How to Enhance Social Relationships of Older Adults: Design and Development of a Mobile Application for Active Seniors

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Abstract

Background   As the aging population increases, the definition of older adults is being diversified and a new group of older adults has been specified, called 'Active Seniors'. While a range of studies have been conducted regarding this group according to their societal significance, not much research has focused on their social wellness. In order to improve their quality of life, in this study, we adopted design research to examine the needs of active seniors, and sought to provide an online platform for them to receive customized information on leisure activities through which they can form and enhance social relationships offline.

Methods   We conducted qualitative interviews with welfare workers to identify the overall characteristics of active seniors. Based on the insights, an online survey was carried out regarding their social relationships, leisure time, and smartphone utilization. According to the findings, we established design implications and implemented an A/B concept test with active seniors. With the final prototype, utility and usability testing was conducted to draw out necessary fixes and obtain feedback regarding the overall satisfaction.

Results   Based on design research, we developed a working mobile app prototype, which is specialized for active seniors who have demands for obtaining information on leisure activities and building social relationships. Through user evaluation, it was revealed that the service is convenient for older adults in terms of legibility, visibility, and touch interface. Moreover, it has been confirmed to be helpful in providing seniors with necessary leisure information and assisting them in interacting with others by building and maintaining social relationships.

Conclusions   Our study presented new evidence that a mobile application can meet the needs of active seniors with respect to receiving useful leisure activity information and building social relationships concurrently. Additionally, the service can exert meaningful implications in the context of society, can be used as a tool that seniors can utilize to spend their time in a more meaningful way, and may promote the awareness that older adults are still active and independent, and considered an equal group in our society.

Keywords   Design Research, Active Seniors, Social Relationship, Mobile Application

1. Introduction

Aging population is a global phenomenon, where old people outnumber the young(Sell, Walden, & Walden, 2017). The number of older persons in the world is predicted to be 1.4 billion in 2030 and 2.1 billion in 2050(DESA, 2015). With regards to such dramatic circumstances, the concern for older adults has been greatly discussed among a number of various fields.

Meanwhile, thanks to the development of medical treatment and economic growth, the levels of health and life expectancy have increased(Rahman, Waly, & Msadek, 1999), and thus the characteristics of older adults have changed in diverse facets. Compared to the elderly in the past who have had physical and cognitive difficulties, a number of seniors today are still physically healthy and willing to achieve their wellness not only in physical and intellectual aspects but also in mental, social, and emotional areas(Bassett, Bourbonnais, & McDowell, 2007). Such group of people are regarded as 'Active Seniors' who are still as active as younger generations, bearing high acceptance of technology and enjoying spare time and consumption based on their economic stability and independent characteristics(Jeon & Shin, 2017). The population of these active seniors is expected to grow continually in a global context, changing the paradigm of the definition of older adults. In this trend, a considerable amount of research is being conducted on this group but it is mostly limited to the fields of healthcare and entertainment. According to the increase of this population, more research needs to be carried out on various aspects of active seniors.

In this regard, our study has focused on the wellness of active seniors, paying meticulous attention to their social and mental aspects. We specifically tackled the enhancement of social relationships, which are reported to be significant in improving their quality of life and preventing some potential problems of an aging society(Jun & Kim, 2016). Focusing on this issue, we aimed at developing an optimal solution to help active seniors to achieve a more fulfilling and satisfactory life. Ultimately, we came up with a method to improve the social wellness of older adults by developing a mobile app prototype, with which seniors can receive necessary leisure activity information and build social relationships simultaneously.

Our study was conducted with three research questions which are the following:
- RQ1: What are the difficulties active seniors experience in the context of social relationships?
- RQ2: How can we design a system to support active seniors' leisure lives and social relationships?
- RQ3: Can such a proposed system function as a tool to empower active seniors to be actively involved in social groups and to enrich leisure lives?

