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Sharetouch: A system to enrich social network experiences for the elderly

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ABSTRACT

The Sharetouch system is designed for raising users' participation in community events. We put three subsystems into Sharetouch: (1) community pond, (2) Waterball interactive game, and (3) multimedia sharing. Sharetouch is based on an optical touch device designed by the Joyplux Company with an infrared LED and camera. This device can support multi-touch functions within a large display area. The software of Sharetouch was developed within XNA and .NET frameworks. We project the users as fish in our community pond. Sharetouch displays all the friends as fish when the users log into the system. Therefore, the number of fish equals the number of friends of the users. This design encourages users to make more friends to increase the number of fish. Waterball is a game that combines virtual images and real objects. The concept is based on the Nintendo Wii games, as players hold controllers (real objects) to play the games (virtual images). We also apply the concept of the cloud flash drive to multimedia sharing to avoid the trouble of carrying a real flash disk. This study employed the TAM measure to measure the validity of Sharetouch in this social platform. Our findings indicated that all proposed hypotheses had a positive and significant impact on the intention of older people to interact with Sharetouch. Unlike the computer-based system, Sharetouch is created as a user-friendly interface system. Sharetouch can enrich the users' social network experiences through its hardware and software architectures.

1. Introduction

A growing number of studies have presented evidence that suggests that communication technologies play a significant role in enhancing social connections and interactions among senior adults (Czaja et al., 1993; Eilers, 1989; Lawhorn, 1996; McConatha et al., 1994; Pieper and Hermsdorf, 1997; Lepicard and Vigouroux, 2010; Wherton and Prendergast, 2009). However, these new and updated technologies are often designed for the younger generations, who are familiar with using such technologies, and so they present barriers for many older adults who are inexperienced technology users (Lepicard and Vigouroux, 2010; Wherton and Prendergast, 2009). For this reason, we have proposed the Sharetouch hardware (Tsai et al., 2011), which is a multi-touch interactive system that merges a digital desktop and a physical table into one with extra capabilities (Tsai and Chang, 2009). The multi-touch sensing technology blurs the gap between the digital and physical worlds. The style of interaction enabled by a multi-touch interface differs from mouse manipulation. Older adults can now manipulate the digital contents placed on the table's surface more easily and more intuitively. In addition to older adults' physical and functional difficulties in using a technology device, many studies have pointed out that interpersonal relationships and social interactions among the elderly make an extremely notable impact on increasing life expectancy and quality of life (Warnick, 1995; Cumming and Henry, 1961; Stevens, 2001; Victor et al., 2005). To leverage technology to encourage social integration for senior users, we explored the social and physical environments of a senior living community and social connections among the ageing residents and employed the related principles of social networking (Carter and Feld, 2004; Haythornthwaite, 2000) for the design concept and development of the Sharetouch system. A simple social network map as the concept for the Sharetouch social platform was presented and TAM measurements validated users' acceptance and feedback (Tsai et al., 2011). Combining the features of multi-touch sensing technology and tangible manipulation, which enable multiple users to simultaneously interact with the system, Waterball, an exergame design for rehabilitation of the elderly, was implemented on the Sharetouch platform. Waterball is a rehabilitation exergaming for the elderly that provides closed kinetic chain exercise. The game combines entertainment and rehabilitation, and thus increases the users' interest in efficient rehabilitation exercises (Tsai et al., in press). However, the above research associated with the Sharetouch design and development focused on showcasing its innovative design concepts, user-centered issues, and technology adoption and acceptance. It had a very limited description of the system's structure and architecture, virtually neglecting to discuss the scientific and systematic framework in detail.

