or a video to others. Overall, dining at a dining table is quite important for families and friends to bond together and learn more about others during the process.

Since dining together is important for families to stay and feel connected, expats and their loved ones also try to dine together [9] using synchronous and asynchronous methods of communication. For instance, an international student talking to loved ones via video call while dining or couples living away dining together over video call by agreeing on a common mealtime. However, this is not possible when people and their loved ones live far enough which leads to change in time zones. Due to large time differences and obvious geographical distance, finding a common time to dine together poses a challenge.

1.3 Issue of Time and Space

As discussed in the previous section experiencing communal dining for expats with their loved ones is limited due to the issue of time and space.

1.3.1 Issue of Time

Due to time zones differences, expats and their loved ones cannot be present for the same meal. Different differences between time zones set varying difficulty levels for expats and their loved ones to find a common time for distant dining. For instance, a 12 hour time difference provides people with two possible common times, one during the day and one at night whereas finding a common time with a time difference of 8 hours is difficult as one sleeps at night, the other is awake and busy with the day or vice-versa. Time differences ranging between 3 to 12 hours are considered long enough to disrupt the communication between expats and their loved ones [4]. For instance, international students residing in the Netherlands cannot eat dinner at the same time as their loved ones in India due to a time zone difference of ±3:30 or ±5:30 hours.

1.3.2 Issue of Space

Space constraint holds off basic physical interactions around a dining table, for instance passing on the dishes or utensils. Further, the physical presence affects the dining situation, diners do not feel connected and a sense of disengagement remains while dining over video or audio calls. For instance, an unconscious synchronisation of eating food takes place due to the presence of others around the table as seen in Figure 1-1 [1]. It might not seem much that physical space impacts dining more or the same as time constraint does, however, there are long term effects of space constraint. Even after using technology to connect to loved ones, physical

presence is an issue that has begun to cultivate chronic loneliness [10].

Figure 1-1: Physical Interactions at a dining table: passing dishes (left), sharing food (middle), eating synchronisation (right). Picture from [1]

1.3.3 Research Question

Time and space constraints while distant dining holds off interactions between expats and their loved ones, the short term issues faced do not seem to have much impact on one's life however, not dining with family and friends for long term pose social issues like disconnect and differences with family and friends, slipping into loneliness which can result in depression. We now understand that dining around a table together is important for families and friends and therefore the idea for this thesis is to first understand how young expats currently distant dine and then design and evaluate a solution to address the time and space gap issue along with other concerns young expats might have for distant dining. The research question we look forward to answering within this thesis is:

"Despite the time and space gap, how can technology be used to improve the current experience of distant dining for young expats with their loved ones?"

For this research question, we will focus our work around international students, specifically, students who face a time difference of three hours or more as it has more impact on one's daily routine [4]. We further introduce two sub-research questions to understand the concept of distant dining from the expats and understand their habits, how they carry out the dining process and which technology do they currently use:

1. What are the habits around distant dining carried by young expats with their loved ones (family and friends) having a time zone difference of three or more hours?

2. How young expats use technology to distant dine with their loved ones (family and friends) where time zone difference is three or more hours?

In the next chapter, we explore available literature to address the time and space gap between young expats and their loved ones. Chapter 3 presents the structure

and key findings of the interview conducted with young expats as participants to answer the two sub-research questions. Information from Chapter 3 is used to ideate concepts and get feedback on the concepts from expats in Chapter 4. Using the feedback in Chapter 4, we design and present a prototype to get feedback from the expats in Chapter 5. After the feedback on the prototype, we improve the prototype and present its functioning in Chapter 6. The improved prototype is used in an experiment in Chapter 7 to compare it against video call for distant dining and present the results of the experiment. Chapter 8 answers both sub-research questions and our main research question of this thesis, followed by limitations of this research and future work in the same chapter and Chapter 9 to conclude the thesis.

Chapter 2

Related Work

This section introduces the literature found around distant dining between loved ones and different target groups like young expats, solitary older adults, hospitalised individuals and more. This section is also used to find the gaps in the literature for distant dining between young expats (our target group for this thesis) and their loved ones to answer our sub-research questions if possible. The research work to provide a solution for the time and space gap issue between different target groups and their loved ones does exist and acquires different technologies to achieve the goal. The existing literature is divided into three sections, solving time gap issue, solving space gap issue and artificial agents.

2.1 Solving Time Gap Issue

One of the solutions for the time gap issue, while expats dine with their loved ones, is by H.Tsujita et al. [11]. The article presents a solution by providing a time-shifted video call communication system known as CU-Later [11]. This article has been cited in many other articles talking about distant dining. CU-Later plays a previously recorded video of person 1 to person 2 when later and the recorded video's time match. For instance, playing a recorded video of an international student eating dinner with their mother when she haves her dinner. Taking note of possible future work of CU-Later, M. Nawahdah and T. Inoue [9] constructed an upgraded version of CU-Later using sensors that can control the playback speed of the video to match the eating speed of the second diner and only record the video if there is food present in-front of the user. These extra features provide a sense of connectedness to both diners with each other, however, the recorded videos cannot mimic an actual conversation and the sense of actual presence is taken away.

2.2 Solving Space Gap Issue

Instead of solving only the time gap issue between two diners, researchers also worked on solving the space gap issue. Synchronous (live conversation, not recorded) version of CU-Later, RoomXT [12] extends the dining table visually into a virtual environment to provide a sense of physical presence along with head tracking to provide an immersive experience.

Along with virtual presence, researchers also focused on implementing physical interactions among diners as done by J. Wei et al. [13]. J. Wei et al. implement different aspects of physical presence, serving food using motorized tabletop, making physical presence feel using temperature changing table cloth and displaying love using a chocolate 3D printer to print on bread.

Another research by P. Barden et al. [14] developed a system to connect multiple

diners at different locations together using projection and a turntable. The projection makes another dining table visible in a perspective manner to other diners and the turntable connects the two dining locations in a physical space. The turntable was used regularly to gain attention when conversational groups were formed or to play teasing games. The turntable acted as a mediator which was present in both spaces and made the sense of other diners presence stronger. While the implementation was well done and testing provided positive feedback, however, from a technical point of view the projections on the dining table overlay utensils on the table and creates a disengagement. During the testing, two locations formed conversation groups among themselves completely ignoring other distant diners.

2.3 Artificial Agents

Artificial agents have been developed not to solve distant dining per se, however provide an artificial dining companion when you do not have access to your loved ones. FOBO [15], myKeepon [16] and Brian 2.1 [10] are three different Artificial Robotic Agents which have been deployed to provide a solo diner with a dining partner. These artificial agents use ticks and motions like, burping or laughing or copy emotions to keep solo diners engaged or to keep diners food intake healthy. As mentioned above, these agents do not help in distant dining but provide an alternative however, there can be learning points from these agents and how virtual presence can be implemented along with distant dining which will be discussed in the next chapter along with concepts learnt from all the above literature.

2.4 Discussion

We have observed that most articles do not present a solution for both the time and space gap issue together while distant dining. Two articles, Dome MR [17] and Virtual Living Room [18] utilise concepts and technologies like Augmented Reality (MR) and Virtual Reality (VR) to provide an immersive experience of being together with friends or family for older adults living alone where the former focuses on solving both the time and space gap issue together and the latter only the space gap issue. We also observed that 7 out of 12 articles in Table 2-1 are between 7-10 years old and no recent articles were found which solved both the time and space gap issue having young expats as target groups. Since this information is not enough to answer our sub-research questions of habits around distant dining carried out by young expats and how they use technology for distant dining with a time zone difference of three hours or more, therefore we gathered more information about the topic via individual interviews as initial exploration presented in the next chapter.

2.5 Conclusion

To conclude, we studied multiple available pieces of literature which presented different ways of using technology to solve or provide possible solutions for the time and space gap issue among different target groups and their loved ones. Only one piece of literature presents a way to solve the time and space gap issue among solitary older adults and their loved ones, which is not our target group for

this thesis. The literature found and used for this research could not provide information on what habits do young expats have around distant dining with their loved ones and which technology they use to do so, hence, we conducted individual interviews to gain information about the topic, explained in the next chapter.

Articles	**Target Group**	**Focus Area**	**Published Year**
CU-Later [11]	Young Expats	Time Gap	2010
CoDine [13]	Expats aged between 20 to 40	Space Gap	2011
Telematic Dinner Party [14]	Users aged between 20 and late 30s	Space Gap	2012
Eating Alone, Together [19]	College Students, Seniors, Hospitalised Individuals	Time Gap	2012
RoomXT [12]	Solitary Older Adults	Space Gap	2012
KIZUNA Design [9]	Young expats aged between 21 to 32	Time Gap	2013
Brian 2.1 [20]	Older Adults	Artificial Agent	2013
Dome MR [17]	Solitary Older Adults	Time & Space Gap	2017
Virtual Living Room [18]	Solitary Older Adults	Space Gap	2019
FoBo [15]	Young Expats	Artificial Agent	2019
Room For One More [16]	Expats, Seniors, Hospitalised Individuals	Artificial Agent	2020

Table 2-1: Articles mediating Distant Dining along with their Target Group, Focus Area and Published Year

Chapter 3

Initial Exploration: Understanding Habits around Distant Dining

As available literature did not provide enough information to answer our sub-research questions, we used Exploratory Interviews to gain the required insights. Interviews are termed Exploratory Interviews when the available literature does not provide required information about a topic [21, Chapter 8], in our case distant dining among expats and their loved ones. These exploratory interviews are an ideal way to gain knowledge about topics with less available information by presenting open-ended questions to the interviewees. These interviews helped us gain an understanding of habits and technology used around distant dining among young expats and their loved ones with a time zone difference of three hours and more which was used to answer the two sub-research questions.

Participants for the interview, who met the criteria for the target group, were found by posting or sending a short description of the research along with a detailed information brochure (Appendix C) on Facebook and over WhatsApp. We interviewed 10 young expats from India, Indonesia, Dubai, Mexico and Colombia between the age of 18-32 years old who are either pursuing education or working or doing both abroad. The time zone difference ranged from 3-11 hours between the expats and their loved ones. As mentioned before in Section 1.3.3, the time zone difference between expats and their loved ones should be at least three hours, as it has more impact on one's daily routine.

3.1 Exploratory Interview

Interviews are a great way to get information about an individuals experiences and also provide better insight when not much information is available about a topic [22]. It is possible, that young expats do distant dine without even knowing that they are distant dining. For instance, both parties eat snacks like chips or other food while video calling or couples in a long-distance relationship try to do a video call date. All this information can only be gathered by interviewing users personally, however, the data collected might not be generalised for the rest of the public [22, p. 261].

3.1.1 Interview Structure

The interview was structured and conducted using the guidelines provided by Jennifer Rowley [22] and Jonathan Lazar et al. [21, Chapter 8] which discusses whom to interview, how to frame questions, which interview structure to use, tips on how to carry out an interview and how to analyse the collected data. The interviews conducted (questions available in Appendix B) were semi-structured since all questions could not be prepared before the interviews due to lack of information about

the topic which leads to a possibility to ask follow-up questions based on the answers provided by the participants which indeed resulted in interesting information. The interview was conducted over a video call as it was not advised to physically meet people due to Covid-19 Pandemic during the month of January 2021. The interview audio was recorded and later transcribed (available in Appendix A). Maximum efforts were taken so that the questions asked during the interview [22]:

1. were not leading or had implicit assumptions
2. did not include two questions in one
3. did not invite "yes or no" answers
4. were not too vague or general
5. were not, in any sense, invasive
6. did have a conversational flow
7. And lead to the conclusion of the interview

All ethic guidelines[1] were followed before, during and after the interview and the audio recordings were deleted after transcribing them. The consent for collecting data and processing them along with consent for being present over video call and recording audio data was taken beforehand (consent form is available in Appendix C).

3.2 Interview Data Analysis

Data collected during the interview was in the form of audio, every interview audio was transcribed using Word's built-in transcribe feature[2]. Transcribing audio data made it easy to go through the data and analyse it.

3.2.1 Methodology

A guided structure provided in Research Methods in Human Computer Interaction by Jonathan Lazar et al. [21, Chapter 11] was followed to perform qualitative analysis on collected interview data. Grounded theory methodology [21, p. 304] suited best for analysing the collected data, as we learnt in Section 2.4, the information gathered from the literature was limited to develop any framework for the analysis in advance. Grounded Theory consists of the following four stages to analyse the collected data [21, p. 306]:

1. Coding Data
2. Development of Concepts

[1] https://www.utwente.nl/en/eemcs/research/ethics/

[2] Word Transcribe Feature does not store any audio data as of 18th January 2021.

3. Grouping concepts into Categories
4. Formation of a Theory

3.2.2 Coding Data

Coding is the process of assigning labels to a block of text based on the repetitive occurrence of the word in the block of text or based on previous work or a framework [21, Chapter 11]. As mentioned in Section 3.2.1 the available literature was limited and therefore developing codes in advance was not possible and hence Emergent Coding [21, Chapter 11] was used to code collected data. Semi-structured interviews allowed us to categorise collected data based on the questions asked and resulted in initial codes to structure the interview data. Codes were as follows:

C1. Times contacted loved ones
C2. Usual contact person
C3. Occasional contact person
C4. Time of contact
C5. Decision to contact
C6. Technology used during contact
C7. Form of communication
C8. Applications used to contact
C9. Common activities during contact
C10. Change in interaction time
C11. Social media role
C12. Munching during contact
C13. Contact during participant's meal
C14. Contact during loved ones meal
C15. Participant during meal
C16. Distant dining with loved ones
C17. Distant dining with local friends
C18. Benefits of distant dining
C19. Issues faced while distant dining
C20. Experience of meal at home
C21. Perfect system to solve distant dining

Demographic data like age, nationality, occupation and time zone difference between young expats and their loved ones, were also part of collected data during the interview. The coded data could be interpreted in numerous ways, to understand the data we followed guidelines presented by Jonathan Lazar et al. [21, Chapter 11]. For instance, by looking for repetitive patterns about a topic within the data. The following excerpt from the interview of P3 (Participant 3) and P10 (Participant 10) were put together and coded as "C14. Contact during loved ones meal":

> *"**P3**: They usually say that they'll finish their meal and call me back because I don't think they enjoy me having, talking to me virtually, and then having food together. I don't think they enjoy that. So majorly it's like this call me like Chyna (nickname) they'll say that I'm having food and I'll call you back once I'm done with food."*

> *"**P10**: I think is kind of the same like I call them sometimes eating I guess, and then because I don't see what they're doing, so I'm just assuming that they're having something, but they kind of talk to me, but because I've noticed that they are eating, so we just decide later. OK, I will call you later."*

The coded data is available in Appendix A.

3.2.3 Development of Concepts and Categories

After coding the interview data, we grouped these codes into concepts. Codes are grouped on the basis of similarities in the data they point towards and based on what relations can be established between the selected codes. For instance, the codes **C6. Technology used during contact**, **C7. Form of communication**, and **C8. Applications used to contact** are grouped under one concept as **Tools for communication** since all the three codes contain information on how expats contact their loved ones daily. This concept **Tools for communication**, is used to establish a relation between which form of technology is widely used based on the form and applications available on that certain technology. This grouping into concepts allows us to connect the codes and analyse the data at a higher level and establish relations between the codes [21, Chapter 11].

Further, the concepts are grouped together to form categories which contain shared characteristics for instance, concepts **1) Contact Person**, **2) Group Calls**, **3) Time of Contact**, **4) Tools for Communication**, **5) Common Activities**, and **6) Social Media** are grouped together under the category as **Usual Communication** since all these concepts explain how expats and their distant loved ones connect with each other through time and space. In Figure 3-1, we can see which codes (Column 1) lead to different concepts (Column 2) which are further grouped into categories (Column 3). These categories and concepts are discussed individually starting from Section 3.3 to Section 3.6.

3.3 Usual Communication

This category consists of the following concepts: **Contact person**, **Group call**, **Time of contact**, **Tools for communication**, **Common activities** and **Social media**. The relation we established using the above concepts was how, when and which loved ones do expats contact regularly or occasionally. We found that people closer to expats are contacted at least four times a week over a video call using WhatsApp on their smartphones, usually at a fixed time by regularly memorising one another's timetable to share highlights about each other's day or to celebrate occasions like birthdays, festivals and more. Contrary to people who are contacted occasionally like friends and family relatives are contacted usually in a group call using laptops over Zoom, Google Hangouts or Skype to catch up, celebrate birthdays or to play online multiplayer games together. Expats also use social media to share their daily lives and stay updated about their loved one's lives. Next, we provide more detailed information about each concept used in this category.

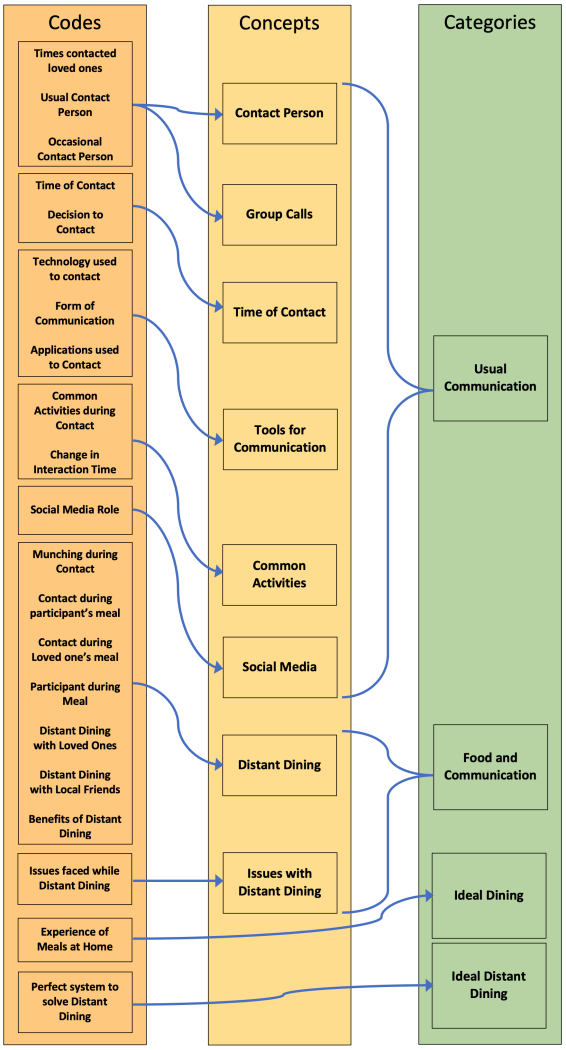


Figure 3-1: Coding, Conceptualisation, and Categorisation of Collected Interview Data.

3.3.1 Contact Person

The codes **C1. Times contacted loved ones**, **C2. Usual contact person** and **C3. Occasional contact person** are grouped under one category as **Contact Person**. The usual contact person is the one who is contacted or contacts expat every day or at least four times a week and in most cases is their mother followed by father and other close family members. For example:

> "***P6***: *I contact my mom and dad regularly as they're on the call together, like once every two days.*"

> "***P10***: *I call my mom at around 10:00 pm every night before going to bed.*"

Whereas occasional contact persons are always friends and few family members. Communication with the usual contact person occurs over a private call whereas,

with an occasional contact person it is mostly in a group with others joining over the call. For example:

> "***P1***: *With my mother and close family we mostly do WhatsApp video calls. But I talked to my relatives over Zoom mostly, and with friends, we use many different applications, we sometimes use discord.*"

> "***P2***: *Last week we planned my friends' bridal shower occasion. That kind of event we really planned it like we even prepared Zoom background stuff and made a schedule for it.*"

3.3.2 Group Calls

Another concept that is derived from **C1. Times contacted loved ones**, **C2. Usual contact person** and **C3. Occasional contact person** is group calls. Apart from individual calls with loved ones, group calls are also an integral part for expats when it comes to contact their distant loved ones. Group calls with family can consist of blood relatives like parents, brothers, sisters and partners or blood relatives and extended family like cousins. These group calls mostly take place around a family member's birthday, or during a family gathering or a festival like Diwali, Christmas, New Year and more. And these group calls are important for expats as they believe this way, they get to stay in touch each year with their extended family while they are far away. During these group calls everyone usually catches up with the expat and have long conversations. Another kind of family group call is when everyone is physically together and one person calls the expat. In this scenario after talking to everyone, expat feels bored as they cannot be the part of the conversation or group physically. For example:

> "***P3***: *During Diwali, everybody was getting together so I called them and everybody passed their phones and everybody listening to the conversation. I was there for half an hour or 2 hours sitting there doing nothing. Just seeing them playing card and so couldn't do anything and responded to their laugh, but this happens only sometimes you're not doing this kind of call every day.*"

Group calls with distant friends also mostly take place around a festival or someone's birthday and requires prior notice to get everyone in a call at once. The group calls consist of conversations about catching up, playing online games (Scribble, Among Us and more) or watching a movie or a show together on Netflix Party.

3.3.3 Time Of Contact

This concept is a group of codes **C4. The time of contact** and **C5. Decision to contact** which discuss how and when expats decide to contact get contacted by their loved ones. With the usual contact person the communication mostly happens at a fixed time of the day and so making a decision is not required.

These communications have been structured over time and end up being a habit for both the expats and their family members as both know each other's daily routine and the adjustment to time zone differences. For example:

> "***P3***: *Usually my parents are free during the night after their dinner and so it is very easy to contact them.*"

Whereas, with occasional contact persons like friends, it is always a text to see if the person is available followed by a video or a voice call. For instance:

> "***P5***: *For my mom and dad, I can call them like that, but for friends and relatives, I have to message them like "are you up or are you busy" or something like that and then I call them over video call preferably.*"

3.3.4 Tools For Communication

This category consists of a group of three codes, **C6. Technology used during contact**, **C7. Form of communication** and **C8. Applications used to contact**. All expats choose WhatsApp on their smartphones to communicate with their loved one who they connect regularly due to ease of access (Figure 3-3), for example:

> "***P8***: *I contact my family using my smartphone via WhatsApp video call, I never use Skype anymore. Since we already talk on the chat, it's easier to just click the video call button than switching to Skype.*"

Interestingly, seven out of ten participants preferred video call over voice call, followed by texting (Figure 3-2) as they wanted to see their loved ones while talking. Video and voice calls, both are preferred forms of communication for expats over texting when it comes to connecting with their loved ones living far away (Figure 3-2). However, texting also plays an important role in establishing video or voice calls. For example:

> "***P5***: *I have to message my friends and sometimes my family 15 or 20 minutes before I'll be free and then we video call. I cannot call them immediately.*"

> "***P6***: *And with friends, we just drop messages like "let's call" and to be honest, it's not always very accurate. Like they will say, "let's plan" to call tonight but then there is a high chance of it not happening. So yeah very good way of planning is needed.*"

Five out of ten participants also have a preference towards Zoom when they are engaged in a group call with their distant loved ones (Figure 3-3).