We implemented the study through the following process:
1. Exploratory user study to derive insights into actual needs of active seniors regarding their wellness
2. Establishing functional requirements of a suggested system
3. Prototype design and development of a suggested system
4. User test to analyze the utility and usability of the prototype

2. Literature Review

2. 1. Aging Population and Active−seniors

While aging population is a global phenomenon, a few countries such as Japan and South Korea are particularly regarded as aged societies with having 14% of the population being people over the age of 65(KOSIS, 2019). In these aged societies, the characteristics of older adults are constantly changing as they become more active, pursuing a younger and healthier lifestyle. The elderly with such new characteristics are regarded as 'Active-seniors', a concept first brought up by Neugarten, B. L in 1982(Neugarten, 1982). This group of people over 50 years of age(Fortune Korea, 2019) are different from the previous definition of older adults in that they are willing to spend their money and time on their quality of life and to achieve a modern lifestyle by communicating with young people through the Internet and SNS, using computers and smartphones(MezzoMedia, 2017). In South Korea, particularly, these active seniors are even considered to be important target consumers in blue ocean markets as they constitute a new demographic that is active in accepting new technology and products(Kwon & Choi., 2018). However, not much research has been conducted on these active seniors in various contexts compared to research on the previous groups of elderly. Thus, since the population of active seniors is going to account for a bigger sector of the elderly, a more profound study needs to be conducted on this group in terms of societal aspects.

Table 1 Characteristic differences between active seniors and seniors in the past(SamJong KPMG, 2017)

	The elderly	Active seniors
Characteristic	Passive, conservative	Active, future−oriented
Hobby	Interact with the same generation	Various interests, interact with other generations
View of life	Interact with the same generation	Value on enjoying life
Technology utilization	Difficulties in using mobile and Internet	Own their smartphone and frequent use of mobile and Internet
Preparation for old age	Rely on their children economical aid for economical aid	Prepare themselves
Perception of old age	Regard themselves as old people	Regard themselves as 5−10 years younger than their actual age

2. 2. Wellness

Along with the aging population and trend of active seniors, the concern for 'wellness' is escalating, focusing on 'living a healthy and happy life' rather than merely tolerating their later years(Lee, Shin, & Lee, 2013). The meaning of wellness has been consistently redefined by a number of scholars. The very first definition was developed in 1654 as an opposite term of "illness" that refers to disease(Sell et al., 2017). Since then, wellness has been interpreted as being well in multidimensional areas. Bill Hettler, the executive director of the National Wellness Institute in 1979, developed a Whole-Person Wellness Model through which he defined wellness as achieving optimization in all six dimensions: physical, emotional, spiritual, intellectual, occupational, and social wellness(Hettler, 1976). Since active seniors are regarded to be relatively successful in achieving physical and cognitive wellness according to their characteristics, their mental, emotional, and social wellness may need to receive more attention. Accordingly, the significance of research on their performance and life quality from these aspects had emerged.

Figure 1 Whole–Person wellness model (Hettler, 1976)

2. 3. Smartphone as a Tool for Promoting Social Wellness for Active Seniors

Interactions, social connections, and support are major contributors to quality of life and aging successfully(Bowling, & Dieppe, 2005; Reichstadt et al., 2010), and thus a lack of social relationships can negatively affect the lives of older adults(House, Landis, & Umberson, 1988). Accordingly, in order to maintain social relationships, active seniors today use smartphones as they can ease and facilitate interaction, providing social support(Pecino, Lera, & Martinez-Pecino, 2012). In South Korea, for instance, a great portion of the elderly have been reported to be using a smartphone for social activities(KISDI. 2018). It has been also suggested from research that the use of smartphones by people over the age of 50 can have positive effects on expanding social relationships as well as social activities, and thus ultimately increasing the satisfaction of their quality of life(National Information Society Agency, 2013; National Information Society Agency, 2015; Kim, & Jun, 2017). Nonetheless, there has not been many studies on services that focus on older adults' social wellness. In case of Korea, mostly used mobile social apps by those older adults are limited to KakaoTalk, Facebook, and Naver Band(Lee, 2014); these apps are aimed at general socializing and thus they do not meet the specific social needs of active seniors nor do they reflect the cognitive and physical characteristics of the elderly.