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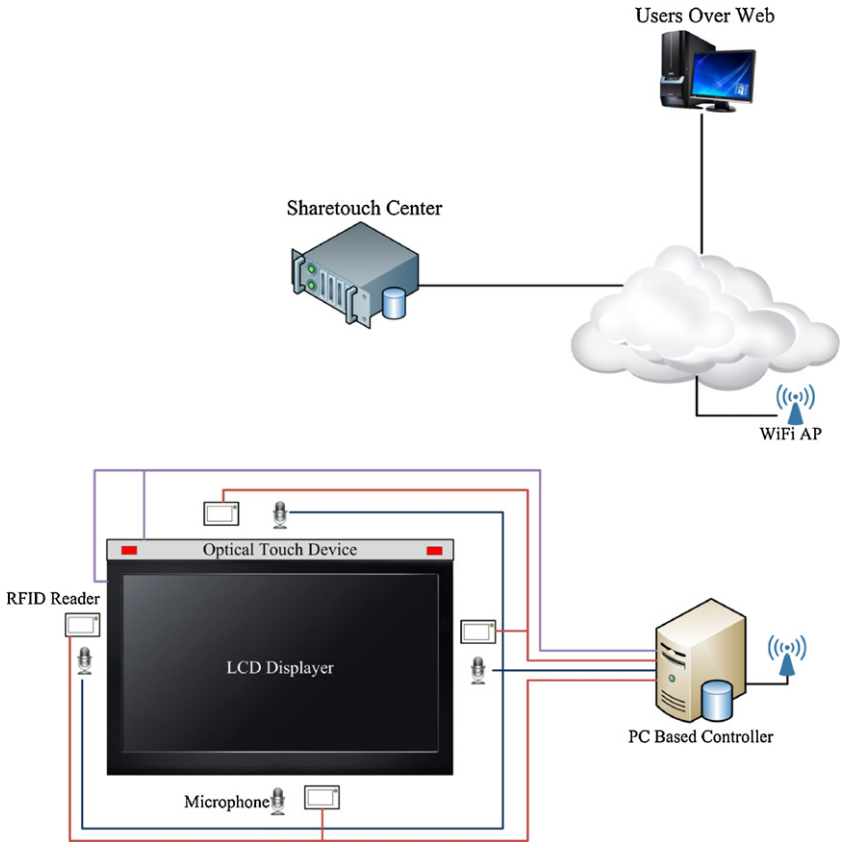

Fig. 1. The hardware architecture of our proposed Sharetouch system.

Hence, the salient point of this research is to give an in-depth depiction and illustration of the Sharetouch system's design. The relevant components of this system, which involves hardware architecture, software architecture, system framework, and equations, are detailed in the following sections.

2. Sharetouch system design

The Sharetouch system is designed to raise users' participation in community events. We put three subsystems into Sharetouch: (1) community pond, (2) Waterball interactive game, and (3) multimedia sharing. In order to implement these subsystems, we combined many technologies and methodologies into Sharetouch, and they will be described in the following subsections.

2.1. Hardware architecture

Sharetouch is based on an optical touch device designed by the Joyplux Company with an infrared LED and camera. This device can support multi-touch functions within a large display area. We cooperated with Joyplux to set up a touch panel with a 52 in. LCD display, which otherwise would have been a huge cost for the capacitive touch panels. We also installed four microphones at the center of the four sides of the LCD display to record and analyze the voices of the users. Four RFID readers for user authentication were placed along each right side. We used a PC-based controller to coordinate the system, and the controller accessed the Internet via a wireless connection. Touch panels are widely used in mobile devices, which provide more convenient user interface for using electronics. We utilize a large touch panel to reduce the inconvenience of Sharetouch for elder users and also the mental resistance of using a computer with a keyboard and mouse. In fact, the design of Sharetouch is similar to normal electronic equipment. It looks like a common table. The elderly can use it without being bias.

The data collected by Sharetouch will be synchronized to our Sharetouch Center via the Internet. This will allow users to retrieve their data through the Internet at their houses. Typically, users will upload their desired sharing objects, like photos or videos, to our Sharetouch Center. Then they can share these objects with friends when using Sharetouch. Fig. 1 displays the hardware architecture and placement of Sharetouch. Fig. 2a and b shows the product views of Sharetouch.

