The Report Committee for I-Hui Liou
Certifies that this is the approved version of the following report:

A Case Study of Designing a Mobile App Prototype for Seniors

APPROVED BY
SUPERVISING COMMITTEE:

Min Liu, Supervisor

Eric Nordquist

A Case Study of Designing a Mobile App Prototype for Seniors

by

I-Hui Liou

Report

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Arts

The University of Texas at Austin

May 2019

Dedication

To my family, thank you for supporting my dream and teaching me what love means. To my friends, thank you for making my stay in Austin a great journey. To my love, Dale, thank you for always encouraging me to pursue the life I want and taking the adventure with me.

Acknowledgements

I would like to express my gratitude to Dr. Liu and Dr. Nordquist for taking the time to read this report and to offer invaluable feedback. I appreciate their support, encouragement and enlightenment during my learning at the University of Texas at Austin. Thank you, Dr. Liu, for your kind advice on my academic performance and career development through my time in the Learning Technologies program. I enjoyed the learning opportunities in your classes and the Alien Rescue team. Dr. Nordquist, thank you for your expert advice on the usability testing methods and user interface design. I was inspired to know the fun of studying user experience through taking your course. I offer my sincere appreciation for the learning opportunities provided by my committee.

Abstract

A case study of designing a mobile app prototype for seniors

I-Hui Liou, M.A.

The University of Texas at Austin, 2019

Supervisor: Min Liu

As technology has advanced rapidly over recent decades, the aging population has also grown. Therefore, the importance of addressing senior users' needs in using and learning technology deserves attention from the government and industry. There have been websites and mobile applications designed for senior learners to take online courses, join online discussions or make friends. However, there are limited mobile apps for seniors to acquire information, while connecting to others online. To fill the gap, this report explores the design considerations that should be taken into account to facilitate seniors to better use of technology. A mobile app prototype, Chatlet, was developed to illustrate the ideas of a mobile app that might interest seniors. To evaluate the design features, a case study on four seniors between 56 and 76 years old was conducted through interviews and usability testing. The findings indicate that seniors are motivated to use mobile apps mostly for getting information and communication, and one's self-efficacy with technology could impact their selection of online activities. It is recommended that a senior-friendly mobile app be responsive to users' actions on the app, have availability of technical support and clearly present the purpose of the app. Further details about design

recommendations on mobile apps for seniors and pedagogical implications are discussed within the report.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

By 2050, over 20% of the world population will consist of people ages 60 and older (Passel & Cohn, 2008). As technology has been advancing over the past few decades, its application has become more prevalent in human lives, being used by people of different ages. The aging population and fast development of technology indicate the crucial need to engage seniors in the using, learning, and designing information and communication technology (ICT) (Orzeszek et al., 2017).

The use of technology has become more common among the elderly these days. The fastest growing group of people online recently are people age 50 and above, mostly active on social media, resulting in *Gerontechnology*, a field blending gerontology with technology (Burkhardt, 2016). According to Anderson and Perrin (2017), "around four-in-ten (42%) adults ages 65 and older now report owning smartphones, up from just 18% in 2013… [and] "Today, 67% of seniors use the internet – a 55-percentage-point increase in just under two decades" (p.1). It is critical to design and develop technology for the elderly (Burkhardt, 2016).

Literature shows that technology use (e.g. Fokkema & Knipscheer, 2007; Shapira et al., 2007) and participation in online communities (Nimrod, 2010, 2014, & 2018) can improve seniors' quality of life and mental health by enabling them to connect with society and cope with the challenges that come with retirement or aging (e.g. low self-confidence and loss of significant others). There are online discussion forums and websites for senior users to get new information (e.g. SeniorNet.com, and AARP.org) and connect with others (e.g. Connected Living and OurTime). However, there appears to be very limited mobile apps for seniors to acquire information while participating in social interactions online.

Problem Statement

Most of the currently available mobile apps for seniors are designed for seeking new relationships and making new friends (e.g. OurTime) or information of events (e.g. Senioricity), while some are only available in the form of non-responsive websites (e.g. Stitch and Senior Forums). There seems to be a lack of mobile apps for seniors to informally get information about their interests, while participating in online communities.

The Purpose of this Report

The goals of this report are to: (a) provide an overview of how technology can enhance seniors' quality of life; (b) examine the design principles of user interface (UI) and user experience (UX) of applications targeted for senior users; and (c) design a mobile app providing seniors with access to get information of interest and connect with others online.

Research question.

With the objectives of engaging seniors in getting information of interest in an online community format, the research question will focus on: What design principles should be considered when designing a mobile app for seniors?

This research question will be answered by reviewing the available literature and analyzing the data collected from a case study of four seniors. This report is organized into six chapters. Following this introductory chapter, chapter 2 of this report reviews the literature on the role of technology in seniors' lives, the UI and UX design principles for the elderly, and instructional principles for seniors. Chapter 3 introduces Chatlet, a mobile app prototype, and the design rationale, while also documenting the development process of prototypes. Chapter 4 presents the procedure and participant recruitment of usability testing. Chapter 5 presents the findings of interviews and usability testing.

Chapter 6 discusses the implications of the findings and provides recommendations for designing mobile apps for senior users. Limitations and future research direction are also identified.

Chapter 2 Literature Review

This chapter reviews the research findings on the issues relevant to seniors and technology use and learning. There are five sections including (a) benefits to seniors of technology use and learning; (b) motivation for seniors' technology use; (c) benefits for seniors of participating in online communities; (d) UI design principles for seniors; and (e) pedagogical implications for teaching seniors about technology.

Benefits of Technology Use and Learning to Seniors

Studies have shown that using technology can increase seniors' quality of life and their well-being. Using technology has been found beneficial to seniors' mental health, such as bringing them more positive feelings and emotions (Fokkema & Knipscheer, 2007; Shapira, Barak & Gal, 2007).

Technology and mental health.

It is observed that senior users initially feel anxious about technology. Many seniors have anxiety about using a computer, but the level of anxiousness decreases after they gain experience using it (Watering, 2005). Forsman and Nordmyr (2017) conducted a meta-analysis on the links between Internet use and mental health among older adults. It was identified by the researchers that the electronic communications help seniors maintain and increase contact and communication with their existing network, as well as connecting with new people. Furthermore, the experience of being a competent ICT user could be a reason why many participants wanted to learn more about using technology. Forsman and Nordmyr's findings (2017) demonstrated that an Internet-at-home intervention experiment decreased loneliness among chronically ill and physically handicapped older adults. The participants were introduced to the use of a computer and the Internet. It was found that the intervention decreased the feeling of loneliness through

offering people a connection with the outside world. It also had a positive effect on increasing their self-confidence when learning the Internet, demonstrating that using the Internet enables the participants to pass the time meaningfully and took their minds away from the loneliness.

On the other hand, the impact of seniors' self-efficacy in technology use and learning cannot be ignored. According to Bandura (1977), self-efficacy is an individual's belief and confidence in one's ability at using internal and external resources to control situations that have significance for them. Perceived self-efficacy affects people's choice of activities, how much effort they spend, and how long they persist when encountering obstacles (Bandura & Adams, 1977). "The stronger the perceived self-efficacy, the more active the coping efforts" (Bandura & Adams, 1977, p.288). The potential impact of self-efficacy on seniors' lives has been demonstrated. Leung and Liu (2011) identified the relationships between lifelong learning, quality of life, and self-efficacy of older Chinese adults aged 60 and over by studying 1,003 participants' questionnaires. Karavidas, Lim and Katsikas (2005) identified the good impact of seniors using computers in a way that computers gave seniors opportunities to establish social connections that can decrease loneliness and alienation. Computer and Internet use serve as a medium for seniors to stay engaged in topics in which they are interested, and connect to a network of other retirees with similar interests. The authors found that elderly people who were more computer-savvy are more satisfied with their lives. This satisfaction is due to higher self-efficacy and lower computer anxiety as users learn more about computers (Karavidas et al., 2005). The research findings aforementioned have indicated that self-efficacy and lifelong learning are determinants of one's positive mental health.

Technology and better quality of life.

It has been proved that using ICT can improve older adults' quality of life. On the other hand, seniors' attitude toward technology use can influence their well-being. Nimrod (2018) explored technophobia, Internet use patterns, and well-being among older users. It was found that technophobia was significantly and negatively associated with the well-being of older ICT users. The author suggested that to reduce the technophobia of older ICT users, they could be encouraged to be selective in their online activities, focusing more on interpersonal communication and less on the consumption of old media (e.g. radio, newspapers, films, etc.). Shapira et al. (2007) tested the hypothesis that the use of computers and Internet could reduce older adults' depression and loneliness and increase satisfaction with life, while also providing more control in their life quality. It appears that computer and Internet use seem to contribute to older adults' well-being and sense of empowerment. The participants reported four key beneficial factors during the learning process: (a) learning something new and receiving positive feedback from people around them; (b) enhancement of interpersonal communication; (c) sense of involvement; and (d) positive feelings when using the Internet. The positive emotions described by the elderly include general happiness, satisfaction, fun, a sense of control, and success. According to the aforementioned findings, technology use and learning play a positive and facilitative role in seniors' lives.

Seniors' Motivation to Use Technology

To further understand what motivates seniors to use technology, an examination of previous studies reveals that the factors are primarily related to a real and perceived benefit to seniors' lives (e.g. Blankson, 2018; Burmeister, 2012; Xie, 2007). Evidence shows that the motivation of seniors to learn or use technology depends on the usefulness of the technology to their lives, such as an impact on their health, social connections, quality of life, etc. (Blankson, 2018). The common reasons for seniors to use and learn

technology include communicating with friends and family (Morris, Goodman, & Brading, 2007), keeping up with technology (Naumanen & Tukiainen, 2008), and suggestions by peers or loved ones (i.e. children and/or grandchildren) (Ito, O'Day, Adler, Linde, & Mynatt, 2001; Naumanen & Tukiainen, 2007; Xie, 2007). Specifically, it was found that social connection plays an important role among the reasons why seniors use and learn technology.

There is one track of research discussing how seniors view online communities. Burmeister (2012) found that what seniors value about online community include (a) belonging to a community of peers; (b) exchanging information and supporting each other; (c) having interaction with peers in a similar way to interaction with their neighbors; and (d) having personal contact with their online friends. Similarly, the value of online community was emphasized by Ito et al. (2001). According to the researchers, social interaction is an attractor to the seniors' online interests, and the notion of online access cannot be restricted simply to the access to equipment, the Internet, or learning how to use technology, but it is also important for seniors to engage in a place where they have a sense of belonging and being themselves.

In addition to the research findings, an examination made on the current products and services for seniors in the industry also indicates the needs and motivations of senior users. It appears that most of the hardware and software targeting senior users feature with functions of communication, entertainment, news, and knowledge. More details will be provided on the competitive analysis of products in Chapter 3.

Benefits of Engaging in Online Communities to Seniors

The literature has shown the benefits to seniors of engaging in online communities. According to Harley, Howland, Harris and Redlich (2014), community participation helps to decrease social isolation, which is often experienced by seniors in

developed countries who are more likely to live independently, away from their family and friends. Four elements were identified to motivate both local and online community engagement. They are (a) family; (b) roles in the community; (c) the loss of significant roles in life and failing health and mobility; and (d) spaces and places to be together. The researchers explained that greater online community engagement could shift seniors' exclusive focus on one thing by increasing opportunities to learn with peers. According to Nimrod (2010), online communities serve as a platform to discuss every topic, including private and public, as well as serious and casual. Nimrod examined 14 communities across the US, UK, Canada, and Australia and found that the more commonly discussed topics include: (a) fun online (e.g. game, jokes, riddles); (b) retirement (e.g. retirement rights, pension, relocation); (c) family (e.g. spousal relationship, parenthood, grandparenting); (d) health (e.g. sickness—medical conditions, medicines; wellness—nutrition, beauty); and (e) work and study (e.g. occupations for retirees, jobs, and courses) and recreation (recommendations of books, films, shows, and TV programs). Online communities are found to serve as immediate and affective support for seniors and casual social interactions and intellectual input.

