INGREDIENTS OF MAKING ONLINE ACTIVITY BETWEEN REMOTE GRANDPARENT AND GRANDCHILDREN SUCCESSFUL

by

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A thesis submitted to the faculty of
The University of North Carolina at Charlotte
in partial fulfillment of the requirements
for the degree of Master of Science in
Architecture and Information Technology

Charlotte

2020

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ABSTRACT

SAQUIB SARWAR. Ingredients of Making Online Activity Between Remote Grandparent And Grandchildren Successful . (Under the direction of ERIC SAUDA, PROFESSOR)

Grandparents and grandchildren share a special bond. Their relationship grows through communication, activities, and taking care of each other. But when they are separated, they fail to nurture the relationship for lack of connectedness and communication. Activities between grandparents and grandchildren are the primary driving force in creating communicational contexts between them. As remote grandparents and grandchildren fail to take part in activities, they fail to develop backgrounds for communication, while leads to less engaging conversations and failure to connect. To help remote grandparents and grandchildren successfully engage in online activities, researchers need to know the elements of online activity successfully. Through extensive literature research and investigating several online activities, I have identified the necessary ingredients for making online activities successful. In my thesis, I describe the ingredients of making online activity and the process I followed to identify the ingredients. I also express my findings after investigating several online activities and my design suggestions for creating online activities for remote grandparents and grandchildren.

DEDICATION

This work is dedicated to Sarina and children like Sarina, who do not know how does it feel to have a friend like grandpa and grandma. Hopefully, future technology with be more favourable towards you all.

ACKNOWLEDGEMENTS

I want to express my deepest gratitude towards Eric Sauda, who supported me in many ways. During my journey of DesComp program, he was like a guardian who always looked after me. I am grateful to Dr. Maher, who always showed me ways when I was lost with my research. I am also grateful to Dr. Wilson, who accepted my request to join the committee at the very last moment and helped me finalize the thesis with very specific feedback. Lastly, Iâm extremely grateful to Syeda Fatema Mazumder, without whose motivation I could never reach this far. Her contribution till now is indescribable.

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HCI An acronym for Human Computer Interaction.

CHAPTER 1: INTRODUCTION

1.1 Motivation

Families are spreading around the world now more than ever. They are getting divided, and people are moving to different cities, states, and countries for education, job, or a better lifestyle. Because of this movement, family relations are suffering. Bonding is getting weaker, and relationships are breaking. Among all the family members, the bond between children and their grandparents are suffering the most.

For grandchildren, grandparents are individuals with many roles. They are playmate, teacher, storyteller, caretaker, babysitter, artist, historian, and many more [14]. Grandparents are the next best thing besides their parents [4]. Sometimes they can share things with their grandparents more comfortably than their parents. Moreover, healthy relationships with grandparents are associated with better mental health for children, especially those from single-parent families [15, 16]. For grandparents, grandchildren are a source of joy and help create a purpose in life [17].

When grandparents and grandchildren live separately, they fail to create the same bond that they generally have when they live together [4]. Although modern software and applications are bringing new tools to connect people from distant places, these are not suitable for everyone. One of the contemporary communication tools is video call applications. Video calling or video chatting is one of the most popular methods of communication between remote people. But most of the video calling applications are not suitable for older adults and children [18, 19]. The interface and system seem very difficult for the older generation to use the application properly [18]. One the other hand, children are not good at focusing on video communication systems [19].

Researcher shows that the communication failure between remote grandparents

and grandchildren is related to the lack of communicational context between them [18]. Research shows that collocated grandparents and grandchildren communicate with each other while they get engaged in activities like playing, storytelling, drawing, gardening, cooking, reading books together [18]. As remote grandparents and grandchildren live in separate places, they hardly take part in an activity together. Also, through activities, the grandchildren get to know their grandparents better, and they may help to create a connection between them, leading to better engagement and relationships between them. This kind of scenario is hardly possible for remote grandparents and grandchildren communicating thought email, phone, or video call.

Researchers have been working on creating activities between remote grandparents and grandchildren [20, 21, 12, 2, 22, 4, 23, 1, 13, 3, 6]. Focusing on the importance of intergenerational activities, they have tried to create activities like playing, storytelling, experience sharing between distant grandparents and grandchildren. They have worked on finding different attributes of remote online activities, the influence of parents on the communication, the medium used for online connections, and activities the external forces on remote activities.

Motivated by the above scenario, the basic concept of this thesis research generated. In this research, the main stakeholders are grandparents and grandchildren who don't have the opportunity of engaging in face-to-face interactions and activities. In this document, these stakeholders are referred to as remote grandparents and grandchildren. As mentioned above, to create communicational contexts between grandparents and grandchildren, they need activities. To support communication between remote grandparents and grandchildren, this thesis focuses on identifying the ingredients of making online activities successful.

1.2 Intergenerational Interaction

Intergenerational interaction is mainly about the interaction between different generations of family members, more specifically, grandparents, parents, and children.

Intergenerational interaction has a moderate amount of research focusing on communication, play, and games. It is also divided into interactions between co-located, where generations live together in the same geological space, and remote, where generations live in different geological areas, family members.

As stated before, grandparents and grandchildren find it challenging to develop and maintain relationships over a distance. Connecting them through intergenerational interaction systems is difficult, as researchers need to design considering both groups. Researchers in this space has pointed out,

> We do not yet have a solid grasp of how to bridge the conflicting needs and preferences.[24]

Intergenerational interaction patterns differ from family locations (collocated, remote), ages, cultures, and languages [25]. When families are together, they are more aware of each otherâs daily routines, schedules, life events, travels, and many more. They also belong to the same culture, language, and society. So, it is easier for them to communicate with each other, interact, and be part of each otherâs lives. The situation is not the same for remote families. Everything is different for them from the collocated families, which makes their interaction much more challenging.

To connect family members over the distance, researchers have been developing systems focusing on intergenerational interaction in both HCI and industry. Commercially available applications are WhatsApp, Telegram, Messenger, and Skype. This application support voice and video communication, photo, video and audio sharing, interactive video communication, and games over the video call. Overall, they support different kinds of interaction techniques, but these applications are developed for users form all age groups. Although some generations find these applications easy to use and interaction, older adults and children find it challenging to use these applications and interact.

Children find video communication more engaging over phone communication. But

children have a hard time sitting in front of the system; they would rather run around the house, which makes the other side to see them and communicate [26]. As most families have a hard time keeping the children steady for video communication, it seems not enough for keeping the children engaged in interaction with their remote family members [27]. As children and remote grandparent, both have time and willingness to interact but failing because of the lack of proper tool; there are opportunities in this field to research on ways of remote intergenerational interaction and create tools that will help families, especially grandparents and grandchildren, to connect over the distance [28].

1.3 Intergenerational Activity

Intergenerational activities play a significant role in the life of both grandparents and grandchildren. Their communication, relationship, and bonding depend on their engaging in activities together. Shared activities build up the childrenâs self-esteem [29] and reduced the loneliness of their adult grandparents. When children and grandparents join in face-to-face interaction, their communication seems to be submerged in their ongoing activity [30]. Their communication is, in parts, closely related to the activities that both are involved [30]. As children, till a certain age, learn through activity, their communication might be in line with the activities as well. Research also shows that childrenâs conversational focus on current activities [30].

For remote grandparents and grandchildren, it is difficult for them to connect like the collocated grandparent and grandchildren. Communication over the phone is inadequate for sharing information about everyday activities for both grandparents and grandchildren [30]. Technology such as video chat can help mitigate some issues. Yet, they bring with them their challenges like parental support, childrenâs difficulties in getting engaged in communication, and problems regarding the system interface [28, 12]. When they live in different time zones, cultures, and languages, interaction becomes even more difficult [24]. Overall, to create proper interaction between remote

grandparents and grandchildren, they need to engage in activities like collocated grandparents and grandchildren [29].

In the vast scope of intergenerational interaction, this thesis is focusing on intergenerational online activities. Intergenerational online activities help children get connected with their relatives of different generations. These activities can be playing online multiplayer games, playing online board games, drawing together, reading books, or watching movies together. The main themes of the activities are connecting real-world topics with activities and bringing offline activities online, for example, online chess where the tactile medium of chess icons and board is replaced by images on the screen [31]. Also, the activities need to be simple, and easy to learn and participate in. They can be challenging but not frustrating, exciting, but not overwhelmingly attractive, fast passed, but not too fast (i.e., speed chess) and should provide room for interaction between the participants as well [31].

Intergenerational activities are not a substitute for personal, face-to-face interaction. The main goal is to create social connections between generations and building social presence [32]. Intergenerational online activities help create a virtual bonding and presence among families, but the real-world meeting is also necessary.

1.4 Thesis Statement

My thesis focuses on this statement,

> The success of online activities between remote grandparents and grandchildren is directly and indirectly influenced by some specific components, or in this case, ingredients and identifying these ingredients will help researchers effectively design and develop online activities for remote grandparents and grandchildren.

To support this statement, I first determine the ingredients of making online activities between remote grandparents and grandchildren. Then I investigate several activities

from earlier literature to show how these ingredients were used how that influenced the success of their system.

1.5 Methodology

As stated above, the goal of this research is to identify the ingredient of making online activities between remote grandparents and grandchildren successful. From that specific goal, several questions arise. Firstly, what do remote grandparents, parents, and grandchildren require the online systems to support for making their interaction engaging and satisfying? Secondly, how are the current online system supporting those requirements and where are they (online system) failing. Answering these questions will help to specify the components needed for creating online activities more engagingly and successfully connecting remote grandparents and grandchildren.

To answer these questions, this research is divided into two parts. The first part is "identifying the ingredients required for online activities between remote grandparents and grandchildren" and the second part is "investigating current systems that support online activities between remote grandparents and grandchildren." For the first part, the focused group of literate should support the communicational needs and failures of remote families, specifically remote grandparents and grandchildren. For the second part, works of literature on online systems that support activities between remote grandchildren and grandparents were focused. Methodologies in each section will provide more specifications on the pieces of literature followed, an overview of those pieces of literature, and the analysis process.

1.6 Research Question

1. What do remote grandparents, parents, and grandchildren require the online systems to support for making their interaction engaging and satisfying

2. Where is success and failure of the current online system supporting requirements of remote grandparents and grandchildren.

1.7 Contribution

The contributions of this thesis are:

- Determining the ingredient of remote online activity between grandparents and grandchildren.
- Identifying the lacking of current systems for online activity between grandparents and grandchildren.

Researchers, who are working on online intergenerational activities, will be able to design efficient and successful activities with the help of this research. They will be able to build robust systems as this thesis is summarizing the research of the past 12 years on online activities between grandparents and grandchildren.

CHAPTER 2: IDENTIFYING INGREDIENTS FOR ONLINE INTERACTION

2.1 Methodology

This chapter is focused on identifying the ingredients required for online interactions by remote grandparents, and grandchildren. This section can be divided into two parts.Understanding themes by analyzing literature, and Identifying ingredients.

To understand themes by analyzing literature, it is important to properly identify the literature. As mentioned above, the focused group of literate should support the communicational needs and failures of remote family members, specifically remote grandparents and grandchildren. On this note, 12 earlier works of literature related to

- remote grandparents and children communication
- young children's communication with adult relatives
- remote intergenerational play
- attributes of online activities

These pieces of literature support relevant scenarios, relevant timeline, and relevant technology to the topic of the research.

For literature analyzing, the âQualitative Analysis Techniques for the Review of the Literatureâ [**?**] method was followed. More specifically, the constant comparative analysis of documents, which focuses on how the reviewer should analyze the document, segment it into chunks, label those segments and cluster them according to similarity and find the theme. From the selected works of literature, the study, findings/results, and discussion sections were analyzed following this method. After

analyzing, segmenting, labeling, and clustering, several themes emerged from every literature.