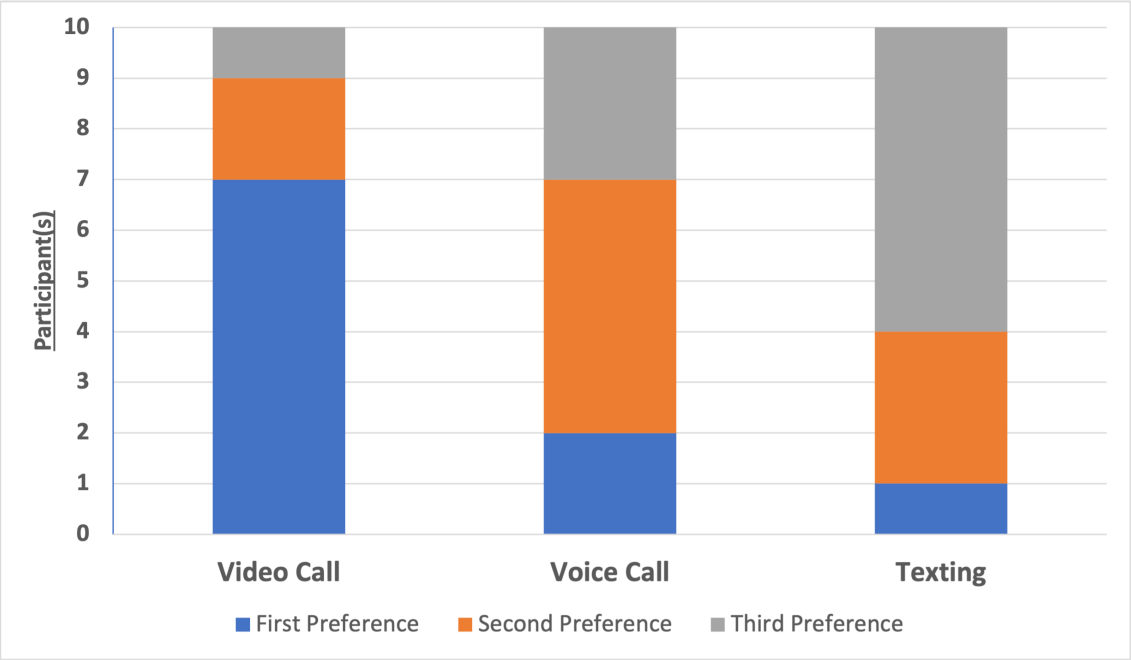


Figure 3-2: Preferred form of communication among young expats and their distant loved ones.

3.3.5 Common Activities

This category consists of two codes, **C9. Common activities during contact** and **C10. Change in interaction time** as the common activities performed during distant dining or during a call changes the duration of time expats and their loved ones interact with each other. Usually, while expats and their loved ones communicate, it mostly is about catching up by sharing their everyday stories and family talks. At times, expats and their loved ones get together to celebrate an occasion like birthdays, festivals (Ramadan, Diwali, Christmas, New Year etc.) or to play games like Scribble[3], Among Us[4] or sometimes cooking together. For example:

> "***P2***: *During Ramadan, we did 3 times of cooking sessions together to break the fast.*"

> "***P3***: *We just chat, we just go through our day how it was. Sometimes I cook and my mom explains the recipes through video call and I'll be cooking. She'll guide me virtually I'll be cooking and the same goes for my boyfriend, he is a very good cook. So even he helps me to cook. It's very rare, but sometimes we also have dinners together, like, I'll be having food and he'll also be having food.*"

> "***P8***: *We would just say happy Ramadan to each other and show my food because it's like a food time. Everyone will celebrate with a lot of*

[3]https://skribbl.io
[4]https://innersloth.com/gameAmongUs.php

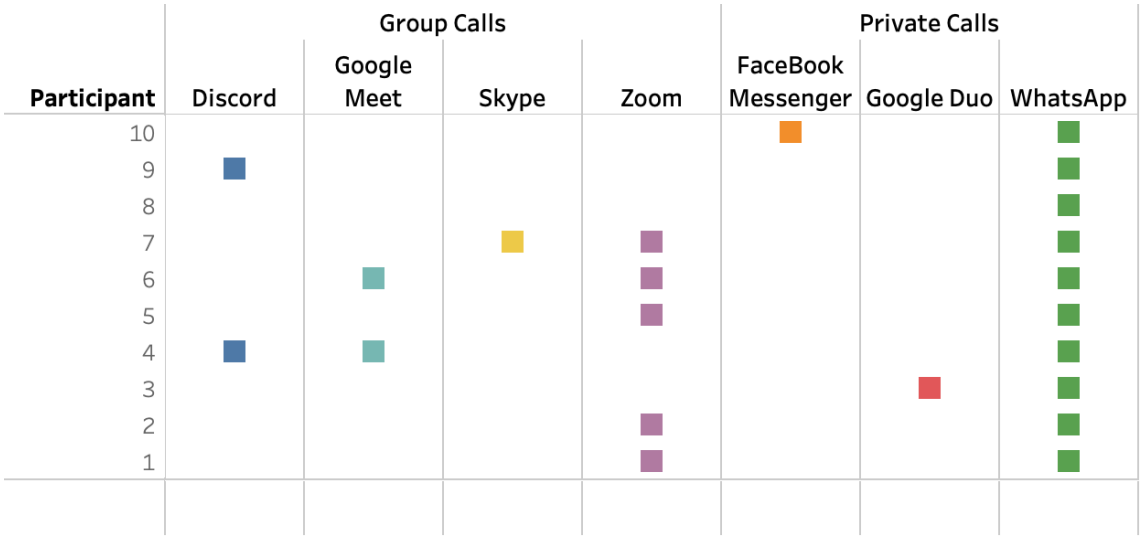


Figure 3-3: Applications preferred by young expats for Private and Group Calls.

food and my parents will show what's in the kitchen or on the dining table and what they're eating."

These common activities do result in an increased interaction time among expats and their loved ones, however, sometimes a disconnect among expats and their loved ones also occur due to technical issues like internet connectivity or not understanding anything as everyone is speaking together or getting bored as the activity is not interesting for the expat. Irrespective of these issues, expats believe that these common activities help in strengthening their bonds with family and friends while living away for a longer period of time.

3.3.6 Social Media

Consisting of only **C11. Social media role**, a small detail we found through these interviews was that social media was an important tool for expats to connect with their distant friends and get updates on their loved one's lives or post about their ongoing life which tends to be a conversational topic during a call. Social media did not help expats to get in touch with their family members much. Only two out of ten expats connected to their family via social media and the remaining eight used it to connect with friends occasionally. For example:

"***P1***: *I don't use social media much except for Instagram because that's where most of my friends are. But apart from that, I don't use social media that much.*"

"***P6***: *For friends, I am primarily connected with them through social media like texting or like seeing what they're up to on Instagram and stuff. And for family also for sharing what I'm doing or where I am by taking a picture and send it to them or to see whether they're doing something interesting and so they can click a picture or video and send*

it to me so that definitely social media plays a big role in contacting and keeping in touch."

3.4 Food and Communication

This category consists of two concepts, **1. Distant dining** and **2. Issues with distant dining**. Through the initial interviews, we found a relationship between food and communication. We asked expats what they would do if their loved ones call them during their meals, six out of ten expats stated that they would continue talking to their loved ones, three expats mentioned that they would only continue talking while having their meal if the call is urgent else, they would call back after having their meal and the remaining one expat stated that he has never eaten food while on a call with loved ones. Out of the six expats who would continue talking to their loved ones during their meals, three expats mentioned that they would only continue the call if they are eating alone. This represents that expats are comfortable talking to their loved ones during their meals given no one is around. However, the opposite is not true with parents, six expats state that parents usually try to postpone the calls during their meals and call back after they are done with their meals.

Another interesting piece of information about food and communication was that eight out of ten expats snack during their calls with loved ones. Snacking usually consisted of eating chips, cookies, drinking beer or tea with sandwiches and more. According to four expats, this snacking habit was unintentional and was not realised when they began to munch during the call. For example:

"***P1***: *Like not while Munching, but while we're having the video call, I might take one like a bag of chips or an orange and just I'll eat it normally. So it's not like a complete dinner or something, just some light snack.*"

"***P3***: *Yes. Even now I'm doing that [started eating unintentionally] so yeah. I'm usually having food or something, the time when I call my loved ones.*"

3.4.1 Distant Dining

For this section, we used the following codes, **C12. Munching during contact**, **C13. Contact during participant's meal**, **C14. Contact during loved ones meal**, **C15. Participant during meal**, **C16. Distant dining with loved ones** and **C17. Distant dining with local friends** as all these codes contain data of distant dining between expats and their loved ones. Through the interview, we learnt that distant dining with loved ones is a far-fetched idea for expats. Six out of 10 expats never tried or heard of distant dining. It was observed that distant dining was clearly not the way for expats to communicate with their loved ones. However, we also learned that expats in a way have tried something similar to distant dining which is explained in the following subsections.

With Distant Family

While distant dining is not something expats have thought about when contacting their families, there have been scenarios where distant dining did occur like, during Ramadan two expats cooked together and ate together or celebrating birthdays together where expats eat snacks while everyone is eating at the party. For expats, these events are a must irrespective of their time zone difference and so instead they try to adjust their mealtimes by delaying it or preponing it. For example:

> "***P2***: *Yeah, so I usually will just adjust to their [loved ones] time and when they're having meals then usually, I get triggered to also have meals so I will just prepare something which is easy.*"

Two expats also explained that their breakfast time or dinner time coincides with family's lunchtime and therefore they do distant dining together with family more than occasionally, for example:

> "***P3***: *Very rare, but it happens sometimes my breakfast time is almost equal to his [boyfriend] lunchtime. So when I'm having breakfast he'll be having his lunch. Yes. It is not necessarily always but yes, most of the time.*"

All expats also believe that technology and food is not a good combination for the family, especially for parents which is also another reason why distant dining is not that common among distant family and expats, for example:

> "***P3***: *No, only on my mum's birthday. We did [dine together]. And that was also my idea. They were first very reluctant about it. And after me insisting they did, and it went, it was great for me. But it was too much hassle for them. Because they have to manage the camera. I'm all alone. But, there is a group of people staying together. And it was not good.*"

With Distant and Local Friends

With friends, the idea of distant dining is very different from that with family. Seven expats have distant dine in one way or another, from sharing meals to drinking beer or tea together over video calls. Expats did raise a concern that arranging for distant dining with distant friends is difficult than it was with local friends during the Covid-19 pandemic. Since younger people are no novice to the technology, therefore, it is easy to organise distant dine among friends. Expats contact their family almost daily and friends occasionally, the contact usually happens during an event like birthdays or on festivals like Easter or Christmas also the timings to contact friends is always flexible but does require an arrangement via text

as mentioned in Subsection 3.3.3. For expats, distant dining is also a way to go on virtual dates with new or existing distant companions. These virtual dates begin with usually showing what the opposites cooked and begin with eating and talking. For example:

> "***P4***: *Yes, I did. I had a date online. We both had breakfast online on Google Meet and it was nice like we were just talking sharing some stories with each other. On Google Meet there is this advantage that you can share your screen so we shared pictures with each other Um, so like she was interested in my project so I could show what I've done like long ago it was like in June or something. Then I could show my room, some artefacts. I have swords so I show that, it was nice.*"

Benefits of Distant Dining

We asked participants during the interview, whether they observed any benefits in distant dining and seven participants agreed that distant dining does have long and short term benefits. As a short term benefit, participants believe that distant dining is also an activity which is performed with their loved ones and so it can be used to increase the interaction time with their loved ones, for example:

> "***P2***: *Yeah, I would say so because I mean the meals kept us talking for a long time, so if there wasn't any food we probably could have ended the call earlier.*"

As a long term benefit, participants think that there are few health benefits to it, it could also be a way to stay connected with their loved ones and have a meal together with the way they used to back home. For example:

> "***P6***: *Well, students don't know how to eat healthy meals, so they might eat a lot of junk food. But then if you're eating, let's say with your family every day, the parents can notice that you're not eating properly and they can guide you to not eat this every day and instead eat more vegetables and more fruits.*"

> "***P9***: *Benefits, I think would be nice also to share a meal with them [loved ones] as the old times.*"

3.4.2 Issues with Distant Dining

The issues with distant dining for expats are coded as **C19. Issues faced while distant dining**. The majority of expats complained about the internet speed during most group video calls. This slow connection interrupted their conversations randomly and resulted in a social disconnect towards the one with slow internet from

the rest of the group. The next problem expats faced during distant dining group calls was when too many people spoke together, which led to a misunderstanding of what others said and required a repetition from everyone. This conversational mess also made everyone wait for their turn to talk which resulted in unnatural conversation. Further, using technology with food was also a concern among expats as they did not want to bring their phones or laptops near the food because the devices are full of germs and also handling devices while eating is a challenge (messy hands and handling the device). The next issue among expats for distant dining was time management, deciding the time to distant dine is a challenge especially when it comes to parents. And the last concern for distant dining is privacy because most distant dine only when they are eating alone, therefore only two expats believe that privacy was an issue during distant dining with their loved ones.

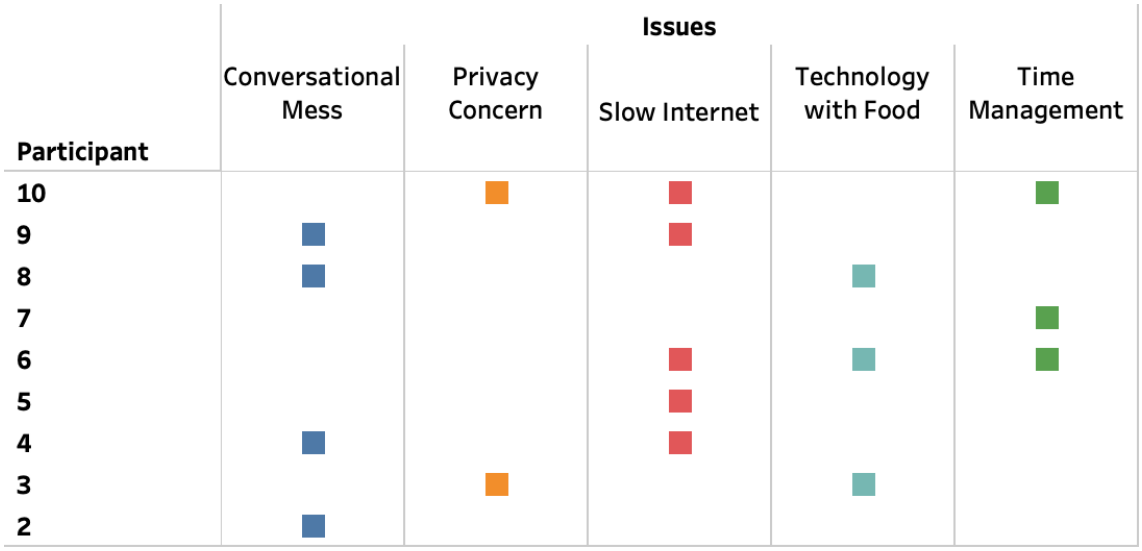


Figure 3-4: Concern raised by young expats about Distant Dining

3.5 Ideal Dining

During the interviews we asked participants to share what their meals looked like when they were not living away from their family represented by the code **C20. Experience of meal at home**. Every participant shared that they used to dine together with their parents and siblings around a dining table. While dining, the expats used to discuss their day's activities, future or past events and sometimes discussions took place to decide actions for future events. Two expats shared that they used to go out on weekends to a restaurant for meals. Apart from this, participants unfolded that during dining with family they also sometimes watch television, however, they claimed watching television reduced the amount of conversation they had together while dining and one participant shared that television acted as background noise and was sometimes not even watched but remained 'on'.

3.6 Ideal Distant Dining

The last question we asked participants was "If you could describe a perfect digital system for improving distant dining, what would it be?" represented by the code **C21. Perfect system to solve distant dining**. Most expats explained a system where realism is important like present in the same room as other members, eating the same food, having a proper conversation without worrying much about whose turn it is to speak and sharing common background noises or having social lubricants[5] like viewing the same images or discussion due to food or watching the same video or television or playing games together while dining. We quantified the collected data based on the similarities in the answers we received, i.e. in Figure 3-5, **Same meal** refers to either eating the same food or cooking and eating the same food at the same time or being able to smell opposite diner's food, **Proper conversation** relate to the issue we learnt about in Section 3.3.2 where everyone talks together and no one understands what is said, **Embodiment** refers to being physically present in the same room using technology like virtual reality or being able to interact with each other surroundings and **Common background** refer to sharing social lubricants like the same music, television, images or background noises.

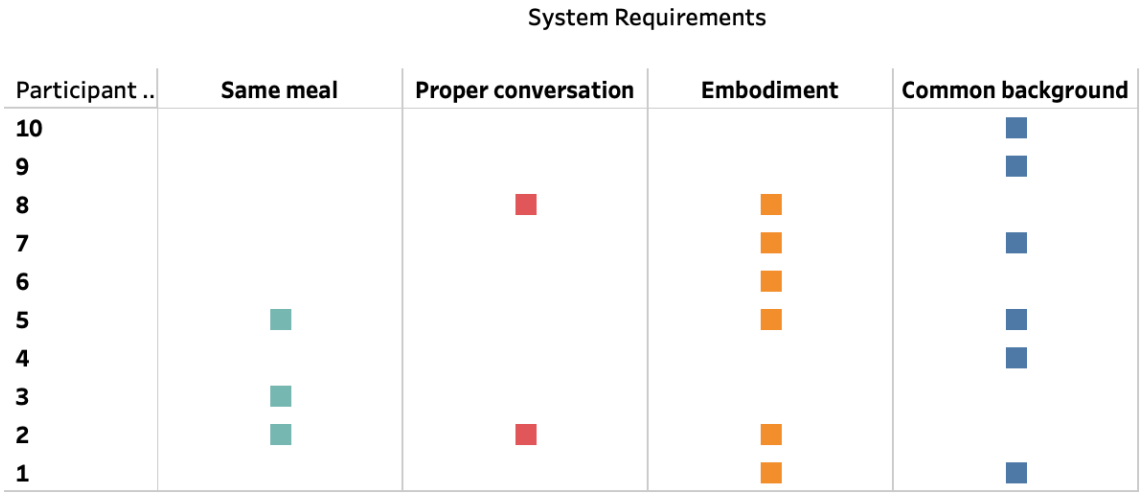


Figure 3-5: Requirements of an Ideal Distant Dining Setup recognised by expats during Interviews.

Using this collected data and what they contain as explained above, we constructed a mind-map of ideal distant dining (Figure 3-6). This mind-map is used in Chapter 4 to ideate and design new possible distant dining technologies by using different parameters. We also represented these requirements and what they consist of as explained above in a graphical format as a mind-map (Figure 3-6). This min-map can be used by other researchers to see which areas affect the quality of distant dining among young expats and can also be used to pick an area to improve upon.

[5]term social lubricant is any food, beverage, drug or activity that stimulates social interactions or helps people feel more comfortable in social occasions. (Definition as per Wikipedia)

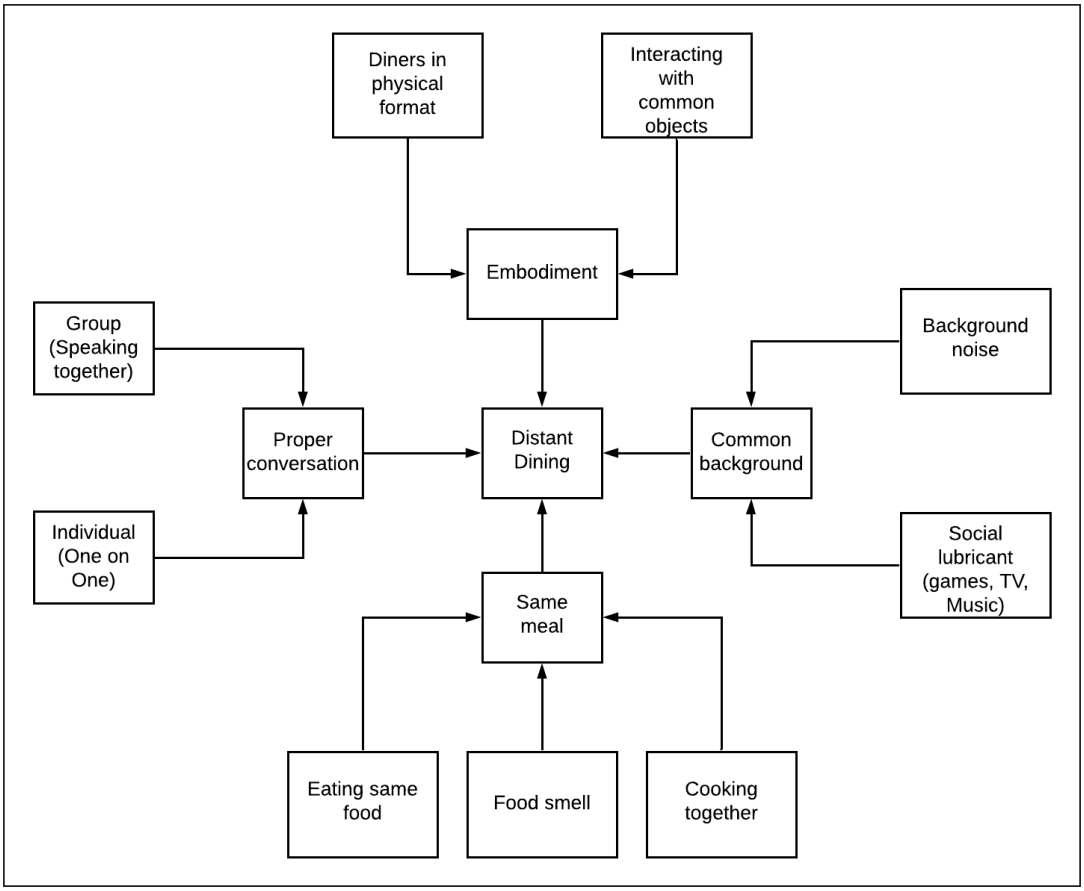


Figure 3-6: Ideal Distant Dining Mind-map

3.7 Formation of Theory

Finally, as per the guidelines presented in the methodology section (Section 3.2.1), the last step is to develop theories using the collected interview data and concepts and categories developed in Sections 3.3, 3.4, 3.5 and 3.6. Through the interviews, we understand what are the habits of expats around distant dining and how they use technology to overcome the time and space gap issue with their loved ones. We developed four theories presented individually below in separate sections.