In 2014, Nimrod investigated the benefits and constraints of seniors' participation in online communities based on an online survey taken by 218 members of 16 English-based online communities of seniors' (55-75 years old). The participants expressed that the benefits from the online communities include (a) service (i.e. being able to help others and make contributions); (b) self-expression (i.e. a sense of openness and self-disclosure); and (c) companionship (i.e. making friends and depending on other participants for information and emotional support). The findings implied that the online communities provide immediate support, as well as comfortable social interactions. It was claimed that members of similar age and from different places or countries were

perceived as a significant advantage for the online community. Thus, Nimrod (2014) proposed that seniors should be informed about online communities and be encouraged to participate in them. Specifically, the promotion can be done by (a) introducing the communities to older adults who are already using computers and the Internet; and (b) engaging public relations and advertising to reach the seniors who already use the Internet.

UI Designs for Seniors

The characteristics of younger learners have been the basis of most UI designs (Morris, 1994). However, the needs of older adults should also be considered given that there are unique use cases in this group. Design principles have been identified for the UI for senior users, such as the selection of font styles, icons, and color. Baharum et al. (2017) identified the importance of (a) high contrast; (b) larger font; (c) easiness to click; (d) a better balance of usefulness, style, and personalization, and (e) simplicity of navigation regarding the design for seniors. Kobayashi et al. (2011) evaluated 20 elderly users' interactions with a mobile touch screen and found that (a) mobile touchscreens were generally easy for the elderly to use; (b) interactive objectives such as buttons, icons, and clickable texts should be larger than a minimum of 8 mm; (c) visual feedback indicating where the users should touch the screen was important; and (d) not only the size of the screen, but also the portability of mobile device, is a concern of the users.

The usability of technology for seniors has also been a crucial design issue. According to Nielsen (2013), some people tend to retire later, and older people are healthier than they used to be. So it is necessary to consider senior users when designing applications because many companies now have growing numbers of employees over 65. Nielsen and his team conducted two rounds of usability testing on 46 websites with 77 seniors aged 65 or older to evaluate the websites' usability. Each round had a control

group of 20 users aged 21 to 55. It was found that 45 percent of the seniors showed behaviors indicating that they were uncomfortable trying new things or hesitant to explore, and seniors were twice as likely to give up on a task. It was proposed to offer supportive design (e.g. noting the links that users have visited) and avoid navigation changes (e.g. half of the participants say that they keep a list of the steps and instructions about how to use websites they need or often visit).

As for the guidelines for designing mobile apps for seniors, there are common guidelines similar to those for website design, but some are more specific to mobile app design. Levdikova (2017) identified the following key design principles: (a) avoid complex navigation elements; (b) keep high contrast between text and background; (c) use San Serif font style (e.g. Arial and Verdana); (d) save sufficient space between text and icons to enable users to tap correctly; and (e) avoid overusing interaction elements which might slow down the interaction between the user and the app.

When it comes to senior users, the simplicity of UI design and navigation have been often emphasized in order to build the users' confidence in technology use. Hazari (2012) pointed out that the market for apps is usually for the younger generation growing up with technology and feeling ease to use mobile devices. It is worthy to note that older users may have technology anxiety when using mobile devices, so having a good support system (e.g. family) could result in a more positive attitude of the elderly toward technology. He emphasized that an app must be easy to use and have other features that appeal to seniors. As he mentioned, usability plays an important role not only to help the elderly navigate the app, but also provide the self-efficacy. A few design principles are suggested by Hazari (2012) including: (a) use minimal design to reduce the cognitive load of elderly users; (b) give clear instructions (preferably text-based) with help screens prominently displayed; (c) use simple navigation (e.g. function of back, forward buttons,

or Menu buttons); (d) provide feedback when an action is taken; and (e) provide a sense of accomplishment when a task is completed to promote self-efficacy.

Exploring the presentation of technical instructions, Dipl-Psych, Wandke and Blessing (2006) investigated seniors' experience using instruction manuals for mobile phones. They interviewed 20 senior users aged 58 to 80 of a mobile phone manual to understand how they used and evaluated mobile instruction manuals. The participants reported that their demands for a clear manual include (a) complete and step-by-step description on what to do for basic functions; (b) short instruction; (3) pictures and diagrams; (c) explanation of every action with corresponding changes; (d) separate instructions for basic and advanced functions; (e) use of the same starting point; and (f) explanation of displayed symbols. In addition, it was suggested that video-based training is better than written instruction manuals to senior users.

In general, the aforementioned studies have made a clear need for an UI design for senior users of websites and mobile apps. Most of the design principles for seniors share the similar guidelines of using certain font style, larger font size, sufficient space among icons, simple navigation, limited interactions, and clear technical instructions.

Pedagogical Implication for Teaching Seniors Technology

Studies on the interventional effects of teaching seniors to use technology show that the role of peers (e.g. Burrows, Mitchell, & Nicolle, 2016; Xie, 2007), sufficient processing time (e.g. Naumanen & Tukiainen ,2007, 2008) and clear instructions (e.g. Naumanen & Tukiainen, 2007) are key elements to be considered. Xie (2007) identified the nature of seniors' learning of technology that older adults tend to have more difficulties learning technology and require more time and assistance than younger adults due to age-related physiological and psychological factors. These difficulties and

differences can more or less be accommodated by senior-friendly technological and educational systems.

In the classroom setting, Orzeszek et al. (2017) analyzed an entry-level course consisting of two four-hour modules teaching 24 seniors (aged between 60 and 80) UI, UX, and prototyping in order to understand seniors' conceptual models of technology. It was found that abstract thinking abilities, learner motivation, self-confidence, and the presence of a role model should be better addressed when teaching seniors technology skills. The authors proposed guidelines for teaching seniors abstract technology related concepts by starting with abstract thinking exercises and providing a role model of elderly professionals to motivate the seniors to learn.

Examining the stance of instructors, Naumanen and Tukiainen (2007) conducted an ethnographic study of 28 participants, aged 52 to 74, in Finland of two 20-hour elementary computer courses of computing. The participants were all retired and took the course due to their loved ones (i.e. children and/or grandchildren). The findings indicated that the elderly need more time, a structured outline, and instructions. The authors provided the following teaching principles and suggestions for course design: (a) peer-tutoring can be a favored motivating factor for seniors to learn technology; (b) having more than one teacher to make sure every student keeps up the pace; (c) moving at a pace suitable for the seniors is crucial; (d) creating a good learning climate by valuing their learning and having interaction during the learning process; and (e) engaging seniors in designing course to better understand their needs. In their study in 2008, Naumanen and Tukiainen proposed that offering cues, reminders, and navigational aids can support senior users' working memory.

Extending learning beyond the classroom, Xie (2017) proposed the needs of prolonged and ongoing learning of IT for older adults instead of a short period of

training. By interviewing 33 older adults at the age of 55 to 79, the researcher found that the elderly peers could better understand the older learners' pain points than younger IT professionals, and thus encouraged older learners to learn. Pedagogically, the author suggested that the creation of a peer supported atmosphere and continuous learning were important to older adults, since their needs of learning, practice, and assistance would not stop after the end of the training sessions offered by learning institutes.

In out-of-classroom settings, Burrows et al. (2016) investigated 24 seniors' first interaction with a new product (i.e. Out-of-box experience) to understand their user experience of technology in their home environment. The authors stated that other people (e.g. friends and family) played an important role in motivating senior users' take up of new technology. They are also considered as technical and emotional support to the seniors coping with their frustrations with technology. Also, the co-experience with peers was important to provide encouragement and support to seniors to use new and unfamiliar technology. Overall, it has been indicated that having age-similar peers, a positive learning climate, and clear instructions on technology operational steps can facilitate to motivate seniors technology learning and use.

Summary

Based on the literature review, the research findings have highlighted (a) benefits to seniors of technology use and learning; (b) motivation of seniors' technology use; (c) benefits to seniors of participating in online communities; (d) UI design principles for seniors; and (e) pedagogical implications for teaching seniors technology. It is shown that using and learning technology are beneficial to facilitate seniors' mental health, promote quality of life, and senior users' self-efficacy of technology influence their motivation and attitude to use technology. Seniors are mostly motivated to use and learn technology if it is useful and helpful to their lives. The engagement in online communities has been

identified to be beneficial to seniors by connecting them to society and providing them with affective support. The need of designing user interfaces for seniors has been emphasized. It is revealed that most designs are based on the younger generation without carefully addressing the needs of senior users. As for the pedagogical implications for teaching seniors technology, the roles of peers, self-confidence, sufficient processing time, and clear instructions are considered crucial to seniors. In short, technology has been identified to be useful to seniors in many ways, and there has been a crucial demand to develop designs addressing senior user needs.

However, to the best of the current author's knowledge, there is limited exploration on the design of mobile apps for senior users to facilitate getting the information in which they are interested by participating in online communities. Therefore, the next chapters are going to fill this gap through designing a mobile app prototype for seniors and evaluating what might work for senior users.

Chapter 3 Prototype Design of a Mobile App for Seniors

This chapter introduces Chatlet, a mobile app prototype for seniors, elaborates the design rationale given the literature review in Chapter 2, and presents a competitive analysis, as well as the process of designing and developing the mockup.

Introduction to Chatlet

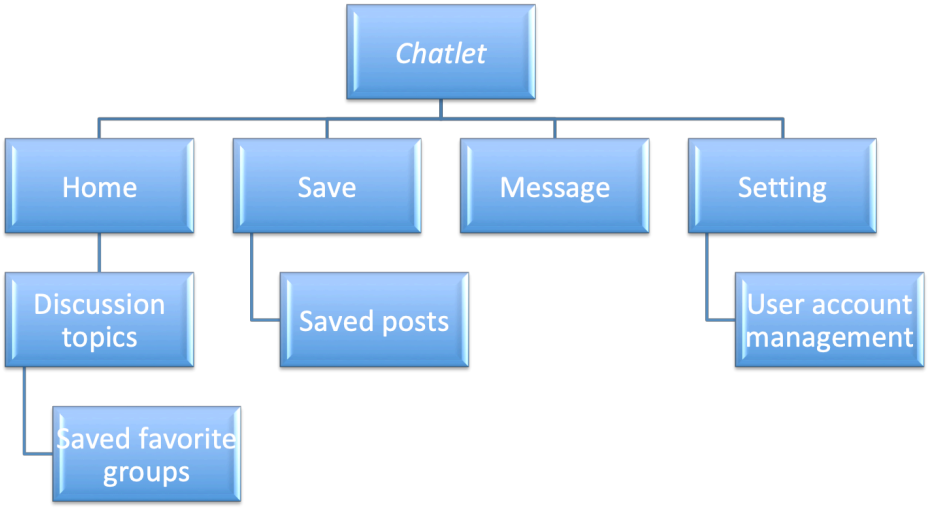
Chatlet is a mobile app designed to enable seniors to acquire information of interests to them in an online community format. This section introduces the objectives of Chatlet, its features, and the design elements I took into consideration.

Design rationale.