After analyzing all the 12 documents, all the themes were gathered and sorted to identify the most common themes. The most common themes will define the ingredients, which are required for online interaction between remote grandparents and grandchildren.

2.2 Literature Review

One of my major references is the work by Fuchsberger et at [31], where the paper discusses the âattributesâ of online activity between family members. In his work, they first find out the attributes of offline activities by collocated grandparents and grandchildren. This part is essential for my research because, through online activities, we want to create scenarios where remote grandparents and grandchildren get engaged in similar activities like the co-located grandparent and grandchildren.

Through intergenerational interaction workshops, they conducted studies that engage participants from different generations to analyze the attributes of co-located activity. They also conducted end-user interviews and expert interviews to get a better understanding of what the users think. From their research, they specified 13 attributes of online intergenerational activities, which are divided into three parts, structure of activity, the appearance of activity, and Special user group. But the attributes donât consider the relationship, bonding, or knowledge of each otherâs lives. They do not talk about the awareness of each otherâs lives in a non-intrusive way. Also, as this research is from 2010, many aspects of accessibility and usability do not include here, and the technology focus here is somewhat outdated.

In the works of Forghani el at [19], they describe the challenges remote grandparents and grandchildren face regularly while trying to communicate with each other. During their extensive diary study and interviewing twenty participants, they focused on participantâs backgrounds, communication patterns, communication needs, barri-

ers, and conflicts. In their communication routines, participants described a variety of communication routines, different technology preferences, methods for engaging children, and varied timing and frequency. The literature also described several social situations and challenges of interaction between remote grandparents and grandchildren, like providing parental support, being self-conscious, and perceived annoyances.

From the works of Wallbaum el at [3], where they provided insights on the question: How to ease communication between different generations and engage them in sharing activities, and strengthen family relationships,â we find that they discussed three major concepts that bridge their concept with finding. By explaining these concepts, they mainly focused on how the system should be designed that can satisfy both sides as well as creating a context for communication. Their focus was the physicality or tangibility of the device that affords to share both 2D and 3D artifacts, handwritten messages, digital and physical photos, etc. These features connected two generations that have different stories to tell and artifacts to share. They also emphasized promoting creativity through open-ended play, like children tend to share photos of them and their hands just for fun and single-purpose device, like a device just to play with their grandchildren. The single-purpose device helps them understand the use and focus on interaction without the fear of making mistakes.

During the research of Abeele el at [33] on âDesigning intergenerational play via enactive interaction, competition, and accelerationâ, they worked on competition, enactive interaction, and acceleration as design rationale for intergenerational activity. They focus on the understanding that âsocial interaction motive most strongly correlates with the competition motiveâ [34, 35] and emphasizes on competition more than collaboration. They also argue that âdesigning for acceleration and enactive interaction results in ease-of-use, equality-in-ease-of-use, and visibility-of-player-actions.â Which effects intergenerational play by promoting competition and fulfilling the need for control. Although they only work on a co-located scenario, their finding and de-

sign rationale can be helpful in the remote scenario as well because they are focusing on online activity, for which both groups of people are focusing on and interacting with the system.

Yarosh and Kwikkers et al. worked on specifically play over video chat for different children [36]. During their research, they focused on especially instruments that support video chat and how those instruments can support online play through video chat. As findings, they provided four design instructions for future online activity designers to make a play over video chat more user friendly for children. These four instructions are, creating constraining structures to simplify framing, supporting remote toy interaction, improving features with children, and empowering children to use and troubleshoot. These suggestions will help to make the activity more engaging for the childrenâs side.

Prior literature also provided ways that helped me specify the quality of ingredients. For sharing presence across households, researchers learned that shared awareness can create the context of communication and future interaction [30]. They also expressed that without proper scheduling and technology, online activities lose their attraction [8] . Moreover, creativity has immense influence over communication [19] and engagement in interaction [4]. the need for a direct communicational channel between both groups [23] and non-forced interaction like co-listening music [2]. The need for the direct communicational channel between both groups [23] and non-forced interaction [2] are also important factors for interaction over a distance. Researchers also highlight the importance of face-to-face sharing and supporting that with artifacts and storytelling [37].

2.3 Identified Ingredients required for Online Interaction Between Remote Grandparents And Grandchildren

Sorting all the themes found during literature analysing, eight popular themes emerges. These eight themes gives an understanding of the components that both

grandparents and grandchildren asks for during online interaction. These components are the key ingredients that should be supported during online interaction to fulfill the needs of both sides.

2.3.1 Awareness

Figure 2.1: Example of Awareness Systems. Face UI [2].

A successful online activity starts with awareness. Grandparents and grandparents being aware of each other life, events, daily, and social activities help create communicational content and makes their online activity more engaging. Grandparents want to be more aware of their grandchildrenâs life [19]. Their eagerness leads them to initiate communication with their grandchildren or their parents.They also want to share stories of their life, culture, and history.

Earlier research shows that, when grandchildren know about their grandparentâs daily life, activity, choice of music, they become more engaged to interact with their grandparents(Figure 2.1). The researcher also found status sharing to be effective in creating engagement between two sides and children seem to more engaged in sharing their presence with the other side [2]. Similarly, grandparents who are aware of their grandchildrenâs life-events, friends, and activities can engage with their grandchildren easily and effectively [19]. Again, before engaging in any activity, both sides should express their interest in a similar activity and share their consent [31]. Earlier

Figure 2.2: Examples of different Awareness Systems.Time display (top) [8] and Activity Calendar (bottom) [9].

research also shows the parent's role to make grandparents aware of the grandchildrenâs life. A parent can work as a catalyst in successful intergenerational activities by making a connection with each other [19]. While sharing grandchildrenâs stories with grandparents, they can also share their grandparentsâ stories with grandchildren. Afterward, they can motivate children to hear the stories directly from grandparents through video calls or phone calls.

In Figure **??**, some more examples of family awareness systems are shown. On top is a system that shows time and weather condition form both locations of grandparents and grandchildren [8]. Although this does not directly connect each other's lives, it represents their environmental scenario. On bottom, an activity calendar is presented which shows the activities of grandchildren on an interactive calendar [9]. This is a direct way of informing the grandparents about their grandchildren's activities.

2.3.2 Scheduling

The grandparents and children will always have a schedule of their own. Grandchildren will have their school, class, homework, game practices, and the grandparents will have their household works, office, and other day to day activities. Both sides calling each other in unplanned times does not help in making the interaction engaging and effective. Moreover, children and grandparents live in different time zones, which makes creating interaction even tricky. Furthermore, activities lose their attraction because of not properly scheduling it [8] and families often miss opportunities to communicate with their family members due to asymmetries in their daily schedules [25].

Establishing a routine of activities between remote grandparents and grandchildren will help reduce the frustration of lack of communication from the grandparentâs site [19, 23]. Routine making might also help children getting comfortable interacting with their grandparents. During their study, Forghani et al. [19] found that it was easier for the children to follow a routine (specific time every week) to interact with their remote grandparents than random phone calls or video chat session interrupting their ongoing playtime. A scheduling and activity calendar used in that project shown in Figure 2.3 below. Again, scheduling might help to make the activity into ritual, like engaging in activity with grandparents every Saturday evening [31].

As we know, routine activity helps us get less distracted and focus on work; it might help the grandparent and grandchildren better engage in their activity. Routine activity form early childhood might also help make childrenâs interaction with their grandparents a habit. This might help to create a strong bond between remote grandparents and grandchildren, like collocated grandparents and grandchildren. Also, research shows having a scheduled or routine contact or communication pattern makes the interaction engaging [23].

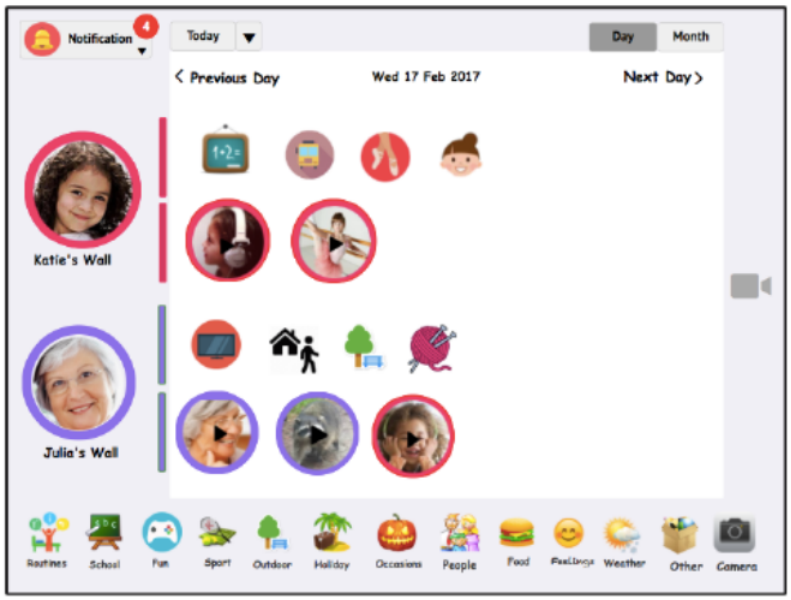

Figure 2.3: Example of Scheduling System. Activity and Scheduling Calendar[9].

2.3.3 Usability

The term usability includes ease of access, ease of leaning, ease of navigating, achieving objectives, and understanding the system or device or interface. To ensure a good flow of activity between the two sides, grandparents and grandchildren need to have a good handle over the system. So, the system should be easy enough for both groups to start the system, make a connection, engage in the activity, and disconnect if needed. The system should not require the participating groups to learn computer operation while the system has become much easier nowadays. The children often rely on their parents to initiate the connection with their grandparents, which make the process lengthy and hectic.

As a communication medium, grandparents prefer video chat over other mediums, but most of them find it challenging to use the system. Frequently grandparents expressed their frustration over the systems not being friendly and changing rapidly [19]. While they are very comfortable with simple systems with a singular purpose, only to communicate with grandchildren [3]. They also expressed that the involvement

of parents to initiate the communication causes the interaction between them not engaging and biased [23]. Froghani et al described in their research finding that systems should be easy enough so that the grandparents and young grandchildren can use them without extra help. [19].

Research shows, when children are given more control over the system, they became more engaged with the activity with their grandparents [23]. Less parental support to operate the system will also lead to sharing expression freely [38, 19, 12]. The grandparents also feel more satisfied when they see the children showing interest interacting with them. So ease of access to the system for children might make the activity successful and engaging.

Figure 2.4: Children are independently using Activity Calendar [9].

2.3.4 Artifact

Artifacts are an essential part of activity between remote grandparents and grandchildren [39]. Artifacts create memories of the interaction and make communication context for the future. Olsson et al. [37] studied the needs for sharing life memories. They highlighted the importance of supporting physical mementos like artifacts. Artifacts also help carry out the context of one session to the future sessions and bring diversity in interaction and activity, which is important in keeping the attention of young children. This ensures the connection between activities, supporting the

relationship between two groups, and makes the interaction device more attractive [31].

Figure 2.5: Artifacts Shared in Magic Box [10].

Artifacts can be both physical and non-physical. Physical artifacts may include books, photos, drawings, and toys. Grandparents can create crafts for their grandchildren, which can facilitate activity and interaction [19], or they can both get engaged in making and learning. Like the grandparents can teach grandchildren origami or knitting, give cooking instruction, or showing how to take care of plants. The artifact-oriented activities create and preserve memories and may help strengthen the family bond. Activities like book reading and photo album viewing depend on artifacts majorly. Children can be engaged in making artifacts out of artifacts like making a photo book out of the photos grandparents and grandchildren share.