Rather, most of the research conducted on mobile applications for active seniors is related to healthcare, physical assistance, and entertainment. For instance, Lee and Kim(2015) explored application contents and user interface for healthcare apps for active seniors; they suggested that those intended for active seniors should be designed in a more intuitive and convenient way than existing smart healthcare apps due to decline in cognitive abilities. Beak and Jun(2015) suggested a UX guideline for a mobile music application for seniors who are relatively alienated in music markets. Oh and Geon(2019) developed a mobile app that helps seniors to enjoy customized traveling according to the state of their health. Yet these studies do not embrace the field of social relationships which is considered a key factor in improving the lives of older adults. Hence, it is stressed that further study needs to be carried out on analyzing the potential of mobile applications as a means to enhance the social wellness of the elderly.

3. Our approach

First of all, in order to figure out the main difficulties active seniors experience today with respect to overall wellness in their lives, we pursued exploratory study through interviews and surveys. We then applied design research methodology to devise a solution for empowering them.

Step 1: Interviews. In order to gain understanding of lifestyle and characteristics of active seniors, we interviewed two welfare workers in Songdo Senior Citizen Welfare Center, Yeonsu-gu, Incheon city on March 25, 2019 for about two hours. Through coding, main insights were derived which worked as the groundwork of our study.

Step 2: Surveys. Based on the insights, to derive provisional solutions and to identify the potential of such solutions, from April 13 to 17, 2019, we conducted online surveys on 81 older adults who were able to use smartphones. The questions were regarding their social relationships, leisure time, and mobile utilization.

Step 3: A/B concept test. According to the results gained through this process, we have formed design implications of the service, and established design requirements to implement the service more concretely. We then conducted an A/B concept test on four seniors concerning their preference between the two different versions of the wireframe design, and from the selected design, a final prototype was created.

Step 4&5: Utility & Usability testing. From June 4 to 7, 2019, we conducted utility & usability testing composed of performing several tasks and follow-up interview on eight senior citizens from the Welfare Center in Songdo in order to draw out necessary fixes and obtain feedback regarding the overall satisfaction. We specifically focused on the utility of service functions; the test assessed how well the functions meet their needs of easy access to leisure activity information, and formation of new relationships.

4. Results

First, in order to understand the characteristics and lifestyles of active seniors, we set our first research question as 'What are the difficulties active seniors experience in the context of social relationships?'. To answer this question, we conducted exploratory studies through interviews and surveys.

4. 1. Interview Results

For the interviews, we interviewed two social workers at the Songdo Welfare Center for about two hours. This institution was selected since many of the older adult attendees are regarded as active seniors who are willing to put efforts into improving their quality of life in diverse ways. Based on the questions regarding older adults' lifestyle, their social relationships, and popular programs at the center, several insightful findings were discovered. The following table illustrates findings discovered from the interviewees.

Table 2 Interview Findings

| Interview Questions	Findings	Description
How is the general lifestyle of seniors? How regularly do seniors attend the courses?	Great interest with self–development	Older adults are interested in taking courses to acquire new knowledge and also actively participate in outdoor activities for their health.
	Willingness to spend time and money on leisure activities	It was turned out that many attendees often miss the courses to go on a trip; they invest a large amount of their money on leisure time.
	Difficulty with receiving leisure activity information	A sufficient amount of leisure activity information is provided by several organizations but since it is often provided through only websites or brochures, most seniors have difficulty with acquiring such information; they need to visit the institutions themselves, check the bulletin boards at the institutions, or know through their acquaintances.
How is the general emotional state of older adults? How is the state of their social relationships? Do they easily form and maintain relationships?	High demand for social relationships	While there are seniors who can actively participate in community activities and meet social needs, there are still seniors who feel the lack of opportunities to form social relationships, suffering from social deficits. Especially, people who live in apartments do not have many opportunities to interact with people from outside due to the closed structure. There are people who want to participate in certain clubs but have no idea how to find and apply for them. In addition, some people seem to be suffering from being involved in new social groups after retirement.
What are the most popular programs at the Seniors Welfare Center?	Proficiency with using mobile phones	Among various programs provided from the center, smartphone education program is increasingly popular, which indicates that seniors today are willing to learn and use smartphones actively. Moreover, most of the seniors can receive all kinds of announcements through messages and use smartphone without great difficulties.