The primary features of this mobile app include enabling users to (a) select their topics of interest to read more information, (b) save their favorite groups, (c) save a post for later reference, (d) message others, and (e) set up a user account. Figure 1 shows the information architecture of Chatlet. Through acquiring and sharing information and having online interactions, the users can experience a sense of belonging and support as they intake new knowledge (Burmeister, 2012; Ito et al., 2001; Nimrod, 2014). Smartphones are selected to be the target devices for Chatlet because it has been shown that this is a commonly used electronic device by seniors (Anderson & Perrin, 2017).

Figure 1

Information architecture of Chatlet



For the user interface, simplicity and clarity are the priorities considered to provide senior users with easy navigation and reduce possible cognitive overload based on the literature review (Burmeister, 2012; Levdikova, 2017; Ito et al., 2001; Nimrod, 2014). Visual cues, such as texts and color changes, are both applied to promptly respond to the actions taken by users and inform users what is going on (Hazari, 2012; Kobayashi et al., 2011). There is also easy access to technical support with clear textual instructions and steps in order to facilitate use of this app as suggested by the literature review (e.g. Dipl-Psych, Wandke and Blessing, 2006; Hazari, 2012).

Competitive analysis.

In order to understand the current availability of senior-friendly mobile apps, a competitive analysis was conducted by examining the features of current websites and mobiles apps designed for seniors users. A few observations were identified, such as: (a)

most of the online discussion forums are based on non-responsive websites (e.g. Stitch and Senior Forums) rather than mobile apps; (b) there are several online platforms providing instructions on tech-related topics for adults in general (e.g. GCFLearnFree.org); (c) most of the mobile apps designed for seniors are for the purpose of starting relationships (e.g. OurTime), while there are few teaching seniors to use technology (e.g. Generations Online); (d) some companies provide both hardware and software services for seniors through tablets with built-in Internet service, functions for communication, and entertainment (e.g. GrandPad and iN2L); and (e) there are limited Facebook groups (e.g. Social Media 4 Seniors) for seniors to connect on common interests, and little online interaction is observed. Mobile apps appear to be even more limited. Among the limited number of mobile apps for seniors (See Table 1), some focus on teaching technology, some inform users of new information, while others focus on developing relationships. Most of the apps have a simple and clean user interface and easy navigation.

However, there seems to be no mobile app designed for senior users to acquire information, while connecting to others. Based on the competitive evaluation, it appears that there is a need for a mobile app designed for seniors to share and discuss ideas of interest to them. Thus, Chatlet was designed to fill the gap by facilitating seniors to explore their topics of interests online with easy navigation. The topics displayed on Chatlet are based on the literature review and the competitive analysis results, including travel, health, study, sports, retirement, entertainment, and relationships. These topics are selected by referring to Nimrod's findings (2010) on the more commonly discussed topics, including (a) fun online; (b) retirement; (c) family; (d) health; and (e) work, study and recreation. At the same time, the results of the competitive analysis on the mobile apps for seniors imply that most of them serve as media for seniors' communication and

information acquisition. Among the seven topics displayed on Chalet, the topic of travel is selected as the one for more detailed demonstration in the mockup because it is a more common experience for users to relate to one another than the topics of health, retirement, relationships, etc.

Table 1

Competitive analysis on current mobile apps for seniors

Criteria/ Apps	**Generations on Line**	**AARP Now**	**Our Time**	**Connected Living**
				
Highlights	Teaches novice senior learners to use tablets, apps, and the Internet	Provides updates on news and community events	Enables singles over 50+ make friends	Builds a private network with families and friends
Purpose	Instruction	Information and in-person social connection	Social connection	Communication, entertainment
UI Design	Simple, step-by-step instructions	Clear and simple navigation	Easy navigation, big profile photos	Clear, harmonious colors

Table 1 (Continued)

Criteria/ Apps	Generations on Line	AARP Now	Our Time	Connected Living
				
Functionality	Textual instructions	Information of events, discounts, news	Discovery of new friends, people search, messaging	Information, communication, entertainment
Limitations	Few social interactions	Few online interactions	Focus on relationship development; Payment required to be able to send/receive messages	Communication within inner circle; Requires entering community codes before joining

Prototype

This section documents the persona and scenario applied to Chatlet and the development of the prototypes in low and high fidelity.

Persona and scenario.

The persona was designed based on the target users of Chatlet (See Figure 2). Mr. Andrew Hunt is retired, has basic knowledge of computers, and has a smartphone. His technology use is primarily for seeking information about his interests. By referring to this use case, I sketched the wireframes (See Figure 3 and 4).

Figure 2

Persona for the target users of Chatlet

	**Andrew Hunt** **Age: 65**
Occupation	Retired
Knowledge of ICT	• has basic knowledge of using a computer • has a smartphone with mobile apps
Habit of Technology Use	To search topics of interest online

The scenario that Andrew Hunt uses Chatlet is that he is thinking about visiting to Taiwan for a vacation. He looks for traveling information online and also wonders how other people's traveling experience is like, and he finds the introduction of Chatlet online. So he uses Chatlet to explore his interested topic.

Wireframe.

According to the person and the given scenario, the researcher first paper sketched wireframes and design the user flows.

Figure 3

Wireframe 1 presents the pages of sign up, topic list, and comment to post

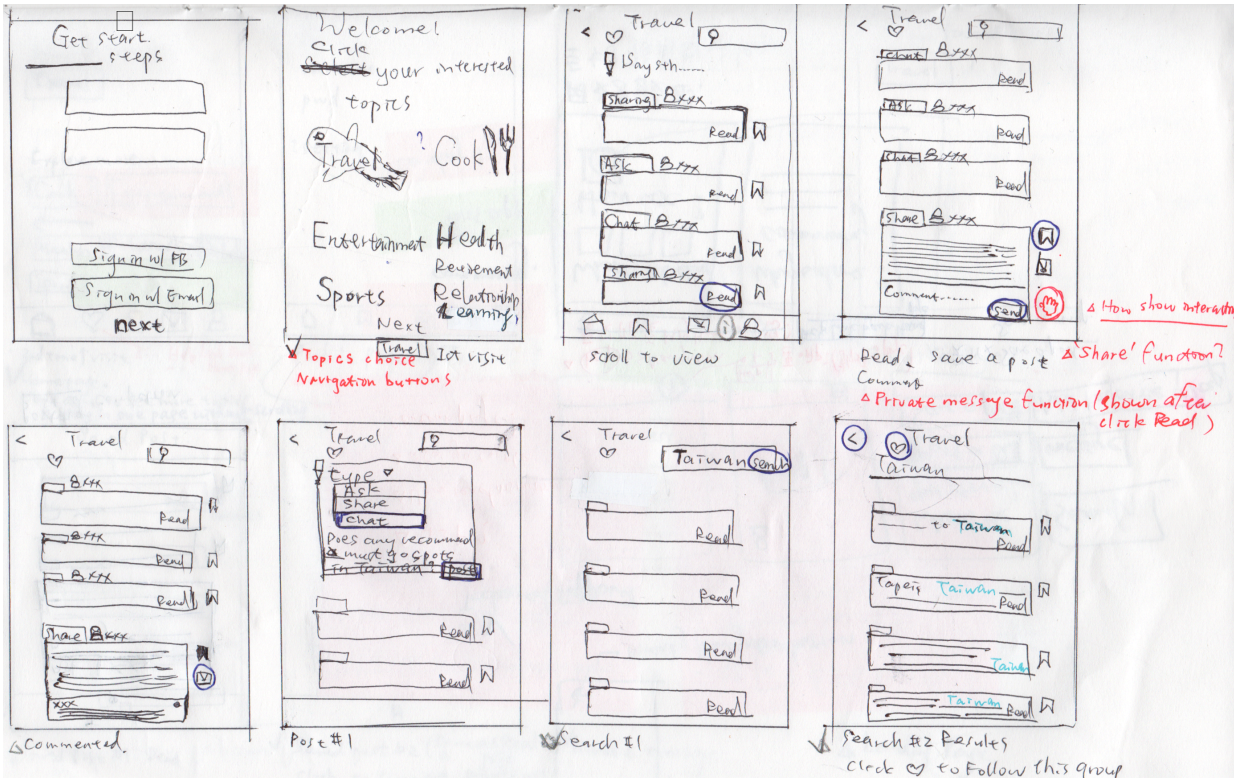
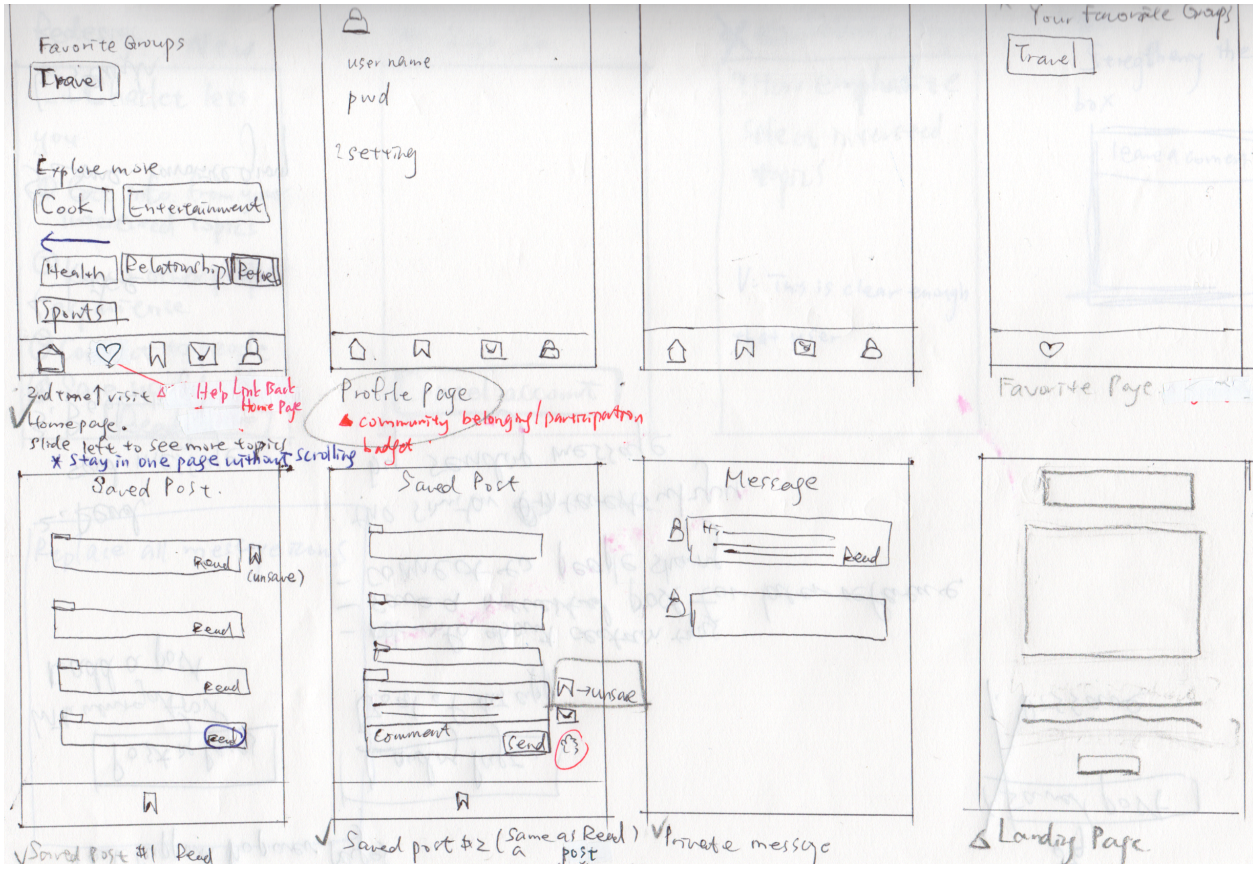


