Give a Dog ICT Devices: How Smartphone-Carrying Assistance Dogs May Help People with Dementia

Chika Oshima
Faculty of Science and Engineering,
Saga University
Saga, Japan

Kiyoshi Yasuda
Chiba Rosai Hospital
Chiba, Japan

Toshiyuki Uno
Akebono Day Service
Chiba, Japan

Kimie Machishima
Graduate School of Science and Engineering,
Saga University
Saga, Japan

Koichi Nakayama
Graduate School of Science and Engineering,
Saga University
Saga, Japan

Abstract—People with dementia suffer from memory loss, speech disabilities, and many other problems. A smartphone could benefit them, because it offers functions and applications that may alleviate their disabilities. However, some people with dementia refuse to carry a smartphone. Many of them dislike doing the tasks ordered by such devices due to a lack of psychological interaction. Therefore, we are exploring the concept of having a dog carry a smartphone on its back to assist these people with their daily lives. In this paper, we first show that, with a little training, a dog can be made to run to its owner when the smartphone on its back emits an alarm. This result suggested that the concept will allow applications and devices for the people with dementia to become the more useful things of their daily lives. Then, we propose an application wherein people with mild cognitive impairment can be reminded what they were doing to a few minutes ago. We also propose a support method using a vibration-sensing device that causes a dog to run up to its severe-dementia person who is trying to open a door to go outside. Finally, we describe an experiment that examined how a person with dementia might respond to a dog who “talks” to them. (Of course, the talker was a person at a different location speaking through the smartphone on the dog’s back.) These suggestions and the results of the experiment show that, with the help of a dog, a smartphone can offer better assistance for dementia patients.

Keywords—Android; Care facility; Memory loss

I. INTRODUCTION

Dementia is a collection of symptoms that include deterioration of mental abilities and cognitive functions such as memory, language, reasoning, planning, recognizing, and identifying people and objects1. Dementia is caused by more than a hundred diseases and injuries that primarily or secondarily affect the brain. About 36 million people have dementia, and there are about 8 million new cases worldwide every year2.

Many people with dementia are tended by caregivers, including their families. Yet as their symptoms become more severe, the caregivers bear a greater burden. When the patients begin to suffer memory loss, their caregivers have to supervise their behavior. Even at the stage just before dementia, these people may forget what they were going to do a few minutes ago. As for people with severe dementia, they are apt to wander outside, requiring their caregivers to watch constantly for their safety. Caregivers also need to communicate frequently with their charges, even if it means saying the same things over and over. In short, there are plenty of things for the caregivers to do in the daily life of a person dementia, even at a time when staffing, time, and finances are becoming scarce.

Many studies have explored the use of information communication technology (ICT) devices to aid with memory [1][2][3]. Yasuda et al. [4] evaluated the use of a digital voice recorder as a voice output memory aid. Their results showed that such a recorder assists patients with prospective memory impairment. Kamimura et al. [5] examined the efficacy of a medication reminder device. They found that it can improve medication adherence in elderly patients with mild cognitive impairment.

The Global Positioning System (GPS) is often used to search for persons who have wandered off [6][7]. “iWander [8]” is a device that collects GPS and other sensor data about location, weather conditions, stage of illness, etc. This data is then evaluated using Bayesian network techniques to determine the probability the person is wandering. Lin et al. [9] proposed a real-time method for detecting wandering based on an individual’s GPS traces. This method is able to detect loop-like traces on the fly. The experimental results showed its effectiveness in detecting wandering behavior. However, GPS cannot prevent the person from going outside in the first place.