Accordingly, five big findings and insights have been derived which demonstrate the main characteristics of older adults today. We also discovered the opportunity of tackling the issue of active seniors' demand for social relationships and providing a proper solution accordingly. Regarding the means of providing solutions, we deduced that a mobile application could work as a decent tool since an app can provide information in a convenient way, and unlike previous generations, many active seniors today are able to utilize mobile phones.

4. 2. Survey Results

Referring to the insights gained through the interviews, we conducted online surveys from 81 seniors who have mobile phones in order to gain an insight into their pattern of leisure activities and social exchange. We also aimed to figure out the elderly's proficiency and willingness of using mobile applications in order to examine the possibility of utilizing a mobile application as a tool to provide the necessary services. As a result, regarding the question of whether they want to expand social relations through interactions from new activities or hobbies, 29.6 % of the respondents answered "Neutral", 22.2% answered "Likely", and 14.8% answered "Very likely". In terms of whether they want to use a service that provides information for expanding social relations, 35.8% of respondents answered "Likely" with the highest rate, 33.3% of respondents answered "Neutral", and 23.5% answered "Very Likely". Moreover, for people who are not satisfied with their leisure activities, the reasons behind the dissatisfaction turned out to be not having an affiliated group to enjoy, and people to communicate with, accounting for 50% of the responses. Further reasons were having no idea how to find new leisure activities and the absence of friends to enjoy activities with.

Through this survey, we were able to confirm the needs of seniors as the following: 1) to expand social relations, 2) to obtain information regarding new activities, and 3) to find an opportunity to enjoy leisure activities and communicate with others.

Q. Do you want to expand social relations through interactions from new activities or hobbies?
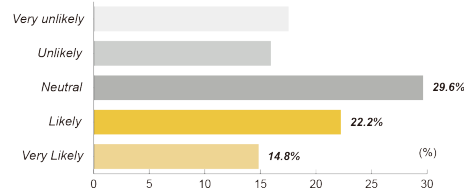
Q. Do you want to use service that provides information for expanding social relations?
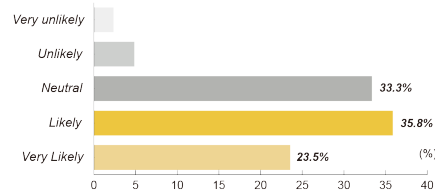

Figure 2 Survey results

Based on the results of the interviews and surveys, various insightful service opportunities were identified. To sum up, active seniors are characterized as bearing independent and active tendencies unlike previous older adults, having willingness to participate more actively in the society, and handling mobile phones skillfully. Furthermore, they have a desire to expand social relations, enjoy hobbies more actively through opportunities for broader social interaction, and receive new information related to these activities.

5. Functional Requirement

According to the insights derived from the previous chapter, we set our second research question as 'How can we design a system to support active seniors' leisure lives and social relationships?'. We then sought for solutions according to each of these needs. First of all, based on the interviews and survey results, we could derive two crucial needs of active seniors: 1) to receive new information related to their hobbies or leisure activities in a convenient way and 2) to form and expand social relationships. We could also conclude that a mobile application would function as an appropriate means since it can be a platform to provide information, as well as a space for meeting others. Thus, reflecting the extracted results, we set our goal as designing a mobile application prototype which can deliver the tailored leisure information and help form social relationships, and thereby we derived two main functions of the application as shown in the following table.

Table 3 Function Derivement from Interview and Survey Results

Insight	Needs	Solution	Function
1.In−depth Interview 1) Willingness to spend time and money on leisure activities 〉 *Needs A* 2) Difficulty with receiving leisure activity information 〉 *Needs A* 3) High demand for social relationships 〉 *Needs B* 4) Proficiency with using mobile phones	A. Desire to receive new information related to their hobbies or leisure activities in a convenient way	An easy and convenient path to deliver leisure information offered by the government.	Function of personalized leisure information delivery
		A function to receive information tailored to individual interests and areas	
2.Survey 1) to expand social relations 〉 *Needs B* 2) to obtain information regarding new activities 〉 *Needs A* 3) to find an opportunity to enjoy leisure activities and communicate with others. 〉 *Needs A, B*	B. Desire to form and expand social relationships	An online platform for seniors to meet others who have similar interests or live closely.	Function of providing communication space between people with common interests
		A space for seniors to easily recruit and interact with members.	