2.2. Software architecture

The software of Sharetouch was developed within XNA and .NET frameworks. We build virtual touch APIs to bridge the real touch APIs from Joyplux by redesigning the API function calls to increase the overall flexibility. In our system, we call the virtual touch APIs instead of native APIs support from hardware. In the future, we replace the Joyplux devices or drivers easily without modifying our Sharetouch software. We can also support more modulated APIs for further development. For example, Joyplux's APIs only support touching two points according to the hardware limitations, but it will pass along the center coordinates when the third point is touched. We can calculate coordinates of the third point by the coordinates of the previous two points and the center by Eq. (1), where $\text{Point}_1 = (X_1, Y_1)$, $\text{Point}_2 = (X_2, Y_2)$, and $\text{Center} = (X_c, Y_c)$. Fig. 3a–c shows the usage concept of community pond, interactive game, and multimedia objects sharing. Fig. 4 shows the overall software architecture of our proposed Sharetouch system. Sharetouch can be separated into hardware and software. Usually, software utilizes drivers and APIs to communicate with hardware. Our software architecture communicates with hardware through

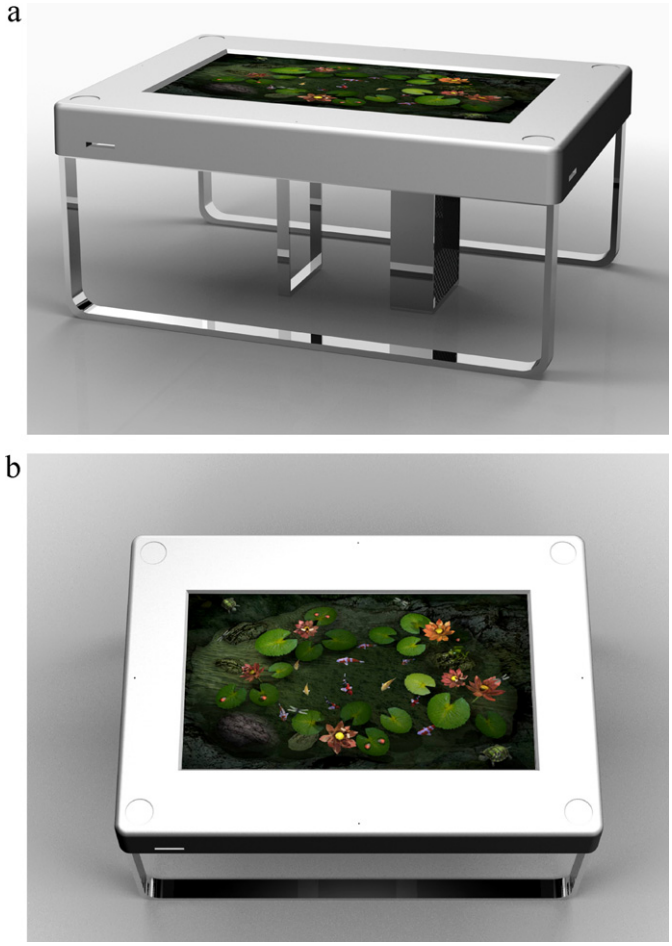

Fig. 2. (a) The product view of Sharetouch from the side. (b) The product view of Sharetouch from the top.

our virtual touch APIs that help software development without caring about hardware configuration.

$$\text{Point}_3 = 3\text{Center} - \text{Point}_1 - \text{Point}_2 \quad (1)$$

2.3. Community pond

We project the users as fish in our community pond. Sharetouch displays all the friends as fish when the users log into the system. Therefore, the number of fish equals the number of friends of the users. This design encourages users to make more friends to increase the number of fish. A user can touch a fish that is represented as a friend to send her/him a message when she/he is offline by making a voice recording using the microphone. Fig. 5a is the snapshot of the community pond and Fig. 5b is the concept map of social networking analysis.

When a user speaks on the community pond, the voice generates a ripple effect to attract other users' attention. The community pond also calculates the source of the voice; the ripple starts from that source. According to Fig. 6, we first capture the volume values from the four microphones. If the top two maximum values of the microphones are Ma and Mb, we know that the voice source must be in the right bottom square. We know that the volume value is inversely proportional to the square of the distance. If Mb/Ma equals 3.16, the voice source could be in the right bottom corner of the screen. We can see that Mb/Ma must be smaller than 3.16

