Blossom: Design of a Tangible Interface for Improving Intergenerational Communication for the Elderly

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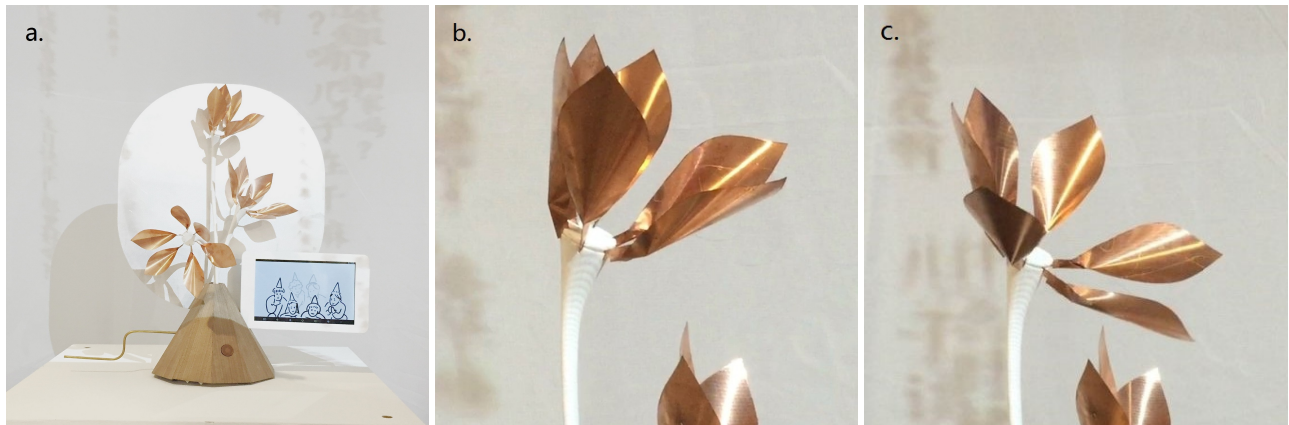15558159521@163.com, ronea@qq.com
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Figure 1. Blossom system. a) One of the two vases with flowers and family photo in Blossom system for the elderly. b) Close-up status of flowers. c) Blossom status of flowers.

ABSTRACT

Exacerbating social isolation and mental problems among older generation, the lack of communication between the elderly and their children has become a prevalent issue in modern society. Previous work of assisting elderly in intergenerational communication suffers from complexity and asymmetry in real use. For the elderly living apart from the children, we conduct a research-through-design study to extract the underlying reasons for the decrease in communication. We propose a concept of embedding asynchronous voice message systems into specially designed tangible interfaces as a complement to the existing synchronous communication systems. A prototype named Blossom consisting of two identical vases with flowers and family photos is implemented. The change in shape of flowers provides users with better ambient awareness of receiving a new message and digital family photos offer two different feedbacks for different user groups to alleviate asymmetry. Qualitative evaluation with elderly and young adult users is conducted and more insights are gained for future research.

Author Keywords

Elderly; older adults; intergenerational communication; asynchronous communication system; tangible interface; ambient awareness; feedback.

ACM Classification Keywords

H.5.2. Information Interfaces and Presentation (e.g. HCI): User Interfaces

INTRODUCTION

Social isolation, leading to a great number of detrimental mental health problems, has already become a prevalent issue in older adults [23]. Social isolation reflects the condition of lacking in communication with other humans and always includes the symptom of lacking communication with family members [12]. Nowadays many older adults are longing for more communication with their children and report the feeling of loneliness [14, 22]. The intergenerational communication between older adults and their children is fairly important.

Except face-to-face communication, wired telephone system is the most adopted way in interpersonal communication among the elderly [4, 19]. However, telephoning always requires the synchronization in timing and immediate responses from the two sides involved [6]. Misalignment in time and space [19, 26] and unawareness of the availability of the other side [21] between older adults and their children result in a deteriorating situation in intergenerational communication.

Having the advantage of being flexible in timing and availability [3], asynchronous communication which allows users to exchange information intermittently [3, 6, 7] are chosen as a complement tool by young adults to overcome inconvenience in synchronous communication. Emails [3], text messaging [3], social messaging such as Facebook posting [15] are the most widely adopted asynchronous communication tools among young adults. These are comparatively new technologies for the elderly and are not widely used among older adults. Interfaces of new technologies with a considerable number of items can be complex [27]. Using new technology for a long period can be an overburden to the elderly considering their degeneration in eyesight, memory and learning ability [27]. And previous work [8, 19, 24] of providing the elderly with special-designed asynchronous communication software suffers from either complexity in real use [17] or asymmetry in information sharing between the elderly and their children [19, 26].