In terms of the first function, personalized leisure information delivery, we need to secure the leisure information for active seniors. The ward office, the government office, or the welfare office, which are subordinate organizations of the government, provide numerous programs for local seniors. They include educational programs, exhibitions, and local events such as flea markets and marathon competitions. As it was discovered from the expert interviews, even though seniors have a strong desire to receive such information, many of them feel a lack of opportunities to obtain information. The source of acquiring such information is limited to visiting the institutions themselves, checking the bulletin boards at the institutions, or knowing through their acquaintances. People who do not often visit such organizations or who are retired and do not have many acquaintances, may not be able to easily obtain such information. Hence, through convenient access of diversified event information, seniors may be able to attend and enjoy a variety of activities in their spare time. This function can also work as a door for seniors to open up the opportunities of social interactions. For the next step of securing rich information resources, we added a feature of tailored information delivery, which functions based on user's location and interests to satisfy each person's unique personal needs.

The second function, communication space between people with common interests, provides a space where seniors can create communities according to their hobbies and meet people with similar interests. Seniors can discover various clubs, contact interested groups, and create their own groups if there are no clubs with their tastes. Thus, the function's specific features include 'group class registration' in which users can apply for certain classes as a group for a group discount, 'recruitment of club members' for regular meetings, 'recruitment of short-term meeting members' for short-term events such as prep groups for marathons, and 'free board' where users can share and discuss any everyday life information. These features are one step further than the first function in that seniors actually use the service as a platform to build and join social relationships, and ultimately form new culture out of it.

In addition to the two main functions, this application provides a SNS sharing function to easily share the recommended contents with acquaintances and enjoy the activities together, and a friend function for users to interact with people within the application. Furthermore,

the app recommends new friends for seniors to expand social relationships through the platform based on location and interests. Users can also arrange their schedule of activities using the calendar function, which would give push alarms to remind them of their schedule. Additionally, to maintain their active use of the application, all users are given a rating system with which they rate other users after each meeting and accumulate medals according to their rating.

In this way, we ultimately aimed to lead seniors to enjoy offline contacts and activities, using our application as a helping tool to start making social relationships more conveniently, and thereby to increase the overall quality of life through our service.

6. Design and Prototype

To identify if mobile applications could contribute to the social wellness of seniors, a prototype needed to be created. Prior to developing a final GUI design, we worked on the wireframe. Since users of the application are elderly even if they are active seniors, certain factors needed to be considered to achieve a user friendly design. First of all, all the icons need to be followed with a simple description in order to help seniors understand the precise meaning of the icons(Smith, & Park, 1990). Second, according to design guideline for older adults, the font size needs to be bigger than normal size for seniors to be able to recognize easily(Calak, 2013). A function of adjusting the font size also needs to be provided. The layout should be precise and as easy to use as possible so beginners can adapt immediately, and the arrangement of components should be consistent and simple(Al-Razgan, 2012). Moreover, regarding the display, we aimed to provide and recommend the contents in a customized order according to the information of each user, such as user's gender, location, and areas of interests.

Reflecting all these considerations as well as formerly discussed implications, two wireframe designs have been developed (Fig.3). First, Design A is generally arranged with a square style and displays mostly four announcement boards on one screen. Users can see additional boards by vertically scrolling down the screen. This type of design can be efficient in that the arrangement is consistent and neat, yet in terms of legibility it can be inadequate since showing many boards on one screen can lower the readability.

In case of Design B, the overall arrangement of boards and menus is both circular and tetragonal. Icons and texts for menus are included in circles, providing a friendly and soft atmosphere. Announcement boards are displayed one by one on each screen for users to swipe the displayed board to the side to see the next one. Such a design can increase legibility as one expanded board is shown in a big size. However, the swipe function can be difficult for seniors to use.

