
Mobile Walking Game and Group-Walking Program to Enhance Going Out for Older Adults

Masami Takahashi

NTT Corp., Network Innovation Laboratories.

3-9-11 Midori-Cho, Musashino-Shi Tokyo 180-8585, Japan

t.masami@lab.ntt.co.jp

Atsuhiko Maeda

NTT Corp., Network Innovation Laboratories.

3-9-11 Midori-Cho, Musashino-Shi Tokyo 180-8585, Japan

maeda.atsuhiko@lab.ntt.co.jp

Hitoshi Kawasaki

NTT Corp., Network Innovation Laboratories.

3-9-11 Midori-Cho, Musashino-Shi Tokyo 180-8585, Japan

kawasaki.hitoshi@lab.ntt.co.jp

Motonori Nakamura

NTT Corp., Network Innovation Laboratories.

3-9-11 Midori-Cho, Musashino-Shi Tokyo 180-8585, Japan

nakamura.motonori@lab.ntt.co.jp

Abstract

Japan is aging rapidly, so “*tojikomori*” has become an important issue. In the field of gerontology, “*tojikomori*” means shutting oneself in a room or house. Tojikomori is caused not only by physical factors but also by social and psychological ones. Once an elderly person becomes tojikomori, it takes a lot of time and energy to recover. It is important to take primary preventive measures, especially for currently active older adults because a little help has a great benefit. A previous study identified two key factors of tojikomori in an urban area: no exercise habits and no participation in community activities. Therefore, we developed a walking game to enhance physically healthy behavior and motivate the elderly to explore a city and lead to the discovery of favorite spots they want to visit again. In addition, we designed a group-walking program utilizing the walking game aimed for face-to-face communication with other community-dwelling elderly people. Our results show that our approach was well received, enjoyable, and effective for older adults in a real-world situation.

Author Keywords

Health, tojikomori, housebound, elderly, mobile games, behavioral intervention, gamification, social matching.

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Introduction

Japan has the highest proportion of older adults in the world, so “*tojikomori*” has become an important social issue. In the field of gerontology, the Japanese word “*tojikomori*” means shutting oneself in a room or house. Tojikomori is usually translated as housebound in English, but the word has a slightly different meaning. For the majority, physical disability renders them housebound. However, even if the elderly can walk and have good access to transportation, they have the potential to become tojikomori. Tojikomori is caused not only by physical factors but also by social and psychological ones. Social isolation is a similar meaning word in a way. Once an elderly person becomes tojikomori, it takes a lot of time and energy to recover, and they face a growing risk of nursing-care due to the decline of physical and mental functions. Therefore, the Japanese government considers preventing tojikomori very important before it is too late and hopes to take primary preventive measures, especially for current physically active older adults because a little help will have a great benefit in the future.

Murayama et al. [1] identified two key factors of tojikomori in an urban area: no exercise habits and no participation in community activities. Moreover, elderly men that have little interest in the area that they live in are prone to becoming tojikomori. Therefore, we developed a walking game to enhance physically

healthy behavior and enable one to become familiar with an area. The walking game is a mobile game that aims to motivate the elderly to explore a city and lead to the discovery of favorite spots they want to visit again. In addition, we designed a group-walking program utilizing the walking game aimed for face-to-face communication with other community-dwelling elderly people because social network formulation is an important step toward participation in community activities and good for mental well-being.

Results from a user study with 30 elderly people over a month showed what was the motivation to walk more and explore a city. We also reveal what was effective in terms of being friendly through group walking. These insights would be a point of departure for future investigation.

Related Work

Project Background: ClouT

The ClouT (Cloud of Things for empowering the citizen clout in smart cities) project [2-3] focuses on leveraging Cloud computing [4] and the Internet of Things (IoT) [5]. The main target of this project is solving actual city problems by using city data collected by IoT technologies. In the ClouT project, we are responsible for field trials in Mitaka city, Tokyo, Japan. Through discussions with city authorities and related organizations, several key issues in Mitaka city have been identified. One important issue is the increasing cost of nursing care for elderly people. In Japan, almost all cities are faced with this problem. To prevent a fall in the number of people using nursing care, the city authorities hope to take preventive measures, especially for currently ambulatory elderly people. We are interested in the social and health issues of the