Figure 4

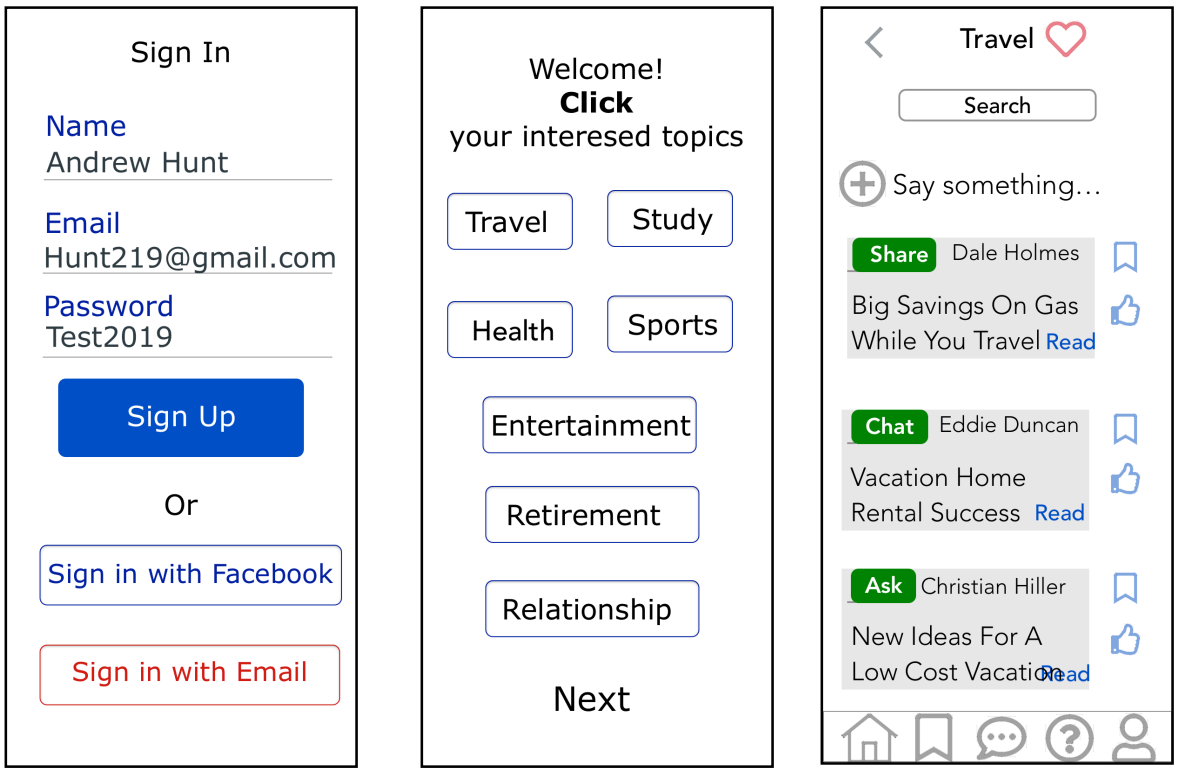
Wireframe 2 presents pages of saving groups, posts, and messaging



With a general idea of user flow, I then used Sketch to develop prototypes in low-fidelity (See Figure 5) and high-fidelity (See Figure 6). Given the limited space, only a few screenshots are presented below. To view the app via Sketch file, please go to: https://drive.google.com/file/d/1fberfHYbzphOKYvKUccivwH-cxAO6aXQ/view?usp=sharing.

Figure 5

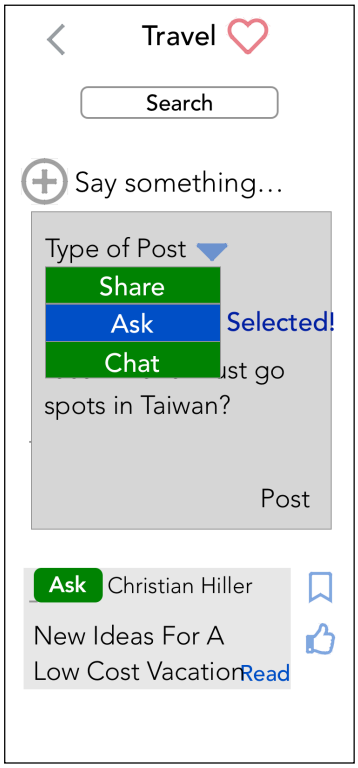
Screenshots of Chatlet in low-fidelity



Sign up page | Topics page | Discussion page

Figure 5 (Continued)

Post page (1)



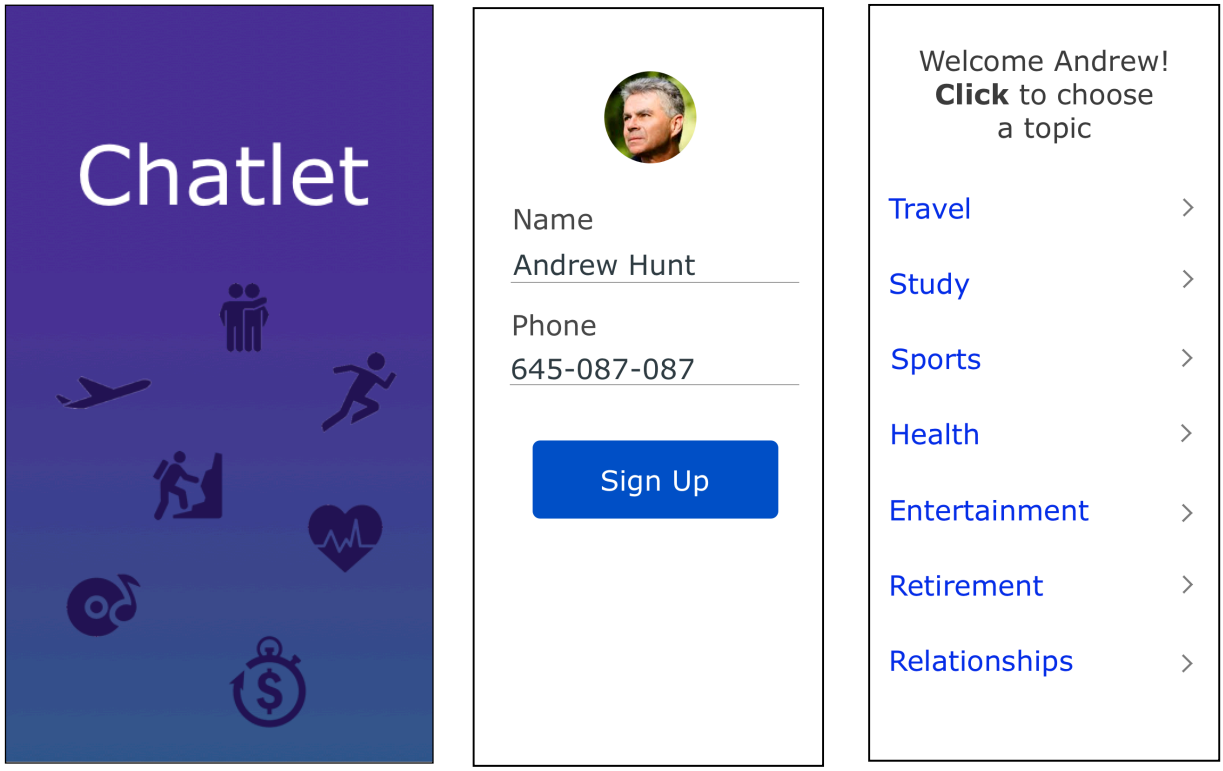
Post page (2)

Technical support page

Some changes were made in the high-fidelity version (see Figure 6), including: (a) a landing page was added; (b) only a contact number is required to simplify the sign up process; (c) the topics are displayed vertically for better alignment; (d) the categorization of a post is removed to make the discussion page background clearer and simpler; and (e) textual technical instructions were added with icon symbols as a visual cue for better understanding. Below are screenshots of the high-fidelity mockup.

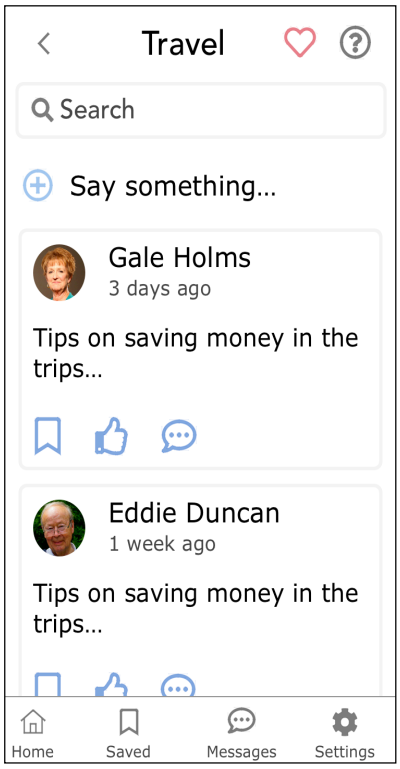
Figure 6

Screenshots of Chatlet in high-fidelity

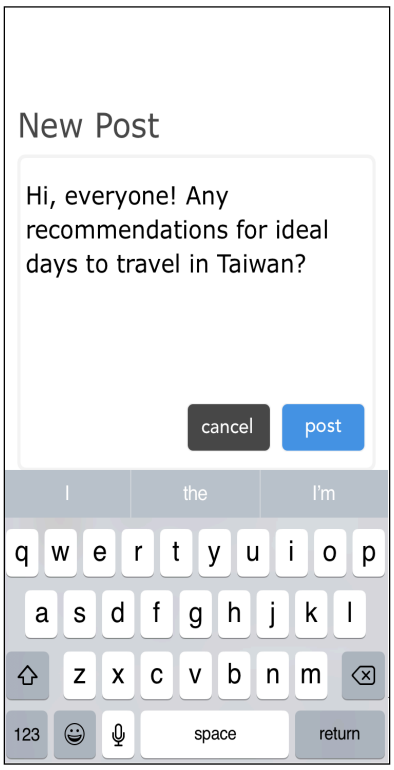


Landing page | Sign up page | Topics page

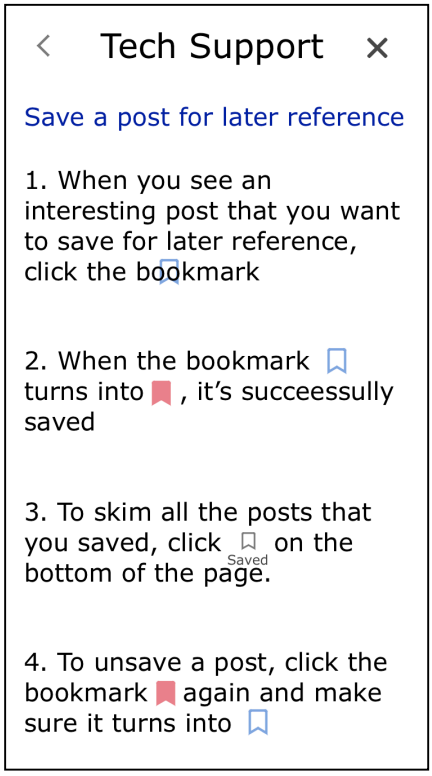
Figure 6 (Continued)



Discussion page



Post page



Technical support page

With the mockup ready, I designed the prototype by adding links among icons and artboards on Sketch. To see a demonstration of the mockup displayed on a mobile screen, please go to: https://drive.google.com/file/d/1jTndXEneDoBwZJ2OdxOFmv9hnn9kgM0L/view?usp=sharing. An example of the navigation of the prototype is shown in Figure 7. The overall flow starts from a landing page that will be first seen by the user. After signing up, the user will see a list of topics to select. With a selected topic, the user will see the discussions within that group. When the user finds a post interesting and wants to read it later, (s)he can click on the bookmark icon to save the post for future reference. Meanwhile, (s)he can click on the Like icon as a way of online interaction with others, or withdraw it by clicking on the Like icon again. The user can also comment or leave a new post. If (s)he likes this particular group, (s)he can save it in Favorites by clicking on the heart icon next to the name of the group.