We then conducted A/B test with four active seniors in order to figure out their preference between Design A and B with regards to ease of use, legibility, aesthetic impression, and

delivery. Two of the participants selected Design A as more preferable in that the square style of arrangement is easy and familiar.
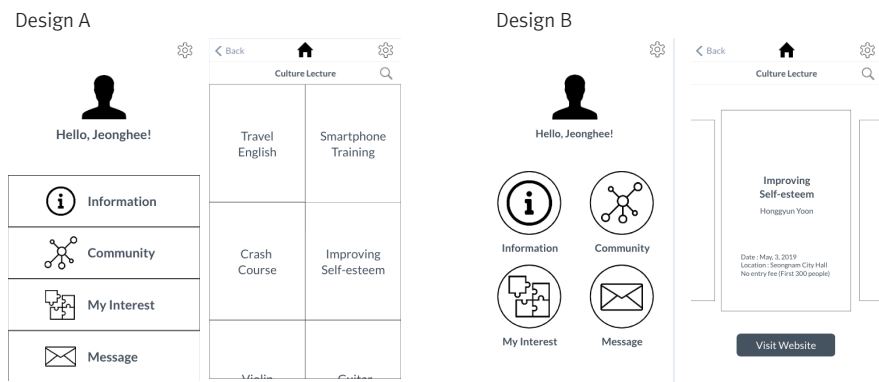

Figure 3 Wireframe

The other two seniors, on the other hand, preferred the expanded boards of Design B, which show one board on one screen through the swipe function, as they increase legibility. Additionally, most of the participants responded that the swipe function is quite easy and familiar. Thus, in order to reflect the opinions of all the four participants, we decided to aptly combine the designs of A and B by maintaining the square style of overall arrangement, yet placing boards to be displayed one by one for each screen.
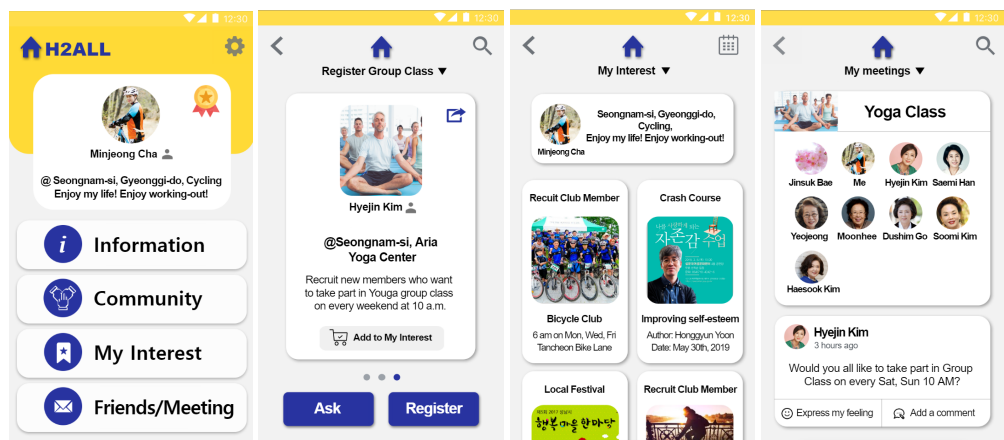

Figure 4 App prototype

Based on the results of the A/B test and the design guideline, we developed the final GUI design of the application using a vector-based design tool for the user interface, 'Sketch' (Fig.4). We decided to set the color yellow and blue as our theme color. We specifically referred to a mobile app design guideline(Lee, 2014) which suggested that active seniors tend to prefer the color blue as they think blue is good for eyesight. Yellow was selected as the other main color since it is a complementary color for blue, and therefore the combination of yellow and blue would be aesthetically pleasing. Furthermore, we hoped that the color yellow would provide a bright and cheerful atmosphere while using the application. The shapes of menus and boards have been unified as round squares to create a friendly and soft atmosphere.