Nonphysical artifacts can include music, song or rhymes, digital photos, drawings, computer games, and ebooks. Grandparents and children can be engaged in shared music listening activity, which is a more indirect engagement proven to create a context for communication [2]. They can also take part in ebook reading, digital photo sharing, drawing, and playing online games [4, 12, 5]. Digital artifact shearing is getting popular every day among remote grandparents and grandchildren.

The type of artifacts differs with age and time. Artifacts of older adults may include physical photos, video recorded in VCR, handcrafts, cultural and historical

items where artifacts of children may include digital photos, digital videos, toys, handcrafts, things they might have found outdoors or things they have made. As artifacts of different generations are different, sharing these artifacts leads to creating a bridge between the ages [3]. Sometimes, to make the interaction more generation oriented, artifacts are presented in the form the generation is most familiar with. For example, this [6] research project focused on ways to let grandparents know about their older grandchildren's activities. This led them to develop a tool that printed the social media activity of the grandchildren to the grandparents, an example of making digital information to the physical artifact for better engagement.

Physical devices or tools developed can also be considered as artifacts. For example, Storybox [3] is a physical device developed only for sharing photos and audios among grandchildren and grandparents. This device itself works as an artifact in this context. As this device is dedicated to connecting 2 groups, grandparents reported that Storybox reminded them of their grandchildren.

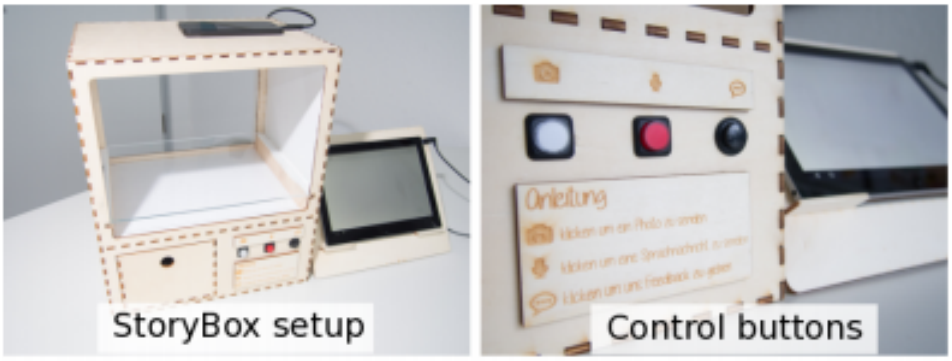

Figure 2.6: Storybox Artifact [3].

2.3.5 Time Duration

Time is a complicated ingredient in making online activity. The requirement for time is different among different generations and different ages. Some grandparents express the need for longer communication duration where some grandparents want the interaction to be time-restricted. On the other hand, grandchildren of different

ages show the difference in their time needs with their grandparents. For example, it is difficult for children younger than seven years to be attentive in communication for an extended period [40]. Many grandparents also complain that particularly boys donât like to take part in any long-distance conversations [8]. Moreover, focusing on the need of one group might neglect the need of the other.

Some points can be followed for the allocation of time for online activity. As different activity takes different time, time allocation can be determined by the activity type. Next, both groups should be flexible enough for proper time allocation, and they should be open to the needs of the other side. Both groups can have alternative options for activity according to their preference. For young children, their parents/caregivers can help to decide the duration of activity and allocating that time in the daily routine of the children. The focus of time should be quality over quantity.

2.3.6 Creativity

Creativity brings new kinds of interactions in the activity. Earlier research shows when grandparents are creative during activity, for example, making up stories as they talk or changing the storyline of a storybook as they read together, makes the activity more engaging [19]. This may also make the grandchildren look forward to their next session together. Grandparents and grandchildren can show their creativity in many ways. For example, during a study, a grandparent was able to make a close bond with their grandchild by making them a blanket, which was related to the grandchild's interests. They used to talk about the blanket for a long time [19]. Open-ended play can bring creativity form the grandchildrenâs end as well. This [3] project identified how children engage in creative activities when given independence to share freely with their grandparents. Bringing diversity in activity can also invoke creativity. For example, in Family Storytelling [4], the system supported online storytelling and photo sharing sessions. On top of that, the system also had options for drawing

during the activity. Having these diverse functions in the activity interface gave both sides access to be more creative during the interaction. They engaged in drawing over the storybook and photos during the activity session. This made the activities funnier and more engaging (Figure 2.7).

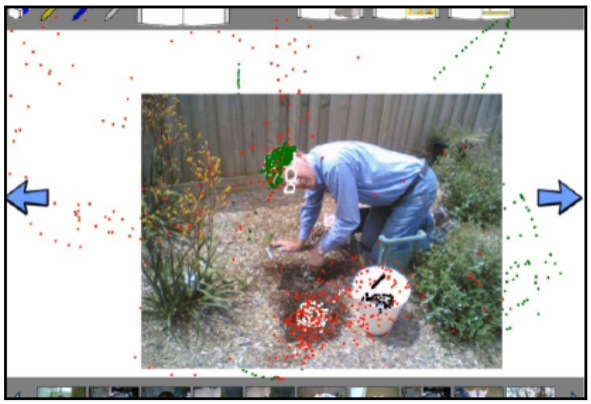

Figure 2.7: Example of Creative Drawing Over Photo [4].

Creativity can also bring collaboration and competition during the activity. Prior research represents that competition can bring social interaction and proven to be useful to bring remote family members together [33]. Solving puzzle games or drawing together. They can also participate in board games competing against each other, as competition can cause engagement in the interaction between grandparents and children [Designing intergenerational play].

2.3.7 Interaction Medium

The medium that is used to engage in activity determines the level of satisfaction and engagement to a great extend. Medium is needed for communication and expression emotions, and without medium, misunderstandings might happen during interaction [31]. Popular mediums on the interaction between remote family members are email, phone, and video communication. Overall, video communication systems are prevalent and the most effective medium, according to most of the researchers, especially for young children [19, 8]. But with age, the choice of medium might differ.

Instead of direct interaction mediums like video and phone communications, users might like something more indirect like text or audio messages, which requires less time commitment. Whichever medium is being used, it should be able to satisfy both groups during the interaction.

As we mentioned earlier, children prefer video communication over other communication mediums. Phone communication does not work for young grandchildren, maybe because they canât see the person on the other side [19, 8, 18]. Evjemo et al. [18] also showed that communication over the phone is not rich and is insufficient for sharing information about everyday activities for both grandparents and grandchildren. During a study, Forghani et al. [19] found that 85 percent of their study participants preferred to use video-based communication mediums. According to them, the grandparents preferred that medium because

> "Grandparents could see their grandchildren, their growth and looks, etc. and share the viewing of objects such as books and toys."

For online activity, a different medium may be needed, and video communication can be integrated with that to give children a perspective about the people on the other side. Video communication also supports open-ended play [7], storytelling [1], and show and tell. Children also like to show the new skills they have acquired or new sports they have learned. But successful online activity requires good quality video and audio connection to give both sides proper satisfaction.

Placement of the interaction medium in a suitable place around the house is also essential. Properly placed media ensures privacy, which is a big concern among parents [41, 42, 43, 2]. When the system or medium is put in a permanent place with always-on audio or video communication, the system is referred to as media space [44, 45]. Media spaces can be of different types. The main specialty is having always-on video, always-on audio, or both. Media spaces contribute to making the engagement focused. This may also facilitate intersession transfer and diversity as media space

needs a dedicated place for the activity.

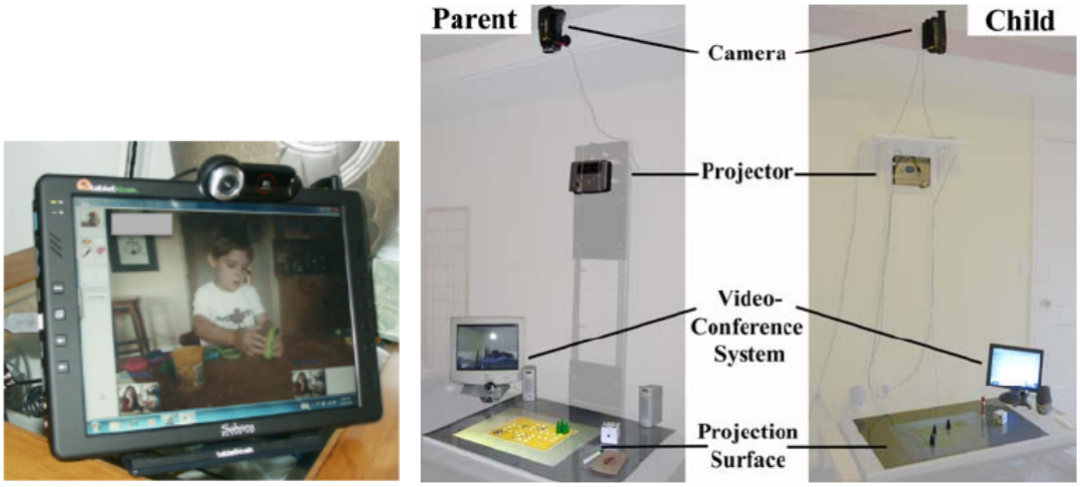

Figure 2.8: Example of Different Media Spaces.Family Portal (top) [?] and ShareTable (bottom) [11]

As children are always on the move, flexibility can also be a part of the interaction medium depending on grandchildren's age. Children often want to share photos or videos of their outdoor activities and things around their homes, both in real-time (synchronously) and asynchronously. If the activity is synchronous, it might cause privacy violations. So, parents should be in control of the flexibility of the medium, controlling when children are staring sharing. If the activity is asynchronous, the contents should go through parents first before getting shared. Also, earlier literature suggests the use of mediums combined with asynchronous and synchronous systems to support both sides adequately. Moreover, parents can be an input provider in the system. As parent knows about childrenâs activity, routine, and habits, they can inform the grandparents though the medium. This input system can be synchronous or asynchronous.

With age, the requirements of placement, flexibility, and video communication might change, and grandchildren might end up using smart mobile devices and still conduct successful online activities. For example, this [23] project focused on cre-

Figure 2.9: Example of Asynchronous Interaction Medium[3].

ating online interaction for remote grandparent and adolescent grandchildren, where they engaged both sides with an online show and tell game. Through asynchronous interaction, both sides took part in the game, grandparents with a physical gaming board where grandchildren used online messaging application WhatsApp [46] (Figure 2.8). After the study, both sides were satisfied with their interaction and knowledge of each other's life learned through the game.

2.3.8 Third-Party Involvement

Third-party presence during intergenerational activity can have both a positive or negative effect on the activity. Grandparents and grandchildren have problems maintaining their relationships independently. Therefore, parents often are the âdriving forceâ for fostering communication and building grandparent-grandchild relationship [18]. Third-party presence can be of two kinds. Parents or caretakers and artificial agents.

As mentioned earlier in the awareness section, parentsâ direct involvement can play a very crucial role in making children more aware of their grandparents. During the interaction between remote grandparents and grandchildren, parents work as a planner, triggering, and supporting the activity [31]. Earlier research shows that

childrenâs communication with their remote grandparents depends on their parentâs conversation with their grandparents[19]. Parents want their children to be engaged in activities with their grandparents as they (parents) used to with their grandparents. So, parents can scaffold online activity by motivating the children and showing the importance of the interaction. They can also help children schedule activity and help them get comfortable with it. As children love to imitate others, parents can engage in online activities themselves to motivate the children.