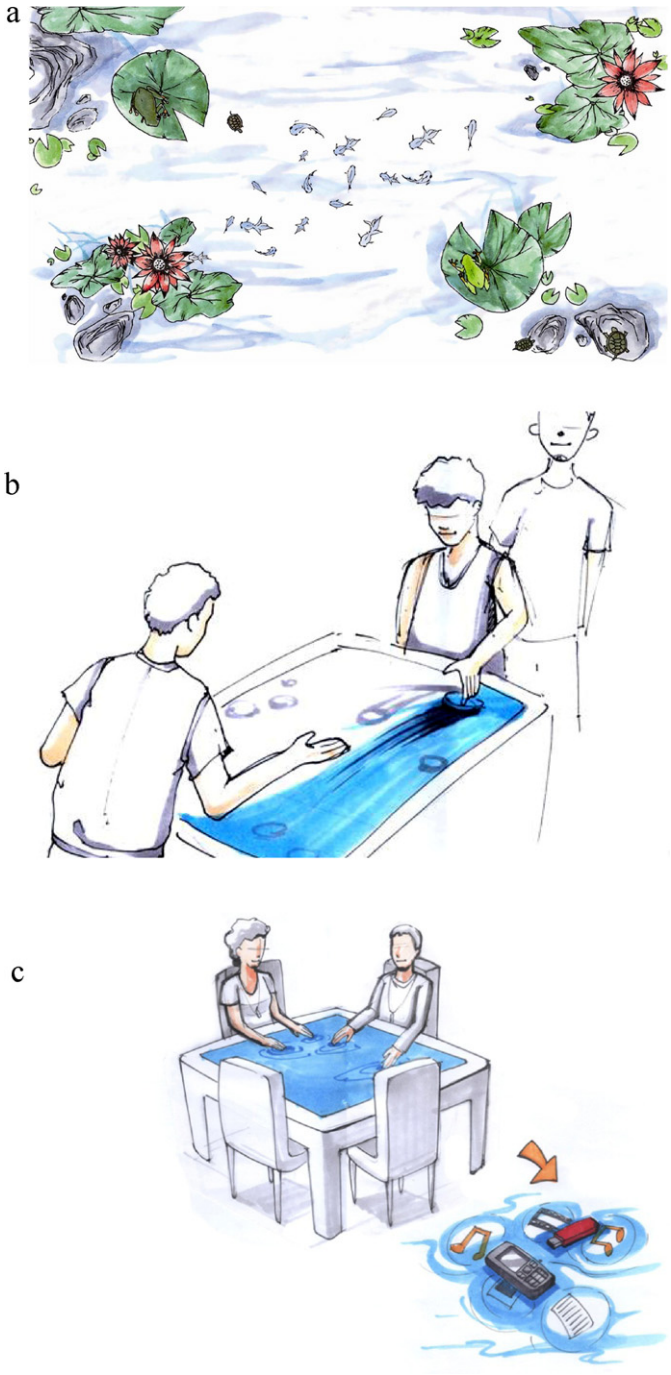

Fig. 3. (a) The usage concept of our proposed community pond. (b) The usage concept of our proposed interactive game. (c) The usage concept of our proposed multimedia objects sharing.

(Fig. 6). And X can be calculated by Eq. (2).

$$X = \frac{-1920\text{Mb} \pm \sqrt{(1920\text{Mb})^2 + 4\text{Mb}(\text{Ma} - \text{Mb})\ \ (960^2 + 540^2)}}{2(\text{Ma} - \text{Mb})} \quad (2)$$

2.4. Interactive game: Waterball

Waterball is a game that combines virtual images and real objects. The concept is based on the Nintendo Wii games, as players hold controllers (real objects) to play the games (virtual images).

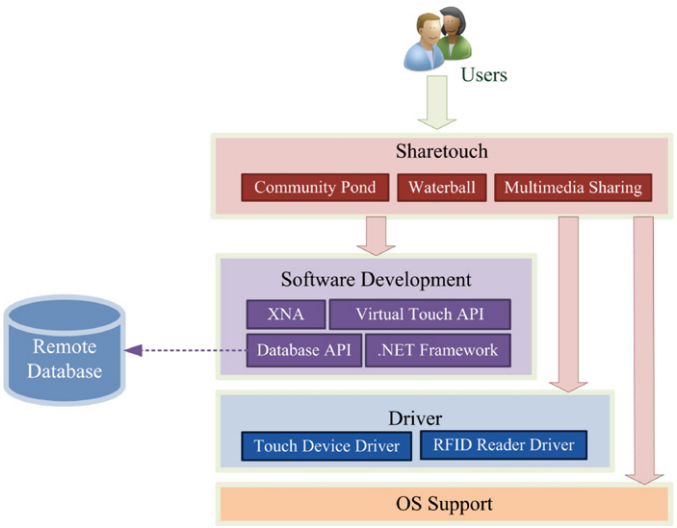

Fig. 4. The software architecture of our proposed Sharetouch system.