In this paper, we conduct a research-through-design study with older adults from an elderly center and an elderly home, young adults from universities and also an officer working in the elderly home. We validate our design concepts of embedding an asynchronous communication system into a common object in elderly's life after iteratively discussing our ideas with potential users. Then we closely collaborate with people from art background and a prototype system called Blossom which consists of two identical vases with metal flowers and digital family photos (see Figure 1.a) is implemented. The pair of easy-to-use vases is designed to be the media of transmitting voice messages. In order to keep the users actively-engaged in the system and maintain a symmetry in communication, we use flower blossoming and closing-up to enhance the ambient awareness of newly-received messages. Also a fading-out figure of parents and a coloring of family photo are integrated in the system as different feedbacks to stimulate further communication. The contribution mainly lies in:

- A concept of embedding voice messaging system into a daily-used object with two different feedback mechanisms to promote asynchronous communication between the elderly and their children.

- A prototype system named Blossom consisting of two vases with flowers and family photos.

- Qualitative evaluation illustrating the usability and usefulness of Blossom through exhibition and interviews.

RELATED WORK

Asynchronous Communication System for Elderly

The goal of previous work [17, 19, 20, 24] in designing asynchronous communication software for the elderly is to compensate for their lack of access to new social media. Researchers mainly focus on extracting and synthesizing social media data from social networking sites into a special-designed software embedded in PC or tablet for the elderly [19, 20], but their systems [8, 19, 24] appear to suffer from the either asymmetry in sharing information [8, 24] or complexity in real use [17].

Asymmetry in Sharing Information
Authors from [24] present a shared calendar system for elderly and their children in a symmetrical manner, which means both sides have the access to the other's time schedule. The information shared or exchanged through these specially-designed software systems are written information. As elderly's time schedule is not likely to change significantly, their young children report boredom and unwillingness to check the parents' schedule just after a short time of using. Also, written words are not the best choice to invoke the feeling of being present and arouse more affectionate connection between family members.

Another work creating a virtual hide-and-seek game between the elderly and their grandchildren also mentioned this problem. There is a need to let the grandchildren and older adults switch their roles to maintain a higher level of symmetry and engaging [9].

Complexity in Real Use
Although researchers start with the concept to simplify existing operating systems and social media platforms, the reality is that their systems are still confusing and complex to use [17]. The recent work SocialConnector [19, 20] is a cloud-based software application specially designed for the elderly which integrates videoconferences, private messages, public messages and a photo display. The system is embedded inside a slate. It serves both the function of synchronous communication and asynchronous communication system. However, this system still requires the elderly to have Skype, Gmail, Facebook accounts and have rather complex choices between synchronous and asynchronous approach. Many older adults in their interview expressed confuse to the system. Despite of the fact that SocialConnector shows some promising results, it still suffers from complexity in real use.

Media Preference

The elderly do not like computer to be the media of communication. The problems of keeping in touch through computer stem from the elderly's apprehension and obsolescence [26]. Even though the elderly regard computer as a valuable communication tool and more than half of users in [26] are curious about how to use it, they still express their fear of computer software for long-term use. For some elderly, they would rather have a piece of paper printing with photos in their hands rather than see the photo in front of the computer [26]. Elderly prefer simple and tangible interfaces rather than tablet, phablet or PC.

Ambient Awareness

Family members who live apart could gain a feeling of being together and tied up through implicit communication. The work [13] proposes a system called Family Planter, transmitting the implicit presence information to other family members based on presence and motion information. The system is constructed by several terminals linking to the same server. When a terminal receives information from others, light will emit through optical fiber as an indicator. In [1], authors share a similar concept of revealing telepresence between intimate friends or family members. Both these systems [1][13] try to provide users with abstract non-verbal communication via interacting with the tangible interface. It is a special way of emotional communication and the presence information can further induce verbal communication through other media.

Feedback for Users

Offering feedback to both sides about how they communicate with each other is important and will largely influence their future action [26], especially for the comparatively loose and flexible asynchronous communication.

Some users feel obliged to communicate with family members while some others express proud feeling resulting from their communication habits [26]. Many young adults say that the study [26] is a "guilt trip" because it makes them more conscious about the gap between their willingness to communicate and the reality. Young adults who are doing well show proud to the researchers but many others encounter guilty. Also, authors in [26] argue that feedback is crucial in communication. Losing feedback and response for a long time causes a direct decrease in contacting each other.

Feedbacks to human behaviors are classified into two categories, namely positive feedback on strengths to enhance confidence and negative feedback on weakness to provide insights of improvement [10, 11]. Positive and negative feedback will be more effective and motivating for different people at different times [10]. According to a recent study [11], researchers argue that sometimes negative feedback is more efficient than positive ones. As people gain expertise (perceived or actual) in pursuing a goal, negative feedbacks are sought and responded more instead of positive ones. This means when people are clear about what they would like to achieve, negative feedbacks will be of more efficiency to provide suggestion of improvement.

DESIGN OF BLOSSOM

Inspired by [18], we apply a research-through-study approach to first generate and then validate our design concept of embedding an asynchronous communication system into tangible interfaces with which the elderly are familiar, and also create feedback mechanisms for different user groups. A prototype called Blossom based on our design rationale is implemented and evaluation is conducted with potential users. In this section, we focus on introducing the process we generate and validate our design concept and explain how we deliver our design features.