3.7.1 Theory 1

> **"Distant dining activity is time-sensitive and that is why many expats have never tried it while few converted it into an occasional festive get together which takes place during festivals or birthdays or on other life events."**

In Section 3.3, we learnt that contacting close loved ones like parents was always predefined whereas contacting friends and other relatives was flexible and limited. This happens because expats tend to take out time when contacting their occasional contacts as it happens once in a while and the initial reason to contact them is

usually because of an occasion like a birthday, a festival and more, something which doesn't happen every day and so it is another way to stay in touch with their not-so-frequently contacted loved ones. Similarly, distant dining is usually occasional for few expats as it is another way of staying in touch with their loved ones and requires strict timing hence, many expats have never tried it.

3.7.2 Theory 2

> **"Distant dining every day is not possible for expats as they would not be eating alone every day and expats are usually busy with their own life."**

From previous theory, we know why few expats have ever tried distant dining, however in Section 3.4 we also learnt that expats are not always eating alone. Expats tend to get busy with their own life and dine more often with their colleagues or roommates and therefore they are not comfortable talking to their loved ones or dining with them in front of their colleagues or roommates.

3.7.3 Theory 3

> **"Video calls using smartphone or laptop is the only way expats have distant dining which doesn't allow them to have a deep physical connection with their distant loved ones, like share common surroundings, interact with common objects or see opposite diner in the same room and share the same meal either by cooking together or ordering online."**

Section 3.4 discusses what different ways expats have tried distant dining using only video calls. Expats have cooked and shared meals on video calls during festivals like Ramadan. Expats have also tried to play games or watch videos together while they consume tea, snacks or beer with their friends on a video call. However, in Section 3.5 participants also discuss that video call doesn't provide the ideal presence of the person on the other side of the video call. Few tools were discussed like Netflix party (to watch synchronised videos) or HouseParty (to play multiplayer games online) which allow both sides to enjoy a shared experience but video call and the tools do not provide expats with the experience of sharing the same physical space like being in the same room as the other diner.

3.7.4 Theory 4

> **"Expats indeed want to distant dine with their loved ones, however, the technology does not allow them to have the proper experience."**

The ideal distant dining (Section 3.6) provides information as to what expats expect to be improved while they dine with their loved ones. The ideal case for distant dining is similar to what happens during dining among family or friends (Section

3.5) without the time and space gap issue where people can share objects, have physical interactions and are physically present in the same room.

3.8 Discussion

The aim of the interviews was to answer the two sub-research questions,

1. What are the habits around distant dining carried by young expats with their loved ones (family and friends) having a time zone difference of three or more hours?

2. How young expats use technology to distant dine with their loved ones (family and friends) where time zone difference is three or more hours?

For the first sub-research question, we found that few expats distant dine with their loved ones occasionally and these can be random days or specific occasions like Ramadan, Diwali, Christmas or Easter where apart from dining together, cooking together also takes place. Other than occasional distant dining, expats unintentionally snack during individual or group calls, and it happens either because they are generally hungry during that time or eating alone is not what people do who live and eat alone [23]. Time is also an important part of distant dining since mealtimes rarely coincide with distant loved ones and finding the right time to sit together and eat is a challenge. However, distant dining among expats and their loved ones is occasional and therefore, time adjustment for meals and taking out free time occasionally is acceptable among expats and their distant loved ones.

For the second sub-research question, expats always use video calls on their smartphone or laptop to distant dine and it is not designed to accommodate such activity since most expats had issues during distant dining like everyone speaking together, not being able to eat the same meal or share same surroundings which could provide a better sense of being together while dining.

From the answers to our two sub-research questions, we can understand that expats do want to distant dine with their loved ones as they used to back home, however, to compensate for the time and space gap issue, they have adopted new ways or habits of eating when they are on call for a normal chit-chat or during a special occasion using the available technology to its limits to feel physically as close as possible to their loved ones. Now that we have addressed the time and space gap issues from our target group perspective, we believe that technology can be used in a better way to improve the dining process for young expats with their loved ones and indeed bring them closer. We now know what participants expectations are from technology while distant dining, which partially answers our main research question, i.e. ***"Despite the time and space gap, how can technology be used to improve the current experience of distant dining for young expats with their loved ones?"*** but we need more information to clearly understand what can actually improve or add to the distant dining experience for young expats.

3.9 Conclusion

This chapter used interviews to gather information on habits and technology used by young expat around distant dining with their loved ones. Grounded theory methodology was used to first collect data using interviews, followed by coding, conceptualising and categorising the collected data to finally present multiple theories which were used to answer our two sub-research questions and partially answer our main research question. Using the collected and processed data in this chapter, we develop concepts to solve the issues and concerns raised by participants during the interviews and get feedback on the concepts from the same set of participants in the next chapter.

Chapter 4

Creating Concepts and Participants' Feedback

This chapter presents possible concepts which can address the issues and concerns raised by the participants during the interviews in the previous chapter and receive feedback on the concepts to improve upon them.

4.1 Concepts

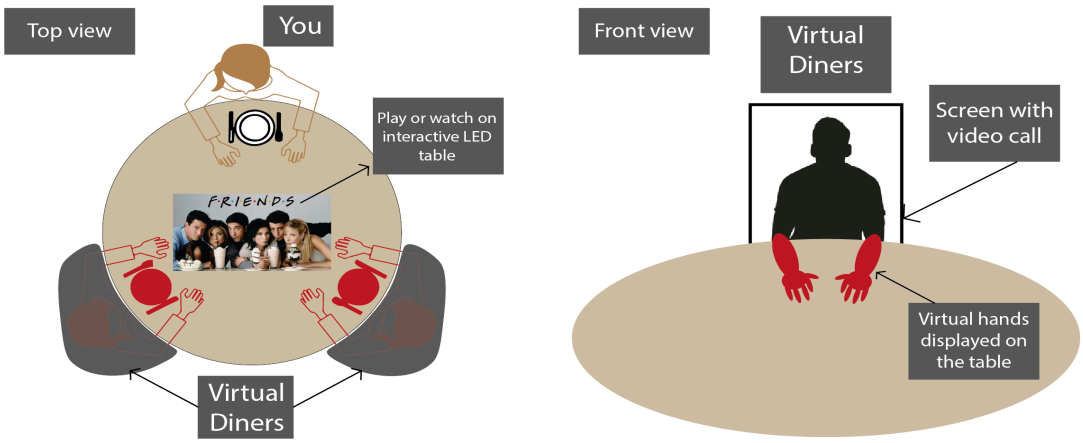
We established the issues expats face while distant dining in the previous chapter as seen in Figure 3-4 and found what their expectations are from the future technology as seen in the Figure 3-6. Further, during the interviews, we asked the participants about ideas for an ideal distant dining setup (Section 3.6). Based on the ideas presented and the issues raised by the participants during the interviews, we set up four concepts. These concepts are a direct result of the ideas participants had during the interviews for distant dining. The concepts presented in this chapter were requested by multiple participants with only slight differences. Further, these concepts might not be feasible with currently available technology however, we did not want the participants limited by technology while presenting their ideas.

4.1.1 Hands Together

The concept consists of a system that can share images, videos or see what other distant diners are doing while eating.

> "***P10***: *Introduce a device where you could share images over dinner so people can take a look at it. Like yeah, I know this is more complicated with maybe some meal you are having, yeah something like that. Something more of interaction where they can see what you're doing because well in video call it is just boring.*"

This system uses a LED display table developed by Roelof A. J. de Vries et al. [1] which can be used to display images, play videos or even play games. Apart from these common social lubricants we also conceptualised a way to see other diners hands on the digital display of the table which could display what other diners are doing on the table and each diner can be viewed on its own display so that 2D video of diner extends to the digital display to provide an immersive way of interaction as seen in Figure 4-1. The projection of hands on the table requires a camera installed on opposite diner's side and for full immersion, all parties require the table and a top-down mounted camera.



(a) Top view (b) Front view

Figure 4-1: Hands Together Concept

4.1.2 VR Restaurant

This concept uses virtual reality to create a 1:1 scale model of the user's kitchen and dining area so that the user's interactions with objects in the real world are overlaid with virtual objects as seen in Figure 4-2. Further, just like in reality the user can invite guests over to their place virtually which can be explored by the guests and finally everyone can eat real food which will also be overlaid in virtual reality. While eating food, diners could also interact with virtual objects like watching a video, image or playing together while dining at a virtual table.

> "***P1***: *This ideas might sound a bit outlandish but what I think is lacking during these social interactions is uh, I don't want to see someones face on a laptop screen or computer screen. I want to see them as is, so some sort of a VR (Virtual Reality) thing would be a bit, you know, on the positive side of interaction.*"

Figure 4-2: Virtual Reality Restaurant. Image reference Grey Madison. The left side is the virtual world and the right side is the real world

4.1.3 Miles Together

The concept is an application that is used to order the same meal or raw ingredients for you and your distant diner. The application could be a one-stop solution for displaying recipes of what you order, video or voice calling, playing games while dining together with distant loved ones. The idea is to make distant diners eat the same meal either by delivering cooked food or by delivering the same ingredients which can be later cooked together and eaten together.

> "***P3***: *Oh, virtual hotels can really work. Like hotels can open up there [India]. So, I am not sure like some idea like this, they can deliver the same food for two people in different locations. Maybe not be like internationally like India and Netherlands, but within the Netherlands, they can do that. Like Yeah, like for example, if someone like let's say Burger King and it is in Enschede and also in Eindhoven and if me and my other friend trying to do a distant dining, there should be not too much to figure out, instead I can use a system to select option for distant dining, and I can surprise one of my friend by sending her food and asking her to come up. Something like that will be really nice.*"

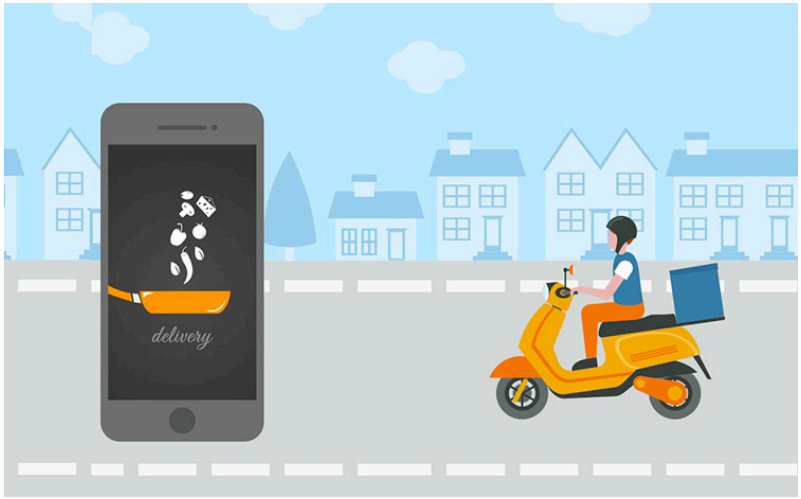


Figure 4-3: Miles Together, an app for delivering same food or raw ingredients across the world.

4.1.4 Bowl and Fragrance

A food bowl concept with a smell sensor and a fragrance emitter with a fan (Figure 4-4). The sensor records the smell of the food in the bowl and is then transmitted to the other bowl via smartphone and then fragrance emitter emits the smell of the food on the other location.

> "***P2***: *I really want to have a feature that can help me to ask someone else to taste or smell my food. So like on Fridays, 'cause it's also what usually we did back then when we have meals together, this is definitely a limitation of doing this kind of remote meal dining.*"

Figure 4-4: Bowl and Fragrance

4.2 Feedback on the Concepts

Since the concepts presented above were conceptualised based on what the participants said during the interviews, therefore we needed to know whether the same participants approved of these concepts, and if not, what changes or other feedback they can provide to improve the concepts. Further, we also wanted to make sure that we did not miss-interpreted any ideas presented during the interviews and so if the participants wanted to redesign the ideas, they could present a new idea of their own or present a new idea inspired by initial concepts (Section 4.1). To get the feedback on existing concepts and allow participants to create their own ideas, a design session was conducted in three parts, Feedback Section (Section 4.2.2) for participants to provide feedback on existing concepts, Ideation Section (Section 4.2.3) for participants to redesign or add new ideas and Verdict Section (Section 4.2.4) for participants to pick top three ideas presented or constructed during the design session. The session was conducted with six participants (one of them did not show up at the end moment) instead of all 10 previous participants since few initial ideas presented during interviews were similar among participants and it would have been difficult to handle all 10 participants together and conversation online would have been a mess. Mural[1] (Figure 7-1 in Appendix G) was used for participants to collaborate online and Discord[2] for participants to communicate. The feedback and ideation section were scenario-based design sessions since scenario-based design help evaluates possible future solutions and gives an idea as to how the design will be used in the given scenario which improves the decision making of participants, it also requires the designers to use a valid and verified scenario for the session [24]. The scenario we created for the session was as follows:

Scenario

"There is an occasion (festival or event) coming up and you with your family wants to distant dine (have a meal) together for the occasion. Apart from conventional video calling, you have four other ways to dis-

[1]https://www.mural.co (an online collaborating space)
[2]https://discord.com (digital platform to communicate via text, voice and video)

Figure 4-5: Ice Breaker Section of the Feedback Session

tant dine given your parents, other family members or friends already know how to use the technology."

This scenario is derived from the themes we presented in the Section 3.7 that expats distant dine with their distant loved ones during special occasions or other life events where they adjust their meal time accordingly.

4.2.1 Ice Breaker

After a brief introduction about the session, the session began with an Ice Breaker Section for a total time of 8 minutes. Ice breakers are a great way to make participants feel comfortable before involving them in activities as teams or before engaging in conversation [25]. Also, since the participants did not know each other before the session, the ice breaker was a great way to get them comfortable with each other and bond as one team.

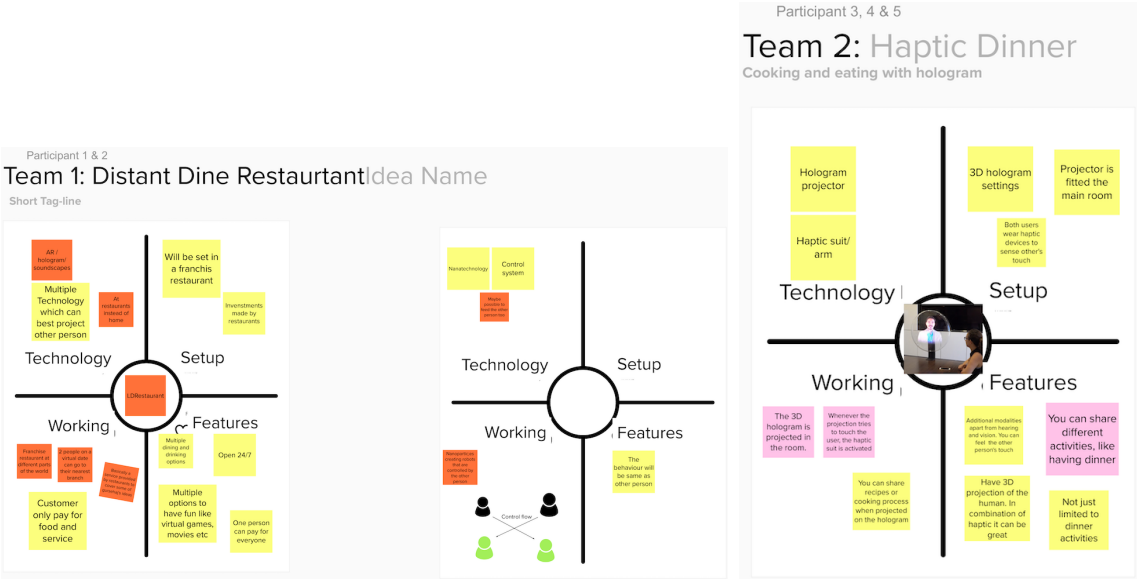
The group answered four questions about the food they miss from home, their favourite restaurants and festivals they used to celebrate with their family by typing and adding additional pictures for everyone to see what they exactly mean which can be seen in Figure 4-5.

4.2.2 Feedback Section

After the Ice Breaker section, we moved on to the feedback section. Here we explained and gave an overview of the concepts designed and explained in Section 4.1 using images and post-it notes as seen in Figure 7-1 in Appendix G. To break the concept into easily understandable parts, we used four quadrants to explain the overall concept in an easy manner named **Technology** explaining the technology used for the concept, **Setup** explaining how the concept will be setup for use, **Working** explaining how will the concept work in terms of interaction and **Features** presenting what features does the concept carry. After explaining each concept, five minutes were given for everyone to fill in the feedback grid to provide feedback on what worked well, what needs to change, any unanswered questions and any new ideas to try for each concept presented, as seen in Figure 7-1 in Appendix G.

4.2.3 Ideation Section

After the feedback session, we moved to the ideation section which was used to see if the participants had any new ideas of their own or if they wanted to improve or redesign the ideas from the feedback section. Participants were divided into two teams, one with two participants and the other with three participants (initially two teams of three participants, however, one participant did not join the session last minute). The teams were also moved to their own Discord channels so that they could discuss the ideas within their teams. Participants had an option to develop ideas together or on their own nevertheless, both teams preferred to develop concepts as teams which can be seen in Figure 7-1 in Appendix G.



(a) Ideas presented by Team 1

(b) Ideas presented by Team 1

Figure 4-6: Concept ideated by participants in teams of two

Team 1 with two participants, conceptualised two ideas seen in Figure 4-6a. First, a service for AR/VR distant dining which is a direct representation of the VR Restaurant concept (Section 4.1.2) and second, developing robots from nano-particles that

can imitate a distant diner in terms of looks, movement and interaction controlled directly by the distant diner (an advanced telepresence robot).

Team 2 with three participants, conceptualised one idea seen in Figure 4-6b, using a haptic suit with holographic projection so that the distant diner is physically present in the room without any screens or headsets and the haptic suit can deliver touch sensitivity to both diners.

4.2.4 Verdict Section

Finally, after the ideation section, every participant was given three stickers which they used to vote for their top three concepts from all presented concepts (from the feedback section and ideation section), participants could only vote one concept once. From Figure 4-7, we can see that the most voted idea was AR/VR service presented by team 1, followed by Holographic Projection with Haptic Vest by team 2 and Miles Together and VR Restaurant coming in third. Bowl and Fragrance and Hands Together both were voted only once and came in last.

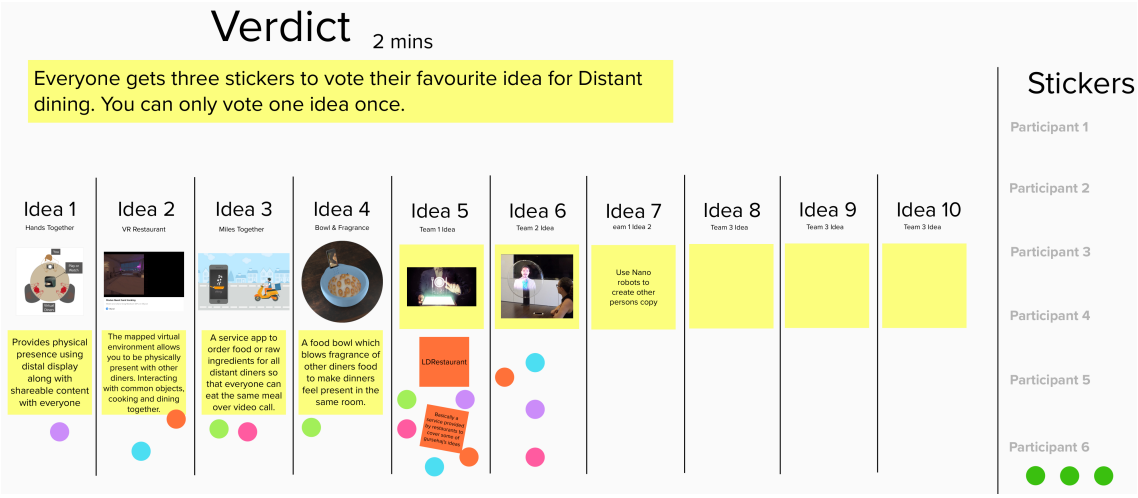


Figure 4-7: Verdict of the Feedback Session, Participants choose their favourite idea which might improve distant dining for them.

4.3 Results

Participants had valuable feedback which could improve all the ideas presented during the feedback session. All raw collected feedback can be seen in the Figure 7-1 in Appendix G. A summary of participants feedback for each concept is presented below.

4.3.1 Hands Together

Participants found that the idea was futuristic and still achievable with currently available technology. The additional presence of virtual hands on the table along with a shareable screen to watch videos, images or to play games was a bonus for table activity. Participants still believed that the 2D presence of opposite dine

on a screen is similar to video call and doesn't add physical closeness and perceived that virtual hands and screen with video call might feel disconnected from each other and hence unnatural.

Participants proposed that instead of using screens for video call, augmented reality headsets could be used to provide the 3D presence of opposite diner or holograms along with the use of haptic devices to imitate touch. The raw feedback from participants can be seen in Figure 4-8.