Figure 7

Mockup storyboard 1 shows the click path from landing page to sign up, topic list, group discussion and Like a post based on the target scenario

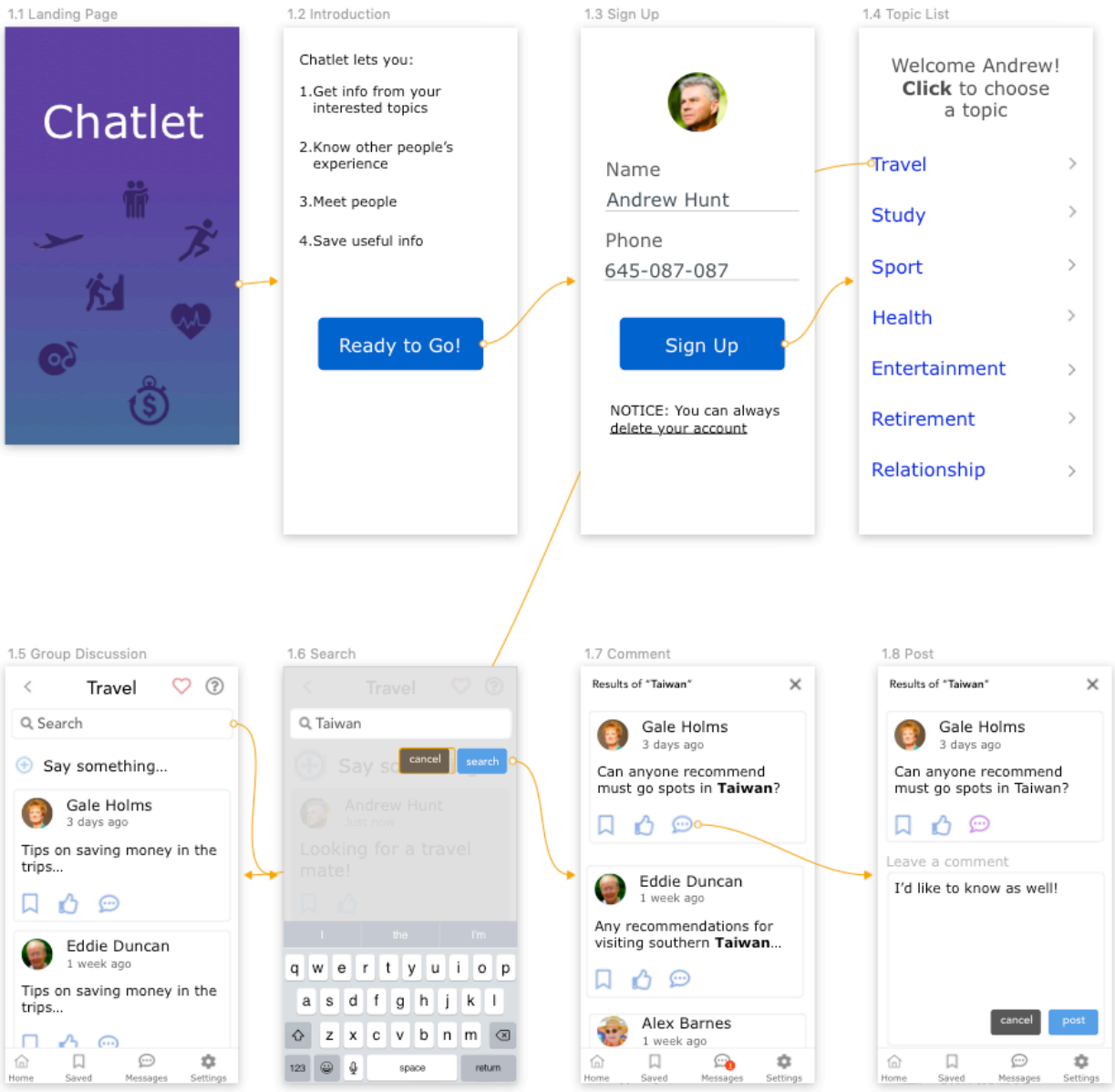


Figure 7 (Continued)

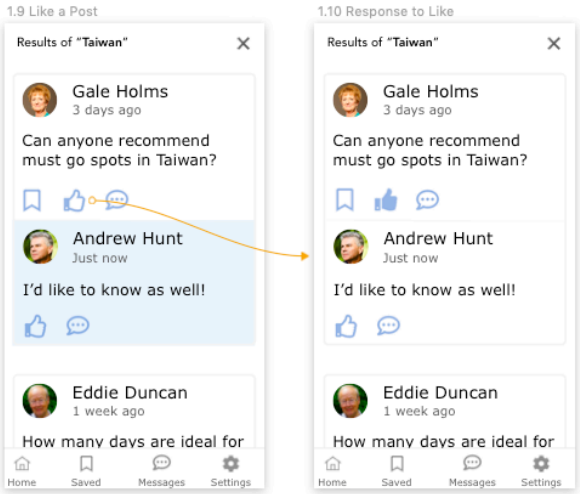


Figure 8

Mockup storyboard 2 shows the click path from saving a post to the page of all saved posts

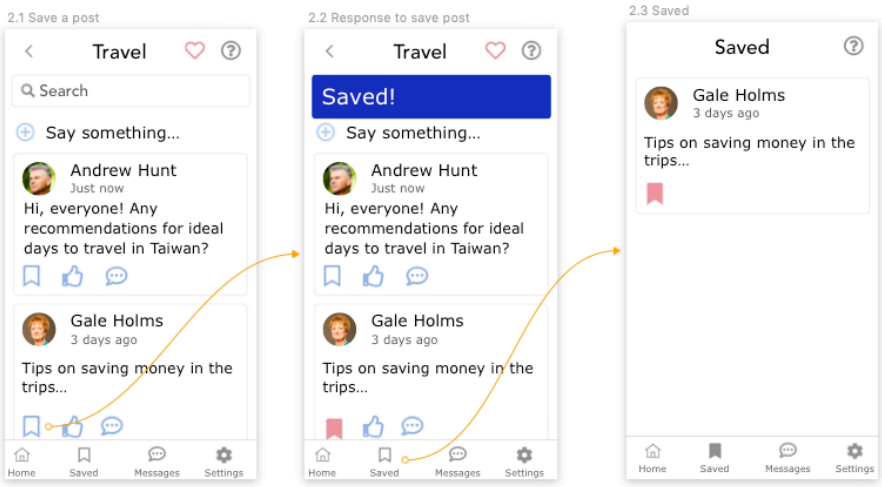
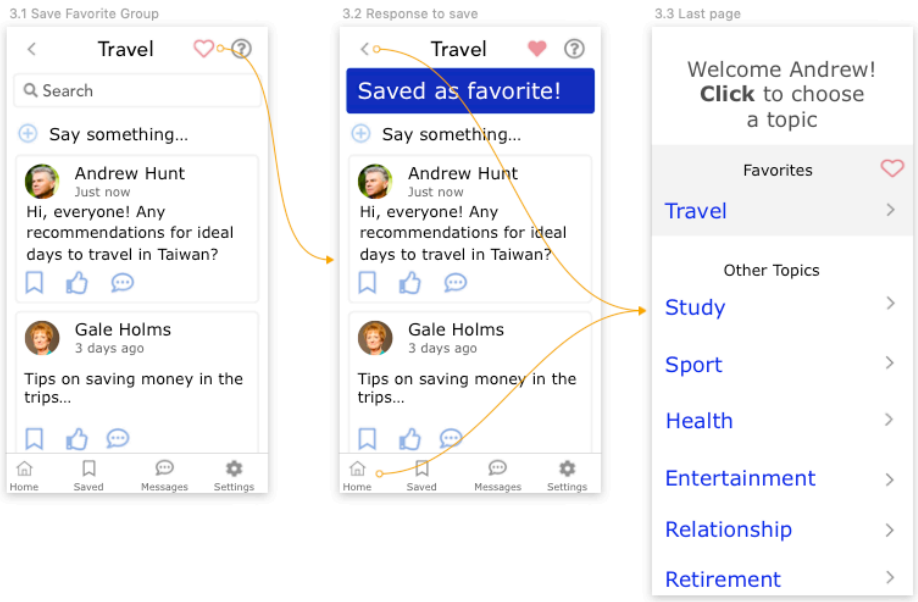


Figure 9

Mockup storyboard 3 shows the click path from saving a group to the list of Favorite group



Chapter 4 Usability Testing

Given the prototype design, the usability testing was intended to collect data to evaluate whether these design features work for the target senior users. This chapter presents the procedure of conducting usability testing, participant recruitment, the usability test tasks, and tools used.

Participant Recruitment

The researcher aimed to recruit four participants aged 55 and over. The case study method was selected to gain a picture of seniors' technology use habits and feedback on the app design through one-on-one conversations. The ideal participants were to have basic knowledge of computers and the Internet, have a smartphone with mobile apps, and know how to search information online.

The process of recruiting ideal participants to join the study was not easy. To recruit senior participants, the researcher contacted a few lifelong learning institutes and one senior center, but received no response. Thus, the researcher visited locations where seniors hangout, including supermarkets, restaurants, and the library. At the beginning, the researcher introduced the study to 13 seniors encountered in public places on the west coast of the U.S., and asked them if they would be interested in taking part in the study. Among the 13 people being asked if they would be willing to be interviewed, five of them agreed, while one of the five volunteers was not able to join due to the fact that she could not read English. In the end, four seniors, aged 56 to 76 (two females and two

males), were interviewed. Table 2 is a general overview of the participant profiles (hereafter pseudonamed as R., K., C., and M.).

Table 2

Participants' demographic information and technology use habits

Participant	**Age**	**Profession**	**Use of computer or smartphone on a weekly basis**	**Purpose of using the technology**	**Top 2 most frequently used mobile apps**
R.	64	Retiree	Mobile, laptop	Get latest news, information	Twitter, NYT (New York Times news)
K.	60	Insurance	Mobile, iPad	iPad to watch movies, Mobile app to order from restaurants	Calendar, Email, Banks
C.	56	Home maker	Mobile, computer	Communication, To pass time	WhatsApp, Email, Apple News
M.	76	Retiree	Mobile, computer	Get information, Translation	Weather App, Email, Google

After agreeing to be interviewed, each participant was first introduced to the purpose of the study and the process of interviewing and usability test. After signing the informed consent form (See Appendix A), each participant was interviewed and then

used the app prototype followed by filling out a questionnaire. The total process was designed to take around 15 to 30 minutes considering the practicality of efficiently interviewing a stranger and the concern of the probability of people's willingness to volunteer when being asked to join a study without acquaintances. Both the interview and usability test were audio recorded by a friend of the researcher, who was familiar with the recording software and procedure. The mobile phone for usability testing was also screen recorded. The researcher guided the interview and usability test independently.

Interview Questions

The interview was aimed to get demographic information about the participants and have a basic understanding of their habits of using and/or learning technology (See Appendix B for Interview Scripts). The questions included:

(1) What is your habit of using the mobile phone or desktop/laptop on a weekly basis? What activities do you usually do with them?