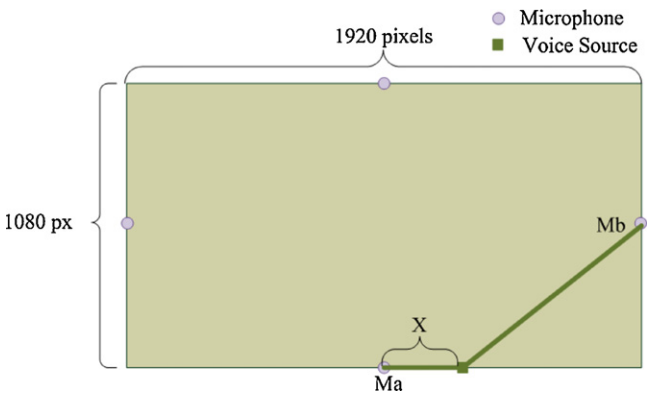

Fig. 6. The concept of calculating the ripple's starting point according to the voice source.

Waterball is similar to air hockey. We changed the surface into a pond to match the setting of the Sharetouch system. Users hold push plates (real objects) on the touch panel to push the turtle shells (virtual images). The force and direction of the users' arm waving will influence the speed and direction of the turtle shells. We captured the coordinates at 0.05 s to calculate the vector of the push plate movement. The vector contains the direction and the value of the force. The movement of the turtle shells can be easily calculated according to physics formulas. Waterball is only one concept for an interactive game. Sharetouch could be used to develop many interactive games to attract users. Fig. 7 is a photo of two elderly people playing Waterball.

