

Question First: Passive Interaction Model for Gathering Experience and Knowledge from the Elderly

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Abstract—We propose the “Question First” interaction model, which aims to reduce the barriers to accessing online mobile information transmission for the elderly and aggregate their useful experience and knowledge for younger generations. “Question First” helps elderly users to transfer their knowledge or experiences by simply answering questions through conventional mobile terminals. The proposed interaction model is based on extending conventional interaction modes of phone calls and emails, helping elderly users become familiar with social networking, without the requirement of learning to use social networking service interfaces. Ultimately, we aim to expand the social participation of the elderly in both online communication and online work such as crowdsourcing. We report the results of a two-week user study on the crowdsourcing of participants’ experience and knowledge through online communication, and analyze the information obtained to evaluate the efficiency of this interaction model by extracting features of each participant’s knowledge and experience via the proposed method.

Keywords—mobile communication; interaction model; accessibility; elderly user; crowdsourcing

I. INTRODUCTION

In developed countries, the proportion of people aged 65 or over is growing rapidly [1]. When this age group exceeds 21% of the total population, the country is defined as a hyper-aged society [2]. Successful aging became a major research topic in social science in Japan, which was the first country to have a hyper-aged population. A recent report from Friedman et al. described one of the key factors to successful aging being a relationship with the surrounding community [3, 4]. An occupation is the simplest way to maintain relationships in society. However, following retirement, it is difficult for senior citizens to find another suitable full-time job. Their ideal working style may be part-time or working online, and they are often less restricted in terms of working hours or location. Crowdsourcing work may be a suitable post-retirement working style in the near future. However, only a small number of people over the age of 65 participate as crowdworkers in the popular crowdsourcing service, Amazon Mechanical Turk [5]. Such services are not designed for senior workers, who are often unfamiliar with the recent information and communication technologies necessary to share their opinions or ideas. For instance, the elderly are largely unfamiliar with current

online communication media such as social network services (SNS)—in Japan, only 1% of Facebook users are over the age of 65 [6]. It seems that the elderly are reluctant to learn new communication media techniques. Hence, we propose an interaction model to encourage the elderly to use mobile communication media and facilitate the transfer of their knowledge to the rest of society. As elderly people are experienced and knowledgeable, their involvement in online society has the potential to be a huge human resource. Such SNS may serve as both online communication and online working support platform for the elderly if we could easily discover a group of elderly users who have profound knowledge on certain topics by searching social-logs. We may search or recommend a certain elderly person who can help younger participants by matching some keywords between problems encountered by younger generations and personal profiles extracted from the social-logs of elderly participants.

In this study, we developed a question and answer based online mobile communication system using the conventional interface metaphor of phone calls and emails. Senior users who are not familiar with online communication may gradually become involved in posting their opinions on the internet by applying a question and answer interaction model. To evaluate the usability of the proposed method and the potential for extracting personal knowledge or skill, we conducted a two-week user study. We examined whether it is possible to generate personal profiles from social-logs by extracting closely related keywords from question-and-answer sets.

II. DESIGN

A. Passive Interaction Model for Elderly Users

Numerous studies have been conducted to create design guidelines for mobile user interfaces for the elderly. Kobayashi et al. presented four guidelines, such as the button size for a mobile touch screen interface [7]. In addition, Rock et al. suggested that icons should be clarified and the function should be simplified for display [8]. There are many devices on the market, such as the Raku-Raku phone [9], that are designed to appeal to the elderly by reducing the number of functions or simplifying the button interface. However, to encourage the elderly to use mobile communications, simply improving the interface design is not enough. Hanson et al. reported that older adults are accustomed to conventional

appliances, so they do not feel the need to adopt completely new digital devices that require the learning of a new interaction model [10]. Many older adults try to learn and understand SNS in culture lessons. Even though they understand how to use new communication tools, they stop using them after the lesson because they are not sure what kind of information to post and/or whom they should address.