Design Concepts

Interview with Older Adults

The first step in our design study is to generate our design concept. We conduct an interview with ten older adults (six females, aging 70-86) in elderly home (five out of ten) and elderly center (five out of ten). All of them do not live with their children. Those who live in the elderly home do not meet their children frequently and many of them suffer from physical and mental health problems like paralysis and dementia. The elderly center is a place for older adults to gather and enjoy activities. Those who come to the elderly center are much heathier and comparatively younger. They still live in their home. Our interview spanned more than five hours. One week later, we revisited these two places again.

Problems in Communication

All the ten participants in our interview showed a strong willing to talk to other people. When we directly asked them what is their commonly used communication tool, all of the ten participants mentioned telephone and six of them mentioned mobile phone. Both telephone and mobile phone are synchronous way of communication [3]. When we asked whether they have problems in communicating with their own children, almost all the participants excluding one old lady with her son also living in the elderly home said "yes" or "kind of", but none of them could put forward reasons behind.

First, to our surprising, we find that the ten interviewees suffer a lot from the problem of lacking in communication topics. They usually struggle to find a topic to start the conversation mainly because the overlapping topics with their children are not much. They also report nervousness and hesitation before and in calling. One old man E1 (male, age 82, elderly home) told us in the interview:

E1: I has only one son and no grandchildren. I really want to know what my son is doing, but I always hesitate before calling. Sometimes I do not know what to say on the phone.

Second, synchronous communication does not allow toning of voice, which means when young adults are busy, they could sound very reluctant to answer the phone. This causes more hesitation before calling as the elderly are not inclined to interrupt. Misalignment in time available will largely influence the quality of communication. Knowing the other side's time scheduling is the pre-step before hanging up the phone and dialing the number [21], but most elderly have no access to their children's availability. Another interviewee E2 (male, age 78, elderly center) told us:

E2: I live alone, and usually sleep quite early and get up quite early too. I have only one daughter. She is very busy and often work overtime. Usually she sounds busy on the phone and only says two or three sentences before hanging up. If I know more about her daily working schedule, I will try to telephone her based on my estimation of her availability. There is no doubt that the communication between us has some problem.

Third, synchronous way means the two sides involved must show up at the same time and exchange information in real

time. If the one side refuses to communicate, the communication is thus cancelled, bringing in much depression for the other. According to E3 (female, age 78, elderly home):

E3: I usually call my children, but many times them refuse to answer the phone. Sometimes I feel worried about them and sometimes I feel neglected and upset for waiting for a long time. They may just forget to call back.

Needless to say that the elderly genuinely need some other assistive technologies to improve their intergenerational communication.

Communication Medium
We then asked the elderly whether they have used some asynchronous communication system such as emails [3], text messaging [3], social messaging such as Facebook posting [15] before. Two old ladies from the elderly center reported "yes" for text messaging, but only with sporadic use. Another three elderly interviewees in the elderly home told us that they do not even want to use the computer for daily communication although they have the access to it. All of the ten interviewees are not familiar with smart devices such as tablet, phablet [25]. PCs and smart devices seem not a preferable media for communication among the elderly. One of the old lady E4 (female, age 86, elderly home) said:

E4: I do not want to use the computer. I even do not want to learn. Actually I have the access to the computer in the activity room, but I would rather choose to talk to my roommate in this elderly home rather than learn the computer and chat online. The interface comprises of many icons. I feel worried about the unsolvable consequences by mistakenly pressing a wrong icon. When it comes to smart phones, I do not have access to them and neither do I have the social media accounts.

Next, we are interested in whether the elderly are willing to share photos and have teleconference via smart devices or PC with their children. To our surprise, many of them show an inactive attitude to the sharing of photo and video conferencing. Sharing photos with their children is a heavy burden for the elderly in that few of them have a camera or a smart phone to take photos. They do not have a lot to share neither. One old lady E3 (female, age 78, elderly home) living in the elderly home told us:

E3: Sharing photos are hard for me. I do not have a smart phone or a camera. The farthest place I usually go outside is the supermarket located in the building next to this one.

All the elderly in our study demand a detailed verbal communication with their children rather than pure non-verbal communication such as the tele-presence information in [1, 13]. Verbal-based communication includes exchange of spoken words and written texts [5]. As mentioned before, a previous work [24] engaging sharing written texts between the elderly and their children suffers from heavy asymmetry in information exchange. Thus, it is necessary to compare elderly's inclining towards spoken words and written texts. From the interview, we find that all of them are more inclined to voice-based verbal communication in daily use. The reason is that although written messages can help in restoring infor-

mation and can be paced according to personal preference, it still involves the process of using computer or mobile phone to do typing or using a camera to capture handwriting on a paper. Typically, from one old man in the elderly center E5 (male, age 80, elderly center):

E5: For everyday use, I think talking about each other's life and listening to their sound is good enough. Typing text messages on mobile phone or in front of computer is demanding.

Given that the elderly prefer spoken words to written texts, we reckon that a voice messaging system would be suitable for them On the one hand, it can arouse affectionate connection between family members like the most-used telephone system. On the other hand, it can restore all the information as the text-based messaging system.

Group Discussion
After the interview, we had a discussion with our collaborator (students from art background) and summarize all the insights from the five-hour interview with the ten interviewees.