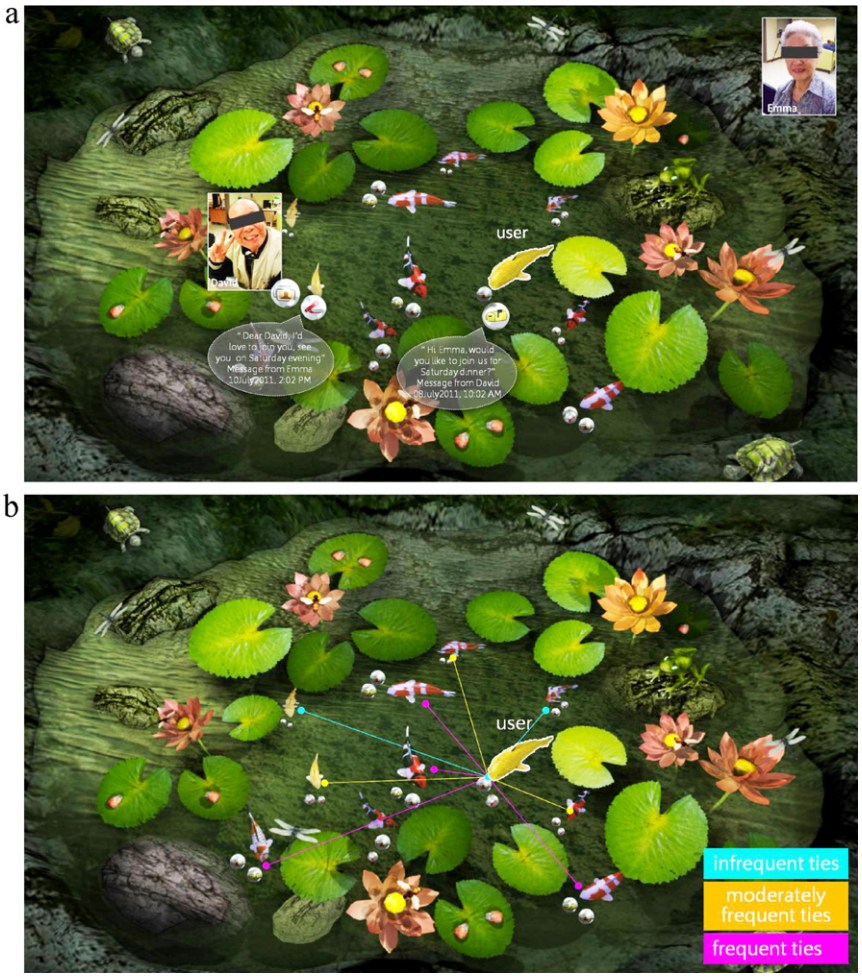

Fig. 5. (a) A snapshot of the community pond. (b) The concept map of social networking analysis.

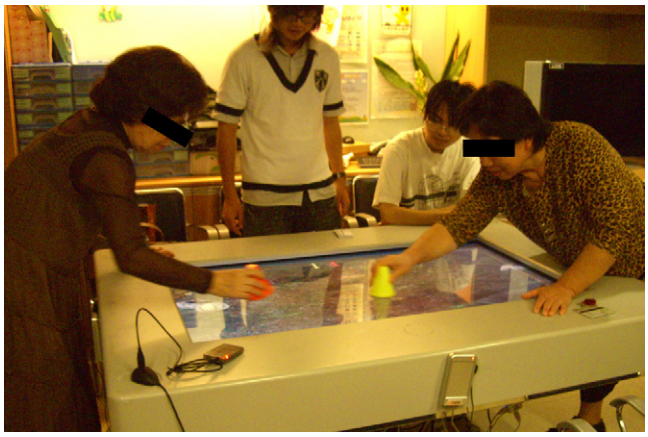

Fig. 7. Two elderly people play the interactive game Waterball.

2.5. Multimedia sharing

The concept of multimedia sharing is based on the Microsoft Surface Project. Users can utilize the power of touch panels to enlarge, rotate, and move multimedia objects. We added some new concepts that are different from Surface to enrich the users' experience of the multimedia object sharing. Sharetouch is designed for four or more people to use. Users can easily display or share their photos or videos with others by dragging them toward a user on Sharetouch. Imagine the scenario in which the users, who recently completed a trip together, can easily discuss and recall the trip by looking at the photos displayed on the Sharetouch. They can also exchange the photos or videos with their friends.

We also apply the cloud flash drive concept to Sharetouch. Users often need to carry flash drives or cards to store multimedia objects, which is tiresome for some users. Sharetouch has a user authentication mechanism that uses an RFID reader. Therefore, we can easily use the cloud file system concept in combination with the RFID card. Users need only use the RFID cards to log in to the Sharetouch system, and it will display the multimedia objects on the touch panel. Users can then upload their multimedia objects to our cloud file system (Sharetouch Center in Fig. 1) using their desktops or laptops and enjoy sharing these objects on the Sharetouch with their best friends. Fig. 8 is a screen shot of the multimedia sharing.

3. User validation

This study applied the TAM measure to the context of Sharetouch participation and measured its validity in this social platform. The Sharetouch validation was conducted in a senior housing community, Taoyuan Taiwan. There were 52 voluntary participants, about one-eighth of the senior community, with 17 males and 35 females, ranging in age from 64 to 91 years old, with an average age of 79. None of them had prior experience in multi-touch and tangible technologies. Prior to participating, each participant signed a consent form. The validation session had two parts: interacting with Sharetouch followed by a TAM questionnaire. After a short demonstration conducted by the researchers, the participant was required to interact with three subsystems of Sharetouch: community pond, Waterball interactive game, and multimedia sharing. Each evaluation session lasted for 10 min. This study replicated the key propositions of the TAM in the context of Sharetouch, focusing on those older participants' perspectives and future intention to take part in the Sharetouch social platform. The TAM measure comprises six key variables: Intention to Use, Perceived Usefulness, Perceived Ease of Use, Enjoyment, Output Quality, and Result Demonstrability to adopt the Sharetouch in question. All items were measured on a 7-point Likert scale ranging from "strongly disagree" to "strongly agree". The summary of hypothesis tests is listed in Table 1. Our findings indicated that all proposed hypotheses had a positive and significant impact on the intention of older people to interact with Sharetouch, as shown in Table 1. The results of the TAM measures were also used to examine the relationship between gender of the senior participants, perceptions of user acceptance and satisfaction, and their future likelihood of participation (Table 2). In Table 3, we extended the TAM by including the different age groups and investigated the moderating role of age in the TAM process of predicting the users' intention of further participation.