At present, some robots can communicate with people and alert them when it is time to take their medication. They were developed for healing and therapeutic use in private and nursing homes. “Paro3” is a therapeutic robot that can locate the source of a voice and recognize words such as its name, greetings, and even praise. By interacting with people, Paro

acts as if it is alive, moving its head and legs, and making sounds. “Palro” is a small, autonomous humanoid robot which can have an intelligent conversation and walk on two legs. Once the user programs information into its computer,Palro alerts him or her at the appropriate time. “Pepper” is a humanoid robot that can converse with a person, recognize and react to their emotions, and move and live autonomously. As the person continues to interact with Pepper, it will recognize its person and learn new things about his or her tastes. People who carry GPS-equipped smartphones can find friends by using a mapping service. “emopa” is a smartphone service that talks a user of this smartphone like family or friends.

Today, even health professionals use their smartphones to alert them about important tasks. However, these applications have limited use for people with dementia [10]. First of all, most of them forget where their smartphones are located [11]. Second, due to a lack of personal interaction, some people are reluctant to perform the daily tasks instructed by the devices [12]. Third, the cost of these robots is still too high for most homes and facilities. It is also difficult for a robot at present to chase after a person and run up stairs. Although these robots might be accepted by some people with dementia, others may consider them as “alien invaders.”

To overcome these shortcomings, we had the idea of mounting an ICT device on a dog [13]. Now people with dementia would not have to remember to carry their phones. Dogs are always happy to accompany their owners, even those with dementia. With a little training, a dog can be taught to rush to its owner when the smartphone on its back emits an alarm. Dogs can run to their owners even up a flight of stairs. Dogs have already been widely used in therapy [14]. Animal-assisted therapy is effective for the treatment of agitation/aggression and depression in patients with dementia [15][16][17]. People with dementia might be more willing to perform tasks if their dogs brought the smartphones.

In the next section, we compare the effectiveness of a smartphone on a dog to that of a stationary smartphone. We built an application where the user can set an alarm and display a message highlighting particular tasks that have to be performed at specific times. In the third section, we show another application for smartphones. Even people with mild cognitive impairment are prone to forget a task that they just did and what they were going to do next. With our app, they can easily set an alarm to remind them of what they had planned to do. In the fourth section, we propose a support method for caregivers. People with dementia might try to open a door to wander outside. But if a smartphone-equipped dog runs up, it may distract the person from going out. In the fifth section, we describe an experiment where a person with dementia converses with someone in another location via a smartphone on a dog. In the sixth section, we discuss the benefits of affixing smartphones to dogs. The final section concludes this paper.

II. A SMARTPHONE ON A DOG’S BACK VS. A STATIONARY SMARTPHONE

In this section, we compare the effectiveness of a smartphone attached to a dog’s back to a stationary smartphone [18].

A. Development of the Application

We built an application for an android smartphone, the FleaPhone CP-D02. It was developed by Java Version 7 Update 21 using a development kit, Android SDK 1.0. The display of the application consists of three parts: setting the alarm, inputting a message, and a completion button. A user (usually the caregiver) can set an alarm for a particular time and input a message telling the person with dementia to begin or complete a task.

B. Subject

The subject in this experiment is a healthy person in her 50s. She has a five-year old female toy poodle that is kept indoors. Fig. 1 shows the dog with the smartphone on its back. It took one week for the dog to become accustomed to having the smartphone tied to its back. The subject trained the dog to run to her when the smartphone emitted a specific sound. This training took only three days. The experiment was conducted after a month of continuous training.

C. Method

Two identical smartphones were prepared with the application. Both phones used in the study were the same. Fig. 2 shows the two conditions of the experiment. One smartphone (named “Set-A”) was mounted on the dog, and the other (“Set-B”) was placed in a predetermined location in the living room. The sound of the alarm was different for Set-A and Set-B. The volume of the alarm was the same for each. The volume was low enough that someone sitting in the next room could not hear it.

An experimenter set the time when each smartphone would emit a sound on that day. The study was conducted for five days over the course of one week. Each study day lasted from 9 a.m. to 9 p.m. These 12 hours were divided into four parts. In each part, each smartphone emitted an alarm at a random time. The subject had a maximum of eight chances of hearing the alarm. The subject did not know when the alarms would sound. The subject was required to turn off the alarm and to

---

3 Sharp: emopa. http://www.sharp.co.jp/products/sh01g/service/emopa/
perform an allotted task. The smartphones recorded the length of time before the alarm was turned off.