(2) What are the top 2 mobile applications you use frequently? How often?

(3) Is there any challenge when you use them?

(4) What do you like the most about those apps?

(5) Have you ever visited an online discussion forum or joined online discussion groups?

By asking about the activities that senior users do with electronic devices, the researcher could gain a general picture of their motivations to use technology. The challenges and favorites included in mobile app use can serve as a quick overview of

one's technology use and pain points. The question about online discussion experience could indicate one's attitude toward and participation in online communities.

Usability Testing

The usability test started from giving a scenario to the users, explaining how the app prototype works within a predetermined click path (See Appendix C for Usability Test Scripts). The users were asked to think aloud while using the prototype. The screen of the smartphone showing the prototype was recorded. Then the users verbally answered questions about the design and their user experience on the prototype, and filled in a questionnaire asking feedback on more specific features of the app.

Usability test task.

The usability test task required the users to utilize the mockup from the landing page to the last page within the predetermined click path set up through Sketch. The click path was predesigned to ensure that users could skim all features of this app. Nevertheless, it would be too complex to prototype all possible click paths that users might click on. At the same time, it would be difficult to evaluate all the users' feedback on the same basis if they used different parts of the app. Thus, a predetermined click path was designed. Given that there was less variation for users to interact with on the app, the users were only expected to go through the pages of the prototype demonstrated on an iPhone 6 to consider the task as successfully completed.

When each participant completed going through all the pages on the app prototype without the researcher's assistance, the task completion was counted as a 100% success rate, while the failure was counted as 0%. It was decided not to evaluate the task

difficulty because the user flow was mostly predetermined. The System Usability Scale (SUS), a 10-questionnaire, was first developed by John Brooke (1986) to quickly measure how users perceived the usability of computer systems that they worked with. Users filled in the questionnaire, and the answers were then calculated into scores indicating the usability of a product. Besides computer systems, SUS has been applied to evaluate the usability of any systems and applications ("Measuring and Interpreting SUS," n.d.). SUS was used in this report for usability evaluation (See Appendix D).

To calculate the SUS score, the answers to each question were based on a 5-point Likert scale rating from Strongly Disagree, Disagree, Undecided, Agree and Strongly Agree, ranging from 1 to 5 points, respectively. Then the formula below was run to gain the SUS score rated by each participant.

X = Sum of the points for all odd-numbered questions – 5

Y = 25 – Sum of the points for all even-numbered questions

SUS Score = (X + Y) x 2.5

The total possible score was 100 points, with each of the questions weighing 10 points. A score below 51 was considered as "Awful"; 56-68 as "Poor"; 68 as "Okay"; 68 - 80.3 as "Good"; and 80.3 and above as "Excellent".

Software tools used for conducting usability testing.

An iPhone 6 was used as the mobile device to display the prototype based on the easiest accessibility to the researcher. Sketch Mirror, a mobile app for connecting to the Sketch mockup file on the researcher's laptop, was used to display the prototype. RecordIt, a mobile app for recording smartphone screens, was used to capture the

usability test. Audio memo, an in-built application in iPhone 6, was used to audio record the whole interview and usability test. After the data was collected, Otter Voice notes, an online platform for automatically transcribing audio files, was used to transcribe the audio recordings for further analysis.

Chapter 5 Findings

This chapter presents the analyses demographic information and habits of technology use of the four participants and the findings of the interview and usability testing.

Participants

The four participants all had smartphones and used mobile apps and a desktop/laptop with personal preferences and purposes. Below is the participant information regarding their purpose of using technology and experience participating in online group discussions or forums:

Participant R.

R., a 64-year-old male, was retired and self-reported that he was comfortable with using a laptop and smartphone to get information. He frequently used Twitter and NYT mobile apps to get updated information, and he described himself as "not a big user of Facebook" though he had the Facebook app on his smartphone. He did not join any online groups. He considered that mobile apps (e.g. NYT news and Twitter) were easy to use.

Participant K.

K., a 60-year-old male, worked in the insurance industry and did not use a computer, but only a smartphone and iPad. He often checked the mobile apps of calendar, emails, and banks for convenience. He was fine using these mobile apps without any difficulty except that he wished the loading speed of some apps could be faster. He used

to visit some professional industry forums, but mostly only read information without having conversations online.

Participant C.

C., a 56-year-old female, was a homemaker and self-described herself as computer literate. She frequently used WhatsApp to communicate with her friends who were far away in Europe. She also used the apps of emails and Apple News to pass time. Occasionally she used Facebook, but she preferred to use it in a computer for the bigger screen. She reported no challenges encountered by her when using these mobile apps.

Participant M.

M., a 76-year-old female, was a retiree who only had basic knowledge of computers and smartphones. It was observed that M. was very active in learning new things in that she often searched for information that she did not know about. She used a desktop three times a day to get new information and translate English messages or texts she would like to understand sent from her children since English was not her first language. In regard to mobile apps, she checked the weather, emails, or Google for translation. She self-reported that she was more comfortable using a desktop when responding to emails. M. often encountered technical problems and usually sought help from her husband, children, or niece. However, it was often difficult to have her children teach her in person because they were busy. Often she called some of them and tried to figure out the solutions on the phone. When using a computer, she had to make sure that there was nothing distracting (e.g. cooking or noises) so that she could concentrate. She

mentioned that she tried not to join any online groups because she did not want to be distracted.

Interview Findings

Purpose of technology use.

The reasons why the participants used some mobile apps were often to get new information, to communicate, and to pass time. Getting new information was the most frequently mentioned reason. As R. said, "I like the fact that they frequently update during the day that I get new info every time I'm on it." The feature of convenience was also important. For example, K. described why he used mobile apps: "[I am] able to do what I want to do whenever (and) wherever I am." Another reason for using technology was to pass time: "[I] check email and WhatsApp. I look at the news sometimes just because you know when I have nothing to do. So I look at that too." In general, getting new information was the most common reason for the participants to use certain mobile apps.

Self-efficacy on technology use.

Three of the participants (i.e. R., K., and C.) were comfortable with using computer and mobile apps, whereas M. viewed learning technology as very hard to her. Age can be a factor that the former learned the technical skills and knowledge easier than the latter. During the interviews, the researcher observed that R., K. and C. had confidence in using technology based on their self-report of having no difficulties when using mobile apps: "[The mobile apps] are very easy to use (R.)"; "No [challenges]. Only some apps are slow (K.)"; "No [challenges]. I'm pretty computer literate (C.)." On the

contrary, M. had relatively low confidence in using technology, and it seemed that her belief would influence how she used technology and her selection of the activities she did with it. She described that technology learning had been challenging to her, for example:

"I don't know anything about [the app]…I'm not really good at [the cellphone]…I had to go [to] Apple [store] to study more…I'm just listening [to the instructions provided by my family on the phone] then doing [what I was told to do]…I'm having a hard time… So many people, 100% people at my age having a really hard time [to] digest the IT…My age is almost too hard to learn."

According to M., age was considered a huge factor influencing her learning of technology. Though M. seemed to have very low self-efficacy on learning and using technology, her attitude toward learning and figuring out how to use technology was still active. She did not give up understanding how to solve technical problems by seeking support from her family and the commercial store. She also tried to provide herself with a user-friendly learning environment by eliminating distractions. Nevertheless, M. had difficulties getting timely technical support from her family, especially from her children who were busy: "Sometimes I call [my family for technical support], but young people are very busy. I can't catch on time. And if they have to be with me, that's more difficult." She described that getting help in person would be more helpful, but that would be even more difficult because her children were busy.

When asked about her experience of taking part in online discussions or communities, M. said that she tried not to read online discussions or join online groups because she might not be able to read so much information: "I try to eliminate

unnecessary things. [I only focus] on the things I have to do. If I open another view [window page], there will be another story. [Then] I had to study more. I don't have capacity yet." It seemed that M.'s self-efficacy on her capacity to use technology limited her willingness to take part in online discussions or communities. The analysis of M.'s experience indicated that in-person technical support, the learning environment, self-confidence in technology use, and the way information was presented would play influential roles in a senior user's experience with technology use and learning.

Usability Testing Findings

Task completion rate and SUS score.

The task completion rate and SUS score were both calculated to evaluate the usability of the prototype. Two of the four participants (i.e. K. and C.) successfully completed the task, while the others (i.e. R. and M.) needed the researcher's guidance and demonstration on the prototype. Thus, the task completion rate was 50 percent. The SUS score calculated on each participant's rating on the 10-question questionnaire was averaged for the final SUS score, ranging from 32.5 (i.e. Awful) to 90 (i.e. Excellent). The average SUS score was 62.5, considered as "Poor" (See Table 3). It should be noted that there were two extremes of the participants' evaluation on the design of the prototype. R. and M.'s ratings suggested "Awful", whereas C. and K.'s ratings suggested "Excellent". One possible reason could be due to the difficulties of using the prototype in R. and M.'s cases. Thus, a further and closer exploration on the interview notes was done to better understand participants' pain points related to the app design.

Table 3

SUS scores of participants' rating

Question/ Participant	**R.**	**K.**	**C.**	**M.**
1	4	4	4	3
2	5	2	2	3
3	2	4	5	4
4	3	2	1	5
5	1	4	5	4
6	4	1	1	4
7	3	4	4	1
8	4	1	1	1
9	3	4	5	4
10	4	1	2	5
X	8	15	18	11
Y	5	18	18	7
SUS Score	32.5	82.5	90	45
Adjective Rating	Awful	Excellent	Excellent	Awful
Average SUS Score	**62.5**			

Challenges of conducting usability testing.

Given the fact that the prototype was predetermined on its click path, the participants were informed that there would be orange boxes indicating where to click to proceed to the next page on the screen of the iPhone 6. Nevertheless, two of the participants (i.e. R. and M.) still did not understand how the default prototype worked, and had difficulties continuing the usability test. Thus, the researcher demonstrated the

flow of the prototype for all the pages and then asked for their feedback on the design. It should be noted that R. was especially frustrated by the unresponsive icons when he clicked on the prototype. In fact, some of the icons that he clicked were already designed as responsive on certain pages that he did not get a chance to see at first.

Feedback on the App design.

Based on the analysis of the interview notes and screen recordings, the participants' feedback was categorized into four dimensions including user flow, layout, technical support, and usage.

User flow.

There were both positive and negative comments on the user flow. Two of the participants (i.e. R. and M.) were not able to complete the task, while the others (i.e. C. and K.) considered that the app was easy to use. The predetermined click paths on the prototype seemed to be quite an obstacle influencing R. and M.'s task completion. For example, R. had difficulty understanding how the prototype worked on the iPhone 6, and considered some of the icons on the app page to not be responsive at all: "[It] doesn't allow me to input my data. I don't see where it allows me to input what I want or respond…it isn't intuitive to me." In M.'s case, she commented that the app was very easy to use, but emphasized that she would not be able to use it independently without the researcher's help. Nevertheless, it was not surprising that M. needed assistance to go through the prototype given that she had little experience with using mobile apps, engaging in reading, and responding to online discussions. On the other hand, C. and K.

both agreed that it was easy to use the app, indicating that the users' understanding of how an app prototype works influences their evaluation of the user flow.

Layout.

The participants were asked to comment on the design of icons, font style, and user interface of the mockup. Below are what they thought about the app:

(a) The layout was simple and clear: "The layout was clear. Very straight forward (K.)."

(b) The font size was mostly easy to read: "Everything was fine. Font size is fine except for the technical support. Nothing noticeable (K.)"; "[The] font size is also good. I'm wearing my glasses, but I could probably even seem them without it, which is a good thing (C.)."

Meanwhile, there were some features expected from the participants:

(a) The sign up page could contain more elements: "It's seems a little plain. Usually there's more on the sign up page (K.)."