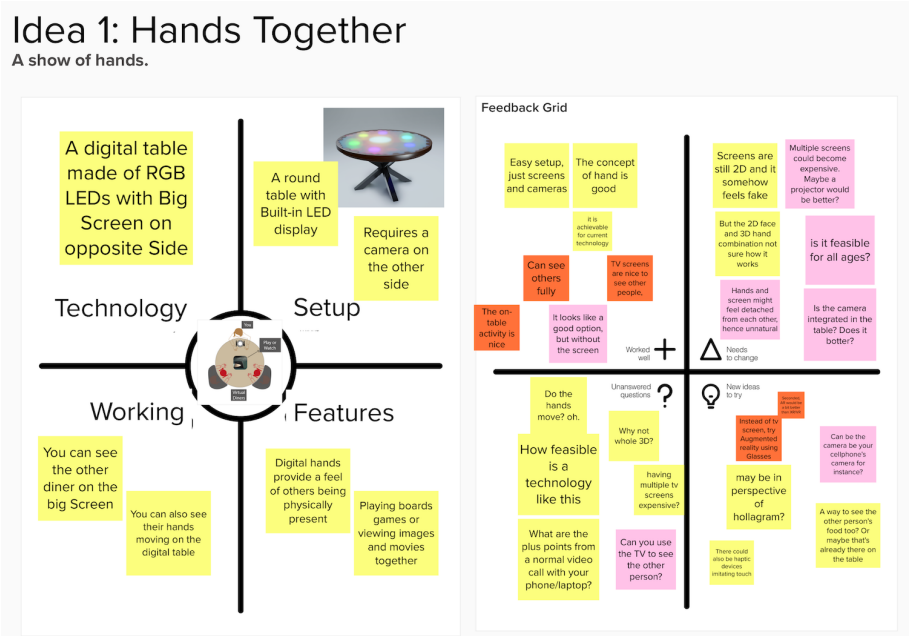


Figure 4-8: Feedback from participants on Idea 1. Hands Together

4.3.2 VR Restaurant

The presence of the opposite diner in the same room in a 3D format was widely appreciated by the participants and believed that it could bring diners physically closer to each other. Participants did raise concerns over mapping the 3D world to the real world as it might not be accurate and therefore will not provide everyone with the confidence to move around freely while wearing a virtual reality headset and the virtual reality headset could interfere with eating.

Due to concerns regarding safety, participants suggested using augmented reality instead of virtual reality so they can see their own surroundings as normal and add virtual objects on top of it, still providing the same sense of being together in the same room. The raw feedback from participants can be seen in Figure 4-9.

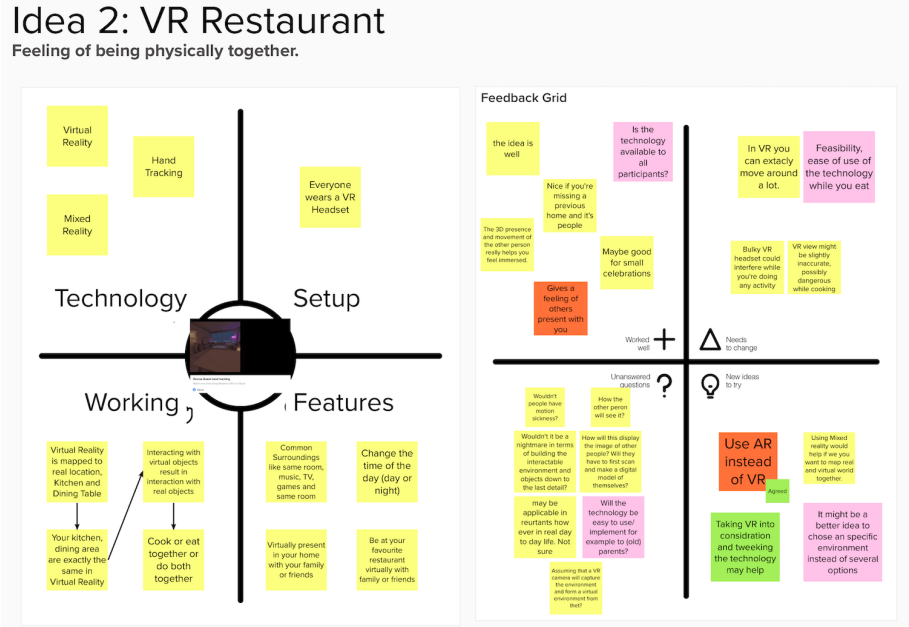


Figure 4-9: Feedback from participants on Idea 2. VR Restaurant

4.3.3 Miles Together

Participants felt that the solution is more focused on cooking together rather than eating together. They mentioned that it does not solve the purpose of distant dining, however an application to be on a video call while watching videos together or play games was welcomed and could be interesting for distant dining. The raw feedback from participants can be seen in Figure 4-10.

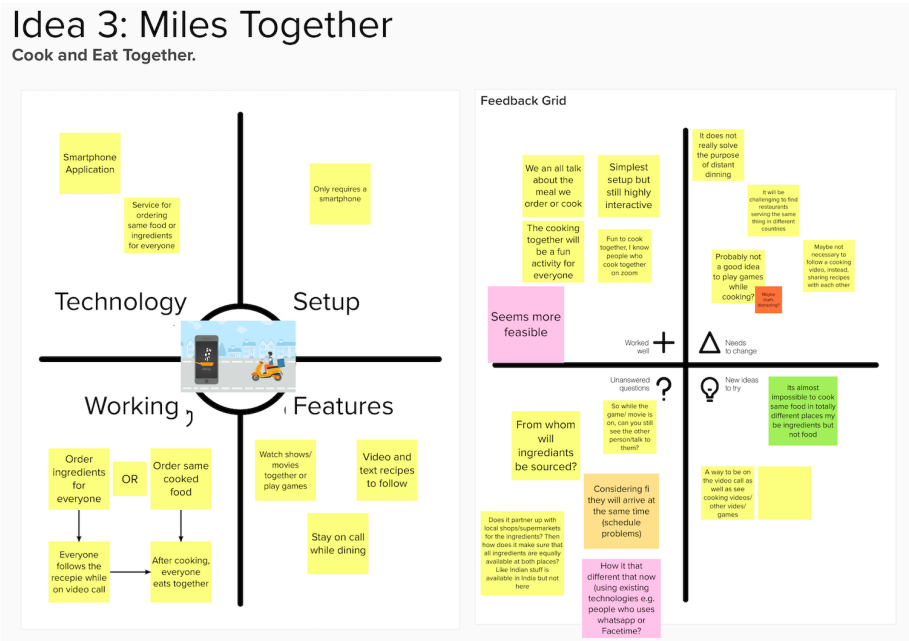


Figure 4-10: Feedback from participants on Idea 3. Miles Together

4.3.4 Bowl and Fragrance

Participants liked the idea of sharing the smell of what they are eating and thought it could also be used to compare the fragrance of two same dishes cooked in different parts of the world. However, participants also suspected that sharing smell will not add any value to distant dining, instead, it would be interesting if they could see what the other diner is eating. Another concern was keeping their phone close to their food as smartphones contain a lot of germs as mentioned by one participant. The raw feedback from participants can be seen in Figure 4-11.

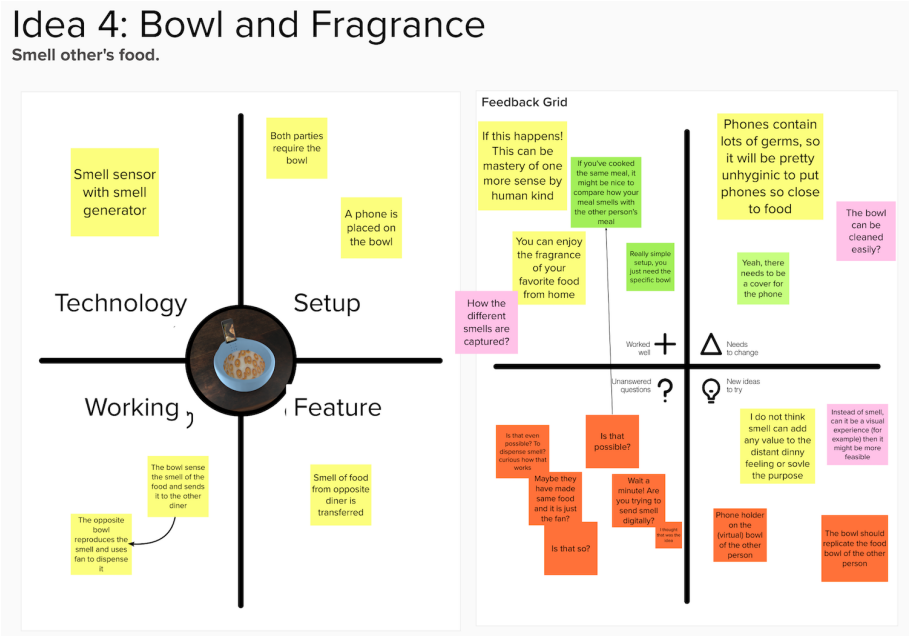


Figure 4-11: Feedback from participants on Idea 4. Bowl and Fragrance

4.4 Discussion

A major focus was on embodiment during the session. Participants felt a dire need for a system that could make the presence of other diners more natural and real in the same room. This can also be supported through the data collected during the interviews about Distant Dining system requirements (Figure 3-5). Participants choose Augmented Reality, Virtual Reality or Holographic Projections as the technology which could provide a better experience during distant dining. From the verdict section (Figure 4-7) we can see that Idea 5, a service to provide VR and AR distant dining experience at a restaurant, a service-based redesign of Idea 2 (Section 4.3.2) was voted by all five participants and Idea 6, a holographic projection of opposite diner with haptic feedback voted by four participants, both focused on opposite diners presence in the same room. The most voted idea, Idea 5 is a service-based redesign of Idea 2 since participants do not want to buy their own expensive headsets and instead they could use the service once a while to distant dine with their loved ones. Hence we focus on developing an AR or VR system as defined in Idea 2. However, participants did raise few concerns during the Feedback Section for Idea 2 (Section 4.3.2), that the virtual world can be slightly inaccurate

from the real world and so it does not provide confidence to walk around the room while wearing a headset and proposed to use augmented reality instead since they could see opposite diners superimposed in their own real-world instead of a virtual one and do not have to worry about hitting something or mishandling things. There is a trade-off of visiting other places that will be in effect which was appreciated by one of the participants using VR however, natural embodiment presence is a more ideal requirement while distant dining by the participants and therefore the trade-off is valid.

4.5 Conclusion

Based on interview data (Chapter 3) and using parameters from mind-map (Figure 3-6), four concepts were ideated and present to six participants in a design session. The design session was constructed of four parts, Ice breaker section, Feedback section, Ideation section and Verdict section. First, the Ice breaker section was used for participants to get familiar with each other. Second, during the Feedback section, participants were presented the concepts and were asked to provide feedback in four parts: 1. what works well, 2. what needs to change, 3. any unanswered questions and 4. any new ideas to try. Third, an Ideation section where participants were divided into two teams of three to create new ideas or to redesign existing ideas. And lastly, the Verdict section was used to pick the top three most voted concepts to improve distant dining between expats and their loved ones.

The output of the design session was that participants are interested in reducing the space gap between diners by using technologies like, virtual reality, augmented reality or holographic projects. All participants voted for the idea which allowed diners to see the opposite diner in the same room to feel physically closer using augmented reality and watch videos, images or play games together while dining. The next chapter presents a basic prototype discussing its features and possibilities followed by a feedback session to get feedback on how to tune the prototype more according to the users.

Chapter 5

Initial Prototype and Feedback

In the previous chapter, we concluded that participants voted the most for Idea 2 during the verdict section (Section 4.3.2) but also wanted a few changes. Participants overall wanted an augmented reality system where they could see opposite diners in the same room as them and could watch videos, images or play games together while dining. Based on this feedback we created a rough prototype using augmented reality in Unity3d[1]. The prototype was presented to a set of participants from the previous feedback session (Section 4.2.2) to get approval of the participants or to get feedback about the prototype which could be used or improved in the final prototype.

5.1 Initial Prototype

The prototype displayed three interaction points in augmented reality, 1. a video player (Figure 5-1a), 2. a board game (Figure 5-1b) and 3. an opposite diner video screen (Figure 5-1c), all placed at different angles so they do not overlap each other. The prototype could also be used to move these interaction points around in 3D space by touching the virtual object using the screen of the smartphone. For the application to place the virtual objects in 3D space, we used Vuforia[2]. Vuforia provides the capability to scan a defined target set by the developer and place the virtual object on it. A custom target (Appendix A) was designed which a user could place on any flat surface like the dining table and Vuforia places the virtual objects on top of the custom target by scanning the target using the smartphone's camera. Since this was an initial prototype to get feedback from users, except for being able to move the virtual objects in 3D space, the application did not provide any controls over the virtual objects like playing or pausing the video screen, moving chess pieces on the board or keeping all virtual object's position and state synced between the two diners.

5.2 Opposite diner

Apart from the quick prototype, a 3D representation (point cloud[3]) of the opposite diner (Figure 5-2) was constructed using Kinect[4] and a programming language called Processing[5] which could be later added to the prototype if the participants liked it instead of the video screen within the augmented reality. This was only coded to work on a computer rather than on an AR device or a smartphone.

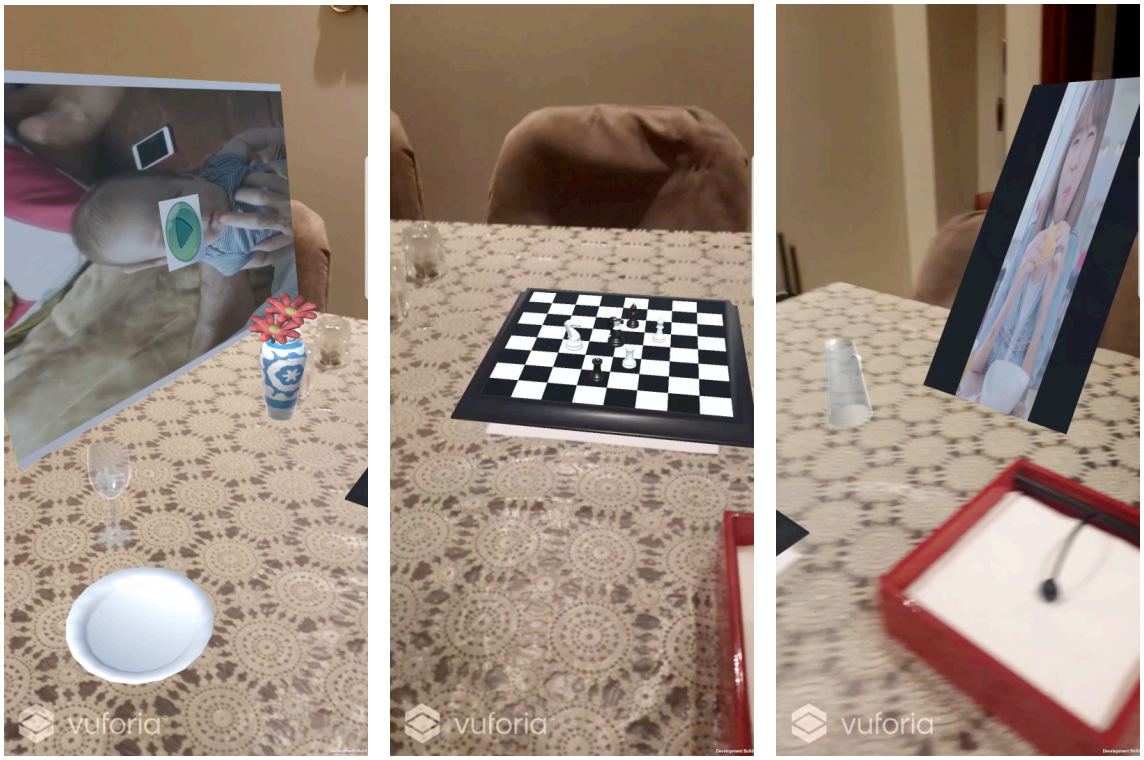
[1]https://unity.com, a game engine widely used for creating cross-platform games including AR and VR games.

[2]https://developer.vuforia.com, an augmented reality addon for Unity3d

[3]https://en.wikipedia.org/wiki/Point_cloud, a set of the data points in 3D space which could represent a space or an object

[4]https://en.wikipedia.org/wiki/Kinect, an RGB camera with depth sensor

[5]https://processing.org, a software to code for visual arts



(a) Video player on left (b) Chess board in the middle (c) Opposite diner on right

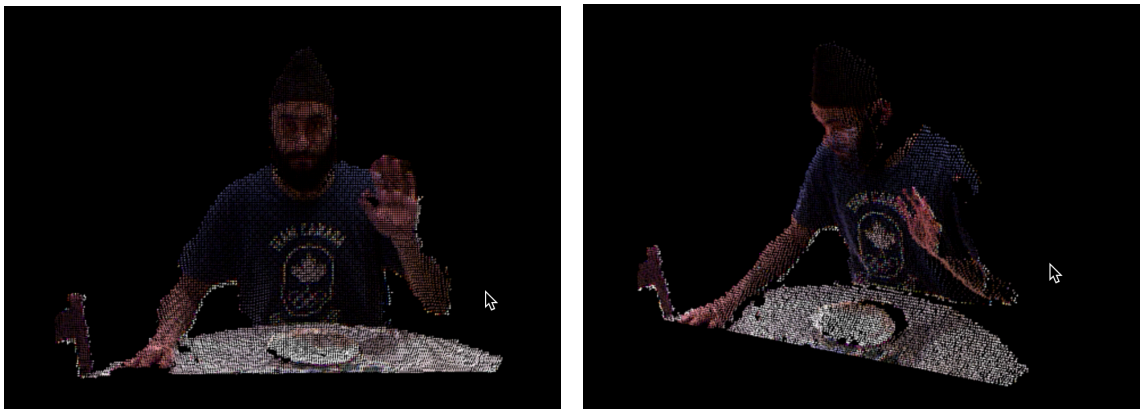
Figure 5-1: Quick AR prototype displaying a (a) video player, (b) board game and (c) opposite diner, in 3D space

The Processing library created by Antonio Vega[6] was used to read the live RGB and depth data from the Kinect camera and create a point cloud.

5.3 Feedback Session for the Initial Prototype

Three participants, both participants from the first team of the previous design session, whose idea was voted by all the participants during the Design session (Chapter 4) and one participant from the second team of the previous design session was also invited to see whether members from both teams had same understanding about the idea that everyone voted for. This session was also conducted using Mural for participants to collaborate and Discord for participants to interact with each other. The session was divided into three parts: first, a recap section to present the top two most voted ideas during the Design session. Second, a concept evaluation section to present the quick prototype and another possible 3D representation (point cloud) of the opposite diner (explained in the previous section) and see whether participants would like the point cloud instead of the 2D video screen (Figure 5-1c) placed within the prototype point cloud of the opposite diner and get feedback on what worked well, what needs to change, any unanswered questions and any new ideas to try. And lastly, user interface section to present and choose one of the possible ways to view augmented reality and ways to interact with the virtual elements in the augmented reality.

[6]https://github.com/totovr/SimpleOpenNI



(a) Front view (b) Side view

Figure 5-2: 3D point cloud representation of opposite diner

5.3.1 Concept Evaluation

After the quick recap section (Figure 5-3a) presenting the top two most voted ideas (Figure 4-7) during the previous design session (Chapter 4), we stated the same scenario used in the previous feedback session (Chapter 4) before presenting the quick prototype to provide an equal ground to the quick prototype as the previous ideas.

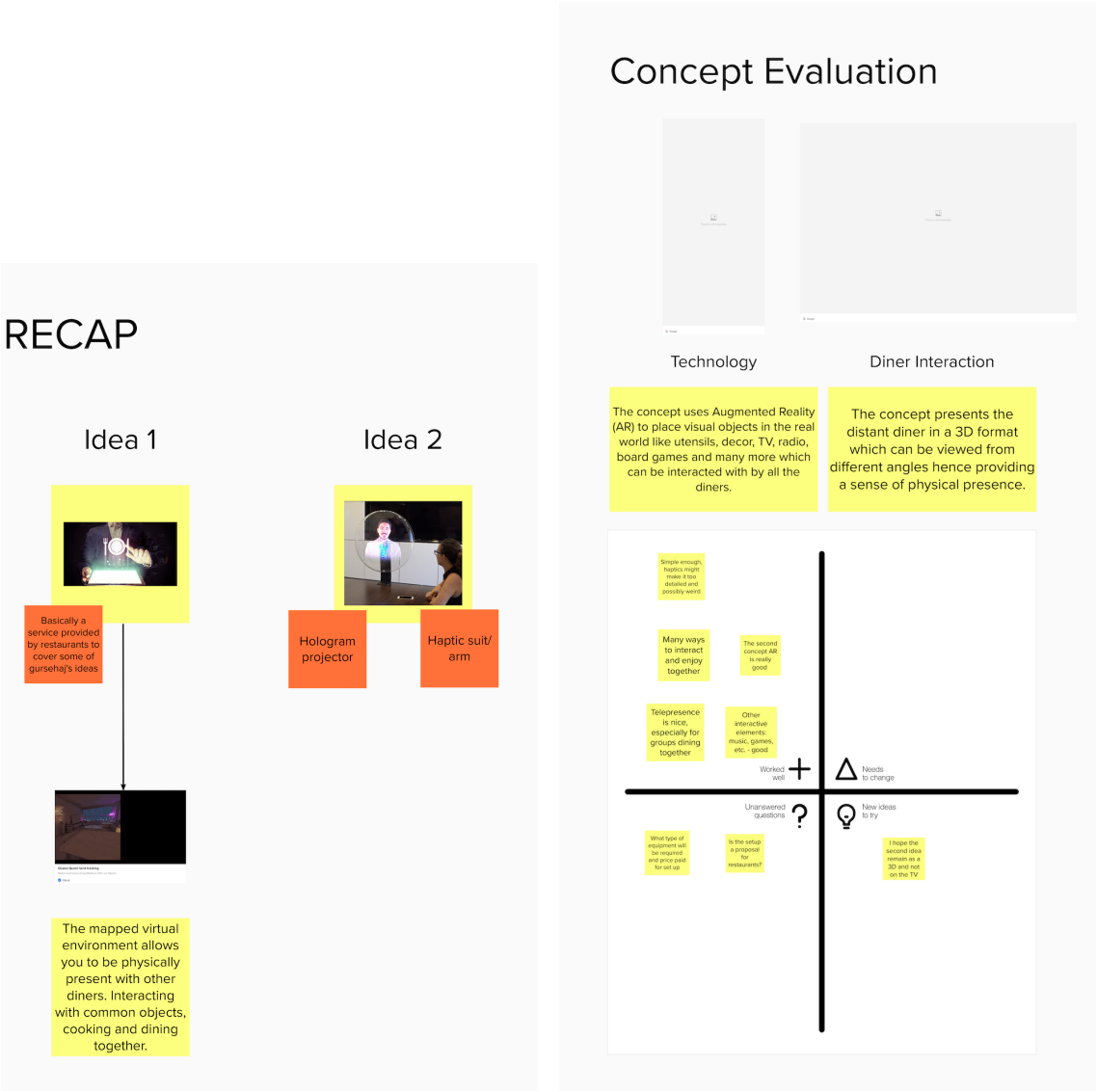
We first presented the quick prototype using a video (link to the video is in Appendix A) and explaining how it works and what features it has followed by presenting a short video of the point cloud an opposite diner (link to the video is in Appendix A) and explaining how it would look within the augmented world (Figure 5-3b). After the short presentation, we requested participants to fill out the feedback grid (Figure 5-3b), presenting their views on what worked well, what needs to change, any unanswered questions and any new ideas to try.