Participating in online society not only leads to knowledge transfer, but also enhances the quality of life of senior citizens. Bentley et al. attempted to encourage intergenerational communication by acquiring stories from elderly people that were related to certain places, and asynchronously sharing them with friends or family via a digital map [11]. In addition, Harley and Fitzpatrick suggested that video blogs such as YouTube help intergenerational communication [12]. However, these methods have the problem that someone who is familiar with the system must create and provide new content. In order to continuously involve the elderly in online communication, we require a system in which they can post their stories without learning a specific interaction method.

In order to involve the elderly in posting their knowledge or opinions via online communication media, we need to add a mechanism to navigate and assist elderly users to post information. We thus propose the “Question First” interaction model. In this system, a moderator posts questions to the elderly to induce them to submit information. “Question First” enables people who are inexperienced in online communication to gradually learn how to post their stories or opinions on the internet by simply answering questions from the system. In this interaction model, we create five categories of question that become gradually more involved. The questions in each step are also designed to be personalized to each participant according to the answers given in previous steps. On the final step, we plan to examine whether mutual communication may occur among participants by sharing their answers.

The five question categories are described as follows:

1) *Life-logging*: Questions about daily activities and routines, such as “What are you planning to do today?” or “What are you going to have for dinner today?” which do not require deep thought. The answers given in this step help the moderator to acquaint her/himself with the participants.

2) *Profile*: Questions about careers and/or background, such as “What was your major at college?” or “What qualifications do you have?” which remind participants of their experiences and familiarize them with posting such information. From the answers in this step, the moderator can post questions about subjects that the participant is acquainted with.

3) *Micro-tasks*: Questions about their knowledge or experience, such as “Which country do you know well besides Japan?” or “Which book do you recommend for students?” to acquaint participants with posting their knowledge to online communication media. From this step,

the moderator will ascertain what kind of subjects the participants are familiar with.

4) *Macro-tasks*: Questions that asks participants’ ideas or opinions, such as “What is the best way to use one’s time well?” or “Would you like to deliver a message to the younger generation?,” allowing participants to get used to giving advice to others on the network.

5) *Social Networking*: Questions to encourage communication with other participants, such as “Do you have any questions for the other participants?,” introduce the idea of multidirectional communication on the network. During this stage, we examine whether knowledge aggregation still takes place without the efforts of the moderator.

III. MOBILE COMMUNICATION INTERFACE

Because mobile phones are the most common device used by senior citizens to connect to the Internet, we focus on designing a mobile communication interface for senior users [13]. Mobile phones are Internet appliances that are always on. Thus, they are more suitable for allowing instantaneous communication with only passive interaction compared with using a PC.

A. Familiar Interaction Method in Mobile Communication

We conducted a pilot survey of 63 elderly people in a community computer class to determine what kind of mobile communication method they use on a daily basis. The results, in Table 1, show that they often use phones and email, but rarely use SNS with mobile phones. Thus, we adopt a phone and email interaction model for the proposed system. In addition, we also implement a smartphone application as an advanced user interface device based on a voice recorder interaction model that is similar to a combination of phone and email interaction models.

TABLE I. FREQUENCY OF USE OF THREE COMMUNICATION METHODS (PHONE CALL, EMAIL, SNS) WITH MOBILE PHONE FROM A SURVEY OF 63 ELDERLY PEOPLE.

Frequency	Phone	Email	SNS
Almost everyday	34	30	1
Once or twice a week	19	14	0
Once or twice a month	6	4	3
Once every 2–3 months	1	4	3
Once or twice a year	1	1	3
Not at all	2	10	53

IV. SYSTEM CONFIGURATION

Fig. 1 illustrates the total system configuration of the following three types of interface. Questions sent to participants are made by the moderator and stored on a question server. Questions are continuously added to the question server in reference to the answers given to previous questions.

A. Answer-phone Metaphor

We adopted the interaction model for recording a voicemail message on a phone-based interface. Users make a call, and answer a question asked by the system. We used Asterisk [14] as the open source Internet Protocol private branch exchange (IP-PBX) and crontab to call the users' phone number at a scheduled time. The system calls and immediately hangs up, leaving the number in the users' history of incoming calls. This is the sign of a new question arriving. Users call back when it is convenient for them, and are asked a question. After the question, Asterisk plays a beep and records the answer given by the user.