We employed the Kraepelin test as a task. This test requires an individual to perform calculations as fast and accurately as possible. The test is a boring task and involves mental stress similar to that experienced by people with dementia who have to take medication. Each test was allowed 30 seconds to complete. The application recorded the number of questions answered and the number of correct answers. After the experiment, the subject was asked to fill out a questionnaire. The question items are as follows:

1) Did you experience any difficulties when you used the smartphone in the experiment?
2) How did you feel about your dog before the experiment?
3) How did you feel about your dog when it responded to the alarm and came to you?
4) How did you feel when the smartphone fixed in the living emitted the alarm? The answers are scored from 1 to 5, with 1 denoting “I did not think at all” and 5 denoting “I thought so very much.”
   a) I was happy.
   b) I was nervous.
   c) I wanted to turn off the alarm as soon as possible.
   d) I felt that it was troublesome to turn off the alarm.
   e) I considered leaving the emitting alarm.
5) Please state how you felt when the fixed smartphone emitted the alarm.
6) How did you feel when the smartphone mounted on the dog emitted the alarm? The answers are scored from 1 to 5, with 1 denoting “I did not think at all” and 5 denoting “I thought so very much.”
   a) I was happy.
   b) I was nervous.
   c) I wanted to turn off the alarm as soon as possible.
   d) I felt that it was troublesome to turn off the alarm.
   e) I considered leaving the emitting alarm.

D. Results

Table I shows the times that the phones sounded the alarm and the length of time until the subject silenced it. A blank space means that the subject did not turn off the alarm within 60 seconds. The subject silenced the alarm within 22-54 seconds in Set-A and within 22-60 seconds in Set-B. The average time to silence the alarm for Set-A and Set-B was 35.77 and 37.44 seconds, respectively (SDs = 10.0, 13.8, respectively).

Fig. 3 shows the number of times that the subject turned off the alarm. The subject turned off the alarm 13 times in Set-A and nine times in Set-B. The rate of silencing the alarm (success) was 76.47% and 52.94%, respectively (z = 1.08, no difference).

In Set-A, the number of times the subject did not turn off the alarm was four. In two of these, although the dog responded to the alarm, it was unable to bring the smartphone to the subject within 60 seconds. On these occasion, the owner was either out of the house, or upstairs. On the other two occasions, the alarm sounded while the dog was taking a nap.

---

TABLE I: The times that the smartphones emitted the sounds.

<table>
<thead>
<tr>
<th>Day</th>
<th>Section</th>
<th>Set-A (dog)</th>
<th>Set-B (stationary)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>15:28</td>
<td>16:15</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>9:42</td>
<td>9:39</td>
</tr>
<tr>
<td>3</td>
<td>13:48</td>
<td>14:25</td>
<td>60</td>
</tr>
<tr>
<td>4</td>
<td>16:00</td>
<td>17:41</td>
<td>–</td>
</tr>
<tr>
<td>5</td>
<td>18:31</td>
<td>18:03</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>10:12</td>
<td>9:34</td>
<td>32</td>
</tr>
<tr>
<td>7</td>
<td>12:37</td>
<td>14:53</td>
<td>–</td>
</tr>
<tr>
<td>8</td>
<td>16:16</td>
<td>16:52</td>
<td>24</td>
</tr>
<tr>
<td>9</td>
<td>18:44</td>
<td>–</td>
<td>19:42</td>
</tr>
<tr>
<td>10</td>
<td>11:52</td>
<td>11:34</td>
<td>60</td>
</tr>
<tr>
<td>11</td>
<td>14:14</td>
<td>13:08</td>
<td>–</td>
</tr>
<tr>
<td>12</td>
<td>17:25</td>
<td>16:57</td>
<td>37</td>
</tr>
<tr>
<td>13</td>
<td>20:19</td>
<td>–</td>
<td>19:25</td>
</tr>
<tr>
<td>14</td>
<td>11:37</td>
<td>9:44</td>
<td>40</td>
</tr>
<tr>
<td>15</td>
<td>12:13</td>
<td>13:32</td>
<td>–</td>
</tr>
<tr>
<td>16</td>
<td>15:02</td>
<td>17:51</td>
<td>–</td>
</tr>
<tr>
<td>17</td>
<td>18:08</td>
<td>–</td>
<td>19:43</td>
</tr>
<tr>
<td>M</td>
<td>35.77</td>
<td>–</td>
<td>37.44</td>
</tr>
<tr>
<td>SD</td>
<td>10.0</td>
<td>–</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Fig. 3: the number of times that the subject turned off the alarm.