Synchronous communication is the most frequently used tools among the elderly but results in many problems. These problems can be attributed to the lack of shared topics, being unaware of the children's availability, and the requirement of immediate response. The elderly really want to engage in more contact and have closer relationship with their children. Existing asynchronous communication is commonly adopted in young adults as a substitute or complement to the synchronous approach, but the elderly have not adjusted to them yet. A specially designed asynchronous communication system is thus required to improve the intergenerational communication for the elderly living apart from their children.

Because of the elderly's degeneration in learning ability, memory, eyesight [27] and lack of access to smart devices, we do not intend to overload them with the tasks of sharing photos, having teleconferences. Their basic needs are quite simple, just to talk and listen to family member's voice. Compared to written texts, voices from family members can provide users with a feeling of presence and arouse more affectionate connection.

Thus, we propose to design an asynchronous voice messaging system to transit and restore the original voices. As PCs and smart devices are not preferred by the elderly, we think of embedding this voice messaging system inside a daily-used objects in a home setting. We want it to look beautiful as a decoration in home even not in use. And we decide to adopt the basic ideas from [1, 13] to create a mechanism of ambient awareness when receiving a new voice message.

Design Features
Based on the concepts, we propose an initial design of "Emotion Feed Flower" system (see the poster of initial design in Figure 2). At this stage, the system only serves the function of voice messaging and enhancing ambient awareness of receiving a new message through status change in flowers.

Previous work [9, 24] raised the problem of asymmetry between the elderly and their children. In order to keep a sym-
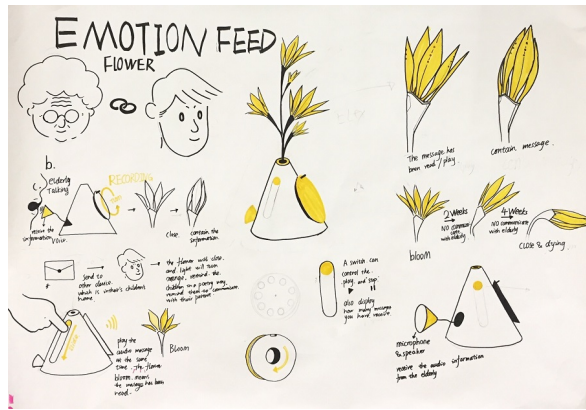
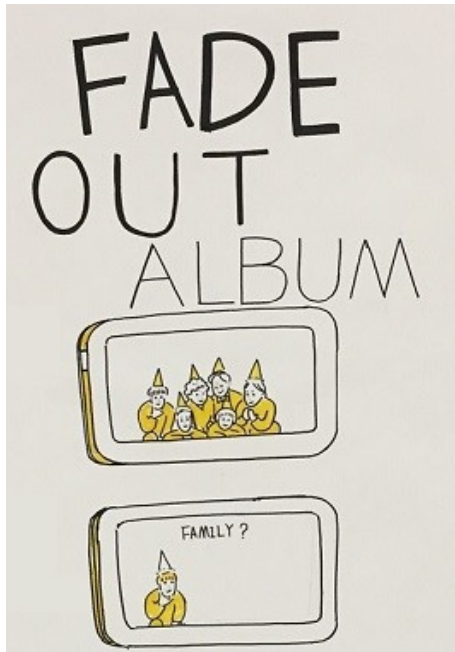Figure 2. Poster of Emotion Feed Flower Design.

Figure 3. Poster of fading-out figure of parents.

metric setting in our system, we design two identical vases with flowers in the system. One vase is located in the elderly's home and the other in the children's home. Whenever the older adults want to leave a message to their children, the microphone inside the vase will record their voices through the elderly's action of rolling the handle on the vase. Pressing the button will sent the newest recorded message to the other side. The two vases are connected to the same server. Voice messages will be first stored in the server and then transmitted to the cache in the other vase. After receiving a new message, the flower in the children's vase will close up as a flower bud (see Figure 1.b) indicating that an unread new message has been received but will not play it automatically. Closing up of the flower pedals serve as the ambient hint which reminds the children to take further action. Children do not need to listen to the voice message immediately, they choose to play it when they are free by pressing the button. On finishing listening, the flower will blossom again (see Figure 1.c). If there

is no unread message, pressing the button plays all the historical voice messages stored inside the cache in turn. Vice versa, when the children want to leave message or give feedback to parents, the process is similar. With the blossom and close-up status change in the flower, we hope to make our system higher level of engaging and also boost the ambient awareness when a new message comes. Seeing the blossom of a flower means the other side might be in front of the vase and available for a telephone calling. Thus, Blossom could act as an actuator of commonly-used synchronous communication.

Our collaborators from art background remind us that the asynchronous verbal communication can be quite loose, which may also have problems in asymmetry and cancellation of use if one side forget or refuse to response. Taking ourselves as an example, we are young adults who use social media and smart phones a lot. The way of reminding us that we have received a new message in asynchronous communication is notification from social media platforms on the smart phone. Forgetting to respond to messages is common. We totally agree with our collaborators' opinions and their insights invoke two different feedback mechanisms to prompt communication. Poster of the negative feedback, fading-out figure of the parents is shown in figure 3.