Date	Schedule
Aug. 25 - 31, 2015	Preliminary online survey
Sept. 8 - 15, 2015	Preliminary questionnaire for participants
Sept. 18 and 24, 2015	Orientation meeting for participants
Sept. 26, 2015	Start of field study and public release of application
Oct. 6, 9, 14, 19, 22, and 25, 2015	Group-walking program
Oct. 25, 2015	End of field study
Oct. 26 - 27, 2015	Interview and questionnaire
Nov. 30, 2015	Follow-up questionnaire

Table 1. Schedule for experiment

aged population and would like to learn what we can do through the use of ICT technologies. Therefore, we design, deploy, and evaluate the application of the technologies and activities in real situations.

Factor Analysis of Tojikomori

Most previous studies about tojikomori have been observation studies. In general, tojikomori is caused by three factors: physical, psychological, and socio-environmental. Murayama et al. [1] examined the relationship between tojikomori and the factors among community-dwelling elderly in an urban area. In Japan, the population of aged people in urban areas is expected to rapidly grow within the next decade. Therefore, we focus on the factors in urban areas and conduct a user study in Mitaka city, which is located in the Tokyo metropolitan area. The previous study identified two tojikomori factors in an urban area: no exercise habits and non-participation in community activities. Moreover, elderly men that have little interest in the area that they live in are prone to becoming tojikomori. On the basis of these insights, we designed a walking based intervention that is aimed at enhancing healthy behavior and interaction with a community such as exploring the area and social network formulation.

Mobile Phone Health Interventions

A growing number of recent mobile phone based interventions have utilized some form of entertainment to engage individuals with their health goals. For example, Armstrong et al. [6] used cellular text messaging as a reminder strategy to improve adherence to sunscreen application. Kharrazi et al. [7] used behavioral models to inform that game-based interventions for health can increase the usability and

the effectiveness of the games at achieving the desired outcomes. Games and gamification techniques are effective approaches for motivating health behavior, and recent years have seen an increase in games designed for changing human behaviors or attitudes. However, our objective is to promote face-to-face communication with other community-dwelling elderly people as well as to motivate healthy behaviors. Most of the existing game-based interventions represent the lack of support for face-to-face communication.

Methods and System Design

Physical activity, especially walking, has lots of important benefits for older adults. Of course, it is good for health, and it is also effective for pausing to realize a city's value and for feeling interested in and an attachment to a region. In addition, interventions to promote walking in groups are efficacious at increasing physical activity [8] and offer a good opportunity to communicate with other community-dwelling elderly people face to face. For these reasons, we chose a walking based intervention. The whole schedule for our experiment took place as follows (Table 1).

Walking Game Design

We designed a walking game named "*San-Poki*" that acts like an electronic version of a stamp rally. A stamp rally is very popular event in Japan where one goes round to certain locations to collect stamps. Each location has a unique stamp. A stamp rally event fits well to motivate people to explore a city and lead to the discovery of favorite spots they want to visit again. We developed the application as a native application on smartphones and released the application to the public before the start of our field study. Everyone could use the application as well as the participants. As shown in

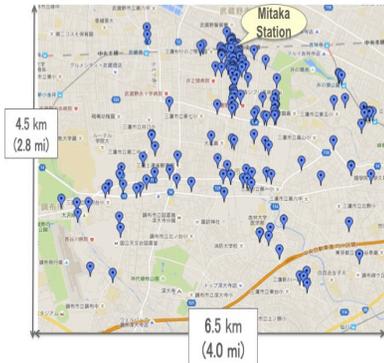


Figure 3: BLE beacon and distribution of 177 visiting spots in Mitaka city

Figure 1, the application has two functions: an electronic version of a stamp rally and a photo SNS for sharing local information by uploading photographs. Uploaded photos can be utilized for town development in Mitaka city.

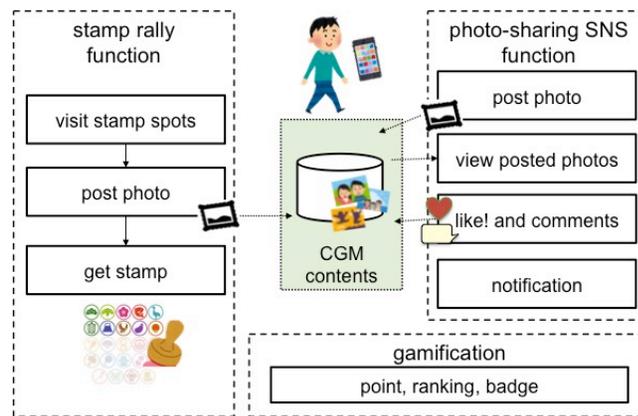


Figure 1: Application architecture of San-Poki.