Also, in order to create a working prototype to conduct usability testing, we used 'Protopie', a prototyping tool for smart devices.

As mentioned in chapter 5, in terms of functionality, there are two main functions, and we named the first function: Function of personalized leisure information delivery as "Information Offering" and the second function: Function of providing communication space between people with common interests as "Community Building" respectively. We also added two sub functions that assist the two main functions. The specific description of each function is as follows:

1. Information Offering: provides information about various programs and events hosted by public institutions. For registration or more information, users can directly access the websites of the public institutions offering the programs. Users can also save and share the interested programs with their friends via their messenger apps.

2. Community Building: users can create meetings or communities themselves to enjoy social activities offline. Users can ask questions to the hosts and apply for participating the meetings.

3. My interest: displays only the boards that users have saved as their interests and provides users' schedule of meetings signed up within the app.

4. Friends/Meetings: provides a platform where users can manage their friends and meetings.

7. Utility and Usability Test

We conducted a usability & utility test in order to find the answer to our last research question, *'Can such a proposed system function as a tool to empower active seniors to be actively involved in social groups and to enrich leisure lives?'*. Tasks of the testing included using the service to find certain announcements and clubs, saving the interested clubs, and sharing the interested notice to friends using the sharing function. Through the follow-up interview, we aimed to figure out their satisfaction with our service in terms of design, functionality, and usefulness.

A pilot test was first conducted on one male senior in his 50s to confirm the final UI/UX, and through this, the interface was modified, such as font size and indefinite icon replacement. After the final modification process, the actual test was conducted on eight seniors in their 60 to 80s who use smartphones at Songdo Senior Welfare Center. The participants consist of 4 males and 4 females who appeared to have a healthier and more active tendency than people who are of the same age. The specific information of participants is shown in "Table 4. Information of the test participants" and the insights and feedback obtained through this as "Table 5. Interview Results".

Table 4 Information of the test participants

Participants	P1*	P2	P3	P4	P5	P6	P7	P8	P9
Gender	M	M	M	M	F	M	F	F	F
Age	59	81	71	81	73	69	67	62	62

*pilot participant

First, we affirmed seniors' need for the formation and promotion of social relations among seniors. They tended to be satisfied most with the fact that they were offered a place for information to interact with others through 'Information Offering' and 'Community Formation' functions. It is noteworthy that seniors showed a willingness to communicate with new people and groups. We could confirm that if a proper space is provided for older adults to communicate, it may be definitely assist them in forming and improving social relationships. In addition to the needs for simple communication with others, we also discovered the need for value creation to exchange and share experiences.

Table 5 Interview results

Findings & Insights		Quotes
Needs for social relationship formation and promotion	Low reluctance to interact with strangers	P5: "We all met here for the first time. It's not difficult for us to talk to new people."
		P7: "Kids and older adults don't really feel awkward meeting new people. They become friends very soon."
	Needs to share and enjoy with others	P2: "I would definitely use this kind of application. It is important to share with others, gathering to enjoy these clubs… seniors have lots of experiences so it's good if we could share them with others."
		P8: "What do I want to learn? Well, I can't learn by myself. And since we are old, it's better to gather and learn together, forming empathy…"
The importance of contents delivery method	Content algorithms based on individual interests	P6: "Bicycles… I am not really interested in them. If there is one that I would like to learn… oh this one I would be interested.
		P8: "Oh this one, my hubby would like! I can't join these clubs because I don't receive any of this information… oh there is a bicycle club!"
	Stabilization through securing sufficient quantity of content	P6: "(indicating interested notice) if there is a lot of information like these, I would frequently look at this app."

Moreover, we could confirm the importance of how to curate the content delivery method. On the content screen provided, some of participants expressed their opinions on the content of the 'example announcement' itself and linked their personal interests to example content to their satisfaction with the service. For example, in the 'Bicycle Club' screen, while there was a participant who expressed his indifference to the service, saying that he was not interested in bicycles, there was also a participant who expressed his interest in the service because of his high interest. When running the actual service, it is possible to assist users to experience more useful and helpful information by implementing the content recommendation algorithm, based on the individual's residential area and interests. Prior to this, the 'Information Offering' function will have to provide rich contents by linking with the local government server of each region, and also this service needs to make sure that the number of contents can be secured, and the rotation and updates of announcements can be done smoothly in the 'Community Building' function.