B. Email Metaphor

Just like the answer phone metaphor system, crontab sends an email with a question via the Gmail server. Users reply to the questions in the same way as they would reply to a regular email.

C. Smartphone Application

We also implement an iPhone application. When a new question is ready, the system sends a push notification to the users' iPhone through the Apple Push Notification Service (APNs). Users start the application when it is convenient for them, then respond to the question on the screen by pushing the record button and answering. After finishing their answer, users push the stop button and the recorded data is sent to the question server along with identification data from that user (see Fig. 2).

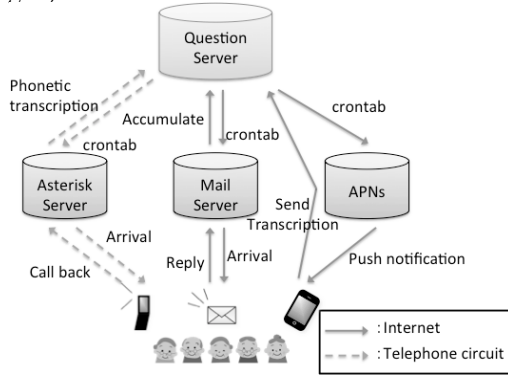


Figure 1. System Configuration.

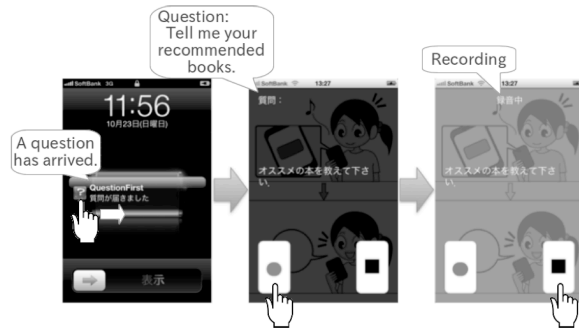


Figure 2. Application screenshots (Left: push notification arrived, Center: check question and start recording, Right: record an answer and finish recording).

V. EVALUATION

A. Objective

In order to verify the effectiveness of the proposed method for aggregating elderly people's knowledge, we conducted an evaluation experiment for "Question First." Our aim in this experiment was to measure two prospective effects of our passive interaction model: Did participants constantly submit their information during the experimental period, and what was the difference between the three interfaces and five question steps. In order to evaluate whether the information obtained is useful, we examine the possibility of generating a personal profile from the gathered information. If this is possible, the data can be used as a human resource database for a future crowdsourcing application.

B. Participants

Participants in the experiment were seven elderly people aged 65 to 78. Each participant's experience of online communication media and the frequency with which they make phone calls or send emails is listed in Table 2. Prior to the experiment, the participants did not know each other. P0 has considerable experience with SNS, whereas P4 does not know how to use email through his mobile phone. Only P0 owns a smartphone. A graduate school student (male, 20s) with a computer science background served as the moderator for the experiment. He posted questions to participants according to his interests based on the answers received from participants.

C. Procedure

First, we conducted a survey about the online communication, phone, and email experience of each participant. Participants then chose one of the three types of user interface (UI) mentioned above according to their online communication experience. We provided simple instructions for each UI. Participants who chose phone call or mail-based interaction used their own mobile phone. We provided an iPhone to participants who chose the smartphone app interface. During the two-week experimental period, three different questions were posted to each participant every day. The 1st day was a practice day. Then, the category of questions changed from *Life-logging* to *Macro-tasks* every day from the 2nd to 5th day and the 7th to 10th day, after which *Social Networking* became the focus of the experiment. The 6th day was a rest day, although if a participant had been unable to answer several questions on previous days, this day was used to ask those questions again. We did not share participants' answers or questions every day, but did share previous answers via email or fax at the end of the 5th and 10th days. From the 11th day, all of the questions and answers on the theme of social networking were shared at the end of that day. After two weeks, we conducted some interviews.