In Set-B, the subject failed to silence the alarm eight times. The subject could not hear these alarms because she was not in the living room.

Table II shows the number of calculations made by the subject and the number of correct answers in the Knaepelin test. The number of calculations was 39-49 in Set-A and 36-46 in Set-B. The average number of questions answered in Set-A and Set-B was 44.15 and 41.78, respectively (SDs = 4.0, 4.5, respectively).

In Set-A, the number of correct answers was 32-45, whereas it was 31-44 in Set-B. The average number of correct answers was 40.6 in Set-A and 37.7 in Set-B (SDs = 4.0, 4.5, respectively).

We compared the results of Set-A and Set-B. In both, questions in some sections were not answered because the subject had not heard the alarm and thus had not performed the test. Hence, we include only the results of those sections where the subject completed both Set-A and -B: sections 2, 3, 5, 6, 8, 10, and 14. We compared the medians of the number of all answers between Set-A and Set-B (signed-rank test). The results did not show a significant difference between sets (two-sided test, T=6.5, P=0.297). In addition, we compared the medians of the number of correct answers between Set-A and Set-B (signed rank test). The results revealed no significant difference between the sets (two-sided test, T=6.5, P=0.297).

Table III shows the responses of the subject to the questionnaire. The subject did not find it difficult to operate the smartphone (see (1)). Before the experiment, she expressed a mixture of anticipation and anxiety about her dog (see (2)). But when the dog responded to the alarm and came to her, she was impressed (see (3)). When the dog’s smartphone sounded, she was a little happier than when the stationary smartphone sounded (see (4) and (6)). She explained why she could not always silence the smartphones (see (5) and (7)). In the case of the living room smartphone, when she was cooking she did not hear the alarm. In the case of the dog-mounted phone, the dog was taking a nap in the early evening and did not wake up by the alarm. Therefore the dog did not bring the phone to the subject when the alarm sounded.

She was happy to perform the Knaepelin test on either set (see (8), (9), and (10)). The Knaepelin test was meant to simulate the boredom/stress encountered in repetitive-drug taking. We wanted to simulate the situation where an individual with dementia would not want to take their medication. We expected that the subject would be more willing to perform the tests presented by the dog-mounted smartphone than the tests on the fixed phone. However, the results showed no difference in the subject’s willingness to perform the tests on either phone.