Figure 4. Sketch of Blossom.

Feedback Mechanism

We reframe our design and a sketch of a new system "Blossom" is presented in figure 4. We integrate a photo frame in each of the vase. In both photo frames for children and parents, a digital family photo is displayed through a tablet. We choose a cartoon family photo drawn by our collaborator in order to bring different users more empathy (see Figure 4).

According to [26], young adults report guilty feeling of knowing the huge gap between their willingness to communicate with old parents and the reality. And based on the conclusion from [11] that negative feedbacks are sought and responded more instead of positive ones if users have gained expertise (perceived or actual) in pursuing a goal, we decide to create a negative feedback as punishment for the children to trigger their hidden sad and guilty feeling. If they neglect or refuse to respond for long, the figure of their old parents in the family photo will gradually fade out (see Figure 5). A negative

feedback for the young children is chosen because we suppose young adults are clear about their obligation of caring for old parents and they know how they should behave in the family communication.

With the purpose of increasing bidirectional communication, in the photo frame in the elderly's home we design a positive feedback as rewards. It is inappropriate for elderly to see their own figures or figures of children gradually fade out. Instead, we intend to bring them more positive feelings. Every time the children listen to their voice message, the black-and-white family photo in the frame of elderly will become more colorful (see Figure 6). All the fading-out and coloring process is controlled by time. We transfer the calculation of Half-life Time into the effect of fading-out and coloring of figures. The formula we adopt in our system is:

$$O(t) = O(0) \times 2^{-t/t_{1/2}}$$

In this formula, $O(t)$ represents the actual opacity the young adults see, $O(0)$ represents the initial opacity, the initial value is 1. t is the passing time counted from the time of receiving the message and $t_{1/2}$ is the half-life of decay. $t_{1/2}$ is set to be 20 seconds for showing demo in prototype. Children's listening to the message will not make the fading-out figure appear as initial value directly. The opacity will add only 10% of all the lost value. Actively leaving message to their parents will bring a 50% increase in total loss of opacity. For the elderly, if their message has been listened by their children, the coloring of the initial black-and-white photo will have an increase of 10%. The coloring of family photo will decay according to the same formula of fading-out figure only after it has already reached 100%.

Figure 5. Fading-out figure of old parents in family photo.

With the blossom and close-up of flowers, fading-out figure of parents and coloring of family photo, we hope we can improve asynchronous communication for the elderly living apart from their children. We hope that the ambient reminder and different feedbacks can avoid important messages missing, make our system higher level of engaging and alleviate

Figure 6. Coloring of family photo.

asymmetry in information exchange. Functioning as a complement to synchronous communication, a blossoming flower could even trigger a telephone call because the process of flower blossoming means the family member is just in front of the vase and may have time.

Ease of Use
Based on the condition that older adults are afraid of new technology, we want Blossom to be very easy to use. Most voice mail applications these days are based on smart phones, tablets and PCs, the interaction between users and systems is limited to touching the screen, using the keyboard and mouse. These interactions are more suitable for young adults and children. For this reason, we do want to offer the elderly a special physical interaction with the vase and flower.

When we design the vase, we only put one handle and one button on it. We try to include less items inside. It is easy to remember that rolling handle means recording while pressing the button means sending or listening. If users haven't recorded anything new, pressing the button plays all the historical messages. A flower bud means you get some new unread messages, and blossom means already listened. This close-up and blossom concept is natural and consistent with people's common sense.

Aesthetics
For the alternative designs of the artefact, we have thought about using a telephone, but still choose vases with flowers because they look more like an elegant decoration at home. Also, hiding the microphone inside the flower will enhance the enjoyment when people use it. Talking to the flower creates some affectionate connection between the user and interface. Thus the communication with family member is emotionally distinguishable from other relationships. If we choose the telephone, we may choose sound effect to provide ambient awareness of new messages for users, but this can easily get mixed up with real telephone calling, causing a chaotic situation for the elderly.

Material
Our collaborators from art background want Blossom to look both old-fashioned and natural. Black walnut is chosen to be the material of the vase. Copper and Aluminum are used to make the flower and the decorations which emphasize the flower (see Figure 7 and also Figure 9). Metal and wood, in art students' eyes are two contradictory materials that will

cause further stimulation in human's emotions. Copper, with the golden shining color, was used as materials for home-made items from ancient time, so older adults can adjust to them quickly. Copper flower with aluminum decoration is consequently located in elderly's home. Aluminum, shining silvery light, is on the consensus with modern aesthetics, so the vase with aluminum flowers and copper decoration is located in young adults' home. With same sizes and functions, the pair of vases makes Blossom system compact and integrated.

Validation of Concept and Feature

Revisit to the Elderly

After we decide the features of Blossom, we revisit the elderly center and elderly home to consolidate our ideas with the ten participants in the previous interview. All the ten older interviewees showed a great interest in Blossom. They looked forward to having a try after system implementation. One old man E2 (male, age 78, elderly center) said:

E2: I think your system sketches looks beautiful and I would be very happy to try the voice messaging first. I would be happy to restore the conversation with my children in the vase and replay them from time to time. I also want to see the close and blossom of the flower.