Parentâs involvement during remote online activity is also important. In the Magic Box [10, 47] project, parents were both indirect and direct influence of the activity. In that project, a âmagic fairyâ used to bring boxes from grandparents to the grandchildren. The parents used to tell the story of how magic fairies bring the magic box from the grandparentâs house. They also used to help children decide which items they should share with their grandparents. During many other projects, parents shared the notion that wants to know what kind of contents the children are sharing with the grandparents. Parents can support communication by handling and observing it.

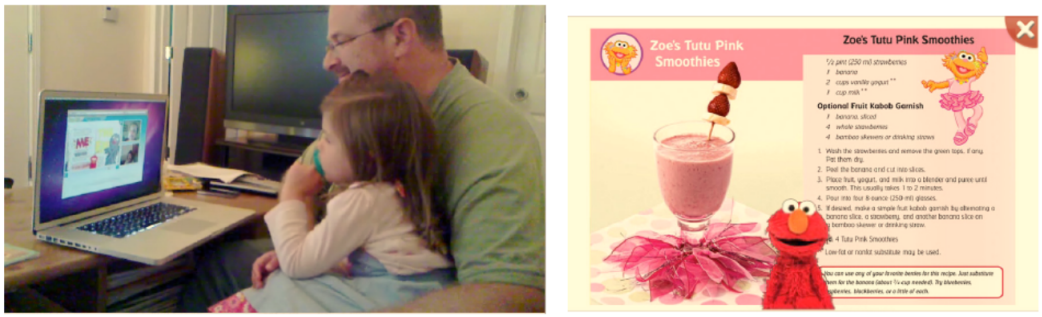

Figure 2.10: Third-party involvement examples: Parental supported activity () and Interactive agent supported activity () [12].

On the other hand, the presence of parents may cause a negative impact depending on the childrenâs age. As children grow up, they create a special bond with their grandparents, and sometimes they share things that they donât even share with their parents [23]. In this case, direct and indirect involvement of their parents during the

interaction might cause privacy issues. The association should respect the privacy of both sides and provide the parent's necessary information only.

Earlier research also shows the influence of artificial agents can lead to an effective remote online interaction. During family story and play, researchers analyzed the impact of Elmo, a character of the children's TV show, as an agent during remote book reading activity between grandparents and grandchildren [4, 12]. Research shows that Elmoâs influence made the interaction more engaging and diverse for children. But the weight of an outside agent may affect the presence of the grandparent during the interaction[4, 12]. Some grandparents expressed their concern about Elmo that children are more interested in Elmo than the grandparents during the activity, and they need more control over Elmo, which brings the possibility of a telepresence agent or robot.

2.4 Conclusion

This chapter was focused on identifying the ingredients required for online interactions by remote grandparents, and grandchildren. For literature analyzing, the âQualitative Analysis Techniques for the Review of the Literatureâ [**?**] method was followed. After analyzing, segmenting, labeling, and clustering, several themes emerged from every literature. The most common themes defined the ingredients which are awareness, scheduling, time, artifact, creativity, usability, influence, and medium. These are required for online interaction between remote grandparents and grandchildren. In the next chapter, we will cross-identify the ingredients with existing online activities between remote grandparents and grandchildren.

CHAPTER 3: INVESTIGATING SYSTEMS OF ONLINE ACTIVITIES

This section focuses on understanding existing online activities dedicated toward remote grandparents and grandchildren. This section is different form the previous section as in the previous section, the focus was to identify the requirements and needs of the remote grandparents, parents and children for online interaction. But this section, i want to understand how existing system supporting the ingredients identified in the earlier section, how different activity supports different ingredient and what are the lacking of these systems.

3.1 Methodology

The works of this section can be divided into two parts. Investigating existing online activities (between remote grandparents and grandchildren) and Discussing ingredients application. For the investigation of online activities between remote grandparents and grandchildren, first, I needed to identify which online activities I need to investigate form the vast literature of online activities. The criteria for an investigation should be related to my research. The literature identification criteria are: The online activities should be focused around remote grandparents and grandchildren The technology of online activities should be similar to current technology. The online activities should be designed and developed around a specific age group of grandparents and grandchildren. The research paper of the online activities should include user studies assessing the online activity and its design These criteria were set up focusing on the theme of this thesis. focusing on these criteria, fifteen (15) online activities were selected. After selection, these works of literature on online activities go to the investigation process.

The investigation is done using the âQualitative Analysis Techniques for the Review of the Literatureâ [**?**] method. More specifically, the constant comparative analysis of documents, which focuses on how the reviewer should analyze the document, segment it into chunks, label those segments and cluster them according to similarity and find the theme.

The first portion of the investigation is identifying the activities and classifying them. This is important because the use of different ingredients may differ from activities. After identification and classification, three groups of activity were found, Storytelling activity, Experience sharing activity, and Play activity. Table 3.1 shows activities with their dedicated activity group. Section 2.2 explains all the activity categories with examples from the selected online activities.

After understanding the activities, I focus on understanding the ingredients used in those online activities. To identify and understand the use of ingredients, some specific chapters of each literature were investigated with special consideration. These chapters were system design, design rationale, study, findings, and discussion. System design and design rationale gave an understanding of how the system included and supported ingredients for online activity, user study showed how participants used to the ingredients or include their ingredient, study results show how participants reacted to certain ingredients and discussion shows the failure of including ingredients. Section 2.3 explains the ingredients used in seven (7) such online activities among fifteen(15) selected online activities.

The last part is understanding the relationships of the ingredients concerning the activities. This part focuses on identifying the most used ingredient, most uncommon ingredients, and essential ingredients by reflecting on the online activities that were investigated. Section 2.4 mainly explains this part.

3.2 Understanding Online Activities For Remote Grandparents And Grandchildren

All online activities can be divided into three major groups. Storytelling activity, Experience sharing activity, and Play activity. This categorization was done by the most common online activities found in the literature of the past 12 years. Each category is also divided into several subcategories. A detailed categorization with sub-categorization is given below.

According to a study of [48], the most common leisure-cultural activity between grandparents and grandchildren is explaining things. Grandparents are often homework assistants, career-advisors, or general supports for educational issues [49].

Storytelling:

One of the most diverse and popular intergenerational activities is storytelling. Most of the intergenerational activities either directly or indirectly connected to storytelling. Storytelling activity can be divided into four segments.

Story Book reading: it is the most common and popular form of storytelling. Storybook reading is the most common activity among young children's lives [50]. Many earlier works of research focused on this form of storytelling extensively. Both physical storybooks, as well as eBooks, were part of many storytelling activities [4, ?].

In the Family Story Play project [1], researchers focused on physical book reading with the help of an interactive device. Grandparents could read storybooks to grandchildren with support from parents and help of video communication of the device included in the Family Story Play system. Another similar system is StoryVisit [12] from the same research group, where they focused on online storybook reading activity. The scenario was similar to Family Story Play. In both cases, an interactive agent (Elmo) was introduced to create diversification in the interaction and catch the children's attention for a longer amount of time. Another similar system is the Family Storytelling system [4] which also focused on ebook reading between remote grand-

Table 3.1: Categorizing Online Activities between Remote Grandparents and Grandchildren with respect to Activity Type

Activity Category	Research Project on Online Activities
Storytelling	Hello! is grandma there? lets read StoryVisit: Family Video Chat and Connected E-Books Family story play: reading with young children (and elmo) over a distance Family Storytelling for Grandparents and Grandchildren living apart InTouch Tactile Tales: Haptic Feedback and Long-Distance Storytelling Supporting pretend and narrative play over videochat
Experience Sharing	FamilySong: A Design for Managing Synchronous Intergenerational Remote Music Sharing Family Storytelling for Grandparents and Grandchildren living apart Peek-a-drawer: communication by furniture Pokaboo: a networked toy for distance communication and play Hi Grandpa!: A communication Tool Connecting Grandparents and Grandchildren Living Apart Supporting Communication between Grandparents and Grandchildren through Tangible Storytelling Systems
Play	Video play: playful interactions in video conferencing for long-distance families with young children Virtual box: supporting mediated family intimacy through virtual and physical play Curball–A Prototype Tangible Game for Intergenerational Play Distributed hide-and-seek

parents and grandchildren. This system integrated a drawing tool over the storybook reading activity to diversify the interaction (Figure 3.1).

Cultural and Historical stories: Storytelling sessions can sometimes revolve around the storyteller's location, society, culture, and history. Through storytelling, one can easily inform others about their culture and history. This kind of storytelling is very popular among grandparents and grandchildren as the grandparents do not want the children to lose track of their root society, culture, and history. A significant number of prior research work also identified that, during intergenerational activities, grand-

Figure 3.1: Examples of Ebook [12] and Physical [1] Storybook Reading .

parents like to inform their grandchildren about their culture and history through storytelling [2, 19]. Parents also want the children to know more about the culture and history through grandparents. This kind of storytelling is focused on sharing local or folk stories as well as sharing music, photos, and artifacts related to one's culture, history, and society.

Real-life stories: Older adults always have plenty of stories to tell. Colocated grandchildren are always interested in real-life stories of their parents and grandparents. Things can be similar for remote grandchildren when they have a good awareness of their grandparent's lives and activities. Because grandparents love to tell stories to form their lives. Sometimes, they show photos of the parents and toys to tell stories and make them more relevant. This kind of activity makes the children engaged and interested in future sessions [19].

Creative stories: Several works of research has shown examples of open-ended creative storytelling to be very intriguing as an online activity [4, 1]. But this kind of storytelling needs creativity from grandparents as well as grandchildren with supporting interaction medium. Sometimes grandparents make up stories where sometimes the grandchildren are a significant character. Also, sometimes both collaborate to make up the story on the go. One of the earlier projects shows grandparent drawing over the online storybooks just to make the stories more exciting and engaging

towards children [family storytelling].

Experience Sharing:

These kinds of activities emerge from grandparents' eagerness to know more about the life of their grandchildren and the grandchildrenâs interest in sharing their activities. As the collocated grandparetns and grandchildren commonly engage in activities related to explaining things [48], things should be similar for remote grandparents and grandchildren given proper oppurtuity. . Experience in this thesis is similar to Kennedyâs category of âtalking together about recent events in each otherâs livesâ [20].

Experiencing music: From early childhood, children are exposed to rhymes and poems by their caregivers. Ofter grandparents and grandchildren create special bonding through these rhymes. When separated, these rhymes can help them come closer and engage in interaction [2]. Musical experience sharing can be termed as co-listening. The CoListen project [51, 52], coined the term co-listening and used it to designate only temporally synchronous listening. This project focuses on children, who listen to musing together with their friends feel much more connected to a special social bond.

In the FamilySong project [2], remote grandparents and grandchildren took part in a shared music listening activity, what they used to do when they were living together. This musical experience sharing system focuses on context creating through unforced interaction. In this project, children listened to rhymes and music with their remote grandparents, which let to creating context and reason to talk to each other. Through studies, they have found that co-listening activity creates an opportunity to get engaged and learn.

Sharing Photo and videos: Photos and video are artifacts or mediums that hold on memories. Before, photos and videos used to be very tactile and physical. Those used be difficult to share. Nowadays, photos and videos are digital and easy to share.

Earlier works of research have proven that sharing photos and videos among family members creates engagement and context for future communication [19, 23] [family storytelling].