www.ijacsa.thesai.org
TABLE III: Questionnaire response.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>None.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>I believed that my dog ran to me when the smartphone emitted an alarm because it was trained to do so. On the other hand, as the dog was unwilling to put the wear, I wondered if the dog runs.</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td>As the dog is small, it might find the smartphone too heavy. I was impressed that the dog came to me when the alarm sounded. I was delighted that our daily training yielded results. I realized how important trust is between people and dogs.</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td>(a) 3</td>
<td>(b) 2</td>
</tr>
<tr>
<td>(5)</td>
<td>I did not notice that the smartphone was emitting an alarm while cooking because the alarm was quiet.</td>
<td></td>
</tr>
<tr>
<td>(6)</td>
<td>(a) 4</td>
<td>(b) 2</td>
</tr>
<tr>
<td>(7)</td>
<td>The dog did not respond to the alarm in the early evening because it took a nap at that time.</td>
<td></td>
</tr>
<tr>
<td>(8)</td>
<td>(a) 3</td>
<td>(b) 2</td>
</tr>
<tr>
<td>(9)</td>
<td>I enjoyed the test because it was a brain-training exercise. Sometimes, I touched the different answer from what I considered because of hasty move. I was concerned about the accuracy of my answers.</td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td>(a) 5</td>
<td>(b) 3</td>
</tr>
<tr>
<td>(11)</td>
<td>None.</td>
<td></td>
</tr>
<tr>
<td>(12)</td>
<td>The dog sat quietly when I performed the test.</td>
<td></td>
</tr>
<tr>
<td>(13)</td>
<td>The dog made a point of shaking itself after it stood up.</td>
<td></td>
</tr>
</tbody>
</table>

(see (8) and (10)).

E. Discussion

There was no significant difference between Set-A and -B with regard to the number of times that the subject turned off the alarm. Moreover, there was no significant difference between the sets in the number of questions answered or in the number of correct answers. If the same experiment was conducted with a large number of subjects, we would expect to observe significant differences between Set-A and -B.

It is clear that the subject was quicker to turn off the alarm on Set-A because the dog was trained to run to her when the alarm emitted. Contrary to our expectations, it took only three days to train the dog. However, the time of training may differ depending on the character of the dog and the relationship with its owner beforehand.

We expected that a person with dementia would be more willing to perform tasks if his/her dog brought over the smartphone. In our experiment, we assumed that the Kraelelin test would be boring. Surprisingly, the subject, a healthy person, enjoyed the test on either Set-A or -B: she described it as a brain-training exercise. On the other hand, she said that when the dog’s phone emitted the alarm, it made her a little happier than hearing the fixed phone. She was also impressed when her dog took the smartphone to her. Therefore, we conclude that individuals with dementia will be more willing to perform daily tasks if influenced through their dogs. This result suggested that other applications for the people with dementia also become the more useful things of their daily lives by the dogs who mount the smartphones.

III. AN APP TO REMIND PEOPLE OF THE TASKS THEY MUST DO NOW

In this section, we develop a smartphone application that reminds people with mild cognitive impairment of which tasks they have to do at this moment.

A. Background

Mild Cognitive Impairment (MCI) is a stage just before dementia. People with MCI have a risk of progressing to dementia. MCI lies between decline of general aging and that of dementia. People with MCI experience difficulties with memory, language, thinking, decisions, planning, and judgment. In most cases, these changes hardly impair their day-to-day living. Most homemakers with MCI can continue to perform their household chores. However, homemakers with MCI often forget the task which they need to do now or were planning to do soon.

We offer an example of a homemaker with MCI who forgot an important a task. This case was based on an event that was written up by one of the authors. It dramatically shows the need to assist people with MCI.

Mary is a homemaker with MCI. While she was making dinner in her kitchen, the telephone rang. She stopped chopping a carrot and answered the phone. The caller was a neighbor who is treasurer of their local neighborhood association. After the call, Mary went to the neighbor’s home and paid her annual membership fee. When she returned home, she sat down in her living room. She opened her notebook PC and started checking her E-mails. Her daughter came into the living room and said, “Mom, I’m hungry.” Only then did Mary realize that she still had to make dinner. She hurried back to the kitchen. She had just placed the pot of vegetable soup over the fire, when her smartphone rang. Her husband was calling to say he would be home soon. Then she cleaned a bathtub, went into the living room and sit down in the front of her PC and started checking her E-mails. Meanwhile, the soup in the pot was beginning to burn. She never noticed it.