VI. EXPERIMENTAL RESULTS

All the participants could understand how to use the assigned interface right away. As a quantitative evaluation,

we counted the number of (Japanese) characters per answer for each participant. The average was phone call–436, email–116, smartphone–158, which shows that answering by phone delivered a remarkable amount of information. We divided each answer into topics and episodes. If one sentence leads to a point of view, we add one to the number of topics. Episodes count the number of detailed stories in the bottom layer of topics. An example is shown in Fig. 3. The first topic is the name of a recommended book. There are two recommended books. Then, the participant changed the point of view from mentioning the names of recommended books to giving a description of each recommended book. Therefore, we add one to the number of topics. As the changes in point of view ended with this description of recommended books, the number of topics in the answer is set to 2. We then count the number of sentences making up the detailed story in the bottom layer of the topics. In this case, there are 4 sentences that describe the recommended books, so the number of episodes is set to 4. If all the sentences in a participant’s answer change the point of view, the number of topics will be equal to the number of sentences and the number of episode will be 1. We defined the number of episodes and topics as the amount of information, and compared the results between each UI and question. In addition, we describe the results of an interview.

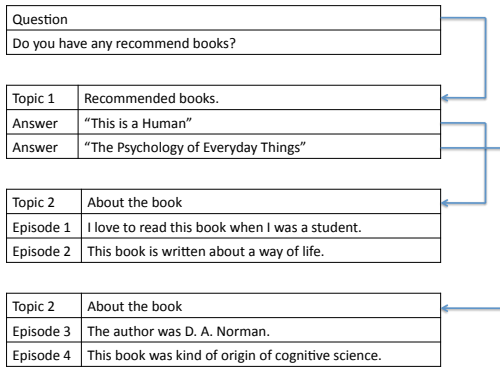


Figure 3. An example of counting the number of topics and episodes in a participant’s answer.

A. Amount of Information per User Interface

Fig. 4 shows the number of episodes given in the answers. The average number of episodes was: 11.8 (SD = 8.9), 10.1 (SD = 6.2), and 6.6 (SD = 2.1) for smartphone, phone call, and email, respectively. As for the number of characters, the amount of information is remarkably rich from participants who used the phone call UI, particularly in terms of the number of episodes. Fig. 5 shows the number of topics given in the answers. The average number of topics was: 6.8 (SD = 4.2), 21.5 (SD = 12.5), and 9.0 (SD = 2.5) for smartphone, phone call, and email, respectively. In terms of topics, smartphone gave the least information of the three, though there is an influence from the different questions—the amount of information obtained via smartphone became larger after the 7th day. The amount of information obtained through email changed less during the experimental period than that obtained through the other UIs.

In total, as each episode and topic contains around as much information as one tweet in Twitter, we constantly obtained approximately 19 tweets from the smartphone, 32 tweets from the phone calls, and 16 tweets from the email interface every day.

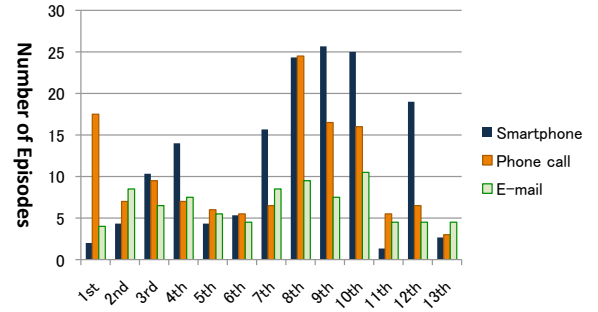


Figure 4. Daily average number of episodes extracted from answers aggregated from each user interface.

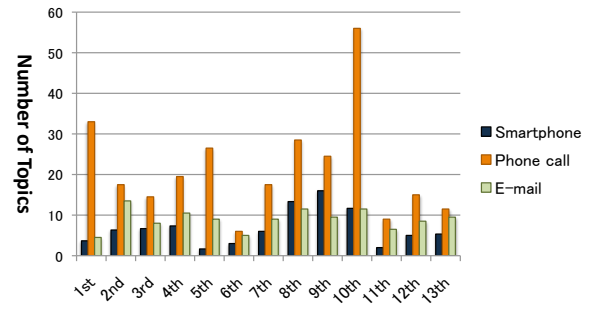


Figure 5. Daily average number of topics extracted from answers aggregated from each user interface.