Interview with Young Adults

We also conduct interviews with twelve young adults (four females, aging 23-49) including five students in art major and seven instructors, four from our university in Human Computer Interaction area and three from our collaborator's university with the background of art. We collect their comments on the punishment mechanism in order to know whether this mechanism load overhead burden on young adult users. Actually all of young adults in our interviews showed a great interest in trying these fading-out mechanism. One young man and one instructor E6 (male, age 24, student in art major), E7 (male, age 49, instructor from HCI background) commended:

E6: Sometimes we are too busy to call them back, but I really want to make our relationship close and never want to let my parents down. What I need might be some reminders highlighting the importance of family communication.

E7: This fading-out photo reminds me of the film "The Picture of Dorian Gray". The fading-out figure in the system is able to visualize how you behave in communicating with your parents. It's really creative and artistic.

IMPLEMENTATION OF BLOSSOM

Technique

Figure 5 shows the final product of Blossom. Micro Control Unit Raspberry Pi 3B (see Figure 8.a) is adopted in each of the vases to maintain the basic operation of voice recording, message storing and voice playing. A back-end server is constructed by node.js to fulfill the function of message transmitting, fading-out controlling and coloring controlling. Both of the vases are connected to the server through Wi-Fi connection. One vase controls the status switch in flowers of the other side via handshaking through the server by employing Websocket communication protocol.

In order to control the movement of the pedals of flower, we link each of the pedals on to a servo (see Figure 8.b) by using metal wires. Thus, the sway of the servo will be mechanically transformed to blossom or close-up status of flowers. Button modules are adopted to achieve the functions of sending or playing voice message according to different contexts. Manual generators (see Figure 8.c) with relay modules are connected to the handle to maintain that rolling the handle starts recording. All the servo, generator, relay and button modules are powered by Raspberry Pi which is directly supplied by a household AC power.

Figure 7. Blossom system with identical vases.

Artefact

The procedures of fabricating the artefact include a lot of handcrafts work. The vase is made of wood. Firstly, our collaborator carves the raw material into standard-sized small wooden pieces after a brief polishing process (see Figure 8.d). Then all the small wooden pieces are burnished and glued together in the shape of a pyramid. The pedestal of the vase is then finished. 3D printing is used to manufacture the hollow scapes of the flowers and the photo frames. As mentioned before, flowers are made of different metals. Bronze and Aluminum sheets are tailored into small pieces and also polished to be less sharp. Inside the photo frame is a tablet controlled by the server. With Raspberry Pi and all the other additional modules embedded inside the wooden pyramid, the pedestal is stable enough to hold upper items including metal flowers, scapes, a tablet and a photo frame.

Exhibition Installation

As this project we closely work with art students, we have a great opportunity to exhibit our prototype to the public in an art gallery for a whole week. With this chance, we not only gather feedback from our instructors, but also get feedback from the public who come to see the exhibition.

For the installation of the exhibition, we allocate the vases on two exhibition booths and hang a large curtain made of yarn between the two booths (see Figure 9). With this arrangement, we conceptually separate space and time into two parts, one for the elderly and the other for the children. The curtain is semi-transparent under the spot light, so it is possible for our
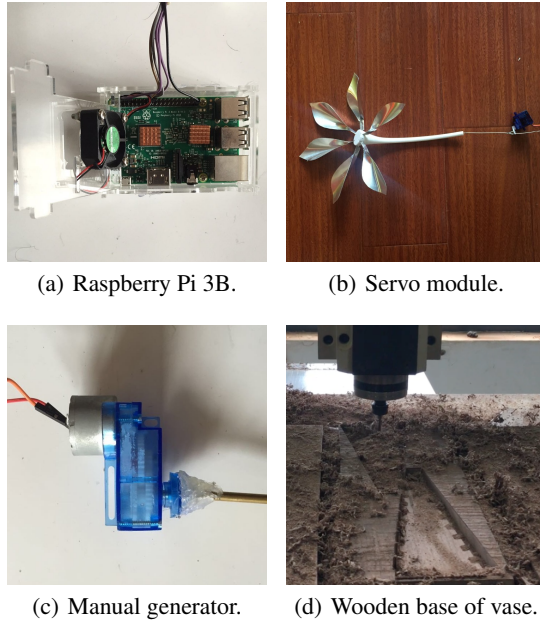
(a) Raspberry Pi 3B.

(b) Servo module.

(c) Manual generator.

(d) Wooden base of vase.

Figure 8. General configuration of vases.

visitors to see blossom and close-up status change in flowers of the opposite vase. Our collaborators also collect real text messages between parents and children, and project all the sentences onto the semi-transparent curtain, creating a warm atmosphere.

Figure 9. Exhibition installation.

EVALUATION

Around 200 hundred people visited our exhibition. We conduct qualitative evaluation with visitors to the exhibitions and also seven instructors from universities. Basically, the pilot evaluation is following the upcoming three question:

- As a complement to the synchronous communication, is this asynchronous voice messaging system useful for the elderly?