All three agreed that they liked the concept. They mentioned that the interactions points were indeed an interactive way to enjoy together while dining and the fact that they could see opposite diner sitting in the same room as them. They were also inclined towards having point cloud displayed in the augmented reality while dining instead of another video screen of the opposite diner which was similar to video call and might not add anything to the overall experience. Surprisingly, participants did not want any change in the concept however, they were convinced that 3D point cloud was the better option to have in augmented reality than a video screen of the opposite diner.

5.3.2 User Interface

The final section was used to present possible devices which could be used to view augmented reality, followed by possible ways to handle those devices while operating and finally possible ways users could interact with the virtual objects in the augmented reality based on individual devices. The four devices presented were:

1. Smartphone



(a) (b)

Figure 5-3: (a) Recap section and (b) Concept evaluation section during the feedback session for the concepts

2. Leap Magic[7]
3. Hololens[8]
4. Smart Glasses[9]

Each device can be interacted with in different ways, like a smartphone can be held in hand or kept on a stand or can be worn with an external headset and in every case can be interacted with in two ways, either by touch or using a controller. The other three devices could be only worn and used and can be interacted with hand gestures or an external controller (refer to Figure 5-4 for all possibilities).

[7]https://www.magicleap.com/en-us
[8]https://www.microsoft.com/en-us/hololens
[9]https://en.wikipedia.org/wiki/Smartglasses

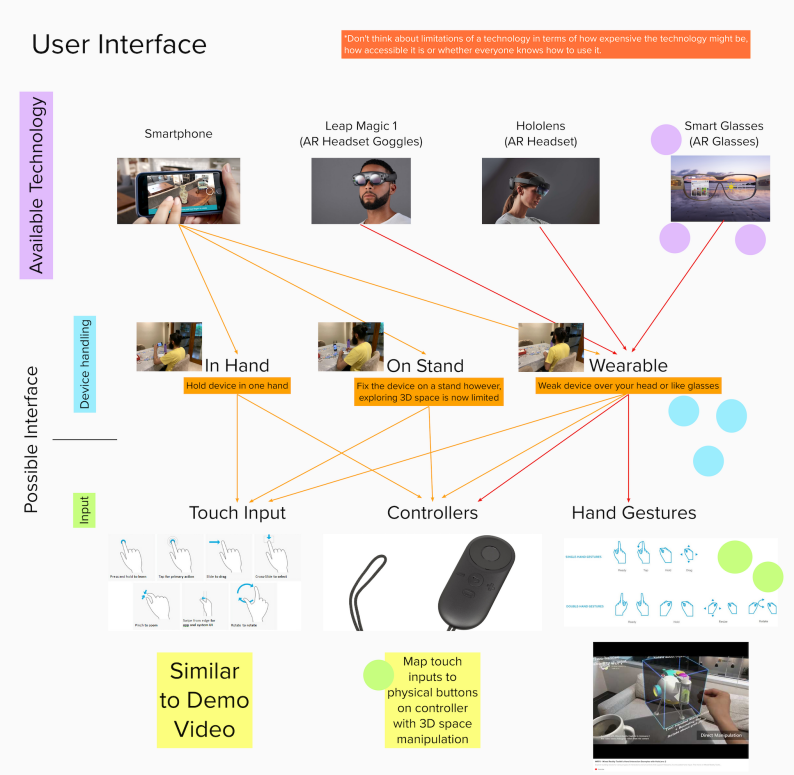


Figure 5-4: User interface section during the feedback session for the concepts

We asked participants to vote for the best possible combination they think would be suitable for the scenario of distant dining. Two participants choose Smart glasses with hand gestures and one participant choose smart glasses with a controller. All participants choose smart glasses because they did not want to wear bulky headsets while eating their food and wanted the experience to feel as natural as possible, further gestures were also preferred as both participants did not want to use an extra device while eating their food since it could be inconvenient for them.

Chapter 6

Final Prototype

From the previous chapter, firstly, we know that our initial prototype was approved by the participants, secondly, the participants wanted the 3D point cloud (presented in Chapter 5) to be the part of the experience and lastly, the participants voted for smart glasses as the device of choice along with gestures to interact with virtual elements in the augmented reality. Based on this information from the previous chapter, in this chapter, we explain how the initial prototype is improved and how does it work.

There are currently two ways to experience augmented reality available in the market instead of three (the smart glasses),

1. Smartphone
2. Augmented Reality Headsets (HoloLens and Magic Leap are commercially available)

Smart glasses are still a technology of the future, there are a few smart glasses available in the market but they do not offer the same level of immersive and interactive experience as the available AR headsets like Hololens or Magic Leap. Since we did not want the participants to be limited by technology, smart glasses was one of the options in the previous section. Whereas, the AR headsets are dedicated augmented reality headsets which offer features like gesture control, POV (point of view), spatial sound and more. Since at a later stage we want to evaluate the prototype and compare it with a video call for distant dining, therefore during testing these features and the AR headsets which participants might have never experienced can act as an external bias which could make the participant like or dislike the augmented reality session and therefore using a smartphone which the participant is already familiar with is a better choice for the evaluation and hence for the development of the working prototype.

6.1 Elements

The prototype, consist of four main elements:

1. Shared television
2. Shared music player
3. Shared board game
4. 3D point cloud of an opposite diner

The television and the music player can be played, paused or skipped by all the diners distant dining together using the buttons present on top and bottom of each element respectively (as seen in Figure 6-1a and 6-1b) and the state (playing, paused or skipped) will remain same for every participant. Whereas, the board game used for this prototype was snakes and ladders instead of chess to keep things simple for coding and therefore only pressing the dice seen in Figure 6-1c is required to take turns. Since this is only a prototype, the shared television and music player had a predefined list of videos and music respectively which can be played during the dining sessions.

The 3D point cloud of the opposite diner as seen in Figure 6-1d is not the same as presented during the feedback session of the initial prototype (Section 5.2), we realised that streaming point cloud from the Kinect of the opposite diner in the application is a highly demanding task for smartphones as the point cloud requires pixels to be coloured and displayed individually which is usually done by a shader (a program or script which defines how each pixel should look like) and therefore the point cloud streamed is displayed without colours (in black and white) as the smartphone is not able to highlight individual pixels at once along with AR integration. This begged the question of whether the colour to point cloud is important or not during the evaluation, in other words, do we need to have colour which could show emotions on opposite diners face or the depth of a point cloud that could potentially make the opposite diner feel physically closer to the participant. We have two options:

1. to remove the point cloud and add a normal video call frame inside the virtual world this solves the issue of colour however, we lose the depth of a point cloud which could make participants feel physically closer to an opposite diner.

2. to keep the point cloud as it is and present the ideal version after the augmented session is over to give an idea of how the point cloud should have looked like.

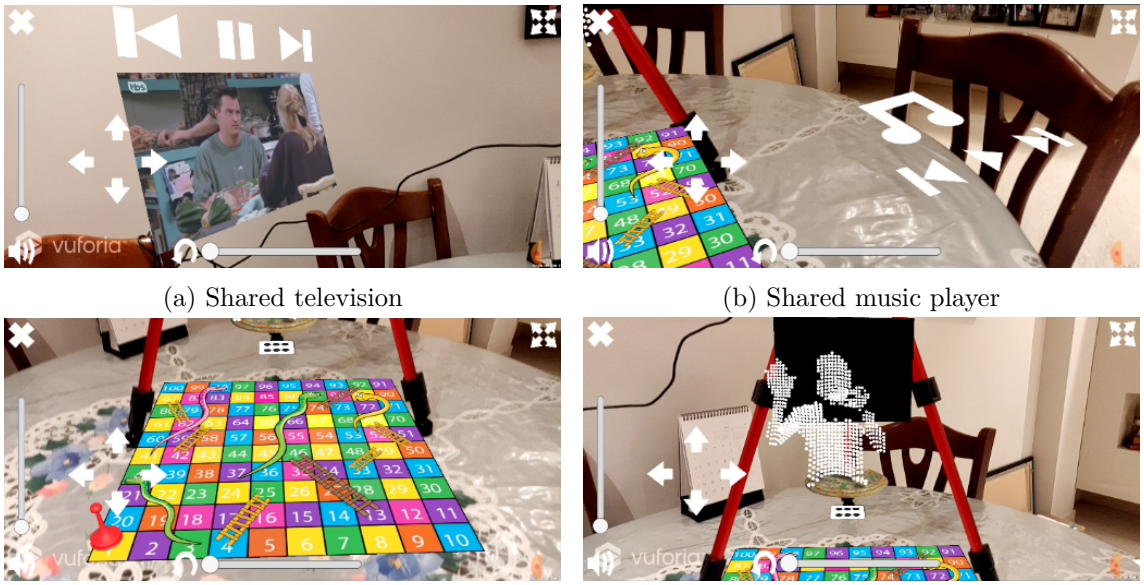
We know that researchers have designed such interactions before where the dining space is extended into virtual space and opposite diner is presented virtually in a video call like CU-Later [11], RoomXT [12] and Dome MR [17] which have resulted in a positive outcome for target groups like young expats and solitary older adults. Therefore, we could argue that evaluating depth offered by the point cloud in the augmented world would be a better option to collect data for and so we keep the black and white point cloud a part of the prototype.

6.2 Interface

The interface for the smartphone application is kept straightforward. From Figure 6-2, we can see four UI elements,

1. Exit button, to exit the dining session.

2. Full-screen button, to hide all UI elements except itself.



(a) Shared television

(b) Shared music player

(c) Shared board game

(d) 3D point cloud of opposite diner

Figure 6-1: Four main elements of the working prototype

3. Volume slider, to control the volume of the shared video player.
4. D-Pad, to move the virtual television in 3D space.

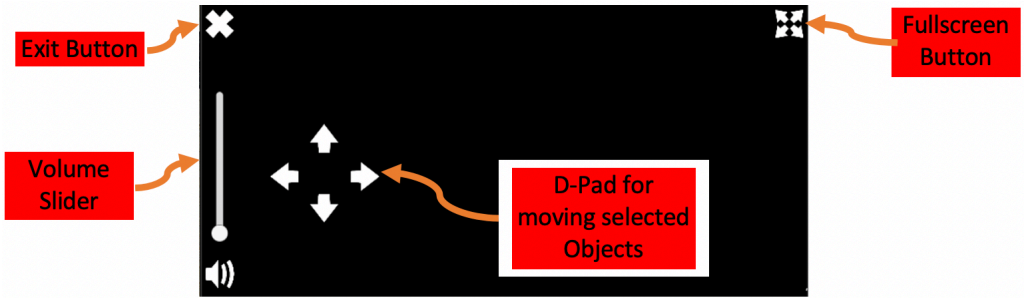


Figure 6-2: User interface for the prototype

The D-pad only works when the user selects a virtual element, in this case, the shared television. Once the user taps on the desired element, it turns red in colour as seen in Figure 6-3 and after the selection, the D-Pad can be used to move the element in virtual space. Since the television is shared over the internet for the state (play, pause and skip) and position, any changes in state from the opposite diner will be reflected at the end of the former diner and vice versa.

6.3 Internal Functioning of the Final Prototype

This section explains how Kinect data is transferred from a Kinect device to diner's smartphone and how the application connects with the opposite diner to sync virtual elements. A diagram in the Figure 6-4 provides an overview of the working of the setup and each element is explained below. The link to the final version of the prototype is available in the Appendix A.

Figure 6-3: Tapping the virtual element turns it red and can be moved using D-Pad, tap empty area to deselect the object

6.3.1 Kinect Server

In Section 5.2, we explained that software called Processing was used along with a library to read RGB and depth data from the Kinect. Further, we coded a WebSocket[1] server in Processing using the library provided by Alexandra Institute[2] so that the Kinect data could be sent to opposite diner over the internet. To access the WebSocket over the internet, we also gave the server a fixed IP and a port that was port-forwarded[3] in the router settings.

6.3.2 Syncing Virtual Elements

To sync the state of shared television, i.e. if one diner plays the television, it should turn on for the other diner as well and vice versa. Similarly, if the position of a shared element is changed by one diner, it should also be changed for the other diner.

To achieve this synchronisation of elements between diners, we used a Unity asset called Photon Pun[4] which is used to sync the state of Unity game-object over the network for everyone using the application. From Figure 6-4 we see that data (play, pause or skip state or position data) from diner 1 application if changed will be sent to Photon Pun server which will broadcast this change to every application connected to the same server, in this case, diner 2 and the opposite also happens similarly.

[1] https://en.wikipedia.org/wiki/WebSocket
[2] https://github.com/alexandrainst/processing_websockets
[3] https://en.wikipedia.org/wiki/Port_forwarding
[4] https://assetstore.unity.com/packages/tools/network/pun-2-free-119922

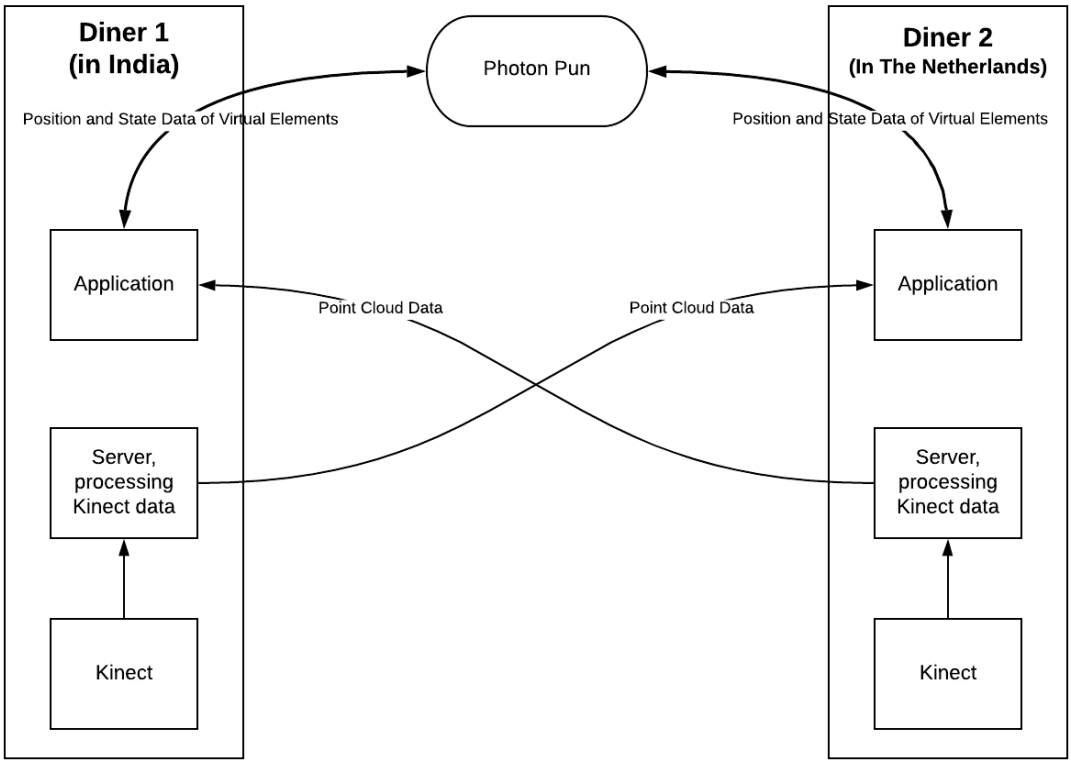


Figure 6-4: Working diagram of Kinect and application between two diners

6.4 Conclusion

To conclude, this chapter explains all the individual elements and the reason why they are a part of the prototype along with the working of each element and how the application connects over the network with different diners. In the next chapter we setup an experiment to use this working prototype and compare it with video call for distant dining and compare the results.

Chapter 7

Experiment Setup and Results

In this chapter we present all the steps taken to carry out an experiment to evaluate the augmented reality application prototype presented in the previous chapter against video call for distant dining and later present the results which could be used to finally answer out the research question, "Despite the time and space gap, how can technology be used to improve the current experience of distant dining for young expats with their loved ones?".

For designing, carrying out, and evaluating the experiment, we will follow the guidelines provided by Jonathan Lazar. The steps consist of:

1. Identify a research hypothesis.
2. Specify the design of the study.
3. Run a pilot study to test the design, the system, and the study instrument.
4. Recruit participants.
5. Run the actual data collection sessions.
6. Analyse the data.
7. Report the results.

7.1 Null Hypothesis

Through the initial exploratory interviews (Chapter 3) and design sessions (Chapter 4), we learnt the ex-pats indicate that presence of other diners in the same room while distant dining will improve the experience using augmented reality. Apart from being present, expats also carry out several activities during distant dining like listening to music, playing games, watching television, or cooking the same food for the meal to spend more quality time together and feel connected. We chose to focus on the presence as it is essential during distant dining and on an activity like watching television together which can be experimented with and easily controlled by syncing video player over the network to reduce potential errors during the evaluation and keep it as similar as possible for all the participants [21, Chapter 2]. Augmented reality could provide a distant dining experience different from video call (the usual way of distant dining currently used), we evaluated whether the distant dining is any different when done using augmented reality. To proceed with our evaluation, we presented a null hypothesis and an alternative hypothesis first [21, Chapter 2]:

H0. There is no difference in distant dining experience while watching television using Video Call or Augmented Reality.

H1. There is a difference in distant dining experience while watching television using Video Call or Augmented Reality.

The experience consists of two independent variables, first, the presence of other diner and second, the interaction with the virtual object like television.

7.1.1 Participants

To carry out a true experiment [21, Chapter 3], we included the following two conditions:

1. Control Condition - Participants distant dine with their loved one using video call.
2. Treatment Condition - Participants distant dine with their loved one using augmented reality.

From our initial interview (Chapter 3), we learnt that there are two groups of expats,

1. those who distant dine with their loved ones occasionally, and
2. those who have never distant dine with their loved ones.

However, since we wanted to compare the experience of participants in each condition, we only used one group of participants who distant dining with their loved ones occasionally so that during both conditions the participants had a similar experience with distant dining. Apart from that, participants also possessed the following qualities:

1. The participant was an expat between the age of 18 to 30 years old (young expats).
2. The time difference between them and their loved ones was three hours or more.
3. Own an Android Smartphone with the installed operating system Android 8 or above.

Since dining is a social activity and can have endless social factors like conversation, food being eaten, time of the day and more which could influence the experience and result in unwanted outcomes. To keep the experience as similar as possible and to control social factors for all the participants [21, Chapter 2], the other diner during distant dining sessions was the researcher (living in India) and the participants considered for the sessions were researcher's Indian friends currently living in the

Netherlands as we are exploring distant dining with loved ones (Family and Friends). However, two possible biases could have occurred with this selection of participants and the researcher being part of the evaluation,

1. Since the participants were researcher's friends, it was possible that participants might provide mostly positive answers towards the augmented distant dining session which could have lead to social-desirability bias and so they were requested in advance to provide answers which were not socially influenced.
2. The researcher himself could bias the experiment unknowingly [21, Chapter 3] which was taken care of to some extent by following the guidelines provided by Jonathan Lazar [21, Chapter 3]

This selection of participants greatly reduced the number of participants which fit the requirement and therefore, a within-group design [21, Chapter 3] was considered for the experiment. A total of six participants were recruited for the experiment. Further, we randomised conditions each participant was exposed to first (between video call and augmented reality) to reduce biases, errors and factors attached with the setup of the experiment or with the conditions (explained below) along with the learning effect. To randomise the initial condition for each participant, we used https://www.randomizer.org to generate a randomly ordered list of numbers from 1 to 6 which represent participant number, the first three participants of the list were exposed to video call session first and the last three to augmented reality first.

7.2 Design of the Study

To keep the dining experience more natural while using video call and augmented reality, both sessions were spaced out and executed on two consecutive days. This solved the issue of having the same interaction between two diners twice on the same day which could have resulted in repetitiveness and awkwardness during the second session. Having the two sessions on separate days might have also reduced the errors caused by fatigue which could have been introduced if both sessions were done on the same day [21, Chapter 3]. After the first and second session, we requested the participants to fill out an acceptance scale which consisted of nine Likert items [26] which are used to collect subjective satisfaction data [21, Chapter 2]. The second session was also followed by an interview to further collect qualitative data (Figure 7-1).

7.2.1 Video call

We already knew that expats widely use WhatsApp on their smartphone as their primary application and technology respectively to distant dine with their family from our initial interviews and hence video call distant dining was conducted over WhatsApp on the smartphone between the participants and the researcher.

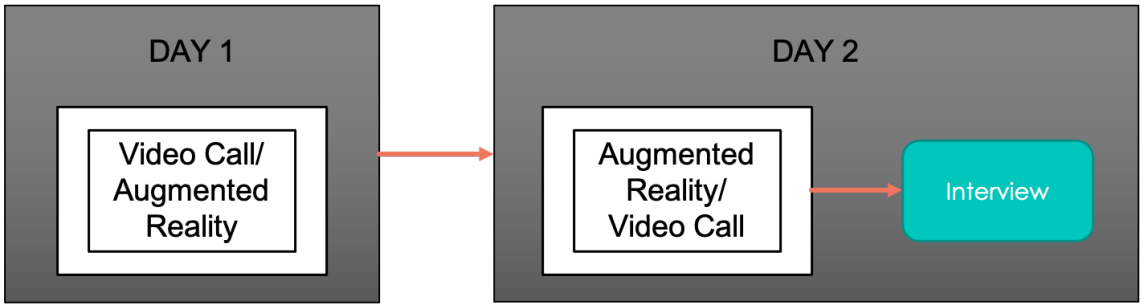


Figure 7-1: Layout of the experiment

7.2.2 Augmented reality

To experience augmented reality distant dining on a smartphone, participants needed to install the application in advance. Before starting the augmented reality session, the participants were asked to use the application and connect with the researcher over WhatsApp audio call (minimised in the background). During this, the controls (as seen in Figure 6-2) of the application was explained, and the participants were asked to use the application and get familiar with the controls or whether they have any questions about the controls of the application. Since we were not testing the layout of the application or the UI and therefore we wanted the participants to get familiar with the controls of the application in advance. The application for testing only consisted of two virtual objects, the shared television (Figure 6-1a) and the 3D point cloud of the opposite diner (Figure 6-1d). We also did not expect participants to have a Kinect with them and hence the point cloud stream of participants will not be streamed.