Through the UT task, we obtained common feedback that it was not difficult to use the functions of our application, and that the use of the elements such as interface structure, color, and size of the text were not inconvenient visually. However, it is necessary to further improve its usability by adding an arrow icon that clearly explains how to use the swipe function, replacing the calendar icon with a more intuitive icon, and adding a keyword to every icon as far as possible.

8. Discussion and Conclusion

The present study was aimed at addressing the improvement of active seniors' wellness by providing a service for seniors to access diverse leisure activity information, and to use the application as an online platform to achieve offline relationships rather than concentrating on online activities. Through user evaluation, the effectiveness and possibilities of our service have been confirmed: 1) seniors can use the application without great difficulties, 2) the service appears to be helpful in providing seniors with necessary information, and 3) it can provide seniors with a platform where they can interact, building and maintaining social relationships.

Other than these insights, we also discovered some difference of acceptance on our service according to gender. For instance, in terms of technology acceptance, male seniors showed a greater willingness to use mobile services than female seniors. Furthermore, most male participants expressed their willingness to utilize the application, but some female participants mentioned that they would not have much time to actually use it to meet people as they need to take care of their grandchildren. Thus, we need to further study if such gender difference can be generalized.

Our study presented the following contribution. First, through empirical research, we figured out desires or difficulties that active seniors experience specifically in the context of social relations, and suggested a new system that could meet the needs of the elderly. Second, it was confirmed from the prototype development and user testing that a mobile application can function as a tool to satisfy their needs of enhancing social relationships as well as enriching leisure lives. Last but not least, the proposed service demonstrated the potential to help empower older adults to be still active and independent, being able to establish their own life and culture.

However, there are several limitations. First, since the interviewees and survey participants were all from the same place, they may not represent the general characteristics of active seniors in our society. Second, the prototype did not reflect specific postings based on each participant's area and interests since it was not technically developed and deployed. For future work, we aim to develop and deploy the app in order to promote older adults to use a fully developed version, and confirm the improved social relationships and leisure lives.

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Appendix.

Survey Questions

(Part 1/6) Questions regarding leisure lives	1. How often do you enjoy leisure activities?
	2. What kinds of leisure activities do you often enjoy? (Choose all that apply)
	3. Who do you enjoy leisure activities with? (Choose all that apply)
	4. Are you satisfied with your leisure lives?
	4-1) If you are not satisfied with your leisure lives, what is the reason? (Choose all that apply)
(PART 2/6) Questions regarding social relations	1. How often did you meet or have contact with your acquaintances in the last three months?
	2. What do you usually talk about with your friends and neighbors? (Choose all that apply)
	3. Currently, how many social groups are you affiliated with? (Social groups: alumni meetings, religious meetings, clubs, etc.)
	4. Please select all of the groups you are affiliated with from below.
	5. Do you want to expand your social relationships through new activities or hobbies?
(PART 3/6) Questions regarding smartphone use	1. Do you use a smartphone?
	2. How proficient do you think you are at using a smartphone?
	3. Have you experienced difficulties with using a smartphone due to small font size? Ex) you repeatedly expand and reduce the screen in order to read words, you often frown to look at words or need to wear magnifying glasses
(PART 4/6) Questions regarding service for information offering	1. Which information would you want to receive if there is a service that provides information for seniors? (Choose all that apply)
	2. Would you be willing to use such a service that you selected from the above question?
(PART 5/6) Questions regarding service social group activities	1. If you are using any service for social group activities, please select it. (If you select 'None', please go to the next page.)
	2. What is the purpose of using applications or services for social group activities? (Choose all that apply)
	3. How satisfied are you with the app/service you are currently using?
(PART 6/6) Questions regarding demographic factors	1. Gender
	2. Age
	3. Religion
	4. Marital status
	5. City of residence
	6. Monthly expenses

App Screens