In the Family Storytelling project [4] remote grandparents and grandchildren used to love sharing photos and talking about them. They also drew over the photos which added diversity to the interaction. For older grandchildren, who have a hard time to keep connected with their grandparents [23], found sharing photos and photos of their activity on social media helpful in keeping connected. Moreover, sharing photos of everyday objects, artifacts, toys, crafts, paintings, and letters is another good way of keeping grandparents informed of grandchildren's life. Storybox [3] is another device that lets both sides easily engage in life sharing activities like this. Pokaboo [53] and Peek-a-drawer [54] showed sharing photos through playful and enactive interaction. Pokaboo combines physically linked buttons with photo and audio communication. A child will press a button down to take their picture, and their self-portrait will pop up on their partner's device. Added tangible button for photo sharing gave children better accessibility, independence of interaction and creative photo-taking without third party involvement.

Sharing items: Showing personal objects to each other is also a form of sharing life. It is a form of Show and Tell. For example, children showing their favorite toys, arts, and crafts with their grandparents and talking about them. Also, grandparents showing old photos of themselves and parents, sharing valuable historical or cultural items with grandchildren is a form of experiencing each otherâs life. Grandparents sometimes make crafts, especially for their grandchildren [19] . These items are considered valuable gifts, creates memories, and strengthens family ties.

The project Magic Box [10, 47] showed that given proper support, sharing items between remote grandparents and grandchildren is an engaging form of intergenerational play. Magic box supported sharing artifacts between distant grandparents and

Figure 3.2: Examples of the artifacts shared by grandparents and grandchildren during the study [3].

grandchildren. Children used the Magic Box to share all kinds of items like physical photos, cooking ingredients, and toys.

Play:

Co-located grandparents and grandchildren engage with different kinds of indoor and outdoor plays. Inspired by those, researchers combined physical objects and interactive systems to develop online games as intergeneration activities. Some of these games are Distributed Hide-and-Seek [21], Curball [13], Virtual Box [55], and Video Play [7].

The game âDistributed Hide and Seekâ [21] is based on the traditional game of hide-and-seek and focuses on re-connecting intergenerational relatives from a remote location. The system, with the help of Bluetooth beacons spread around the homes of the grandparent and grandchild, makes each other hide and find virtual objects inside home. " Virtual Box" is also similar to âDistributed Hide and Seekâ where children have to find the virtual box and inside the box, there are messages from the grandparents.âCurballâ [13], similar to the bowling game, focuses on collaborative interaction between an older adult and a child. it is a combination of the real-world and virtual world. The grandparent controls the tangible ball and its movement in real-word and plays with the younger generation to successfully move the object to its goal without touching objects in the virtual world. These objects in the virtual world are controlled by the grandchild.

Video play [7] proposes three games, Find itâ, âFarmerâs Animalâ, and âPeek-a-boo Portalsâ, that can be integrated with video communication. In the âFind itâ game, the objective is to find an object that has a property and show it to the other user. The players can see each other in the interface, and when a player presses a ânewâ button on the interface, the âfind somethingâ placeholder specifies the quality of the object to find. Farmerâs Animal is a game of digital dress-up where players wear digital masks of different animals. Face tracking software aligns the mask of an animal to the player's face so that the players can pretend to be the animals together. Playing Peek-a-boo Portals, a player can instantly appear in an unexpected region of the screen, or they can uncover a silly or surprising face or object. A controller is used to control the hiding and finding in the digital space.

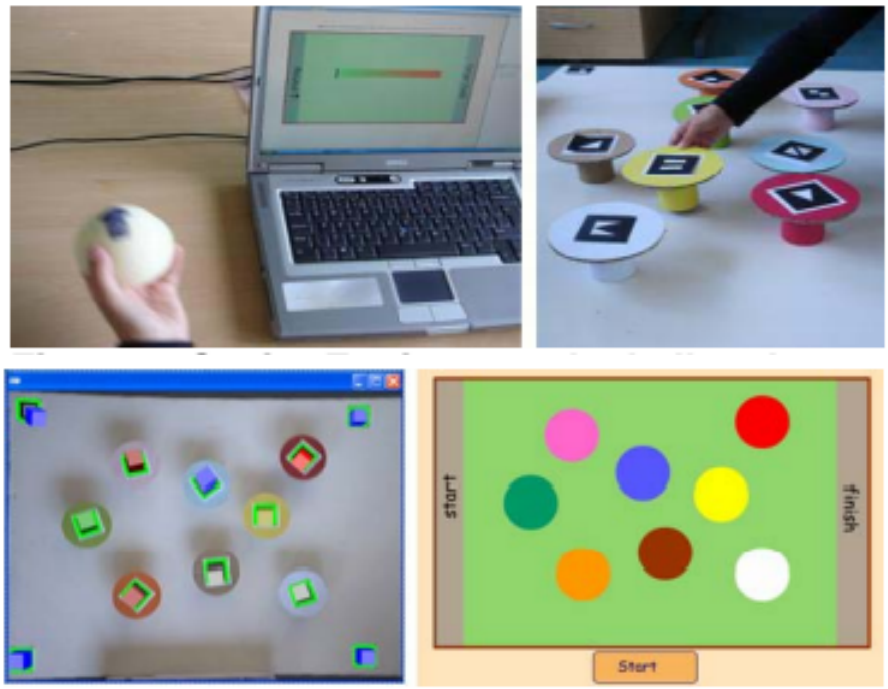

Figure 3.3: Curball physical and virtual setup [13].

3.3 Investigation Online Activities Between Remote Grandparents and Grandchildren

In this part, I am going to investigate in detail the several online activities and describe how these activities are utilizing most of the ingredients which I have identifies in earlier section.

3.3.1 Family story play: reading with young children (and Elmo) over a distance [1]

Family story play describes a system where family members can get engaged through storybook reading, with the influence of Elmo, an online interactive agent. In this system, grandparents and grandchildren (with the help of parents) read books together and can see each other through a video call as well. The system consists of a physical book and two screens, one to show the grandparents and the other one for Elmo.

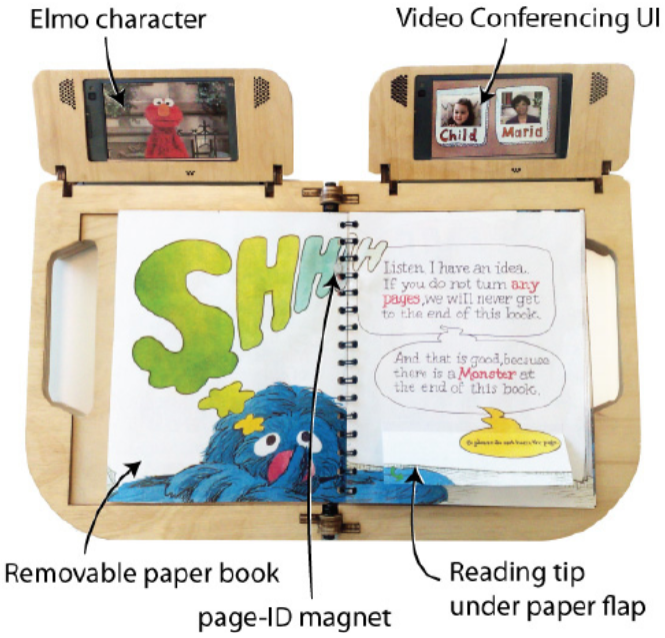

Figure 3.4: Family Story Play System [1].

Awareness:The system is not designed to make users aware of each otherâs activities. In other words, users won't have any knowledge of other userâs status through the system but, as both users can communicate through the system, they can ask each other about themselves during activity.

Scheduling:The system does not support scheduling any activity. Activities can start whenever both users want to start the activity. This system might fail if it is used as a regular activity between grandparents and grandchildren in different time zones.

Accessibility and Usability:No extra features were added to make the system more accessible to both groups, For grandchildren, parents supported their reading and communication process, and for grandparents, they needed to connect with their grandchildren using Skype.

Artifact:The physical book worked as an artifact in this system. This also affords intersession transfer, which is an essential element for future interaction.

Time:The grandparents and parents report that both sides enjoyed the activity of the system, and they had a prolonged activity of shared book reading. This is the case where both sides engage in long term activity by their own will

Creativity:Creativity is an ingredient which majorly depends on the user than the system. In this case, one of the grandparents showed creativity by making the book reading to a theoretical performance. According to the grandparent, being theatrical helped them hold the attention of the child. They tried to imitate the performances that kids see on TV. This kind of creativity makes the activity more engaging.

Interaction Medium:The primary interaction medium is video communication. Video communication makes the system effective by showing the other side of the interaction, who is reading the book.

Third Party Involvement: Parents and Elmo both belong to this category in this system. Parents are supporting the activity by assisting them using the system,

modeling their behavior toward their grandparents, positioning them in a way that the grandparents can see them, and helping them with book reading as well. On the other hand, Elmo is making the activity more exciting and engaging for children. Elmo is collaborating with the grandparents in storytelling and showing his thoughts (through thought bubbles) and reactions. But in cases, children are more interested in Elmo than the grandparents, which is disrupting the activity between grandparents and grandchildren.

Figure 3.5: Family Story Play scenario [1].

3.3.2 FamilySong: A Design for Managing Synchronous Intergenerational Remote Music Sharing [2]

This research talks about a musical experience sharing system which focuses on context creating through unforced activity. Through studies they have found that co-listening activity creates opportunity to get engaged and learn.

Awareness: This system had a âFaces UIâ that shows the status of family members. So, the system showed if a member of the family is awake or asleep. During their study, the researcher found that children used to love the âFaces UIâ system. They wanted to change their status from sleep to awake right after getting up form bed.

Figure 3.6: FamilySong prototype [2].

They also used to check if their grandparents are aware or not. They also checked-in between games to see if grandparents are there and what music they are listening. Many times that lead to communication between families.

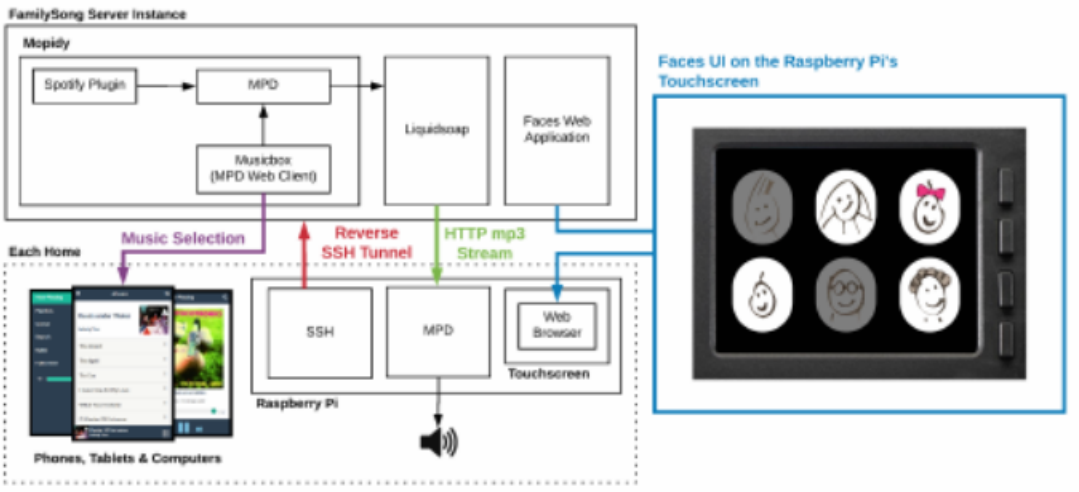

Figure 3.7: FamilySong System Architecture [2].

Scheduling: Although the system didnât have direct schedule, it afforded indirect plan through its awareness system. As both sides know about each otherâs status (âFaces UIâ) and presence (âMusic listeningâ) near the system, they understand that the other side might be available for communication. For some families, the grandparents used to test the parents to know if their grandchildren will talk. Although

this kind of unstructured scheduling would not work for other systems, this system was built explicitly for this.