7.3 Similarities and Differences between the Setup for Participants

The setup for both the sessions were almost similar which helped us keep the systematic errors [21, Chapter 3] under acceptable range and hence the collected data was least influenced through these errors.

7.3.1 Similarities between the Setup

Each dining session was 10 mins long, keeping the dining sessions short kept participants fatigue the least and shouldn't have altered the experience during the dining sessions. During the session, the researcher and the participants engaged in the activity of eating together, conversing and watching television. The activities were triggered by the researcher via specific cues or directly asking the participant as explained below. After the participant joins either session:

1. The researcher greets the participant with a hand wave followed by greetings.
2. Asking the participant about what they have cooked for the meal.
3. Ask participants how they are and talk about the participants day and what

plans they have for the next day.

4. Talking about my day.
5. Requesting the participant to watch a short specific English video on YouTube (The video during the second session will be different but of a similar genre and from the same YouTube channel).
    - During the video call, the video will be played on YouTube, this will minimise the WhatsApp video call (users will still be able to see opposite diner).
    - During the AR call, the video will be played on shared television which will have the same video on it.
6. Let's end the call with a fist bump.

These activities were derived from the initial interviews we took, we learnt that expats during distant dining with their loved one's discuss about how everyone's day went, what they have cooked for the meal, what are their plans for the future (or next day) majorly and watching a video or a movie together. The hand wave and the fist bump were acted out so that these interactions could be compared between the video call and augmented reality and learn which one brought the opposite diner physically closer. For both sessions, the participants were requested to prepare sandwiches which could be eaten with one hand (not with too much filling) for the lunch and sit in a quiet room alone in their own house as expats only distant dine when they are eating alone. All sessions were conducted within the Netherlands lunchtime between 1:00 pm and 2:00 pm [27] which coincides with tea time in India (possible communication window as discussed in Chapter 3.2), i.e. between 4:30 pm and 5:30 pm Indian Standard Time. After each session, the participants were requested to fill out a form of Acceptance Scale [26] on Google Forms (link available in Appendix A).

7.3.2 Differences between the Setup

There were slight changes in the setup for each session which are mentioned below:

1. Video Call
    - For the video call distant dining, participants were requested to connect over WhatsApp video call on their smartphone and place their smartphone phone vertically using a bottle, wall, saltshaker, or another object as support (Figure 7-2b).
2. Augmented Application
    - For Augmented Reality distant dining, the participants were requested to connect over audio call using WhatsApp (running in the background) as the AR application did not support a voice channel. Print the Table Marker (Appendix A) provided on an A4 sheet (Black and White).

- Participants placed the printed table marker (Black and White on A4 sheet) on their dining table in the centre about one meter in front of them as seen in Figure 7-2a. The marker was used by the application to align virtual objects with the real world.
- The participants were also asked to use their non-dominant hand to hold the smartphone and the other hand to interact with the screen and eat their meal.

The setup details along with the AR application and the table marker were mailed (sample email available in Appendix F) at least 2-4 days in advance to every participant so that the participants had enough time to setup for the sessions and ask for any follow-up questions before the day of testing.

(a) Augmented reality setup (b) Video call setup

Figure 7-2: Setup for participants during both sessions

7.4 Interview

After the second session, a short interview over Microsoft Teams was conducted which was recorded only for audio using OBS for future evaluation of the collected data, consent (consent form in Appendix C) for the same was taken beforehand. The interview began with a summary about the two sessions which participants experienced to refresh their memory about the first session they had the previous day, so they can answer with an informed opinion rather than what they have latest on their memory. The interview was a semi-structured interview consisting of two parts,

1. Comparison between Video Call and Augmented Application.
2. Effect of the coloured point cloud.

In the first part, we asked questions to understand what differences each participant felt while experiencing each session and the second part consisted of questions to see whether the coloured point cloud could have changed the experience of distant

dining while using augmented reality as compared to the initial experience of using augmented reality with the black and white point cloud. Questions prepared for both parts are available in Appendix E. The coloured point cloud was presented to the participants within the interview after asking all questions of the first part. The presentation of the coloured point cloud is explained below.

7.4.1 Coloured point cloud

To take care of the technical issue of black and white point cloud explained in Chapter 6, we presented the participants with the ideal case of point cloud mentioned in Chapter 5, i.e. the coloured high-resolution point cloud of the researcher as seen in Figure 5-2. By presenting the ideal case of coloured point cloud, we could compare whether participants believed that the augmented reality distant dining experience was improved or not because of the coloured point cloud. After presenting the coloured point cloud and providing a short explanation on how it would be different than the point cloud seen during augmented reality distant dining session (Figure 6-1d), we requested the participants to fill in another acceptance scale (link in Appendix A) to see how it matches up to the acceptance scale filled after the AR dining session. And finally, after presenting the coloured point cloud we also interviewed the participant again to see how they would compare it with the AR dining session presence and the video call presence of the opposite diner.

7.5 Results

This section discusses the outcomes of the research experiment conducted. We divided the analysis into two parts,

1. Acceptance Scale Analysis
2. Interview Analysis

The acceptance scale allowed us to observe which session was more acceptable by the ex-pats and further, the interview data was used to reason as to what ex-pats think about both the sessions (including Coloured AR).

7.5.1 Acceptance Scale Analysis

This section of the analysis presents the bigger picture of the outcome through the Likert data collected during the experiment. The raw data collected for the acceptance scale is available in the Appendix A. In tables 7-1, 7-2 and 7-3, we can view the usefulness and satisfaction values for each participant and the overall average for each session (including coloured point cloud concept) calculated as directed by Van der Laan [26]. Figure 7-3 represent the tabular data graphically.

In Figure 7-3d, we can see that the average satisfaction and usefulness of the Coloured augmented reality concept is the highest followed by Augmented reality session and lastly video call. Through this information we can say that Augmented

Participant	Usefulness	Satisfaction
1	0.60	0.75
2	-0.20	0.25
3	0.40	0.25
4	0.60	0.25
5	-0.40	-1.25
6	1.60	1.00
Average =	0.43	0.20

Table 7-1: Usefulness and Satisfaction scores of participants for video call

Participant	Usefulness	Satisfaction
1	1.20	1.50
2	1.60	1.00
3	0.80	1.00
4	0.60	1.50
5	1.80	2.00
6	1.20	1.00
Average =	1.20	1.33

Table 7-2: Usefulness and Satisfaction scores of participants for augmented reality call

reality is a better form of distant dining for ex-pats with their loved ones than video calls, we can also mention that the coloured format of the point cloud of opposite diner does improve the overall dining experience for expats with augmented reality. To argue as to why this is the case, we explain the data collected through interviews in the following section.

7.5.2 Interview Analysis

To analyse the interview, we used a mix of priori coding based on the questions asked during the interview and emergent coding for what most participants stated repetitively and further combine them into concepts (column 2 in Figure 7-4) which are additionally combined into categories (column 3 in Figure 7-4) to understand the connection between collected data at a higher level. Each category has been presented in a separate section below discussing the higher level using the concepts consisting of individual codes. The interview data is available in the Appendix A. The codes used to understand the data are as follows:

C1. Initial setup

C2. Phone holding

C3. Dining preference

C4. Distant dining

C5. Added depth

C6. Resolution

C7. Comfortable environment

C8. Television sharing

C9. Shared Experience

C10. Conversation while dining

C11. Physical closeness

C12. Appearance of opposite diner

Participant	Usefulness	Satisfaction
1	2.00	1.25
2	1.60	1.50
3	1.80	1.50
4	1.40	1.75
5	1.80	2.00
6	2.00	1.25
Average =	1.76	1.54

Table 7-3: Usefulness and Satisfaction scores of participants for Augmented reality call with coloured point cloud concept

Setup Differences

Participants realised that setup for the dining is as important as the dining itself as it affects the experience of distant dining with their loved ones. The first part discusses the differences between the dining setup for *VCS*[1] and *ACS*[2] which participants observed and what did they think about it, the second part discusses what participants overall preference was for distant dining.

The **Distant dining setup** consists of two codes, **C1. Initial setup** and **C2. Phone holding** which provides information about what participants thought about the overall setup for both sessions. During *VCS* the initial setup for the participants was easy as they are used to this setup beforehand and have done it multiple times before, for example, P2[3] stated the following:

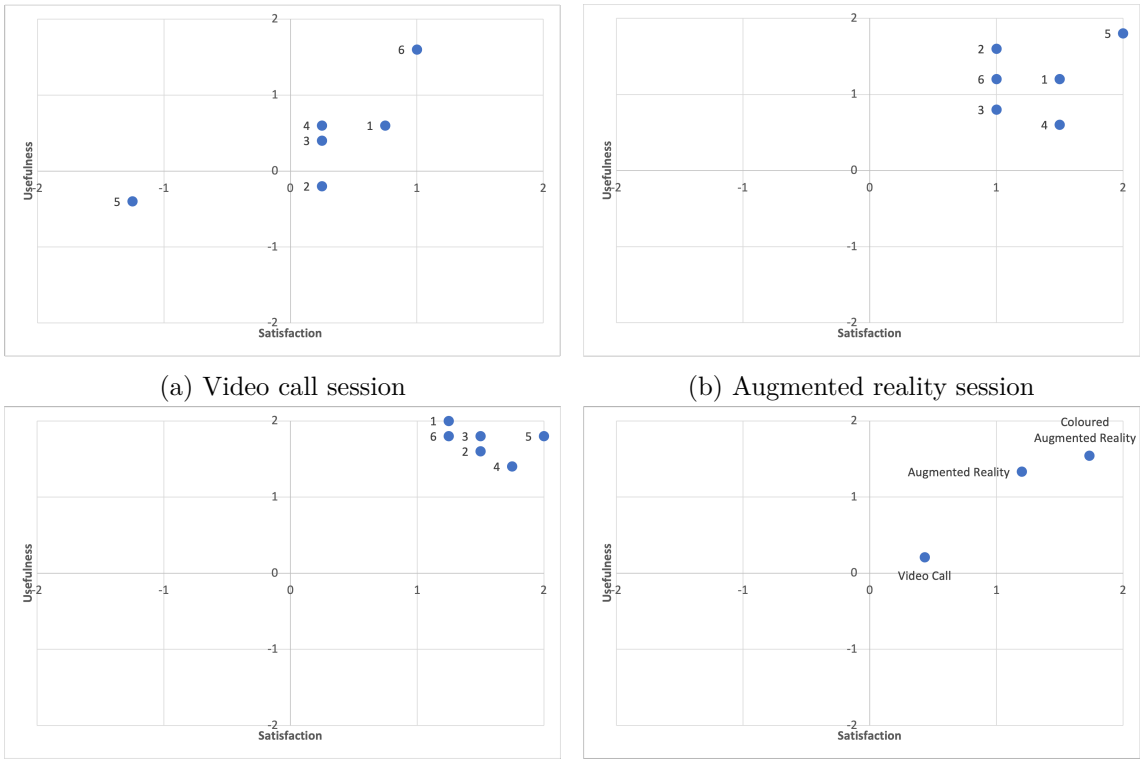
> "***P2***: *The experience was very normal during the video call as it has been done a thousand times. Well, it's something that I am familiar with.*"

Whereas it was opposite during ACS, for example, P2 also stated the following:

> "***P2***: *Since something like this is new, it will take some time to getting used to and once we will get used to it, setting it up will not be an inconvenience.*"

Like the initial setup, participants also had opposite views on holding the phone during the two sessions. Five out of six participants raised concerns over holding the phone in hand while dining during *ACS* and informed that they would instead prefer keeping the phone in front against some support as they did during *VCS*. They realised that using one hand for eating food and the other to hold the phone and use the application is a tiring and complicated process. For instance:

[1]VCS = Video Call Session
[2]ACS = Augmented Call Session
[3]P = Participant



(a) Video call session

(b) Augmented reality session

(c) Coloured augmented reality concept

(d) Average acceptance scale

Figure 7-3: Acceptance Scale

> "***P6***: *I did not like that I had to keep my hand up and move around. I wanted to keep it on the table as I did during the video call and then talk, then that would have been nice.*"

The **Distant dining using technology** consists of two codes, **C3. Dining preference** and **C4. Distant dining needs**, as these codes contain information on why participants preferred one way of distant dining over the other one and which technology can fulfil their needs while distant dining.

We asked participants to choose a preferred way of distant dining between *ACS* and *VCS* before presenting the coloured point cloud, three out of six participants chose video call as the preferred way of distant dining as they were not able to see the opposite diner properly (black and white dotted format), the remaining three participants chose the augmented reality as the preferred way of distant dining provided, they could see the opposite diner with colour. Further, these three participants also mentioned that they would love to see more virtual elements which they could interact with likes games which could also be shared with more diners: For example,

> "***P3***: *In case you want to talk to your friend and have fun or if you have a girlfriend who is far away and you want to play a game while having a meal, so that would be a nice thing to have.*"

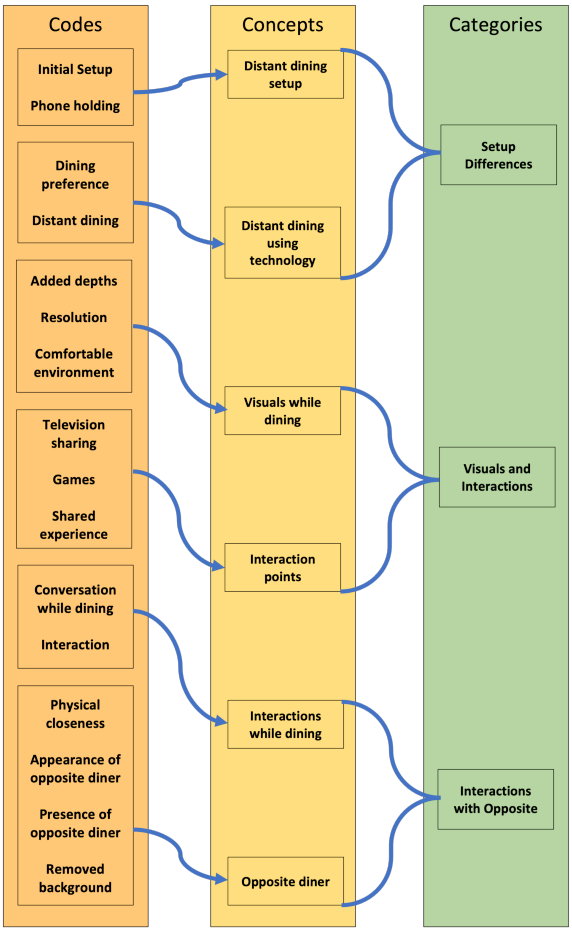


Figure 7-4: Coding, Conceptualisation, and Categorisation of Collected Interview Data for the Experiment.

Visuals and Interactions

This section presents the opinion on various interaction points participants interacted with during both sessions and the way those interaction points were presented during each session along with other visuals presented during each session. We further discuss the differences between these interaction points and what difference their presentation made for participants during each session.

For the **Interaction points**, codes **C5. Television sharing**, and **C6. Shared experience** are grouped for this section as they all present multiple interaction points with which participants interacted and provide a comparison between the two sessions. The two interaction points during both sessions were a video screen (television) and the opposite diner.

During each session, participants were asked to watch a F.R.I.E.N.D.S.[4] short clip while eating their food. Five out of six participants were in favour of having a shared screen which allowed them to control (play, pause, next, previous or position) it for both diners and the fact that the opposite diner can do the same as well during *ACS*. This shared experience over controls and position of the video screen in *ACS* made

[4] An American television series in English.

participants felt that the opposite diner was watching the same screen in the same room as the participants were. We argued with participants that the similar control (except positioning) over video sharing is provided in Netflix, participants agreed but also stated that the experience of moving and positioning their head towards the screen felt that the opposite diner is in the same room in front of them even if they are not able to see the opposite diner while focusing on the virtual screen, for example:

> "***P4***: *In augmented reality, I had to turn my head towards the left which felt quite real because that is how we sit at home and watch TV while eating.*"

> "***P5***: *The main thing I liked was the idea of moving the screen around otherwise Netflix provides similar controls. The moving was also in 3D space, so it helped in providing a more immersive experience while eating.*"

> "***P6***: *It felt like I was moving my laptop around to setup my table and I could see you in front of me. Since it was on the left side, I was able to see you (the researcher) and the screen at an angle and it felt more realistic.*"

Further, there was a clear distinction between what participants thought about the opposite diner during both sessions. All participants shared that during *ACS* they could figure out that the black and white dotted area was the opposite diner, however, it was not interactive and attractive due to the lack of colour and details when compared to the presentation of the opposite diner during *VCS*. For example:

> "***P1***: *No doubt the video call one was much better than the augmented reality because the augmented reality could not display the colours properly, but the movement was fine, so I was able to see the clear picture of the diner in front of me in the video call which was lacking in the augmented reality one.*"

> "***P5***: *Well, during the video call I could see quite clearly but in the second one, as you know, the dotted version, I could differentiate that it was you, of course, but I would prefer to watch like an actual face like in the video call.*"

The **Visuals while dining** presents information about what the participants thought about the visuals of interaction points discussed above using the following codes, **C7. Added depth**, **C8. Resolution** and **C9. Comfortable environment**. Participants realised that there was a difference as to how during both sessions the information was presented to them. Participants expressed that during *VCS*, every

item (the opposite diner and the video player/YouTube) was on top of each other as layers and during *ACS*, the same items were presented in different areas in 3D space at different rotations which felt more natural to the participants. Further since during *ACS*, the items were placed in their own home setting, it created a comfortable environment for them as well.

> "***P2***: *I also liked the depth aspect of it that I could see the screen at different depths as compared to my eyes so I could see you further away, I could see the video screen on my left which was at an angle with you. I liked how you and the tv were an individual element in their own plane which helped me segregate all those things. Whereas in the video call, everything was on the same plane.*"

> "***P4***: *I felt like in a safe environment, it was comforting, it was relaxing, and I could watch you and tv in a natural way rather than just one fixed screen for everything.*"

> "***P6***: *It felt like there is no space in between during the video call. During augmented reality, it felt like you were sitting right in front of me and so the added depth felt more natural.*"

Participants also pointed out the low resolution of the television and the opposite diner which were more attractive during *VCS*, something which they would like to be improved about the *ACS*.

Interactions with Opposite Diner

During each dining session, participant's interactions with virtual elements and the opposite diner were different which affected the way they interacted with the opposite diner. A decrease in the amount of conversation was observed with the opposite diner during *ACS* and was more focused on the virtual elements. These observations are explained in detail below.

The **Opposite diner** consists of the following codes, **C10. Physical closeness**, **C11. Appearance of opposite diner**, and **C12. Presence of opposite diner** as these codes contain information about the appearance of the opposite diner, how it affected the participants and what improvements they might like. The presentation of both diners were completely different in each session. During *VCS* opposite diner was presented in a video format whereas, in *ACS*, the opposite diner was presented in a point cloud format with depth and without colours. As mentioned in Section 7.5.2, participants could figure out there was a person in front of them during *ACS* however, they were worried that it could be someone else. For example:

> "***P5***: *In augmented reality, I'm not looking at you, I'm looking at a black and white pixelated version of you and so it could be anyone.*"

This presentation of opposite diner was also not accepted when asked to choose a preferred version of the appearance of the opposite diner.

> "***P1**: No doubt the video call one was much better than the augmented reality because the augmented reality could not display the colours properly, but the movement was fine, so I was able to see the clear picture of the diner in front of me in the video call which was lacking in the augmented reality one.*"

> "***P6**: I would prefer WhatsApp because in WhatsApp I was able to see and in AR I could not see you.*"

Later during the interview, we presented a coloured high-resolution point cloud to give an idea of what we intended to do. The participants were again asked to choose a preferred version, all participants did agree that this coloured version of point cloud was indeed an improvement and what they expected to see during ACS. After viewing the coloured high-resolution point cloud, participants realised that the previous black and white point cloud was also 3D, but they were unable to figure that out. Participants did agree that the 3D point cloud would indeed provide a better experience and bring opposite diner physically closer as if they were sitting in the same room because of added depth however, it still lacked the detailing which video call provided of the other diner.

The **Interaction while dining** uses **C8. Television sharing** and **C13. Conversation while dining** codes as we identified a connection between how television sharing affected the conversations among diners. When participants were asked whether they felt any difference between the dining sessions, four out of six participants mentioned that they did not have a long conversation with the opposite diner during *ACS* when compared to *VCS*, although the number of questions and the overall conversational flow was kept as similar as possible during both sessions. For example:

> "***P3**: Honestly, during video call, I felt we were talking more and in AR it was mostly entertainment and fun.*"

> "***P6**: In the augmented reality, it was much more focused on food and video. And in the video call, it was much more focused on the conversation.*"

Participants also reasoned that this break in conversation also happened due to limited field of view while watching television during *ACS* as they were not able to see the opposite diner since their field of view and focus was towards the television.

7.6 Discussion

The initial null hypothesis for the experiment stated, "*There is no difference in distant dining experience while watching television using Video Call or Augmented Reality*", where experience consisted of two independent variables, presence of other diner and interaction with a virtual object like a television. The null hypothesis can be stated as false for this experiment, in Figure 7-3d the average usefulness and satisfaction in acceptance scale for both augmented reality session and leading concept is more than the video call and so we can argue that there was indeed a difference in the experience of distant dining between a video call and augmented reality while watching television. All six participants said that they would choose augmented reality to distant dine with their loved ones instead of video call given they could see their loved ones more clearly, the overall system is improved with the option to add or remove virtual objects, they can interact with virtual objects without tapping on the screen and if they do not have to hold their smartphone all the time. These issues raised by participants can be overcome by using a dedicated augmented reality headset as explained in Chapter 6 but it also goes to shows that participants appreciated the technology without being exposed to a new fancy gadget which could have biased their opinions.

The experience of dining with video call is limited to the screen of smartphones whereas the added depth provided by augmented reality was an extra dimension for the expats to explore. The spatial positioning of the opposite diner along with other virtual elements required participants to move and look around which provided a physical presence of those virtual elements and the opposite diner in the same room. The shared controls (play, pause, previous, next and position) further provided participants with a sense of deeper connectedness among the opposite diner while distant dining. We know that limited expats have distant dine with their loved ones (Chapter 3) however, an introduction to technology like augmented reality for distant dining can promote more expats to dine with their distant loved ones. On the other hand, at the moment the setup for such technology is a daunting task, explained in Section 7.5.2 which might get easy in the future, but currently, expats do choose the option which is easily accessible and easy to setup for example WhatsApp (Figure 3-3) which is the most preferred option to contact and to distant dine with their loved ones.