The home screen of the application [Figure 2 (1)] shows a list of stamp spots near the current place of the user. We set 177 BLE beacons across the city such as in shops and public facilities (Figure 3). If a user comes close to a beacon, a notification screen [Figure 2 (2)] is displayed. If the user taps "Open," a photo upload screen is displayed. Then, the user gets a stamp of the spot if he or she takes a nearby photo and selects photo tags from "unique to city," "landscape," "festivity," or "discovery" [Figure 2 (3)]. Users could use the application by installing it on their commonly used smartphone or tablet.

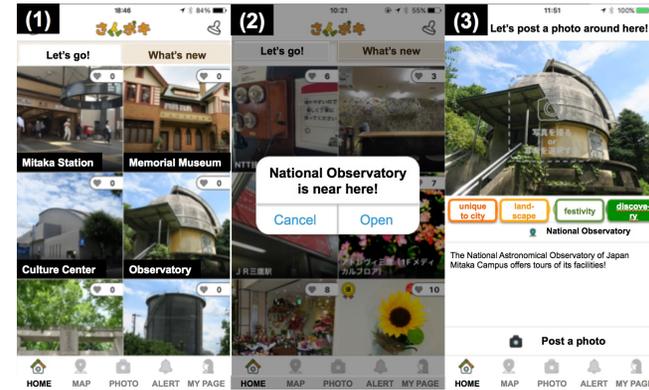


Figure 2: Screenshots of San-Poki application

Group-Walking Program Design

Before going into design details, we conducted a preliminary online survey on enhancing friendship among older adults. The participants were 412 elderly people whose ages were more than or equal to 65. As a result of our survey, we confirmed several findings. Firstly, it would be effective to hold an event where the elderly can interact and talk with each other and let them meet about three times. Secondly, a walking event could be preferable for many elderly people because many participants included it as a specific example of hobbies. Finally, frequent triggers for being friendly were having a same hobby and enjoying it together.

We held a group walking event utilizing the walking game in which participants walked along two or three out of seven courses in Mitaka city during the field study period. Participants walked for about one or two hours on the basis of a walking map made by the Mitaka City Tourism Association [9] and collected stamps along walking courses of the map. We let



Figure 4: Participants during group walking program

participants take part in group walking three times. The number of people in each group was from three to six. While the group walking members were changed each time, some participants were in the same group several times.

We organized groups to meet the participants' schedules and courses on the basis of the result of a questionnaire that we conducted beforehand and asked participants about the dates that they could participate in the group walking and courses that they wanted to walk along. Moreover, to make it easier to become friendly with group members, we let participants who had the same or similar hobbies belong to the same group as much as possible. Although we organized groups manually in this field study, the process could be computed fully if it is possible to calculate similarities among hobbies. Finally, 29 out of 30 participants who had the same or similar hobbies joined the same group at least once.

Field Study

Study Sites and Participants

We conducted the user study in Mitaka city, Tokyo, Japan. The city is located almost in the Tokyo Metropolitan Area. The number of registered residents is 182,897 (as of the beginning of January 2016), and the population aging rate is 21.4% (as of August 2011). During the rapid economic growth of the 1960s, Mitaka's population expanded from 90,000 in 1960 to 150,000 in 1970. Many of the new residents at the time have become old now.

The participants were 30 people (15 men and 15 women) who did not have difficulty walking, and lived in or near Mitaka city. The majority of participants were

members of an incorporated NPO because we recruited participants through this incorporated NPO. Some participants were acquainted with each other, and others were strangers to each other. The male participants' age composition was as: 50s: 1, 60s: 9, more than or equal to 70s: 5. The female participants' age composition was: 50s: 3, 60s: 8, 70s: 4.

In this user study, we did not inform the participants of the group members with whom they would walk before the date when they took part in group walking because we wanted to keep them from contacting and meeting each other before. Figure 4 is a photograph showing participants during the group walking program.