(b) Less personal contact information could be required for sign up. The requirement of providing contact numbers made one of the participants hesitate to continue to use the app without knowing first what this app was about: "Sometimes I don't want to give my phone number, too….Depends on what I'm doing, sometimes I hesitate to give either my email or my cellphone because I want explore a little further (K.)."

(c) The icons could be more responsive to users' actions. It was expected that the icons would show textual options to indicate what the users could do: " The icons

should be more responsive (R.)."

Technical support.

All the participants thought that it was helpful and necessary to have access to technical support. Three of them (i.e. K., C., and M.) read the technical support instructions carefully. However, there were individual preferences on the format of displaying the technical support. Some suggested that it should be displayed somewhere near the icons or spots where the actions were taken, some expected to have video instruction rather than textual steps, while some thought the current design was clear:

" I'm not sure how helpful it is to have a separate technical [section] because I should be able to know [what it can do] if the icon gives you some options in language to explain what they are…I don't have to understand it as an instruction (R.)."

"I think [the technical instruction] is clear. I only use it for a few minutes, but I think if I was working with it, I think it's easy (C.)."

" Video will be easier [than textual instructions] (M.)."

The usage of this app.

The participants were invited to describe what the app was about in one sentence. Three of them (i.e. R., K., and C.) perceived correctly that the design objectives were to acquire information and connect people. For example, C. described Chatlet as "to connect with people regarding a certain topic." Nevertheless, two of them (i.e. R. and K.) thought the app was only restricted to traveling, which might be because they only noticed the travel topic selected to be displayed in the usability testing: "The app is to give people information on places to travel to or get people's personal experience (K.)."; and "I'm

fearful that you're reinventing Twitter for travel…A lot of this could be done within Twitter (R.)." Overall, the participants understood the information acquisition and social interaction features of this app, while the flexibility of selecting their topics of interest seemed not to be clearly understood.

App Redesigned Decisions

Based on the findings, the researcher then refined the app for better user flow. See complete prototype file: https://drive.google.com/file/d/1fberfHYbzphOKYvKUccivwH-cxAO6aXQ/view?usp=sharing

To open the file requires macOS High Sierra (10.13.4) or newer. Here are the primary edits and the considerations taken into the design decisions: (a) sign up page: the users are still requested to sign up with a phone number instead of email. This was designed intentionally to reduce the steps of signing up and to make the beginning step easy to the new Internet users. To reduce users' worries about receiving spam messages, there is a note added that they can always delete the account (See Figure 10); (b) introduction page: an introduction page highlighting the usefulness of this app was added as an overview for users (See Figure 11); and (c) leveraged responsiveness to icons: some dialogue boxes were enhanced in color contrast and textual notes to help users see what actions they can do with certain icons (See Figure 12).

Figure 10

Screenshot of sign up page

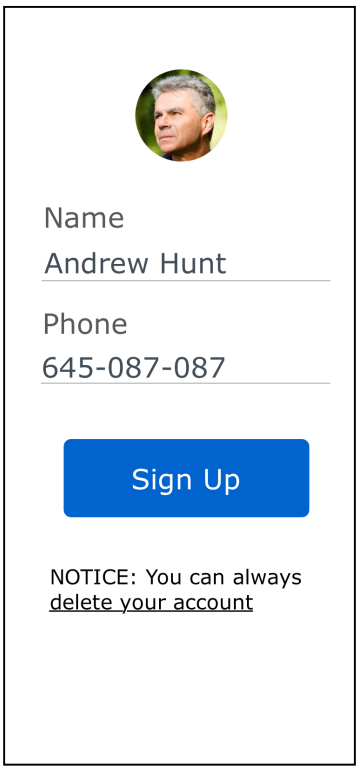


Figure 11

Screenshot of introduction page

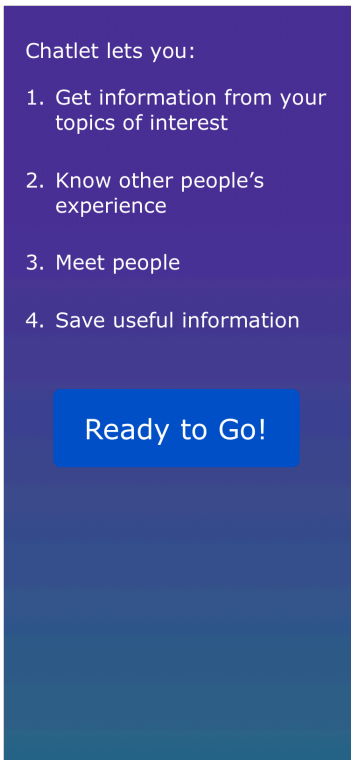
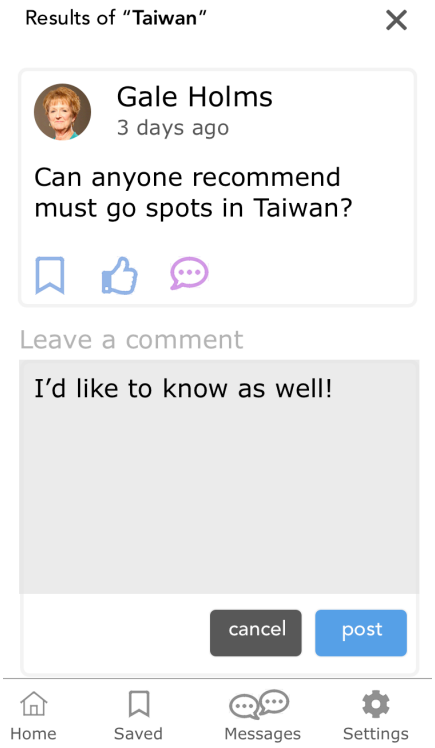


Figure 12

Screenshot of comment page



Summary

Based on the findings of the interview and usability testing, the habits of four seniors' technology use and their perceptions of the prototype were identified. The interview findings show that the participants used certain mobile apps mostly for getting information and for the convenience that they could do some activities without limits on space and time. Another common reason that they used mobile apps was to communicate with family or friends. The researcher also observed that one's self-efficacy for using and

learning technology could influence one's selection of online activities. Based on the usability findings, the participants correctly perceived the objectives of Chatlet, which features information access and social interaction. However, there were two extremes on the SUS scores varying from 32.5 (i.e. poor usability) to 90 (i.e. excellent usability) with an average of 62.5, indicating that the usability of this app was poor. The task completion rate was 50 percent. Half of the participants could not complete the task themselves due to the limited derivation of the click path on the prototype. The usability findings present that the participants mostly considered that the layout, such as the font size and navigation, was clear. All of them agreed that technical support was necessary, but had different preferences on the format of the instructions.

Chapter 6 Discussion & Implications

This report aimed to explore the design considerations for designing mobile apps for seniors through conducting a case study of four seniors. Given the literature review, seniors are a growing population that needs to use technology. However, there are limited mobile apps designed for this group of people with the features of information acquisition and social connection. In order to fill the gap and to facilitate the effective use of mobile apps among seniors, the researcher developed a prototype to illustrate the ideas that might interest and encourage seniors. By conducting usability testing, the design features were found to work for some participants and not for others. This chapter discusses the implications of the findings, limitations, and direction for future research.

Motivation of Technology Use and Learning

The findings support previous study results that seniors are motivated to use and learn technology in order to get information (Blankson, 2018; Naumanen & Tukiainen, 2008) and to communicate with family and friends (Morris et al., 2007).

Lack of interest in online communities.

Nevertheless, the findings show that the participants lacked interest in joining online communities or conversations. This finding does not lend support to Burmeister's (2012) claim that seniors value online communities because they care about belonging to a community, information exchange, and social interaction. On the contrary, three of the participants in the current study mentioned that they did not take part in online discussions or groups. Instead, they seemed to be more like followers of certain topics of

interest or discussion entries and readers of the information. This can be relevant to individual preferences about the way and extent of participation in cyberspace.

Self-efficacy and selection of online activities.

Three of the participants were observed to be comfortable using computers and mobile apps, while one of them (i.e. M.) intentionally restricted her own online activities because she thought her technical skills and knowledge were not ready. We can see that M.'s selection of online activities was limited due to her low self-efficacy for using technology. Nevertheless, M. possessed an active attitude to learn technology and had strong interests in getting new information online. It seems that for senior users like M. who have low self-confidence in technology use and learning can be encouraged to build more self-efficacy with technology. The strategies can be: (a) informing senior users of the benefits of online communities (Nimrod, 2014 & 2018); (b) providing seniors with instructions on how to take part in online communities; and (c) letting senior users see the role models at their similar age (Burrows, Mitchell, & Nicolle, 2016).

Pedagogical Implications

Based on the insights gained from the literature review and the findings of the case study, a few pedagogical implications can be indicated for teaching seniors technology:

(a) technical support is useful and necessary to seniors and face-to-face instruction can be more useful to seniors who have low self-efficacy on technology;

(b) encouragement and the existence of role models at senior learners' similar age can facilitate them to build self-confidence for using technology;

(c) the benefits of engaging in online communities can be promoted to motivate seniors to participate in online discussions.

UI Design Recommendations

Given the usability testing findings, there are design considerations suggested for designing mobile apps for seniors: (a) ensure feedback to users' actions taken on the app. For example, providing textual responses to a user's action can help them understand what is going on; (b) give clear and sufficient technical support; The technical instructions should be provided in a way that senior users can easily refer to; (c) inform the users clearly of the features of the mobile app. For example, providing an introduction page showing the usefulness of a mobile app and how it works could enable users to gain a better sense before deciding to move on or not; and (d) ease users' worry about security issues. For example, providing users with an option to delete an account on the sign up page can reduce their hesitation to sign up for an app.

In summary, this report evaluates the design features of Chatlet using a case study of four seniors. It is implied that the simplicity and clarity of the UI of a mobile app is easy and comfortable for seniors to use. The technical instruction is helpful for seniors to navigate and interact with the mobile app. However, there was a lack of interest in actively participating in online communities, and one's self-efficacy was indicated as an influence on his or her selection of online activities.

Limitations and Future Research

There are some limitations of the represented case study. First, the limited time allowed for the interviews could reduce the opportunity to get more insights from the participants. I, the researcher, suggest that future qualitative research could be conducted with a longer interview time, such as one hour. Secondly, predetermining click path for navigating the prototype could prohibit natural exploration and cause confusion to some senior users. This format of prototype can be better used at the early stage of mobile app design and development, whereas an app produced in codes could generate more in-depth details of users' intuitive click path. Thirdly, the findings and implications were based on a small sample size that could not be generalized. Nevertheless, this case study lends support to the need for designing UI and UX addressing seniors' needs and provide pedagogical implications for encouraging seniors to build self-efficacy and motivate their technology use and learning.

To advance effective mobile app designs for seniors, future research can further explore: (a) effective formats of giving technical support on mobile apps for seniors (e.g. textual or video-based); (b) how to facilitate seniors' learning process in a context of self-teaching without timely in-person technical support from one's family or friends; and (c) what factors might hinder seniors from online community participation, and what challenges senior users have when engaging in online communities. With further exploration, there can be more senior-friendly UI and UX designs applied to promote senior technology use and lifelong learning.

Appendices

Appendix A. Informed Consent form

Hello,

Thank you for volunteering to join this study. This study is about designing a mobile application for senior users, and all the information and feedback collected will be remained anonymous.