With respect to gender difference, the results revealed that the test of homogeneity of variance is not significant, and there were no gender differences among the 17 males and 25 females (Table 2).

Additionally, in terms of age difference, it is expected that the effect of age on the TAM plays a significant role in decisions about technology acceptance and adoption. The 52 participants were divided into 3 age groups: 65–74 (the young–old), 75–84 (the old–old), and those aged 85 and over (the oldest-old). The analysis of variance (ANOVA) indicated that there is no significant difference between the three groups as presented in Table 3. However,

Fig. 8. A screen shot of multimedia sharing.

Table 1
Summary of hypothesis tests and Subjects' distribution (%) for each item in Sharetouch ($n = 52$).

	Hypothesis	Measures	*Mean*	*SD*
H1	Intention to Use has positive impact on intention of older people using Sharetouch.	M1. Using "Sharetouch" improves the quality of interacting with others.	6.12	1.59
		M2. Using "Sharetouch" enhances my ability to interact with others.	5.46	1.71
H2	Perceived Usefulness has positive impact on intention of older people using Sharetouch.	M3. I find "Sharetouch" helps me interact with others.	5.38	1.39
		M4. Using "Sharetouch" enhances the interaction with others.	5.21	1.50
H3	Perceived Ease of Use has positive impact on intention of older people using Sharetouch.	M5. My interaction with "Sharetouch" is easy for me to understand.	5.37	1.30
		M6. I find it is easy to learn to use "Sharetouch."	5.51	1.44
		M7. Overall, I find "Sharetouch" easy to use.	5.17	1.41
		M8. I find it easy to get "Sharetouch" to do what I want it to do.	5.23	1.30
H4	Enjoyment has positive impact on intention of older people using Sharetouch.	M9. I find it WILL be interesting using "Sharetouch."	5.19	1.62
		M10. It is a pleasant time when using "Sharetouch."	4.88	1.13
		M11. I find it interesting after using "Sharetouch."	6.15	1.09
H5	Output Quality has positive impact on intention of older people using Sharetouch.	M12. If I got a chance, I would use "Sharetouch."	6.15	1.06
		M13. If you gave me "Sharetouch," I would definitely use it.	5.35	1.45
		M14. Overall, I am satisfied with the quality of "Sharetouch."	6.00	1.55
		M15. I have no doubt about the quality of "Sharetouch."	6.06	0.99
H6	Result Demonstrability has positive impact on intention of older people using Sharetouch.	M16. I am glad to share the benefits of "Sharetouch" with others.	5.62	0.96
		M17. I will exchange the experience of using "Sharetouch" with others.	5.19	1.24
		M18. I find it hard to distinguish between advantages and disadvantages.	3.77	1.94

the mean of the majority of variables shows that oldest-old participants tend to have lower scores on the TAM measure. Compared to the young–old group, the old–old and the oldest-old participants had the lower self-efficacy and least favorable attitude in predicting perceptions of enjoyment in using technological devices such as Sharetouch (i.e., M9). It had a positive impact on the future intention to use Sharetouch after using the system (i.e., M9 and M10). In addition to 'enjoyment', these age differences did not affect the relative importance of the factors affecting users' intention of using Sharetouch, represented by Intention to Use, Perceived Usefulness, Perceived Ease of Use, Enjoyment, Output Quality, and Result Demonstrability, as outlined in the TAM (Table 3).

Table 2
Gender difference for each item in Sharetouch ($n = 52$).