Logging Data, Interview and Questionnaires

We conducted questionnaires and an interview with 30 participants in this user study. We conducted questionnaires for each participant two times, that is, right after the user study and one month after the user study. The interview was semi-structured, one-on-one, and took 30 minutes for each participant. We asked participants during the interview to give details on the closeness and triggers that made them friendly during the walking. In addition, we collected data about their behaviors such as check-in spots detected by BLE beacons and geotags on photos taken by participants.

Results

Results of Walking Game

We asked participants "Compared with the time before you used the San-Poki application, did your frequency of going out, your walking distance, and steps increase when using the application and after that?" in the questionnaire that we conducted one month after the user study. As a result, it was found that our walking

Content of responses	No. of responses
It was becoming fun to collect stamps	27
The uploaded photo would be utilized for town development in Mitaka city	19
To get points and badges	16
To go higher up in the rankings	14
To get likes and comments	11
To get prizes	8

Table 2. Motivations to get stamps (multiple choice).

application had positive effects for exercise habits. The frequency of going out increased when using the application for more than half of participants. 70% of participants felt that their walking distance and steps increased. We also asked the participants "Did you find a place that you wanted to go to again?" As a result, 83% of participants found such places through this group walking in the city. 73% of participants answered that it was fun to walk in the city with the application. 77% of participants answered that they wanted to continually walk in the city.

The average value of gotten stamps among all 30 participants was 74.5 (there were 177 stamps altogether), and 10 out of 30 participants got more than 100 stamps. The application was used by 535 people (including not only participants in the user study but also general users). Many participants got high in the rankings among the 535 people.

We asked the participants "What was your motivation to get stamps?" The result is shown in Table 2. We found that game elements, such as points, badges, and rankings, were effective for about half of the participants. Most answers were "It was becoming fun to collect stamps." Also, in the free description space, some answered that it was fun to go and see unknown areas. Although users of the San-Poki application could get prizes such as a sticker (3 stamps were required) and a tote bag (100 stamps were required), the intrinsic motivation to enjoy collecting stamps and the sense of responsibility toward town development done by taking photos in Mitaka city were more effective for encouraging the participants than the extrinsic motivation to get prizes.

To reveal the effects of the walking game on social network formulation, we asked the participants "Is the San-Poki application a trigger to making new friends?" 21 out of 30 (70%) participants answered "Yes" because it became a common subject among strangers, and teaching each other how to use it.

Results of Group Walking Program

After participants finished participating in group walking three times, we asked them "Compared with the time before you participated in group walking, is there a special participant with whom you grew closer to at present?" As a result, 18 out of 30 (60%) participants answered "Yes" and named a specific participant (of 18 participants, males were 10 out of 15, females were 8 out of 15). We asked those 18 participants "What was the trigger that made you be friendly with the participant?" The result is shown in Table 3. "The number of times to be in the same group," "having the same or similar hobby," and "fitting each other's personality" were answered by many participants.

Discussion

Effects of Walking Game

In our field study, we made the participants join three group-walking events but left it up to them to decide whether they would use the application or not during the days except for the group-walking events. Nevertheless, almost all the participants used the application during the days except the group-walking events. Some participants said, "I used the application while I walked around alone" or "I had heard about some nice restaurants and their areas, which I had never been to before, and I eventually went there along the way using the application."

Responses	No. of responses	
Number of times to be in same group	9	We used the questionnaire to find whether the participants' steps or distances walked had increased. The ratio of participants who answered "agree" or "weakly agree" was more than 70%. This is because the number of stamp spots with BLEs was as many as 177, and the participants had opportunities to stop by some of the spots on their way to the spots where they wanted to go originally. In our interviews, a participant said, "I walked around the spots along the way to the barber." Therefore, we can presume that walking around places along the way to the spots where they wanted to go originally increased their steps and the distances they walked. Many of the participants have been lived in Mitaka city for a long time. Nevertheless, it was indicated that visiting various places during the experiments and finding places where they want to go again are important for the enhancement of going out.
Having same or similar hobby	8	
Fitting each other's personality	7	
Having certain things in common (except for hobbies), interacting together	2	We asked the participants the places where they wanted to go again. They answered the memorial museum of a famous writer, an astronomical observatory, and parks, as well as libraries and culture centers. In our user study, the 177 spots included shops and museums as well as community facilities. With the variation of the places to visit, more than 80% of participants found places where they wanted to go again. Moreover, because the spots were deployed in city-wide areas, we can assume that the participants can find their favorite places on the way to destinations in their daily lives. We embedded game elements such as points, badges, and rankings in the application and found that the participants who got more than 100 stamps and were high in the rankings were particularly conscious of these elements. The following answers to our interviews or questionnaires indicate that the game elements motivated the participants. "I felt competitive.
Having similar sense of values	1	
Helping and teaching	1	