We do realise that the generalizability of these results could be limited among expats of different age groups due to the small sample size and the fact that all participants were from the same ethnic group. The system's performance as a long-term solution might be different since initial exposure to new technology could have introduced a novelty effect among the participants for augmented reality even after not using a dedicated augmented reality headset for the experiment.

7.7 Conclusion

We first presented a null hypothesis, "There is no difference in distant dining experience while watching television using Video Call or Augmented Reality" which was stated false via the experiment conducted for this research. For the

experiment, every participant was exposed to two conditions, a control condition (Video Call) and a treatment condition (Augmented Reality Call). After every condition the participant were asked to fill out an acceptance scale form, followed by an interview after the participants were exposed to both conditions. The average usefulness and satisfaction value or the acceptance scale was higher for *ACS* than *VCS* stating that there was a difference between the two ways to distant dine. The follow-up interview after conducting both sessions provided reasons for the output of the acceptance scale. The collected interview data was coded, conceptualised and categorised to connect the raw data and understand it at different levels. This processed data provided reasons for why distant dining was different for expats while using video call and augmented reality.

Chapter 8

Discussion

Our main goal for this thesis was to explore how technology can improve the experience of distant dining considering the time and space gap issues for young expats with their loved ones. We initially addressed the time and space gap issue from our target group perspective in Chapter 3 followed by a possible solution for both the issues based on inputs from the users and finally, compared the prototype with video call for a distant dining experience for young expats with their loved ones. In this discussion, we answer the two sub-research questions followed by our main research question individually, all presented in the Introduction (Chapter 1). We also present the limitations and the possible future work for each sub-research question and the research question.

8.1 Sub-Research Question 1

> ***"What are the habits around distant dining carried by young expats with their loved ones (family and friends) having a time zone difference of three or more hours?"***

In Chapter 3, we carried out interviews with young expats (mostly students) living in the Netherlands to understand their habits around distant dining, whose time zone difference between them and their loved ones was three hours or more. Interviews revealed that six expats never tried distant dining with their loved ones because of the time zone difference between them, as their meal times never aligned with their loved ones mealtime. We also proposed before the interviews, that it might be possible that expats do distant dine without knowing, which was true as all the expats did dine together with their loved ones at some point in time. Instead of having a proper meal with their loved ones, expats have shared snacks, tea, beer and more, over video calls. Further, during occasions like birthdays or festivals, expats and their loved ones have dined together over a video call. For instance, during Ramadan, three participants cooked and shared a meal while connected over a video call. We also learnt that occasional distant dining does occur among expats and their loved ones as mentioned before and therefore, the time difference is not taken into consideration as it happens occasionally. It might be on an important occasion and it is another way to connect with their distant loved ones. These are also predefined windows set up between expats and their usual contact person (Section 3.3) which are developed over time by learning each other's schedules. For instance, expats sharing their breakfast with their mother who is having her lunch in a different time zone over a video call.

Since no literature was found and used in this thesis that provided the answer to our sub-research question 1, we could not compare our results with any literature for

similarities or differences. What we did find was a process called Mukbang[1] which is a recorded or live stream video of a host eating different kinds of food over the internet, and others join in to watch that. Although this activity is not between expats and their loved ones, research by Anjani et al. [23] reported that young students between the age of 18 and 24 who eat and live alone found Mukbang useful as it helped them to watch others eat while they are dining alone. These results do match with our results from the initial interviews where we concluded in Chapter 3 that expats dine with their loved ones when they are alone, hence a private activity. This also shows that people who live and eat alone including expats are exploring different ways to sit and eat with someone and therefore, we believe that connecting them to their loved ones over distant dining is really important as "*Death of the Dining Table*" is on a rise [10].

So to summarise, irrespective of their timezone differences, expats do distant dine with their loved ones knowingly or unknowingly when they are alone during a break-time or during coinciding mealtimes or on occasions where the type of food changes based on when they distant dine. This answers our first sub-research question.

Limitations and Future Work

There were a few limitations to the answer of this sub-research question. The sample size for the interview was fairly limited and the age of the participants were mainly between 18 and 32 years, the majority of which, were studying in the Netherlands. The number of participants for the interview could have been increased and the diversification of young expats too as this could have provided us with information which could have been generalised to expats of different age groups and with different ethnicity or culture. Further, we could have also considered interviewing the expats based on their current phase of life, i.e. whether they are students or working or married or married and have kids, as this could help us understand which type of expats are most likely to distant dining with their loved ones. These limitations could be the base for our future work and help us explore more in-depth about the habits around distant dining among different types (age, culture and phase of life) of expats with their loved ones.

8.2 Sub-Research Question 2

> ***"How young expats use technology to distant dine with their loved ones (family and friends) where time zone difference is three or more hours?"***

The interviews conducted (Chapter 3) were also used to find the answer to this sub-research question. During intentional or unintentional dining stated in Section 3.4, expats have used video call as the primary way of connecting with their loved ones. The device and the application used would vary based on the type of loved ones the expat would contact. Results from the interviews state that expats use WhatsApp on the smartphone to dine when they contact their parents or siblings,

[1] https://en.wikipedia.org/wiki/Mukbang

whereas a laptop with applications like Zoom or Google meet or Skype are used when dining with extended family or friends with multiple people, mostly during an occasion. We also learnt that distant dining is not similar to the way expats used to dine with their loved ones back at home because of two factors, first, the presence of other diners, and second, added elements or social lubricants like sharing a television screen or common background noise like music or environmental noise. Expats have tried using elements like listening to songs together while on call or watching a video or playing games, however, these elements were always too daunting to setup and continue using because of difficulty in hearing the other diner while using the element. And therefore, after usually a bad experience with the elements, expats avoided or did not add social lubricants while distant dining.

So to summarise, video call is the only way through which expats distant dine with their loved ones using an application like WhatsApp or Zoom on a smartphone or a laptop, respectively. Expats also try to add more interactive elements to the dining process however, the experience is not fluent and enjoyable.

Limitations and Future Work

The limitations to the answer of this sub-research question are similar to the previous sub-research question, out of which is a limited sample size for the interview. Larger sample size from different countries and cultures could have provided more ways as to what technology do expats use to distant dine with their loved ones and how do they use it. Although we know that expats mostly use WhatsApp because of its ease and accessibility, therefore, future research could be conducted on how to design an interactive and simpler way to use augmented reality for distant dining so that more expats choose to distant dine with their loved ones regularly.

8.3 Research Question

> ***"Despite the time and space gap, how can technology be used to improve the current experience of distant dining for young expats with their loved ones?"***

We know expats use video calls, audio calls, texting and social media to stay in touch with their loved ones and have majorly used video call to distant dine. Apart from video call using WhatsApp on a smartphone which is widely used by expats to distant dine, in Chapter 2 we also explored different ways where technology could be used to enhance the experience of distant dining either by addressing the time gap issue using recorded videos while dining [11] or by addressing the space gap using technologies like virtual reality [18] or projection mapping [14].

We obviously know that we can not travel through time or shift it for an individual as depicted in [19] and therefore, addressing it or providing a sense of two diners being in the same timezone is only possible either by recording dining and using it for later at the expense of real-time interaction [9] or by tricking the brain in thinking that all diners are in the same environment as presented in [17] using virtual reality or using sounds and extending the dining table into a virtual display [12]. From the

answer to our first sub-research question, we also know that expats do not distant dine every day and is more of an occasional activity and therefore the time gap issue need not be fundamentally improved or fixed but as mentioned before, that tricking the brain to address the time gap issue is a better option. The prototype constructed during the thesis achieve the same perception by presenting the first diner into the second diners space and vice versa and therefore it is possible for the users to perceive as if both are in the same timezone and space.

Through our interviews (Chapter 3) and design sessions (Chapter 4 and 5), expats shared that they wanted more focus towards the presence of the opposite diner and the fact that they could interact with them in improved ways. Figure 3-5 displays what 10 expats expect from a distant dining setup, first being embodiment (physical presence of opposite diner in same room) and second, common background (sharing social lubricants like the same music, television, images, food and background noises) and Figure 3-6 present the same expectations of expats in a mind-map along with less chosen options which could be used by other researchers to evaluate their focus area for distant dining. Apart from physical presence or embodiment, social lubricants are the key to good social interaction at a dining table [28] and most literature which were reviewed, proposed or tested the ideas to address the space and time gap issues but lacked social lubricants which usually connect diners during the mealtime. The social lubricants could be a television, sharing an image, food or the dining space. Most literature in the Table 2-1 focused to improve the presence of distant or remote diners or by making surroundings look or feel similar by changing backgrounds or playing background sounds or music as explained before but lacked these social lubricants which could be shared among diners and provide a more cohesive experience. Few pieces of literature do discuss shared experience like in CoDine [13] with a magnetic table, ambient cloth and a chocolate printer and in Telematic dinner party [14] with a shared rotating turntable but both lacked in providing a sense of the presence of opposite diner in the same room. We believe it is a mixture of both, the physical presence and the shared experience, which provide more connectedness among diners. The augmented reality prototype established in this thesis, providing the presence of opposite diner along with shared social lubricants like a shared television, game broad and a music player while distant dining do provide an immersed experience of sitting with someone in the same room at the same time, hence addressing the time and space gap issue, metaphorically and literally, respectively. Another difference between the Telematic dinner party [14] or CoDine [13] and our prototype is that the former uses physical shared elements whereas the latter uses virtual elements. From a technical and economical perspective, the virtual elements might attract expats as they don't have to individually setup physical elements as all virtual elements are in the application. Whereas, from an interactive point of view the physical elements do provide better touch and feel which is not possible with virtual elements, this can be a possible study in the future to observe what type of elements are preferred with augmented reality by the users (physical elements with added virtual elements or all virtual elements). Depth also presented great possibilities for this research which was also present in two literature [18, 12]. The added depth within the screen of a smartphone extended the view for every user during the experiment (Chapter 7) as the users had to move in 3D space to focus on the screen on their left (Figure 6-1a) and switch back to the opposite diner

in front of them (Figure 6-1d). This movement in 3D space or the perspective which is similar to what happens when families or friends eat together while watching a television could improve the commensality and social connectedness among distant diners. During the experiment (Chapter 7), this movement of smartphone in 3D space came at an expense of using one hand to always control the smartphone as the device for augmented reality and the second hand for eating food. This situation is not something people experience everyday and was not welcomed by the participants as well. The smartphone could have been placed on a stand to keep both hands reserved for eating food, however in that case the view of augmented reality would have been fixed in one location and would have not provided the sense of added depth to the experience. Obviously this issue could have been solved by using an AR headset, however, wearing a headset while eating is also a challenge [18]. An interesting observation is that, smartphones and televisions which are usually considered bad while on the dining table and is believed that they affect the social interaction and connectedness while dining [29], are welcomed while distant dining to increase the social interaction and connectedness and at the end is used to end loneliness. A possible future research to explore multiple fields presented in Figure 3-6 of ideal distant dining and compare them to see which provides the most social connectedness or improves the distant dining experience among distant diners.

To answer our research question in short, we first needed to understand the needs of young expats and what they expect while distant dining with their loved ones. The technology can surely add value to the process of dining by improving different parts of a dining process which includes **Embodiment**, **Proper conversation**, **Common background** and **Same meal** or collectively could be described as **Social Lubricants**. As the technologies like virtual reality and augmented reality reaches more people in an affordable manner, we could see them replacing normal video calls for better a dining experience.

Limitations and Future Work

A few limitations which could have been improved or can be taken into account for the future, the sample size for both feedback sessions (Chapter 4 and 5) were fairly limited as the number of participants were a subset of participants from the initial interviews (Chapter 3). Since the number of participants during the design session were limited, the ideas presented were also limited in number and newness. More participants during design sessions or multiple design sessions with different groups could have provided more and different ideas to explore and eventually have more furnished and executable ideas. To keep things simple, the development of the initial prototype was limited which could have been improved. Providing a close to finished prototype for feedback in Chapter 5 would have resulted in improved participant feedback. The prototype used for the experiment had a technical issue where point cloud data was not coloured and so participants could only see a point cloud of the opposite diner in black and white, we did try to compensate for it but the participants never got to experience the point cloud which was intended to be used. Further during the experiment (Chapter 7), we exposed all participants within the target group to both conditions, i.e. control and treatment condition randomly to get unbiased results. However, keeping a separate group for each condition would

have been a better option because, after the second session, the participants could compare the sessions while filling out the acceptance scale (Chapter 7) which could have resulted in an influenced output. The experiment conducted (Chapter 7) in this thesis exposed participants to different conditions for a very short period and therefore a long term exposure might produce different results. This could also be possible future research that can be conducted using a diary study instead of a short experiment. Another possible study could be conducted to see whether expats will be comfortable wearing an AR headset like Hololens or is smartphone a better option. During the entire process of this research, the loved ones themselves were not a part of the research and therefore this presents a possibility of future research work where loved ones are also a part of the study to observe how they would feel about distant dining and how it would work for them with their distant expats using video call and augmented reality.

Chapter 9

Conclusion

This research aimed to explore how technology can improve the dining experience by addressing the time and space gap issue among young expats and their loved ones. We first addressed the time and space gap issue from the available literature (Chapter 1 and 2) and personal interviews (Chapter 3) with young expats to correlate and have a better understanding of the issues faced by them to distant dine or while distant dining with their loved ones. The interviews also provided information about how expats use technology currently to distant dine with their loved ones. We found that expats mostly use video calls on WhatsApp to distant dine and had limited issues with the time difference as distant dining was an occasional activity, therefore adjusting time by either eating earlier or late was acceptable. However, the users did want to have a better embodiment (physical presence of another diner) while dining with their distant loved ones and have more possibilities for interaction while dining. Further, we concluded that technology can be used in multiple areas of distant dining like embodiment, background noises, same meal, conversation and more to improve the experience of distant dining. Through this information, the focus shifted towards improving the embodiment. The design process (Chapter 4) consisted of first, ideating (virtual reality, sharing the same meal, interactive elements like shared video or images and smell of food) based on data collected through interviews and get feedback on them along with more new ideas from the target group over a design session, and second, conceptualising the most voted idea (Idea 2 4-6b) followed by another design session (Chapter 5) to discuss the details of the concept and keep the target group a part of the research throughout. After the design process, a working prototype (Chapter 6) was constructed to compare the distant dining experience for expats against video call (Chapter 7). The prototype using augmented reality could provide a better sense of embodiment of the opposite diner by presenting a point cloud of the opposite diner in 3D space and improving or intensifying the connectedness using shared virtual social lubricants (syncing states like play and pause and 3D position in virtual space) like board games, a television or a music player. We found that augmented reality did provide a better sense of physical presence in the same room than video call and helped establish an improved sense of connectedness among diners using the shared elements (Chapter 7.5) and the augmented reality experience proved to be more acceptable (7-3) than a regular video call distant dining experience among young expats.

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Appendix A

Links

1. Raw initial interview data (Link)
2. Coded initial interview data (Link).
3. Initial concept video used for feedback on concepts (Link).
4. Custom image target for augmented reality application (Link).
5. Coloured augmented reality concept video used during experiment (Link).
6. Acceptance scale form for video call (Link).
7. Acceptance scale form for augmented reality call (Link).
8. Acceptance scale form for coloured augmented reality concept (Link).
9. Raw interview data of experiment (Link).
10. Raw acceptance scale data for video call (Link).
11. Raw acceptance scale data for augmented reality call (Link).
12. Raw acceptance scale data for coloured augmented reality concept (Link).
13. All codes for Kinect Point Cloud and Augmented reality application is available on request.

Appendix B

Initial Interview Questions

1. How old are you?
2. What is your Nationality?
3. Which country and city have you been majorly living in for past two years?
4. What is your occupation? (Student, working or both)
5. What is the time zone difference between you and your loved ones?
6. How often do you contact your loved ones?
   (a) Whom do you contact the most? Can be multiple people.
7. What is the usual time you contact them?
   (a) Is it same for your friends, family or partner?
8. How do you decide the time of contact?
9. Which devices do you use to contact your loved ones? (Laptop/Smartphone/Telephone etc)
10. Which form of communication do you use? (video call, voice call etc.)
11. Which medium do you use? (WhatsApp, skype, social media etc)
    (a) Is it same application for laptop and smartphone?
12. Do you use different forms of communication for different people?
13. What common activities you and your loved ones perform during the call/type of connection? Can be anything, playing games, watch same show etc.
    (a) Do they help keep your interaction long? (longer in terms of time).
14. How do you contact your loved ones while having a snack or during random break times?
15. What do you do when your loved ones contact you during your meal time (Meal can be breakfast, lunch or dinner)?
    (a) Do you contact them during their meal time?
        i. If yes, what do they do then?
    (b) If any of the above happens,
        i. where are your loved ones or you sitting during the meal?
    (c) Which device do you use to contact your loved ones during the meal?

16. What did your mealtimes looked like when you were staying with your family?
17. Have you ever dine together with your loved ones for different meals (Breakfast-Lunch, Lunch-Dinner or Dinner-Breakfast)?
    (a) If yes, can you share your experience?
    (b) How many times a month do you distant dine?
    (c) How did your habits changed over the time for distant dining?
18. Have you and your loved ones decided to dine together for a special occasion?
    (a) If yes, what was it like? share an experience of distant dining.
        i. Did you face any technical problems during the process?
        ii. Did you face any social problems during the process? Disconnect between you and your loved ones or not having enough common interaction points, etc.
        iii. Can you share a bad experience of distant dining, if any.
        iv. What kind of issues your parents face while using technology for distant dining?
        v. If you do not feel any issues or trouble during distant dining, why do you feel the process is easy and comfortable?
        vi. What benefits do you see of distant dining?
    (b) If not, have you ever thought of doing it?
        i. If not, why do you feel distant dining is not required?
        ii. What challenges or problems you might face if you decide to dine together?
        iii. What benefits do you see of distant dining?
        iv. Can give an insight about why have you never tried dining together?
19. Apart from your loved ones living far away, have you distant dining with your local friends during current ongoing pandemic?
    (a) If yes, can you share the experience?
    (b) If not, would you do it and if yes, then how?
20. If you could describe a perfect digital system for improving distant dining, what would it be?
21. Finally, if you could describe a way to promote distant dining for expats with their loved ones?

Appendix C

Information Brochure and Consent Form for Initial Interview

Background

Students these years look for the best education, even if they have to travel abroad and leave their families and friends behind for a few years. The same goes for adults who look for better job opportunities outside their home country. Statistics show that there has been a growth in the number of international students from 2 million to 5.3 million between the years 2000 and 2019 according to data provided by UNESCO 2019. Another research report published by Finacord, forecast that an increase of 65.71% i.e., from 52.8 million to 87.5 million in the number of adults taking jobs abroad from 2013 till 2021 will happen.

During the time these expatriates, or for short expats (collective word for people residing in a country other than their native country), stay abroad and away from their families and friends, they connect with their friends and families using their smartphones over voice calls, videos calls and through social media, where these virtual interactions usually take place during one's free time.

However, one important interaction is being ignored during this time and that is dining together. Dining around a table has many positive impacts on one's life and also has health benefits. We are in a time where globalization is resulting in "Death of Family Meal" and "Death of Dining Table". We believe that this can be resolved using available technology however before we work on it, we need some insights on how expats[1] connect with their loved ones[2] and do they try to dine together?

Information Leaflet

Blurring Time and Space Gap for Distance Dining

Connecting loved ones over a meal

UNIVERSITY OF TWENTE.

Human Media Interaction

This brochure contains information about the research project: Blurring Time and Space Gap for Distance Dining. The brochure helps you decide if you want to cooperate with the research.

Contact Info:
Gursehaj Singh Arora (s2134772)
g.s.arora@student.utwente.nl

1. International students and those who take jobs abroad
2. Loved Ones (Family, Friends and partners)

Figure 3-1: Information Brochure, Page-1

Interview Structure

The interview will consist of at most 20 questions which participant can or cannot answer and will take at most 45~60 minutes. If you feel a certain question distressing, you can withdraw from the interview without any provided reason. The interview will be done over a video call as it is not currently advised to physically meet people due to the current Covid19 pandemic situation. The interview will help us better understand out two goals:

1. To find and understand habits around distant dining carried by expats[1] with their loved ones[2] having a time zone difference of three or more hours.
2. To understand how expats[1] use technology to distant dine with their loved ones[2] using technology where time zone difference is three or more hours.

Participation

Participation is entirely voluntary. Participants can choose to not answer certain questions or can stop the interview at any given point without any specific reason and all the collected data will be destroyed for the particular participant. People above the age of 18 years who are expats will only be allowed to participate in the interview and further research.

Once the participation is granted, the participant can be contacted again for a follow-up interview or research related to the topics Distant Dining.

During Interview

During the interview, the participants are requested to not answer questions with a simple yes or no, they should provide at least an explanation for it. Participants can question the interviewer during the interview.

Data Collection

Through the interview personal data namely age, gender, nationality, occupation, and email address will be collected along with interview audio will also be recorded through software called OBS so that it can be played back to take notes.

Emails will only be used to contact the participant for a follow-up study or in an event where participant requires to delete their collected information.

Data Processing

The participants will have 48 hours window to withdraw from the study, after which audio data will be transcribe to text and all the personal identifiable information will be removed from the text and the original recorded audio will be permanently deleted. Email will not be deleted as they will be used to contact participants for a follow up research, also emails will not be used in the research at all.

All collected data and used in the research will be made public anonymously through the project report.

Data Storage

The collected data will be kept securely and processed anonymously according to AVG guidelines. According to VSNU guidelines, research data is kept for at least 10 years.

Data Analysis

Processed data will allow us to understand key points about this research, 1) common technology used for distant dining and communication, 2) habits around communication with loved ones[2] based on participants occupation, gender, nationality and age, and 3) problems and challenges face while or preparing for distant dining.

Adverse Effect Warning

The interview consists of questions which might be personal for you and can result in you being hesitant to answer. The questions require participants to talk about their frequent contact with their loved

1. International students and those who take jobs abroad
2. Loved Ones (Family, Friends and partners)

Figure 3-2: Information Brochure, Page-2

ones[2] and which technology do they use to do so. Hence, participants can choose to withdraw from the research at any given point without any reason or can choose to not answer specific questions.