- How do users assess the tangible interfaces with vases, flowers and family photos?

- Will the two feedback mechanisms bring in higher level of user engagement and alleviate asymmetry in communication? Do users like it?

Usability

Visitors appreciate the idea to use an asynchronous voice messaging communication system as a complement to the traditional telephone and mobile phone. From one visitor E8 (male, in his seventies, visitor), our asynchronous communication is useful and flexible in that he can use it to record messages at any time:

E8: I usually forget things I want to say when I am on the phone with my children. So I often write them down on a piece of paper. Now with your Blossom system, it will allow me to send message to my children at any time.

Another visitor E9 (female, in her forties, visitor) suggest that we should transfer the missed telephone calls and mobile phone calls into Blossom system:

E9: I hope you put all the missed telephone and mobile phone calls into Blossom, which will be very useful for us working people. The notification from mobile phones are easily ignored. I am very happy to see the blossoming and closing of flowers as a cue for raising attention of missed phone calls.

User Engagement

Few of the elderly uses voice messaging systems on smart devices before, but with our special designed Blossom interfaces, they express their willingness and interest in trying. From their perspective of view, our tangible interface is able to stimulate more participation in the family communication. One visitor E10 (male, in his sixties, visitor) shared his suggestion after seeing the demonstration of flower blossom and close-up:

E10: These flowers and vases looks very beautiful. Undoubtedly, it is surprising and pleasing to see the flower blossom. Maybe you can add some light and music in the meantime with flower blossoming.

A young visitor E11 (female, in her twenties, visitor) shared her opinions with us about our ambient awareness design:

E11: I find the design of blossoming very eye-catching. Your design concept itself has already remind me of the potential problems in the communication with my parents. The blossom and close-up status of flowers can remind me of the new messages and I will always notice it. If it is only a notice from my iPhone without any ambient reminder, it is easy for me to forget.

However, one instructor E12 (female, age 29, instructor from HCI area) reminded us that:

E12: If the young adults turn off the tablet to avoid seeing the fading-out figure, do you have a plan B? And if it is the elderly that do not want to communicate, how do you address this problem?

This is an open question for us at this stage. As mentioned in [11], we assume the young adult users involved in our systems have already born the obligation of caring for their parents in mind, and thus we design a negative feedback for them with the purpose to help them do better. As has been shown in the process of concept generation and feature validation, all

the young adults appreciate the fading-out figure design and would like to have a try, which means they are comfortable with the design at this stage. The real problem is we do not know the long-term effect of these feedbacks. If young adult users see the fading-out figure for a long time, will they still feel guilty and be invoked to initiate a conversation with the parents is unknown.

For the question regarding the elderly, from our interview in the first time, we have already extracted the elderly's needs of talking to family members. And we also see some elderly living the elderly home put large photos of their children, grandchildren and great-grandchildren on the wall. We do not rebut that some elderly may have already suffered from isolation, depression, autism or some other mental problems and do not want to talk to their children. The target users in our system are older adults who are willing to talk and long for family communication.

Creativity and Empathy

All of the seven instructors appreciate the idea of fading-out figure and the exhibition presentation. From one of the instructors E13 (male, age 35, instructor in art area):

E13: The good point in this project is that you really put your feet into the elderly's shoes. Empathy is quite important when designing something for others. And the design of fading-out figure is really impressive.

Another instructor E7 (male, age 49, instructor from HCI background) said:

E7: This design of fading-out figure of the old parents is a fairly creative one. It translates the obligation of caring for old parents into a polite psychological expression. Both the fading-out figure and coloring of family photo will be beneficial to the elderly. I also view this fading-out figure design as a special kind of visualization encoding the quality of communication through a family photo. Using the fading-out effect or opacity to encode children's behavior is very shocking and will raise more emotional resonance in young adults. I believe they will pay attention to the change in the family photo and contact their parents more actively.

An older adult visitor E14 (male, in his seventies, visitor) showed his appreciation for our design of coloring family photo:

E14: The coloring of the family photo is warm and touching. If I have such a pair of vases I would talk more and more to my children.

One officer E15 (female, in her forties, officer in elderly home) praised our punishment mechanism designed for young adult users:

E15: Many older adults become anxious and upset when they are waiting for children's response. With your fading-out figure of the parents as a strong psychological implication, I think most children will respond and give feedback more frequently. And meanwhile, the coloring of family photo design for the elderly is also delicate, they would contact their children more actively to see the colorful photo.

First Prize in Competition

There is competition hosted by our university with the theme of assisting ageing population after we finish the exhibition of Blossom. In a total, there are ten groups participate in the competition and finally we win the first prize among all the ten groups. Other than the strength of combing technology and art tightly, our system is a neither a pure software embedded in existing smart devices nor a specially designed hardware without any software support. Our system can be further improved and packaged to be products in real use. The interface is eye-catching with the functions delicately conceived for elderly and young adults.

DISCUSSION

Adaptability

Blossom can be easily adapted to different places, either in home setting or working place setting. Elderly is able to use our system at the time they are available, so are the children. People can use it according to their personal preferences.