Table 3. Triggers to being friendly through group walking (open question).

When acquaintances got high in the rankings, I felt I didn't want to get lower in the rankings than them," "I felt interested because the points and my rank order fluctuated every day. When I woke up one morning, I was lower in the rankings than someone who had been lower than me the day before," and "At first, I only wanted to get the badges at the spots in my neighborhood, but I got devoted myself."

Other than the game elements, we observed that some participants started to walk frequently because they perceived the severities that emerged from their illness and their doctors advised them to walk, and they were motivated by the group-walking in our experiments. These severities and motivation fit the health belief model [9][10]. In the case of a comparatively short term of experiments like ours, it is pointed out that the participants went out more frequently or walked more steps than before the experiment period, while they did not continue such activity after the experiments. We found such a tendency in the answers of our questionnaires. We should consider how to link the participants' activities during the experiments to make them go out continuously after the experiments.

Our walking application and group-walking events were well received by the participants. Moreover, they requested us to provide the application and hold these events regularly. If we do that, we may lead the participants to go out continuously. For continuous community-based activities, it is important to share the know-how for holding the activities to citizens or municipal organizations in order to transfer the organization of the activities from researchers to them.

Effects of Social Networks Formulation

We organized the groups on the basis of the participants' schedules, courses, and hobbies. However, it is important that one or more of the triggers to feeling closer to others in Table 3 strongly pushed the participants to feel closer to each other during a short period of time like in our experiments. The eventuality of being assigned to the same groups in all three group-walking events is an example where one of the triggers strongly exerts itself. The number of pairs of participants who were assigned to the same groups in all three group-walking events was three; the participants of one pair had known each other well, and the participants of the other two pairs had not known each other. We asked the participants of the latter pairs whether they had had other participants whom they had felt close to, and all of them answered that they had felt close to the participants who were assigned to the same groups in all three group-walking events. Moreover, they answered that the reason was *"being assigned to the same groups in all three group-walking events."* Although we did not confirm which combination of triggers is superior under the number of participants in our experiment, the participants answered with the following combinations of triggers for feeling close to each other. *"I think we fit personality-wise, and we had the same hobby," "We were assigned to the same group twice and had the same hobby," "We had the same hobby and similar feelings,"* and *"We were assigned to the same group twice, had the near rank orders in the application, and lived the near place before."* We can presume that walking around together more than once could be a trigger to feeling close to others.

Although this is an unexpected positive effect, the application certainly had an effect in some cases because it became a common subject among strangers, and teaching each other how to use it could be a trigger for them to feel closer. Moreover, the participants used the application as a communication tool by checking their rank order, looking at online photos taken by other participants, or sending and receiving "likes" and comments except on group walking event days.

Among the participants' comments were *"Walking around with more than one person was, regardless of the number, very good because we could deepen our relationship," "I could get acquainted with strangers,"* and *"I could talk with strangers and get close to them."* These comments show that group-walking events have positive effects on formulating social networks.

Conclusion

We proposed and developed a smart phone based walking game application that engages users to explore a city and go out more. Moreover, we designed a group-walking program utilizing the walking game to promote communication among community-dwelling elderly people. In a 4-week user study conducted with 30 elderly people, 83% of participants found favorite spots to visit again through the application. Furthermore, 60% of participants got new friends through the group-walking program. Our results show that our approach was well received, enjoyable, and effective at enhancing going out for the elderly. Results from the user study also revealed key aspects such as health benefits, game elements, and social contributions that would make an application more persuasive for elderly adults. Future work will be to conduct a similar user study in another city and verify

the effect in the long term. We also need further study to undertake a detailed analysis of the influence of social and environmental factors.

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