Leading Design Research

After the interview can be contacted for a following Design Research related to Distant Dining using your email provided. The design research will also be carried out over the internet and will be one to two hours long. The research will require you to be in a group video call using Microsoft Teams. No personal information will be collected during the session. Audio and video will not be recorded during the online session; however, you will be asked to write down your ideas to improve distant dining among expats and their loved ones[2] on an online blackboard. Participants will require to at least keep their audio on during the session in order to interact with other participants. If participants feel hesitation in writing down ideas for the prototype, they can withdraw from the session without any reason or can choose not provide ideas for parts of the session. Further participants can choose to join the design session only via audio call if not comfortable with video call. Participants will be asked to not write down any personal information on the virtual whiteboard during the session. As well all the collected data will be anonymised by removing personal identifiable data from the whiteboard if any.

Contact Information

For any questions or comments about the research or survey, you can contact the lead researcher Gursehaj Singh Arora at g.s.arora@student.utwente.nl.

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1. International students and those who take jobs abroad
2. Loved Ones (Family, Friends and partners)

Figure 3-3: Information Brochure, Page-3

Consent Form

Aim

The aim of this interview is to find habits around distant dining among expats (international students and people who take job abroad) and their loved ones (family, friends or partners) and learn which technology do they use to do so.

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Declaration

I hereby declare the following for the Research Topic "Blurring Time and Space Gap for Distant Dining" for the 2020-21 season:

☐ 'I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described in the aforementioned information brochure 'Blurring Time and Space Gap for Distant Dining'.

☐ I reserve the right to withdraw this consent without the need to give any reason and I am aware that I can withdraw from the experiment at any time.

☐ If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous.

☐ My personal data will not be disclosed to third parties without my express permission.

☐ I give consent to record my personal data like email, age, occupation, gender and nationality during the interview.

☐ I also give consent to record my audio during interview for data collection and would not be used in the research without processing it.

☐ I would like to be contacted for a follow-up interview or research via my provided email.

Contact Information

If I request further information about the research, now or in the future, I may contact **Gursehaj Singh Arora (g.s.arora@student.utwente.nl)**. If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of

Figure 3-4: Consent Form, Page-1

Electrical Engineering, Mathematics and Computer Science at the University of Twente, P.O. Box 217, 7500 AE Enschede (NL), email: ethics-comm-ewi@utwente.nl).

Name Participant: Signature & Date:

_____ _____

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.'

Name Researcher: Signature & Date:

_____ _____

Figure 3-5: Consent Form, Page-2

Appendix D

Information Brochure and Consent Form for the Experiment

Background

Students these years look for the best education, even if they have to travel abroad and leave their families and friends behind for a few years. The same goes for adults who look for better job opportunities outside their home country. Statistics show that there has been a growth in the number of international students from 2 million to 5.3 million between the years 2000 and 2019 according to data provided by UNESCO 2019. Another research report published by Finacord, forecast that an increase of 65.71% i.e., from 52.8 million to 87.5 million in the number of adults taking jobs abroad from 2013 till 2021 will happen.

During the time these expatriates, or for short expats (collective word for people residing in a country other than their native country), stay abroad and away from their families and friends, they connect with their friends and families using their smartphones over voice calls, videos calls and through social media, where these virtual interactions usually take place during one's free time.

However, one important interaction is being ignored during this time and that is dining together. Dining around a table has many positive impacts on one's life and also has health benefits. We are in a time where globalization is resulting in "Death of Family Meal" and "Death of Dining Table". We believe that this can be resolved or improved using available technology.

We developed an Augmented Reality Experience where a virtual table is shared among diners. Apart from virtual table, presence of other dinners can also be experienced via point cloud using Kinect sensor. This brochure provides information about the data collection that will be caried out while by first allowing the participant to experience the distant dining over video call and then with Augmented Distant Dining Application followed by an interview with related questions about the experience participants experienced.

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1. International students and those who take jobs abroad
2. Loved Ones (Family, Friends and partners)

Figure 4-1: Information Brochure for Testing, Page-1

Experiment Structure

The experiment is a three-part process, both requiring participant to distant dine with the researcher.

1. Video Call Distant Dining
2. Augmented Distant Dining
3. Interview

Each part will be carried out on the same day and the duration of overall evaluation will take at least one hour and thirty minutes. At all times the researcher and the participant will be connected via Microsoft Teams using a Laptop.

Video Call Distant Dining

After a short introduction, participant and the research will distant dine with a simple meal each prepared beforehand. During the meal, basic actions, and conversational topics like presenting each other's dish, interacting with objects around, controlling media like music or television, discussing about one's day or sharing views on a hot topic.

The distant dining over video call will be limited to 15 minutes at most.

Augmented Distant Dining

After the distant dining over video call, we will carry another dining session using an augmented android app, most interactions will remain same. And the session will also be limited to 15 minutes at most.

About the App

The application is an Android application using smartphones camera to project virtual objects onto real world creating an augmented world which can be controlled and altered by both the participant and the research. The android application will also connect to a server with a dedicated IP address to get a livestream of point cloud data generated by a Kinect camera at researchers end.

Security and Privacy

The application always requires access to the internet. It connects to an external server using server's public IP address which streams live point cloud data generated via Kinect connected to a computer owned by the researcher. This server connection does not access or store any personal smartphone data of the participant and is only used to stream point cloud data over the network.

Interview Structure

Following the experiment will be the interview which will consist of at most 10 questions which participant can or cannot answer and will take at most 45 minutes. If you feel a certain question distressing, you can withdraw from the interview without any provided reason. The interview will allow us to answer two important questions:

1. How augmented reality improved the distant dining experience and how would the participants compare it with using video calls for the same?
2. How inviting augmented form of distant dining was to participants who never distant dine with their loved ones?

Participation

Participation is entirely voluntary. Participants can choose to not answer certain questions or can stop the interview at any given point without any specific reason and all the collected data will be destroyed for the particular participant. People above the age of 18 years who are expats will only be allowed to participate in the interview and further research.

During Interview

During the interview, the participants are requested to not answer questions with a simple yes or no, they should provide at least an explanation for it. Participants can

1. International students and those who take jobs abroad
2. Loved Ones (Family, Friends and partners)

Figure 4-2: Information Brochure for Testing, Page-2

question the interviewer during the interview.

Data Collection

Through the interview personal data namely age, gender, nationality, and occupation will be collected along with interview audio will also be recorded through software called OBS so that it can be played back to take notes.

Data Processing

The participants will have 48 hours window to withdraw from the study, after which audio data will be transcribe to text and all the personal identifiable information will be removed from the text and the original recorded audio will be permanently deleted.

All collected data and used in the research will be made public anonymously through the project report.

Data Storage

The collected data will be kept securely and processed anonymously according to AVG guidelines. According to VSNU guidelines, research data is kept for at least 10 years.

Contact Information

For any questions or comments about the research or survey, you can contact the lead researcher Gursehaj Singh Arora at g.s.arora@student.utwente.nl.

Research Supervisors

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Ethics Committee (CIS)

Secretary
University of Twente
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1. International students and those who take jobs abroad
2. Loved Ones (Family, Friends and partners)

Figure 4-3: Information Brochure for Testing, Page-3

Consent Form

Aim

The aim of this Follow Up Concept Evaluation is to find whether the research was able to mirror and present a concept which was discussed and ideated during Feedback session for improving distant dining among expats (international students and people who take job abroad) and their loved ones (family, friends or partners).

Lead Researcher

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Research Supervisors

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Declaration

I hereby declare the following for the Concept Evaluation Session for Distant Dining for the 2020-21 season:

☐ I hereby declare that I have been informed in a manner which is clear to me about the session.

☐ I reserve the right to withdraw this consent without the need to give any reason within 48 hours of signing the consent.

☐ If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous.

☐ I give consent to record my personal data like email, age, occupation, gender and nationality during the interview.

☐ My personal data (age, gender, occupation and nationality) will be anonymised and used for research and will be publicly available.

☐ I give consent to record my audio during interview for data collection and would not be used in the research without processing it.

☐ I give consent to be present in front of a group over a video/voice call during the session.

Figure 4-4: Consent Form for Testing, Page-1

Contact Information

If you request further information about the research, now or in the future, you may contact Gursehaj Singh Arora (g.s.arora@student.utwente.nl). If you have any complaints about this research, please direct them to the secretary of the Ethics Committee Computer & Information Science at the University of Twente, P.O. Box 217, 7500 AE Enschede (NL), email: ethicscommittee-cis@utwente.nl).

Name Participant: Signature & Date:

_____ _____

Participant Email:

_____

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.

Name Researcher: Signature & Date:

_____ _____

Figure 4-5: Consent Form for Testing, Page-2

Appendix E

Interview Questions for the Experiment

Questions for Comparison between Video Call and Augmented Application

1. What were your likes and dislikes about the video call distant dining session and why?
2. What were your likes and dislikes about the augmented reality distant dining session and why?
3. What did you think about distant dining experience using video call and why?
4. What did you think about distant dining experience using augmented reality and why?
5. Do you think the two distant dining experiences were different?
    - Why if there was a difference?
    - Why not if there was no difference?
6. How would you compare the appearance of the other diner during both distant dining sessions?
    - Which appearance would suit the best for your distant dining needs and why? Or why not?
    - Do you think the fist bump at the end of each session were different and why? Or why not?
    - Do you think it added better physical presence than the other dining session and why? Or why not?
7. Does keeping the phone in front vs holding it in hand effect the process of eating food and dining and why? Or why not?
8. Do you think the initial table setup during augmented session changed the distant dining experience as compared to during video call and why? Or why not?
9. Which type of television sharing would you prefer while distant dining and why?
    - Why not the other one?
    - If none, does any other activity would be preferred and why?
10. Which way of distant dining would you prefer and why? (Video Call or Augmented Reality)
    - Why not the other one?

Questions for comparison between Initial Concept and Ideal Concept

1. What do you like and dislike about coloured point cloud in comparison to the black and white point cloud and why? Or why not?
2. How would you compare the appearance of the other diner now during both distant dining sessions?
    - Which appearance would suit the best for your distant dining needs now and why? Or why not? Between Video, Black and White point cloud and Coloured point cloud.
3. Does the coloured point cloud provide same or more level of detail of opposite diner as in the video call or not and why? Or why not?
4. Which way of distant dining would you prefer now and why? (Video call or Augmented reality with black and white point cloud or Augmented reality with coloured point cloud)

Appendix F

Experiment Checklist

Recruiting participants

- ☐ Participants who fit the description of the target group are approached via Facebook and WhatsApp using a short description of the experiment. All the interested participants are sent an invitation email as follows:

  Dear Participant,
  Thank you for showing your interest in the experiment. Follow the steps below to learn more about the experiment and pick a preferred date and time,

  1. *Please read the information brochure provided in this email.*
  2. *Read the consent form attached with this email and send a signed copy or digitally signed back to me.*
  3. *Finally, Choose a date and time using this link for the session.*

  To participate in the experiment, you'll be required to install an application. As mentioned in the information brochure, the application will not record any personal data and will access your microphone and camera sensors only when the application is turned "on". You are also requested to print the PDF provided in this email on an A4 sheet.
  Note: If you are not able to download or install the application on your android smartphone, please reach out to me as soon as possible before your session. Please make sure you have an Android phone with Android OS 8 or above.
  You will receive another mail a day before your selected date for the experiment, containing details about how to set up for the session.
  Best Regards
  Gursehaj Singh Arora

- ☐ A day before each session, every participant will receive an email containing information on how to prepare for the session in advance. The email will be as follows:

  Dear Participant,
  As per your selected date, you have a session with me tomorrow on date for my experiment. Below are a few details which need to be taken care of from your end. Kindly read them carefully and comply as this might vary the results of the experiment to some extent.

  1. *Please keep your smartphone and laptop fully charged before the session begins as they are both required during the session and connect them to Wifi.*

2. *Please use this link to download the Augmented Reality App and install it on your smartphone if you haven't already.*
3. *Please print the PDF provided in this mail on an A4 sheet if you haven't already.*
4. *Since the session is about distant dining, I would request you to prepare yourself a sandwich which could be easily eaten with one hand.*
5. *Have support like a salt shaker or a water bottle to keep your phone straight up during the video call.*
6. *Please sit alone in a quiet room at a table.*

Note: If you are not able to download or install the application on your android smartphone, please reach out to me as soon as possible before your session. Please make sure you have an Android phone with Android OS 8 or above.
Best Regards
Gursehaj Singh Arora

Before Session

- ☐ Participant has prepared sandwiches.
- ☐ Support for the phone (If video call session).
- ☐ AR application installed (If AR call Session).
- ☐ Printout of the Table Tracker (If AR call session).
- ☐ Connect over WhatsApp video call (if video call session).
- ☐ Connect over WhatsApp audio call running in background and open AR application (if AR call session).
- ☐ Tell participants that they will receive a link via email after the session, which they need to fill in.
- ☐ Tell participants to not think about technical issues during filling out the forms and during interview.

Before AR Call Session

- ☐ Explain how the application works. (The app uses your smartphone's back camera to project virtual objects in the real world using the Table Tracker marker as a reference and therefore you can move your phone around to see virtual objects in your real world)
- ☐ Provide the IP address to connect with Kinect for streaming point cloud.
- ☐ Explain controls of the application.

1. How to interact with virtual objects?
2. What does the D-Pad do?
3. What is volume slider for?
4. How to play or pause the television?

- ☐ Task 1: Try to move the television around by tapping on it and using D-Pad to move it around and deselect it by touching the screen at an empty space.
- ☐ Task 2: Play the television by tapping on the play button above the virtual television and change the volume using the volume slider.

During Session

During the session the researcher will try to stick to the script below:

1. Researcher greets the participants "Hello" with a hand wave.
   (a) Participant might or might not greet back.
2. Researcher requests participant to position the virtual television according to their own view, "Let's begin with positioning the television". (If AR call session)
   (a) Researcher also moves the virtual television around a bit as per his view.
3. Researcher asks, "What have you cooked for the meal?"
   (a) Participant replies, sandwiches with some fillings (like chicken, ham etc).
   (b) Participant might ask the research "What have you prepared, or have you also prepared sandwiches?"
   (c) Research replies, "Yes, I have also prepared sandwiches with some fillings."
4. Researcher tells participants, "Let's start eating."
   (a) Participant and researcher begins eating.
5. Researcher ask's participant "So how are you and how was your morning?".
   (a) Participant reverts and ask researcher how are you?
      i. Researcher replies with "I am doing good. Currently busy with my thesis. In the morning I woke up around 10:00 am and the weather was rainy and beautiful."
6. If participant doesn't revert with the same question, researcher replies with "I am doing good. Currently busy with my thesis. In the morning I woke up around 10:00 am and the weather was rainy and beautiful."

7. Researcher tells participant to watch together a YouTube video (Friends episode) which is shared over WhatsApp and is watched on the smartphone itself. Researcher tells participants to play it together in 3, 2, 1 and play. (If video call session)
    (a) In first 10 seconds of the video, researcher asks whether the participant has seen Friends (the YouTube Video) or not.
    (b) Researcher replies, I love Friends (the YouTube video).
8. Researcher tells participant to watch together a video (Friends episode) which is shared over virtual television. Researcher tells participants to play it. (If AR call session)
    (a) In first 10 seconds of the video, researcher asks whether the participant has seen Friends (the Video) or not.
    (b) Researcher replies, I love Friends (the video).
9. Researcher asks participant to pause the video and tell the participant that "I have finished my lunch and have to go".
10. Researcher tells participant to end the call with a fist bump.
11. Researcher ends the call.

After Session

- ☐ Ask participants not to compare the previous session and fill the acceptance scale (if last session).
- ☐ Send Acceptance Scale link for video call via email (if video call session).
- ☐ Send Acceptance Scale link for augmented reality via email (if AR call session).
- ☐ After first part of interview, send Acceptance Scale link for coloured point cloud via email (if last session).
- ☐ Request participant to join Discord using this link on their laptop for the interview (if last session).
- ☐ Setup audio recording on OBS to record the interview. (if last session)

Appendix G

Feedback Session

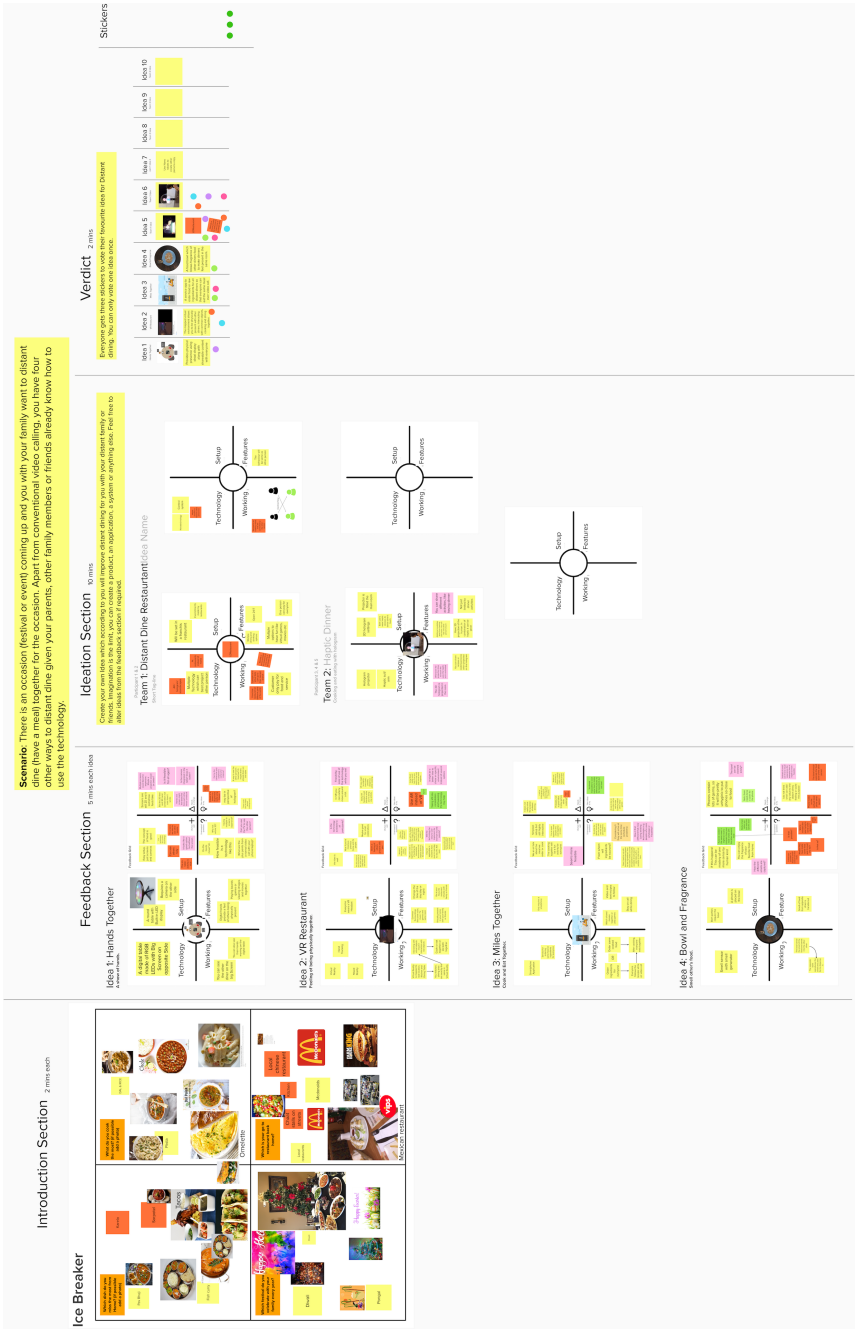

Figure 7-1: Feedback Session on Mural

Appendix H

Prototype Feedback Session

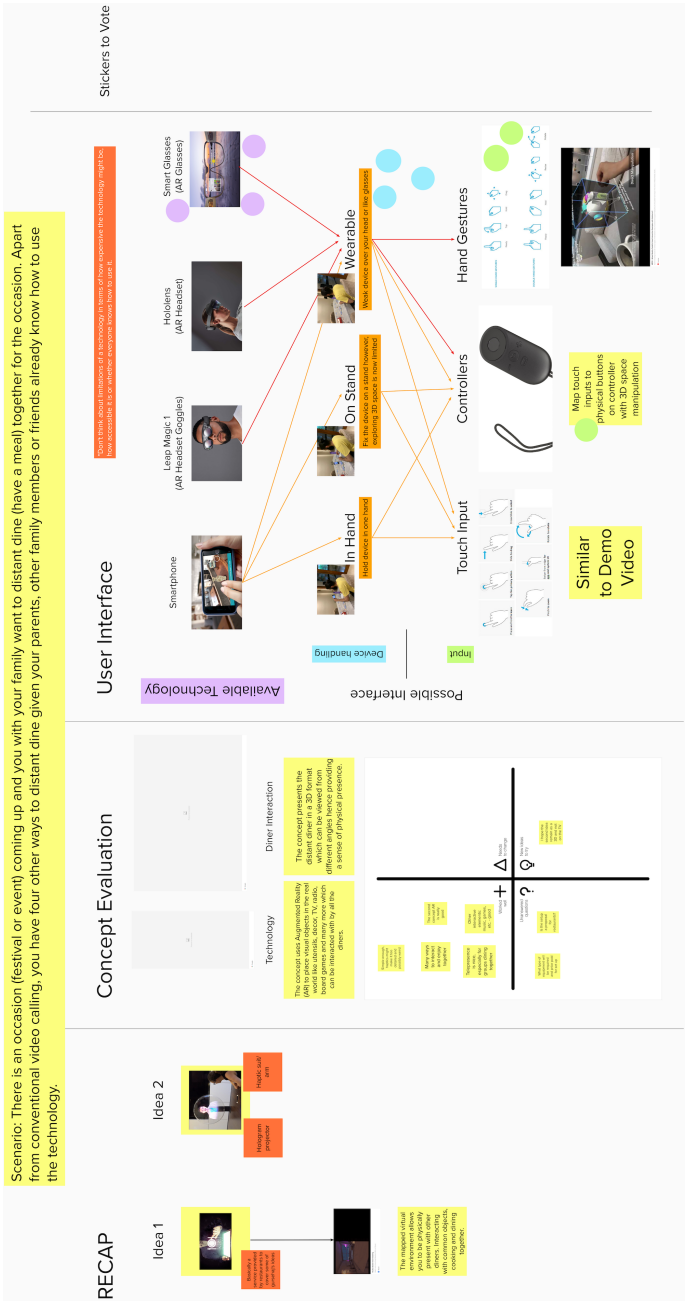

Figure 8-1: Feedback Session for Concepts on Mural