Item	Male		Female		*t* test	
	Mean	*SD*	*Mean*	*SD*	*t*	*p*
M1.	5.24	1.39	5.46	1.69	5.24	1.39
M2.	5.00	1.66	5.31	1.75	−0.47	0.64
M3.	5.06	1.52	5.51	1.31	−0.62	0.54
M4.	5.24	1.48	5.17	1.52	−1.11	0.27
M5.	5.35	1.32	5.59	1.31	0.14	0.89
M6.	5.24	1.68	5.14	1.33	−0.61	0.55
M7.	5.59	1.42	5.06	1.39	0.22	0.83
M8.	5.65	1.17	4.97	1.32	1.28	0.21
M9.	5.00	1.55	4.83	1.67	1.80	0.08
M10.	5.82	1.07	6.31	1.13	0.35	0.73
M11.	6.06	0.97	6.20	1.16	−1.49	0.14
M12.	5.94	0.90	6.20	1.13	−0.43	0.67
M13.	5.53	1.18	5.43	1.58	−0.82	0.41
M14.	5.41	1.62	5.31	1.53	0.23	0.82
M15.	5.82	0.95	6.09	1.01	0.21	0.83
M16.	6.00	0.79	6.09	1.04	−0.89	0.38
M17.	5.47	1.23	5.69	1.25	−0.30	0.77
M18.	4.00	1.80	3.66	2.01	−0.58	0.56

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Table 3
Age difference for each item in Sharetouch ($n = 52$).

ANOVA								
Variables	Age 65–74 ($n = 14$)		Age 75–84 ($n = 28$)		Age $\geqq 85$ ($n = 10$)		F	p
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*		
M1.	5.79	1.31	5.50	1.45	4.50	2.07	2.17	0.13
M2.	5.71	1.20	5.25	1.73	4.40	2.07	1.80	0.18
M3.	5.64	1.22	5.11	1.59	5.70	0.82	1.06	0.35
M4.	5.00	1.57	5.18	1.63	5.50	0.97	0.32	0.73
M5.	5.69	1.03	5.46	1.45	5.40	1.26	0.17	0.84
M6.	5.21	1.53	5.07	1.51	5.40	1.17	0.19	0.82
M7.	5.29	1.54	5.21	1.40	5.20	1.40	0.01	0.99
M8.	5.36	1.22	5.18	1.25	5.00	1.63	0.22	0.81
M9.	5.29	1.73	4.93	1.39	4.11	2.03	1.49	0.24
M10.	6.36	1.08	6.18	1.02	5.80	1.48	0.72	0.49
M11.	6.07	1.14	6.25	1.00	6.00	1.33	0.24	0.79
M12.	6.29	0.83	6.14	1.08	5.80	1.32	0.62	0.54
M13.	5.93	1.07	5.25	1.65	5.40	1.26	1.04	0.36
M14.	5.71	1.07	5.36	1.66	4.80	1.75	1.02	0.37
M15.	6.29	0.91	5.86	1.04	6.00	0.94	0.87	0.43
M16.	6.14	1.17	5.93	0.90	6.30	0.82	0.62	0.54
M17.	6.00	1.11	5.39	1.40	5.70	0.82	1.16	0.32
M18.	4.50	2.07	3.43	1.69	3.70	2.31	1.46	0.24

$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

4. Conclusions

The Sharetouch system is designed to raise users' participation in community events through the sub-systems of the community pond, the Waterball interactive game, and multimedia sharing. We utilize the optical LED touch technology and large LCD displayer to help users enjoy the pond scenario. We also apply the concept of the cloud flash drive to eradicate the tiring need to carry around a flash drive. Unlike a computer-based system, Sharetouch is created as an easy-to-use interface system. Sharetouch can enrich the users' social network experience through its hardware and software architecture.

Such usability issues are also critical to older adults in measurements of a new technological device. The term usability is often used to refer to the measurements of system/device performance, acceptance, and suitability. Accordingly, TAM was adopted as a user evaluation method in this study, and the results of the TAM measure offer some meaningful insights and practical implications for the next stage of the project. However, there is no doubt that a user is the core of usability assessments. Each person who has participated has shown his or her unique physical and psychological barriers and life experiences. This research would be meaninglessness without the concern for people and issues. For this reason, it is necessary to involve people in the field of technology outcome measures and for further evaluation.

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