Accessibility: The FamilySong system gives control to individuals, even children, over the activity. The children understand the meaning of the faces in the UI means. They are also not forced to engage in the activity, which also gives them a choice wheather they want to communicate or just enjoy the music. But their music selection systems are not well described in the literature, so that might not be accessible to children.

Artifact: This system depends on non-physical artifacts like music, rhymes, and songs. These kinds of artifacts are great ways of creating memories.

Time: The activity with this system is not restricted by time. As this is an unforced activity, children can engage during their play without any intrusion.

Interaction Medium: This system can be thought of as a media space, as this system has its specific placement and creates influence on the architectural space. Also, this system does not require any video calling or photo-sharing medium. As the interaction is passive and only audio-based, it does not require a high-quality video camera or internet connection.

Although this system affords synchronous and asynchronous interaction both, it majorly focusses on shared syncronoys music listening activity. As children can communicate while listening to music, they can also send messages regarding the music or just enjoy the music and talk afterward whenever they wish.

Although the âFaces UIâ gives control to individuals, even children, to control the activity by sharing their status, it also depends on the placement of the system. During the study of FamilySong, researchers saw that one family placed the âFaces UIâ is a high place where children cannot reach. This made the system inaccessible to children, and the system lost its motive.

Third-Party Involvement: The parents are the only third party involved in this

system. Although the activity stating does not need any support, when the activity leads to interaction and communication, it requires support from parents or caregivers. Also, choosing to muse in the playlist requires caregivers' support.

3.3.3 Supporting Communication between Grandparents and Grandchildren through Tangible Storytelling Systems [3]

This paper is about the development of âStoryBox,â a tangible device that allows sharing photos, tangible artifacts, and audio recordings of everyday life. This paper also describes studies that they have conducted to identify design issues and to understand real-world use and examine inter-generational connectedness. The system focuses on accessibility, simplicity, and steps taken to bridge the technological gap between grandparents and grandchildren

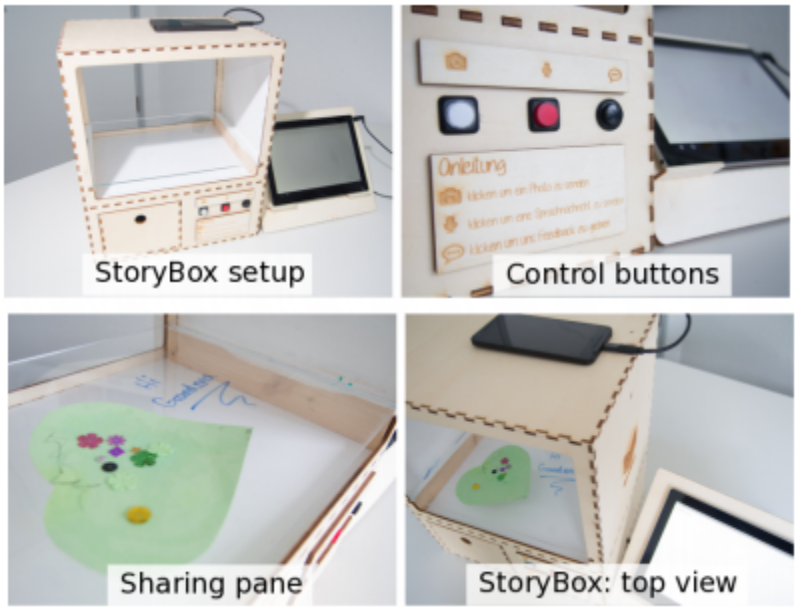

Figure 3.8: Storybox design [3].

Usability: The system is built focusing accessibility and usability. During their design study, they got good feedback from both generations about the system is easy to use, learn, and understand. The device âStoryboxâ is a tangible device with physical buttons to take photos, share photos, and share audio recordings. The tactile

nature of the device made it easier for both generations to interact with each other as well as the device. For that, many participants expressed that they are using this device more frequently to receive and share things where earlier they only used to accept messages and were afraid of sharing because of the usability issues.

The system also affords to send handwritten information. Both the grandparents and grandchildren liked that part as it is the tangible and old-fashion method of sharing intimacy. The system and device also support independence in interaction, i.e., the children can independently interact with their grandparents without parental scaffolding.

Artifact: âStoryboxâ is very rich in creating and sharing artifacts. The âStoryboxâ itself can be considered as an artifact as this device is solely made for the interaction and activity between grandparents and grandchildren. As the device only has one purpose, it reminds users to that specific purpose. According to one participant, "It reminded us to send something when we saw the box in our living room."

This system affords to share 2D and 3D, physical and digital as well as audible artifacts. Grandchildren can share photos of things, like clay sculptures they made at school, toys they have, items in their home, pictures and handwritten letters to their grandparents, and vice versa. They can also send audio messages to their grandparents. These kinds of artifacts help create memories and context for communication. For example, many grandparents expressed that their grandchildren are calling them more than often after using the system. Although there were some hiccups here and there, overall, both parties were pleased with the usability of the system.

Creativity: The system, which is very rich with artifacts, generally supports creativity a lot more than other methods. This system had a lot more options to be creative form both sides. Grandchildren used to share photos of their hands, toys, clay sculptures, and things they find around in their home. According to the authors, âThis highlights the need to help children express themselves naturally and

Figure 3.9: Examples of the artifacts shared by grandparents and grandchildren during the study [3].

creatively.â

As this system affords to share childrenâs daily artifacts by children as they wish without parental support, the system helps open-ended play [**?**] from the childrenâs end and open engagement with their grandparents. This device also showed creativity from the grandparent's side, where the study showed that one grandparent was teaching their granddaughter how to write, which was not intended to form the system but is an example in which the system can be used creatively.

Interaction Medium: The interaction medium in this system is mainly audio-based. In earlier prototypes of this system, they didnât have any interaction medium other than sharing things. But they updated their design after design study where participants shared the need for interaction systems like audio or video. Moreover, this system focuses on asynchronous interaction, which reduces the need for video communication. But during the study, they found that some of the participants are looking for a synchronous system where they can get a real-time notification and can share real-time. This system does not afford any video communication. But this system works as a media space which is dedicated only for communication between grandparents and grandchildren. Which creates focus on interaction and removes distraction. This system also is relatively flexible but depends on interaction connection for sharing. The table below shows that this device is vibrant with ingredients like artifact and interaction medium.

Artifact (22)	**Everyday Life (30)**	**Special Event (10)**	**Funny/Aesthetics (83)**
• Explanation of usage to a partner • Usage of different materials for cleaning the glass • Test messages to try functionality • Requests to send confirmations	• Experience sharing • Questions about location and activity • Accident sharing • Appointment request • Goodnight wishes • Reminder to communicate • Food • Weather • Homework and stories from school	• Birthday discussion • Visiting friends, vacation • Invitation to do something together • Horse riding	• Playing a remote game • Singing songs • Handmade objects • Playing a song on a trumpet • Hands, heads and faces of kids • Pictures, books, flowers, toys
Message (27)	**Greetings (19)**	**Reminder to Communicate (8)**	**Feedback (3)**
• Pictures of articles/books to read • Audio and picture of a poem	• Messages with names • Greetings to parents over kids • Greeting words and kisses	• Messages to remind about communication	• Suggestions to share crafted emojis

Figure 3.10: Types of content and number of threads (in brackets) shared among families. [3].

Third-Party Involvement: The system supports independent interaction without a caregiver, so it does not require influence form caregivers to connect and share. But parents were also interested in the system as the children so, sometimes they used it together just for fun.

3.3.4 Family Storytelling for Grandparents and Grandchildren living apart [4]

This paper describes the design, implementation, and evaluation of a remote storytelling system for remote grandparents and grandchildren. With this technology probe, this paper studied how a technology probe can help the situation of remote grandparents and grandchildren.

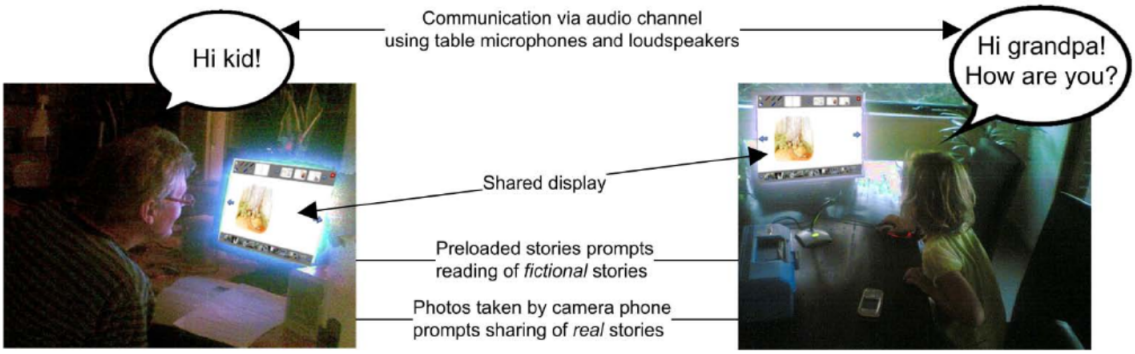

Figure 3.11: The basic design concept for the distributed storytelling system [4].

Awareness: This system support creating awareness by shared photos between groups. This is a good way to let each other know what both sides are doing. This

will also help both sides prepare for activity mentally.

Schedule: There is no scope of scheduling the activity between the groups in this system. One side can initiate the activity, and it is up to the other side to accept or decline the invitation. This unscheduled invitation might surprise one side, and because of rejecting without any message, it might emotionally hurt the other side.

On the other hand, as the system or device didnât have options for scheduling, sometimes the mother engaged in the activity just to ask the grandparents availability and manually setting up a schedule. Although, after several interactions, they automatically had a schedule, it affected the schedules of the grandchildrenâs personal and family life. Because of it, during the activity, the grandchildren used to get distracted because of some household work and made the grandparents feel insecure.

Usability: This system uses standard household desktop settings. As this system is not touch screen dependent and has tactile input components like keyboard and mouse, it might be easier for older adults to use this system. The system also requires users to take photos using a phone and send it to an email address, which might be difficult for both groups, and they might need caregivers' support.

The interface of the system has small icons for pictures and books, which might be difficult for the older generation to interact. Again, the participants need to be familiar with using desktop computers and specifically proficient in using the mouse. Otherwise, the caregiver's support is required in order to conduct the activity.

Artifact: The system uses digital artifacts, like books and photos, for the activity. Both sides can engage in reading books together and telling stories through photo sharing. This kind of artifact sharing engages both sides in a storytelling activity. Also, a right way of learning about each otherâs lives by talking about photos.

Time Duration: The activity was not limited to any specific time duration, which led to a chaotic mess in the daily schedules of both groups. The unstructured activity led the grandchildren to delay their bedtime often, which let them disobey their

Figure 3.12: Interface of Family Storytelling system [4]

.

parents.

There is also the option of drawing or painting for both sides. Although it is not like natural drawing with a pen/pencil, it has the affordance of creating digital drawings as artifacts. There is also an option to draw over the books or photos, which creates new artifacts from existing artifacts and affords intersession transfer.

Creativity: The system encouraged creativity by introducing the affordance of painting on the screen. Children used these functions to paint over the storybooks engaging in open play and creating artifacts. According to the researchers, âA common behavior by the grandchildren was to paint on top of story characters, which amused both parties.â This also engaged both sides in creative storytelling. For example, âgrandchild painted red spots on top of a story character, which prompted the grandmother to say, âOhh, heâs got measles,â which made the child laugh.â

The coloring function was also used with photos. Like the figure below, a grandchild was having fun with grandparents by coloring over the grandparentâs photos. They also used to draw together, play games like tic-tac-toe. The system also afforded one

Figure 3.13: Example of drawing over a photo [4].

grandparent reading to multiple grandchildren, which lead to creative storytelling, collaborative storytelling, and competitive behaviors. A user study showed kids engaged info fights while trying to engage together with the system.