B. Amount of Information in Relation to Questions

The questions that maximized the number of episodes seem to be those in the *Micro-tasks* category, which ask for participants’ knowledge, and the questions that maximized the number of topics were those in the *Macro-tasks* category, which ask for their opinion. The *Social Networking* questions on the last three days obtained relatively little information in terms of both topics and episodes.

C. Generating a Personal Profile from Answer Data

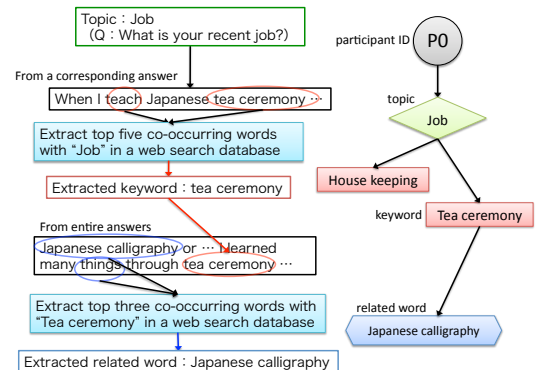


Figure 6. Extraction of keywords and related words from each participant’s answers.

In order to extract keywords from the obtained answers, we first need to extract each noun from the whole dataset. For this, we use a Japanese morphological analysis API provided by Yahoo! JAPAN [15]. We must then determine the keywords that form the characteristics of each participant. We used a tf-idf (term frequency-inverse document frequency) method for this process [16]. Nevertheless, the obtained answers are a fairly small set of data. Thus, we need a set of document databases to evaluate the co-occurrence probability among extracted keywords. We use documents on the Internet as a huge text database and the Bing Web API to measure the co-occurrence probability between two keywords [17]. Fig. 6 illustrates the flow of this algorithm.

D. Generated Personal Profile

Table 3 shows the experience and knowledge profile obtained from the proposed method. As a result, if we want to ask a certain question, our approach makes it possible to search for appropriate participants using keywords of the topic and answers.

E. Findings from a Post-experiment Interview

Most participants said that it would have been easier for them to talk in a face-to-face situation so that they could imagine what kind of information the moderator, who posted the questions to the question server, expected. They also suggested that it would be easier for them to answer if they could gradually get information about the moderator. In relation to the social networking step, participants also mentioned that, as they got older, they were rarely influenced by others' opinions. Indeed, it seemed that participants would rather maintain communication with their present community members than expanding into new social groups. On the other hand, P4, who had the least experience of online communication media, started learning weblogging during the experiment, as he was stimulated by the other participants.

VII. DISCUSSION

A. User-friendly Interface

We found that the phone UI was the most useful of the three. However, it has a drawback in that it is difficult to hear the questions, which is likely to make participants feel annoyed. In contrast, the smartphone application gathered less information, even though it uses the same voice input as the phone UI. From the interview, it appears that this difference was caused by anxiousness in using new devices and applications. Participants felt the need to end their answer if the smartphone automatically turned off the backlight, and did not have a sense of how long the application could record them talking. However, the participants seemed to gradually accustom themselves to the smartphone application. The phone problem may be solved if participants were to use a smartphone over a longer experimental period. It is apparent from the results that typing text seems to be more difficult than voice input for the elderly. In addition, if users wish to participate in existing SNS, such as Facebook or Twitter, adding a function to

future smartphone applications to bridge the gap to such SNS will be the quickest way to enable senior users to seamlessly interact with such services.