However, what is the real influence of Blossom on the telephone and mobile phone system has not been researched yet. There must be some change in using synchronous system after deploying our asynchronous communication system. Further evaluation about whether there is an increase in the use of telephone system is needed. Although from current feedback, almost all the participants in our qualitative evaluation process express their willingness to have more contact with their parents or children, we are still curious about the actual change in communication. Inspired by [8], we also think about having a joint-analysis with telephoning data and generating a report about all-round variation in intergenerational communication in the future.

Now we only put one servo module inside each vase so we can only control all the three flowers simultaneously, which means if users have not finished listening the previous unread messages, a newly received one will not cause any change in the vase. Although users will not lose any message, this is not smart enough. If we add more servo modules in the system, flowers can be controlled separately. With more flowers manufactured, it will even become explicit and intuitive for users to know how many unread messages they have.

Multi-modal Communication

At this stage, we only use a visual effect of blossoming and close-up in the flower to indicate whether the users receive new message, hoping to raise their attention when they are immersed in the environment. We do not doubt about the effectiveness of using visual cue to enhance ambient awareness, whereas it is also natural for us to think of integrating more sensory channels other than vision in the system. The method we think of could be adding one micro LED light inside each flower. Sound effects could also be included inside the system.

Simultaneously, interpersonal communication is never simply verbal communication and ageing can result in degeneration in hearing and eye-sight. When it comes to old adults who

suffer from hearing impairment, integrating non-verbal communications such as gestures, facial expressions, body languages within Blossom will be more beneficial. Diagrams and short notes will largely assist in understanding voice-based information [2]. Inspired by [16], we also think of extending Blossom to be a multi-modal communication interface, which might be a solution to better cater for the elderly according to different physical and cognitive abilities. At a future stage, we still want the voice messaging communication to be the main channel conveying specific and explicit information while other channels to be complementary in conveying implicit information and to facilitate the process of understanding voice-based information.

Long-Term Usage
Our evaluation at this stage only elicit first step user feedback from people attend our exhibition and seven instructors. According to [26], the final goal of an interactive system is to achieve the long-term engagement among users. Thus, we still need to have longer experimental trials for testing usefulness and user engagement of Blossom. Although many potentials users summarize their feedback to Blossom as a useful and interesting system, there is still a problem that they may lose their interest, and regard the system dispensable or simply ignore it in the future.

Being reminded by the instructor in the exhibition, another crucial issue is to test whether the two different feedback mechanism still work effectively after users' long-time exposure to our system. Whether the fading-out figure still invoke guilty feeling needs to be tested in long-term field evaluation.

CONCLUSION
Social isolation which results in considerable amount of physical and mental illness among the group of older adults accentuates the importance of designing elderly-centered interactive systems to enhance their communication with outside world. In this work, we closely collaborate with people from art background and focus on the intergenerational communication problem of the elderly who live apart from their own children.

We adopt the general design process of research-through-design study. Real needs among the elderly and underlying reasons of problem elders face are extracted through iterative interviews with ten older adults from an elderly center and an elderly home. From our design study, we propose an idea of utilizing an asynchronous voice messaging communication system to complement existing synchronous telephone system. We generate our design concept of embedding the voice messaging system into a specially designed tangible interface with ambient reminder and different feedback mechanisms.

On the basis of our design rationales a prototype system called Blossom with two identical vases, flowers and photo frames is developed. Recording and sending a voice message will cause the flower in the other side to close up as a flower bud, while listening to the new voice message received leads to the blossom of the flower. We utilize the status change in flowers to boost ambient awareness of receiving new messages. In case young adult users ignore the visual change

in flowers and in order to boost symmetry between elderly and young children in information exchange, two different feedback mechanisms are applied in Blossom. For the young adult users, a fading-out effect of parent's figures is applied in the family photo with the purpose to continuously trigger guilty feeling. We hope the negative feedback can push them to engage in family communication more actively. Coloring effect of family photo, serving as a positive feedback, is applied in the photo inside the elderly users' vase to arouse more interest and also keep the symmetry in communication.

We have a great chance of exhibiting Blossom at an art gallery and collecting first hand feedback from the public. Qualitative evaluation is conducted through the exhibition process. Feedbacks are gathered from people who visited the gallery including potential elderly users, young adult users, an officer working at elderly home, instructors from our university and instructors from our collaborators' university. Results of pilot evaluation have shown a promising outlook in usefulness, adaptability and user engagement of Blossom. At this stage, both the older adults and young generation are quite interested in and willing to have a try on Blossom. They view this asynchronous system as a stimulator for better intergenerational communication. Also, many visitors put their emphases on the fading-out figure design. They think the fading-out figure effect is creative and is a representation of the designers' empathy and respect to the elderly. A first-prize award is won by our group in a competition held by our university. Instructors also view this fading out figure as a special kind of visualization encoding the evolution of family communication and connection.

In general, this study elicits some first steps toward addressing the problem of intergenerational communication in the elderly and future work will focus on testing the long-term engagement among different user groups and exploration of multimodal communication in Blossom. Field study will be conducted under real scenarios for further quantitative evaluation.

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