Interaction Medium: An audio channel was used as a direct synchronous interaction medium. This was the method used by the participants to engage in storytelling, photo-sharing, and playing. User study reported both sides getting engaged in the activity with only the audio communication. It also reported that, because of the absence of video, some families felt their bonding increased as previously the grandchild was shy with the grandparent, now they were easily interacting.

The device was fixed, not flexible, similar to media spaces. As it didnât have any video communication medium, the diversification of activity might not be possible through the system. But this medium also supported multiple connections, which was useful to engage multiple grandchildren together, offering open interaction between several family members. It also allowed them to collaborate in storytelling and sharing activity as well as competing among themselves for their turn of reading and sharing.

Third-Party Involvement:The parents involved in the activity as a facilitator, ini-

tiator, and manager. In one family, the mother used to manage the scheduling of both sides for the activity. Also, the parents use to call the children if they didnât hear the incoming request form their grandparents. They also used to help provide context to grandparents during activity as well as motivate the grandchildren for the activity. As the system didnât have a video, the grandparents sometimes didnât understand the situation on the other side, so the parents had to describe it.

3.3.5 The Family Window: The Design And Evaluation Of A Domestic Media Space [5]

Family Window (FW) is an always-on video media space that connected two households over a distance. The FW was deployed within the homes of two families for eight months and four families for five weeks. Results show that always-on video can lead to an increase in feelings of connectedness by providing availability awareness and opportunities for sharing everyday life.

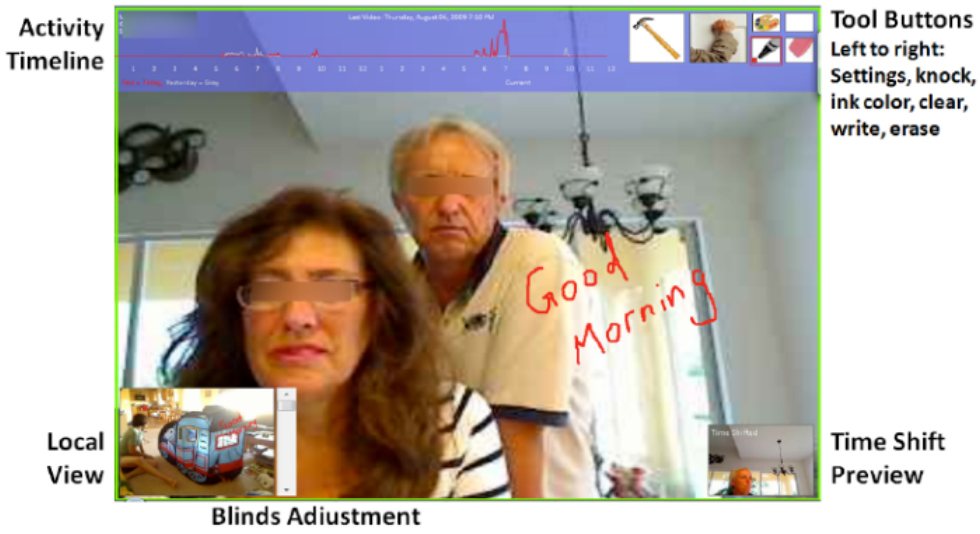

Figure 3.14: Family Window Interface [5].

Awareness: The FW system shared active and passive awareness among the families. With the help of the always-on video system, although sometimes covered by blinds, families in a different location always had the sense what activity is going

around on the other household. In their words,â To foreshadow, the always-on nature becomes important because it creates opportunities for serendipitous awareness information to be transmitted, which may or may not be triggered by motion.â They also had an activity timeline system where uses can report their activities to show what they are doing and when they will be available. But none of the participants used that feature.

As both families were able to see each other every day, they noticed changes in their everyday lives, which initiated the conversation. Like someone with a new haircut, new dress, or someone at home at an unexpected time. According to the authors, this is awareness acquisition, which is a planned interaction for the FW. Participants also reported other ways of being aware of each otherâs lives, life background movement, and lamp on or off in the room. This helped initiate communication much more than usual.

Scheduling: Although the FW didnât provide any direct scheduling system, participants could use the activity timeline to schedule a future meeting. Participants preferred using the drawing on-screen function to send messages to the other side, let them know about their availability or the time they will return home. Also, the FW system proved to be useful for people who were already used to scheduled communication.

Accessibility Usability: The system reduced many accessibility issues of a video communication system by making it always on. As the system is always the steps of starting an application, making a call, receiving a call, disengaging the call, and exiting the application. This system simplified video communication, which was helpful for older generations and younger generations specifically. The writing function of the system was also user friendly. Users could write the message using their fingers or a stylus pen.

Then the location of the device also provides accessibility to the users. When

placed in an accessible location for the children, they should good interaction with their grandparents. Placement is a significant factor in media spaces.

Artifact: The system afforded to create video and digital writing artifacts. By using the âTime Shift Recordingâ function of the system, uses could record only the video of the activities. But these video recordings were automatically deleted after 24 hours. This system allowed one side to get in touch with the other side, always even if they are not present in front of the screen to see the other side. The system also afforded writing messages on the screen. Uses send a lot of messages and quotes to each other with this function. The existence of the written messages depended on the user choice and might help with intersession transfer depending on situations.

Creativity: With the system, users showed creativity with the writing on the screen function, be drawing on it, sending messages, and learning to write alphabets. This is a creative way of one generation teaching another generation and interacting at the same time, showing love and affection.

Interaction Medium: The FW system can be considered as a mobile media space. Although the system is was designed as a media space, its mobile nature contradicts the notion of earlier media spaces [44, 45]. This system afforded video communication without audio, drawing and recording video. The always-on video function was useful for awareness transfer and communication, but it was a great privacy concern. Because of this, the placement of the device was important. The audio system was not in the system for privacy issues, but during the interaction, the users showed interest in having the audio. The system also afforded recording videos. If users feared that they would miss any activity or communication, they could just turn on the recording like they are recording a TV show. This helped them be updated with the other sideâs activities. It was also a good was of asynchronous interaction.

The digital writing medium was also helpful in interaction. Families used it to send messages, schedules, and random notes to each other. These notes where handwritten

using a finger or stylus and carried special meaning to the family members. It was also used as a good way of synchronous and asynchronous communication between families. Children used it to connect with their elderly as well, learning how to write letters from their grandparents and sharing messages. It showed that if the device is placed in a proper accessible location, people from different ages can easily interact.

Third-Party Involvement: As the system is always on, the children donât need any help from the parents to interact, connect, or activate the interaction. Properly placed, the system showed that children could have an excellent interaction with the system and with their remote grandparents. One child was using it frequently to interact with the grandparents and learn to write alphabets. This didnât require any influence from other family members.

3.3.6 Hi Grandpa! A communication Tool Connecting Grandparents and Grandchildren Living Apart [6]

To develop and design a platform that could promote overseas Asian students are sharing their regular activity through social media with their remote grandparents in an intuitive way to increase communication between them. As a final prototype, they have developed a device for the grandchildren to share their social media with their grandparents in a paper version, where the grandparents can comment by writing on it, and it will be shared with the grandchildren.

Awareness: This tool shares social media information with the grandparents to make them more aware of their grandchildren. Overall, the activity is making one generation aware of another generation. With this tool, the researchers are focusing on creating awareness between two generations, which will help create communication.

Usability: The design process of the tool and the device was significantly focused on by the researchers. They decided to you two different devices for two sides as both the parties have different design guidelines and needs. For grandparents, they focused on the mediums older adults are used to, paper. They also decided on using

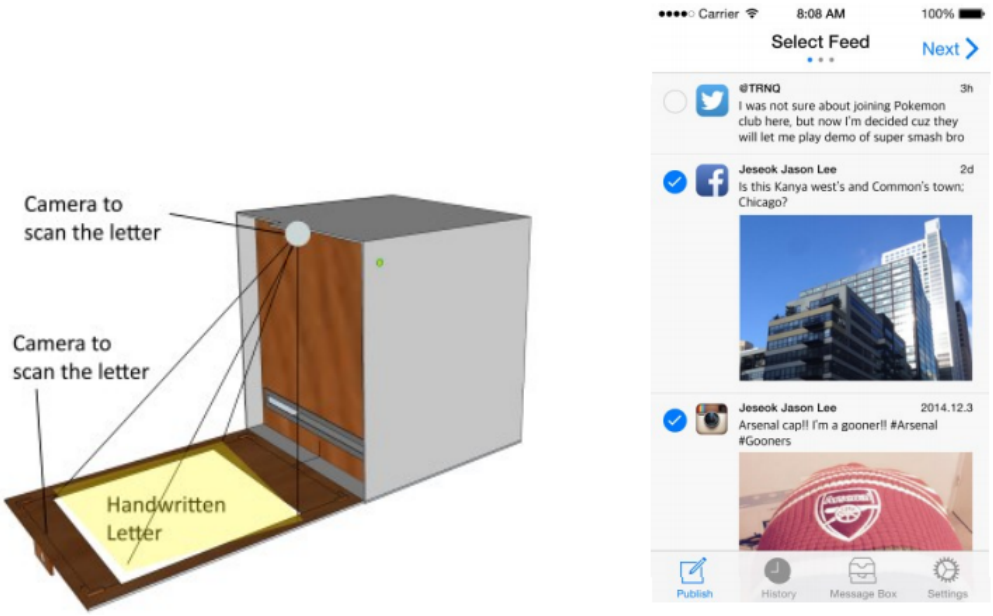

Figure 3.15: Grandparents side interface (left) Grandchildren side interface (right) [6].

handwritten messages as input information from the grandparentâs end with the help of the camera. It can also help with sharing photos, news, and other 2d print media information. In this way, the grandparents donât need to learn new skills to interact with their distant families. For the grandchildren, they made it easy to share the daily activity by letting them share their social network contents. As they already post their daily activity in their social media, sharing that with their grandparents seems like an easy and inactive way of communication.

Time Duration: No sense of time duration and schedule is found in the system. As this life story sharing system is asynchronous, it does not require any scheduling. Moreover, the research is focused on the older grandchildren who are old enough to control their emotions and talk for a reasonable amount of time if they are willing to.

Artifact: At the end of grandparents, this creates a physical paper artifact. As helps create memories for older adults, and it will remind them about their grandchildren. The device also works as a physical artifact.

Creativity: Unfortunately, this system does not offer many options for creative interaction. But as the grandparents can send written messages, they can get creative by drawing on the paper and send the drawings as a message.

Interaction Medium: This tool is using asynchronous interaction by sharing social media activities in a printed version. From the grandchildrenâs end, they are using smartphones to share their daily activities with their grandparents. One the other side, a device is printing that shared social media activities on paper and showing it to the grandparents. They can then write messages on the article, and the camera captures it and shares it with their grandchildren. In this way, the interaction medium works. It is easy and convenient for both sides as none of them has to learn new techniques to use it. Also, as this is a dedicated device for grandparents, it works as a physical reminder of interaction and people on the other side. Furthermore, none of the uses need the caregiverâs assistance use to the system in the standard scenario.

3.3.7 Video play: playful interactions in video conferencing for long-distance families with young children [7]

Video play introduces games for intergenerational families to play with young children during a video communication to create a pace for shared activities. The system is built to support family interactions over a distance by providing several play activities for children and elders to share. This paper shows a series of prototypes and a design framework to scaffold the creating of intergenerational activity.