B. Five-step Design of "Question First"

Our five-step design worked well in preparing questions for information aggregation. *Life-logging* information contains the current job or hobby of the participant, providing useful hints for preparing questions for the *Profile* step. The *Profile* information was very useful, as it not only served to generate a personal profile but also greatly helped in creating tasks for the *Micro-tasks* and *Macro-tasks* steps. The elderly felt anxious about creating new communications with each other. As the participants did not know each other before this experiment, the situation may be different if we gather a group of friends for the next experiment.

VIII. CONCLUSION

In this paper, we proposed a system to reduce the barriers faced by the elderly in using mobile online communications and digitalize elderly participants' knowledge. During the experimental period, participants did not face any problems in terms of operating the proposed interaction model. From the experimental results, we found that our proposed interaction model worked well in aggregating participants' experience and knowledge. We were also able to generate personal profiles from the information gathered. In the future, we plan to extend the whole system and conduct an experiment with a large number of participants, including groups of younger people, over a longer period. We also plan to facilitate crowdsourcing work to produce intergenerational communication and knowledge or decision support for the younger generation.

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TABLE II. SEVEN ELDERLY PARTICIPATED IN THE EXPERIMENT. P4 DOES NOT HAVE ANY EXPERIENCE OF USING EMAIL OR OTHER ONLINE COMMUNICATION SERVICE.

#	Gender	Age	UI	Posting opinions on Internet (Often/Have an experience/Have an interest, no experience/No interest, no experience)	Phone call with family (Often/Sometimes/Rarely)	Email with family (Often/Sometimes/Rarely)
P0	Female	70–74	Smartphone	Often	Sometimes	Sometimes
P1	Male	75–79	Smartphone	Have an experience	Sometimes	Sometimes
P2	Male	70–74	Smartphone	Have an experience	Rarely	Often
P3	Male	70–74	Phone	Have an experience	Often	Often
P4	Male	75–79	Phone	Have an interest, no experience	Sometimes	Rarely
P5	Male	65–69	Email	No interest, no experience	Sometimes	Sometimes
P6	Female	75–79	Email	Have an Experience	Rarely	Sometimes

TABLE III. ESAMPLES OF KNOWLEDGE AND EXPERIENCE DATA GENERATED FROM PROPOSED METHOD.

Topic	Specialty	Job	Qualification	Travel	Sports	Subjects
#	Keywords (Related words)					
P0	university (graduation), nutritionist (myself), domestic science (myself)	housekeepin g, Japanese tea instructor(knowledge, calligraphy, paintings)	teacher(father, teaching credential), nutritionist(domestic science), myself(time, period, usual), University(domestic science, graduation, period)	Australia(Switzerland, trekking, New Zealand), Czech(Switzerland, trekking, Canada), New York (Art museum Boston, Paris), Washington(Paris, Boston, London), latter half(London, Rome, art museum)	badminton(housekeeper), tennis(junior high school, high school), good at(national language, class), defeat(match)	National language, Mathematics(weak subject), good at(tennis, badminton), Physics(weak subject), class(weak subject)
P4	English literature (classics, part time job), situation (elementary school, myself, weblog), Tokyo University of Foreign Studies (part-time job, classics), university (part time job, high school, linguist)	sales(business firm, repair, manufacture), robot(high-tech, offer, job), TV(refrigerator, age, Japan)	company (communication, TV, shipbuilding), high school (study, English), drivers license (STEP), teaching credential (graduation)	establish(repair, pass, shipbuilding), shipbuilding(company, repair, pass), foray(robot, offer, job), Singapore(life, church, family), field(robot, offer, job)	backache(prevention, treatment, leg), basketball(representative, junior high school, high school), distant shot(left forward, proficient), merit(court, strong leg, instantaneous force)	Mathematics (junior high school), Japanese language (situation, university), women's college (university, memory, lady), English (myself, hard, complain), linguist (question, relationship, part time job)
P6	university	instructor, housekeepin g, design, fabric(Tuesday)	2008, senior information advisor	manner(important, atmosphere), people(important, many, atmosphere), community(important, atmosphere), England(important, atmosphere), resort(country, Australia, strong)	ice skating(popular), play(ice dance), ping-pong(popular), tennis(popular), ski(popular)	mathematics, English, weak subject, favorite subject