During the interview, there will be **two primary activities**:

1. *Get some basic background information about you and your technology use habits.*

2. Try a mobile application mockup and capture your thoughts on that experience and fill a questionnaire.

Here are few important things for your information:

1. This is **a completely voluntary activity**. You do not have to answer any questions that you do not want to and can stop at any time.
2. The session will be video and audio recorded to facilitate data analysis and reporting. I want to ensure you that all recordings will only be used for internal purposes.

Thank you for your participation.

Sincerely,
I-Hui Liou
Curriculum and Instruction/Learning Technologies
the University of Texas at Austin Feb. 2019

If you are willing to participate in this study and agree to all of above, please sign here:

Name: _____ **Date:**_____

Appendix B. Interview Scripts

Part 1. Introduction Script (3 min)

Hello, my name is ***. I'm a student at The University of Texas and I am doing my master's report to design a mobile app and understand senior users' technology usage habits. This is my friend, **, who will help to take notes and video record. Thank you so much for your participation in my study. Your feedback will be very helpful.

Over the interview we'll complete two primary activities:

First thing we will do is get some basic background information about you and your technology use habit. After that you will try a mobile app and share your thoughts on that experience and filling a questionnaire. Here are few important things for your information:

- This is a completely voluntary activity. You do not have to answer any questions that you do not want to and can stop at any moment.
- The process will be videoed and audio recorded for data analysis. All the recordings will only be used for research purposes.

Do I have your consent to record this process? Do you have any questions before we begin? If you are fine with the process, please sign the informed consent form.

Part 2. Interview Questions (5 min -10 min.)

One. Demographic info

1. What's your occupation? Still working or retired?

2. May I ask your age please?

- <54 (TERMINATE)
- 55-60
- 61-65
- 66-70
- 71-75
- 76+

Two. Technology use

3. Please tell me a little bit about your habit of using the mobile phone or desktop/laptop on a weekly basis. What activities do you usually do with them? What's the frequency? How long?

4.What are the top 2 mobile applications you use frequently? How often?

5.Is there any challenge using these apps? What do you like most about those apps?

6.Have you ever visited an online discussion forum or joined online discussion groups?

Appendix C. Usability Test Scripts

Part 1. Use the app (5-10 min.)

Now you are about to use this app to see what's up there. When you try the mobile app mockup, it would indicate you which button to click, and you will be given an avatar. As you are exploring it, I'd like you to **think aloud** –please just talk to me as you go through each task, so I get a sense of what you are doing, thinking, feeling, looking for etc.

Scenario:

You are thinking about traveling to Taiwan and would like to have more information and know people's traveling experience. So you skim few mobile apps featured with group discussions, and you find this mobile app.

Part 2. Post-task interview (5-10 min.)

1.What do you think about the design, the font size, the color about the app?

2.How would you suggest this app to be improved for better experience?

3.Can you use one sentence to describe what this app is about?

Appendix D. Questionnaire

Please rate your experience with the app

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1. I think that I would like to use this app to look for my interested information frequently.	☐	☐	☐	☐	☐
2. I found the process of getting technical support information is unnecessarily complex.	☐	☐	☐	☐	☐
3. I thought that this app was very easy to use.	☐	☐	☐	☐	☐
4. I think that I would need customer support to be able to save an interested post on this app.	☐	☐	☐	☐	☐
5. I found the various features on this app were well integrated.	☐	☐	☐	☐	☐
6. I thought there was too much design and/or information inconsistency on this app.	☐	☐	☐	☐	☐
7. I would imagine that most people would learn to use this app to find their interested topics very quickly.	☐	☐	☐	☐	☐
8. I found that this app is very cumbersome to use.	☐	☐	☐	☐	☐
9. I felt very confident using this app to connect with people.	☐	☐	☐	☐	☐
10. I needed to learn a lot of things before I could use this app to find interested information.	☐	☐	☐	☐	☐

Please leave your contact in case there're follow up questions.

Name:_____ **Email:**_____

References

AARP.org. (n.d.). Retrieved from https://www.aarp.org/

Anderson, M. & Perrin, A. (2017). Tech adoption climbs among older adults. *Pew Research Center.* Retrieved from: http://www.pewinternet.org/2017/05/17/tech-adoption-climbs-among-older-adults/

Baharum, A., Zain, N. H. M., Taharudin, A., Hanapi, R., Saudi, A., & Alfred, R. (2017). Guidelines of user interface design for elderly mobile applications: A preliminary study. *Asian Journal of Information Technology*, 16(1), 38-44.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.

Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive Therapy and Research*, *1*(4), 287–310. https://doi.org/10.1007/BF01663995

Blankson, A. (2018). 4 ingenious technologies to help aging adults stay connected and engaged. *Forbes*. Retrieved from: https://www.forbes.com/sites/amyblankson/2018/09/07/4-ingenious-technologies-to-help-aging-adults-stay-connected-and-engaged/#7f0f74a64ab8

Bohemian B.V. (2019). Sketch (Version 54.1) [Software]. Retrieved from https://www.sketchapp.com

Bohemian B.V. (2019). Sketch Mirror (Version 3.2.2) [Application]. Retrieved from https://www.sketchapp.com/docs/mirror/

Bruder, C., Wandke, H., & Blessing, L. (2006). Improving mobile phone instruction manuals for seniors. *Gerontechnology*, *5*(1). https://doi.org/10.4017/gt.2006.05.01.006.00

Burkhardt, W. (2016). The next hottest thing in Silicon Valley: Gerontechnology. *Forbes*. Retrieved from: https://www.forbes.com/sites/vinettaproject/2016/09/20/the-next-hottest-thing-in-silicon-valley-gerontechnology/#30ec11d03abe

Burrows, A., Mitchell, V., & Nicolle, C. (2016). Let's spend some time together: Exploring the out-of-box experience of technology for older adults. *International Journal of Mobile Human Computer Interaction*, *8*(2), 69–82. https://doi.org/10.4018/IJMHCI.2016040104

Connected Living. (2019). Retrieved from https://www.connectedliving.com/

Fokkema, T., & Knipscheer, K. (2007). Escape loneliness by going digital: A quantitative and qualitative evaluation of a Dutch experiment in using ECT to overcome loneliness among older adults. *Aging & Mental Health*, *11*(5), 496–504. https://doi.org/10.1080/13607860701366129

Forsman, A. K., & Nordmyr, J. (2017). Psychosocial links between Internet use and mental health in later life: A systematic review of quantitative and qualitative evidence. *Journal of Applied Gerontology*, *36*(12), 1471–1518. https://doi.org/10.1177/0733464815595509

Generations Online. (2017). Retrieved from https://www.generationsonline.com

GrandPad. (2019). Retrieved from https://www.grandpad.net/

Harley, D., Howland, K., Harris, E., & Redlich, C. (2014). Online communities for older users: What can we learn from local community interactions to create social sites that work for older people (pp. 42–51). Presented at the HCI 2014 - Sand, Sea and Sky - Holiday HCI. https://doi.org/10.14236/ewic/hci2014.5

Hazari, S. (2012, June 20). Usability factors to consider when developing apps for senior citizen population. [web log comment] Retrieved from: http://appsusability.com/2012/06/20/elder/

It's Never 2 Late. (2018). Person-centered technology. Retrieved from https://in2l.com/

Brooke, J. (2013). SUS: A retrospective. *Journal of Usability Studies*, 8(2), 29-40.

Kobayashi, M., Hiyama, A., Miura, T., Asakawa, C., Hirose, M., & Ifukube, T. (2011). Elderly user evaluation of mobile touchscreen interactions. Presented at *Human-Computer Interaction – INTERACT 2011.* https://doi.org/10.1007/978-3-642-23774-4_9

Leung, D. S. Y., & Liu, B. C. P. (2011). Lifelong education, quality of life and self-efficacy of Chinese older adults. *Educational Gerontology*, *37*(11), 967–981. https://doi.org/10.1080/03601277.2010.492732

Levdikova, T. (2017). Designing apps for elderly smartphone users. *Clutch*. Retrieved from:https://clutch.co/app-development/resources/designing-apps-for-elderly-smartphone-users

Morris, A., Goodman, J., & Brading, H. (2007). Internet use and non-use: Views of older users. *Universal Access in the Information Society*, *6*(1), 43–57. https://doi.org/10.1007/s10209-006-0057-5

Morris, J. M. (1994). User interface design for older adults. *Interacting with Computers*, *6*(4), 373–393. https://doi.org/10.1016/0953-5438(94)90009-4

Naumanen, M., & Tukiainen, M. (2007, December 7-9). Guiding the elderly into the use of computers and Internet - Lessons taught and learnt. Paper presented at the IADIS International Conference on Cognition and Exploratory Learning in Digital Age.

Naumanen, M., & Tukiainen, M. (2008, October 13-15). Practises in old age ICT-education. Paper presented at the IADIS International Conference on Cognition and Exploratory Learning in Digital Age.

Nielse, J. (2013). Seniors as web users. *NN/g Nielsen Norman Group*. Retrieved from:https://www.nngroup.com/articles/usability-for-senior-citizens/

Nimrod, G. (2010). Seniors' online communities: A quantitative content analysis. *The Gerontologist*, *50*(3), 382–392. https://doi.org/10.1093/geront/gnp141

Nimrod, G. (2014). The benefits of and constraints to participation in seniors' online communities. *Leisure Studies*, *33*(3), 247–266. https://doi.org/10.1080/02614367.2012.697697

Nimrod, G. (2018). Technophobia among older Internet users. *Educational Gerontology*, *44*(2–3), 148–162. https://doi.org/10.1080/03601277.2018.1428145

Orzeszek, D., Kopec, W., Wichrowski, M., Nielek, R., Balcerzak, B., Kowalik, G., & Puchalska-Kaminska, M. (2017). Beyond participatory design: Towards a model for teaching seniors application design. *ArXiv:1707.05667 [Cs]*. Retrieved from http://arxiv.org/abs/1707.05667

Otter Voice notes. (n.d.). Home. Retrieved from https://otter.ai/note/22A5RGFLPNXOKZAG

Passel, J.S., & Cohn, C. (2008).U.S. population projections: 2005-2050. *Pew Research Center*. Retrieved from http://www.pewhispanic.org/2008/02/11/us-population-projections-2005-2050/

People Media. (2019). OurTime. Retrieved from https://www.ourtime.com/?notrack

Senior Forums. (2019). Retrieved from http://www.seniorforums.com/

SeniorNet.com. (2019). Retrieved from http://seniornet.com/

Seniorocity. (2019). Retrieved from https://www.seniorocity.com.au/

Shapira, N., Barak, A., & Gal, I. (2007). Promoting older adults' well-being through Internet training and use. *Aging & Mental Health*, *11*(5), 477–484. https://doi.org/10.1080/13607860601086546

Social Media 4 Seniors. (n.d.). Retrieved from https://socialmedia4seniors.net/

Stitch. (n.d.). Retrieved from https://www.stitch.net

Measuring and interpreting system usability scale (SUS) (n.d). Retrieved from https://uiuxtrend.com/measuring-system-usability-scale-sus/

Van De Watering, M. (2005). The impact of computer technology on the elderly. Retrieved from https://tinyurl.com/y3hfuqtp

Xie, B. (2007). Information technology education for older adults as a continuing peer-learning process: A Chinese case study. *Educational Gerontology*, *33*(5), 429–450. https://doi.org/10.1080/03601270701252872

Vita

I-Hui Liou received her first master's degree in Teaching English as a Foreign Language at National Tsing Hua University in Taiwan, and taught English at secondary schools in Taiwan. She is passionate about digital inclusion with a focus on engaging the seniors in technology use and learning. Over the course of her time at the University of Texas at Austin, she devoted to projects focused on instructional systems design and user experience research.

Permanent email: ihui.liu015@gmail.com

This report was typed by the author.