Video play proposes three games that can be integrated with video communication. These games are âFind itâ, âFarmerâs Animalâ, and âPeek-a-boo Portalsâ. In the âFind itâ game, the objective is to find an object that has a property and show it to the other user. The players can see each other in the interface, and when a player presses a ânewâ button on the interface, the âfind somethingâ placeholder specifies the quality of the object to find. Farmerâs Animal is a game of digital dress-up where players wear digital masks of different animals. Face tracking software aligns

the mask of an animal to the player's face so that the players can pretend to be the animals together. Playing Peek-a-boo Portals, a player can instantly appear in an unexpected region of the screen, or they can uncover a silly or surprising face or object. A controller is used to control the hiding and finding in the digital space.

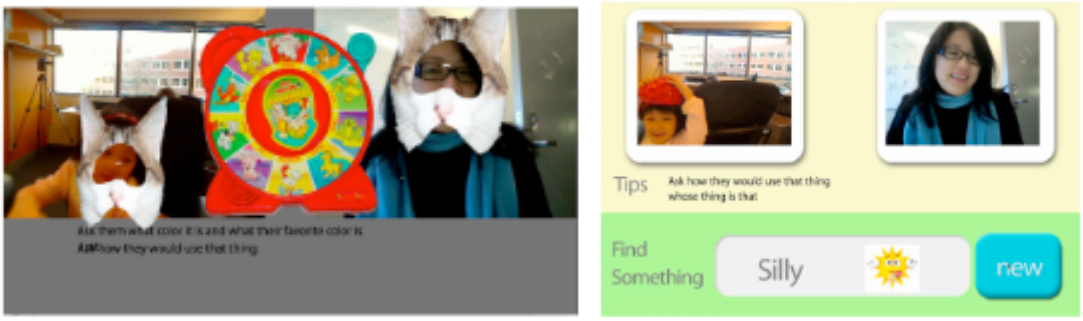

Figure 3.16: Video Play Farmer's Animal Game (left) Find It Game (right)[7].

The video play system does not provide any additional awareness, scheduling, and accessibility features. Usability is similar to any video communication system with added steps for the game. But the Peek-a-boo Portals are different where the users use a controller to control hiding and finding.

Artifact: Although the system does not provide and support any artifact, other then the controller for Peek-a-boo Portals game, the study participant came up with several ideas for artifacts. They expressed interest in ârecord, playback, and organize albums of interactions with their children over the system.â They also wanted to add activities like drawing together. The researchers have expressed interest in including additional features in the future.

Creativity: The system provides plenty of scope for the players to be creative. In the âFind itâ game, the adult player can ask the young player about the object they found and make up names and stories about the object. In the Farmerâs Animal game, adult players can make up silly faces, make stupid sounds and expressions with the animal masks, which will make the interaction engaging and playful.

Interaction Medium: Video communication is the primary interaction medium of

the system, providing the players to see each other and engage in the activity. For Farmerâs animal and Peek-a-boo Portals, players sit in front of the screen and interact, but for âFind itâ game, players move around to find objects, which sometimes takes them out of sight. With a modern smartphone system, this problem can be reduced.

Third-Party Involvement: The system requires the involvement of parents or caretaker to start the activity. Also, parents scaffolding might be needed to keep children engaged in the game.

3.4 Investigation Findings: A Discussion on Ingredients

In the prior section, several existing online activities between remote grandparents and grandchildren were investigated to identify the ingredients and see the application of the ingredients. After the investigation, some general conclusions can be made about the ingredients. This section is going to be about the understanding of the ingredients concluded form the investigation of existing online activities between remote grandparents and grandchildren.

Stakeholders and Ingredients relationship: The major stakeholders during online activities are grandparents and grandchildren. Parents can be considered one of the main stakeholders of the activity as well. These stakeholders have a very close relationship with the ingredients of online activities. For example, upon investigation, it was found that four of the eight ingredients (awareness, scheduling, time, and 3rd person influence) are directly controlled by the parents. Where only two ingredients (artifact and creativity) are controlled by the grandparents and grandchildren.

Most of the literature on online activities directly or indirectly assumed and mentioned parents controlling the ingredients. During the activity, parents work on creating awareness, scheduling activity. managing time and supporting interaction. In a few cases, where the system supported these ingredients (if needed), researchers expressed that children are more engaged and interested in the activity. More specifically, the Family Song[2] is the only project which had a dedicated system for aware-

ness sharing called face UI. Researchers of FamilySong expressed that children were self-motivated towards sharing their status and learning other's status. On the other hand, Storybox [3] and Family Storytelling [4] supported awareness sharing through asynchronous photo sharing. Investigation reveals that these kinds of systems are engaging for both grandparents and grandchildren to share and experience their like in an unstructured and unmonitored manner. And for asynchronous interaction medium, scheduling, and specific time duration for activity is not required, which gives both groups the flexibility to passively engage in the activity. The real-time always-on video system of Family Window [5] was also proven effective to share awareness only by the system.

Activity and Ingredients relationship: The online activity type also controls the ingredient's usage. For example, different types of interaction mediums were applied by the researchers for storybook reading activity and photosharing activity. For example, Family Story Play [1], StoryVisit [12], and Family Storytelling [4] focused on online storybook reading activity and all three of them preferred synchronous real-time interaction systems like video and phone calls. For these kinds of activity, awareness and scheduling are controlled by parents, artifacts and usability are controlled by the system, time and medium are controlled by the activity and creativity are controlled by grandparents and grandchildren. On the other hand, Storybox [3] supported photo-sharing activity and had an asynchronous audio system for communication. For them, awareness was supported by the activity, scheduling, time restriction, and influence were not needed, grandparents and grandchildren controlled artifacts and creativity. Family Storytelling, for photosharing scenario, shared similar characteristics like Storybox. But supporting the comment of Forghani et al. [19], in both cases, participants asked for a synchronous system of communication.

Most used ingredients: After investigating fifteen (15) works of literature on online activity, the most used ingredients could be identified. There are three ingredients

that were most used and most common for all the activities. They are Artifact, Interaction Medium, and Usability.

3.5 Conclusion

In this chapter, I investigated earlier works on successful online activities between remote grandparents and grandchildren, classified the activities, and analyzed selected successful online activities. Those online activities were selected on the basis of user study, which showed to what extent the activity and ingredients were successful. The focus of this investigation was to cross-examine the ingredients identified in the second chapter and understand how the ingredients were used in successful online activities. Upon investigation, we can insist that all the activities that were analyses have used some if not all of the ingredients. The ingredients were used in different quantity and quality, which created a balance in those activities and made them successful. It should be noted that not all the systems for online activity that were analyzed were robust. Some systems needed modifications after getting preliminary feedback from the users. All the analyzed activities used well-developed user studies to prove their claims, which indirectly supports our final statement, these ingredients help make the online activities successful.

CHAPTER 4: DISCUSSION

The work discussed in this thesis is an approach to improve online activities between remote grandparents and grandchildren. As discussed earlier, activities are important in making a communicational context between these two groups. So focusing on identifying and investigating the ingredients of online activities, this thesis is contributing towards improving the interaction between remote grandparents and grandchildren and supporting their relationship.

The idea of this thesis research came to light form the intention of creating an online activity to connect remote grandparents and grandchildren. During the process of designing the online activity, I found that there is no proper documentation and literature related to the kinds of activity are suitable for online interaction between grandparents and grandchildren. Also, no proper listing of the components the system supporting the activity should have and how the activity, as well as the system, should be designed. Although there are many prior works of literature on online activities, it was difficult to connect all of them under a common framework. From this understanding, the idea of finding the ingredients required for creating online activities arose.

To identify the ingredients, the approach was to first look at what the major stakeholder's requirements and the researcher's understanding of remote intergenerational interaction. These requirements and understanding were then categorized and eight (8) ingredients were identified. Chapter 2 was on this investigation and identification process in detail. The next step was to understand if the system that supports online activities have these ingredients. To prove that the ingredients are required to make online activities, I need to analyze existing successful online activities be-

tween remote grandparents and grandchildren and match their ingredients with my ingredients. After analyzing several existing online activity between remote grandparents and grandchildren, I found out that most of the ingredients I found earlier were present in all the existing online activity. Chapter 3 is mainly about this investigation with an explanation of how the existing systems used those ingredients and relationships among the ingredients. The cross-matching of the ingredients of existing online activities and my identified ingredients supports my thesis statement, the identified ingredients can be used to make online activities successful.

4.1 Limitation

This thesis is a literature review based thesis there no user study was conducted to solidify the claims that the ingredients are the key to make online activities successful. Our claim is supported by the success of other online activities and their user study, but the results of user study might differ with time, scenario, and place. So if I could conduct user studies on a system developed by using the ingredients, I could better clarify the claim. This should be noted that the thesis is not claiming that the ingredient will create successful online activity, which will need robust user studies to claim success. We can't still claim that adding all the ingredients will make the activity successful with a proper user study.

The research works followed to identify the ingredient in Chapter 2 were majorly conducted by researchers living in North America, Europe, and Australia. So the ingredients might be geographically biased. Moreover, most of the literature did not specify the technological knowledge of their study participant, which is important in this kind of online scenario, which can be an important study parameter as the system considered for activity are internet-based and technology-oriented.

Chapter 3 shows that the same ingredients are used differently and supported by different stakeholders. This shows that ingredients application can be different based on the environments, stakeholder's demography, system, or location. So, any activity

might fail if the ingredients are not properly applied and implemented. For example, one ingredient might have different applications depending on the time zones that grandparents and grandchildren live. Chapter 3 also shows that the activity differs with different demography, location, and family condition. Choosing the activity is also important to make the ingredients work.

4.2 Future work

As families are spreading relocating around the world more than ever in recent years, the necessity of online activities is increasing with leaps and bounds. This thesis describes the ingredients of online activities between remote grandparents and grandchildren, which can be the perfect starting point for developing many new online activities and improving existing online activities. Researchers can also extend the work done here focusing on specific geographical locations, demography, or culture. They can also work on bringing diversity in ingredient's application and implementation. Some of the ways this thesis work can be expanded in the future are described in the next sections.

From "making activities successful" to "making successful activities": This thesis document claims that the ingredients can help make online activities successful by finding the presence of these ingredients in successful online activities. But to claim that these ingredients can make successful online activities, robust user studies are required. In the future, this research can be expanded by designing online activities using these ingredients and doing user studies to support the claim that these ingredients indeed make successful online activities between remote grandparents and grandchildren.

A cookbook for online activities: Starting with the ingredients, this research can be expanded by introducing several recipes for making online activities using these ingredients. like traditional cookbooks, several recipes will be prepared using these ingredients in a different combination, concentration, and composition. All these

activities combined in one book, A Cookbook for creating online activities between remote grandparents and grandchildren, will help grandparents and grandchildren develop their own activities.

Location, culture, and age-specific ingredients: This thesis identifies general ingredients regardless of age, location, culture, environment, literacy, and accessibility. But this document opens the door for developing and identifying more specific ingredients dedicated towards different age, location, or culture.

Bringing diversity in ingredients: during the investigation of different activities, we have found that some activities taking unorthodox approaches for some ingredients. For example, Elmo from Family Story Play [1]. This uncommon use of ingredients brings diversity in interaction and makes the activities more engaging. for example, using telepresence robots, IoT devices, augmented reality (AR), mixed reality (MR) can bring a lot of diversity during activity. Researchers can also work on bringing new activities online, like multiplayer games, co-drawing systems, or doing household chores together to online platforms to make the interaction more enjoyable, educational, and enactive.

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