People with MCI may experience an impairment in short-term memory. However, if someone tells them what they have to do, they can do that task. Most of us write down our plans on a calendar or in an appointment organizer. However, we usually don’t need to write down tasks that we are going to do within a few minutes. Yet these are the very near-term tasks that people with MCI often forget. Fortunately, the kinds of the jobs that homemakers do within the household are few and can be listed. In this section, we construct an application that lets people with MCI set an alarm to remind them of what they have to do now. And if they have a dog in the house, that dog can carry the smartphone and run to the householder when the alarm goes off.

B. Structure of the Application

We built an app for an android smartphone, an XPERIA C6903. It was developed by Eclipse SDK 4.3 and works on Java Version 8. Fig. 4 shows a flow chart for operating the app. When some new task requires a person with dementia to interrupt the current task, he/she touches the start button on the app’s display. This display shows twelve pictures and a
message “What are you planning to do soon? Please touch the button matching your task.” The twelve pictures show typical daily chores: cooking, doing laundry, ironing, house cleaning, feeding the dog, taking a bath, making an important phone call, taking medication, preparing a meal, going shopping, brewing tea, and using the PC. The user pushes the button which corresponds to what he or she intends to do after a few minutes. After a predetermined time (5 minutes, 10 minutes, or some other preset amount), the smartphone alerts the user and displays another message, for example: “You were planning to do laundry. Do you still wish to do it?”

C. Using the Application

The app can be downloaded to any smartphone. The user invokes the application whenever something interrupts his or her planned task. When the smartphone gives the alarm, the dog carrying it runs up to the user. The user is reminded of what he or she was going to do.

IV. HOW A DOG CAN PREVENT A PERSON FROM OPENING A DOOR

In this section, we propose a method whereby a dog equipped with a smartphone distracts a person from attempting to open a door.

A. Background

In some homes and institutions, caregivers must watch over those people with dementia. That is because these people often try to open a door to go outside. Locking everything down is an imperfect solution, since it interferes with the caregivers’ own movements.

A person with dementia will stop opening a door if the caregiver speaks to them. However, caregivers cannot watch everyone all the time. Many minutes might pass before they discover that someone has gone outside.

However, if a dog can be trained to play with the patient until the caregiver shows up, then the dog may prevent that person from going through the door.

B. Setting the Devices

We used two different devices: a vibration sensor and a smartphone. For this experiment, we used a loss-prevention tag, an REX-SEEK1-X, as the vibration sensing device. To test the feasibility of the concept, we hung a single tag on a selected door. An application linked to the Bluetooth-compatible tag causes a smartphone to sound an alarm when the door is vibrated.

In an extended application, the smartphone can be made to play predetermined messages to the person with dementia. For example, the smartphone says “Don’t go away!” “Play with me.” or “Shall we go over there?”

C. Training the Dog

A few things are needed to train a dog for this application. First, when the smartphone on the animal’s back sounds off, its owner should call it to the desired door. If the dog runs to the owner, it gets a little treat from a box in front of the door. For the next step, the dog’s treat is placed in the box in advance. When the alarm sounds, the dog becomes accustomed to finding the treat in front of the door. For the last step, the owner reduces the size of the treat. At last, the dog will run to the door whenever the alarm goes off, even if there is no treat.

D. Using the Devices

Fig. 5 shows the setup of the devices. The smartphone-equipped dog runs up to the person when the alarm goes off. The dog might twirl around or bark. The person with dementia will notice the dog and forget about the door. A caregiver also notices the dog making a commotion and rushes over to the scene. Moreover, we expect that the person with dementia hears the messages from the smartphone and may come back by him/herself.

V. PEOPLE WITH DEMENTIA TALKING THROUGH A SMARTPHONE ON A DOG

In this section, we describe an experiment where a person with dementia converses through a smartphone on a dog’s back. A second person at a different location chatted with the first person via Skype over the smartphone.

www.ijacsa.thesai.org
A. Method

We conducted an experiment in which one of authors, who was at a different location, spoke with a person with dementia at facility X through Skype on the smartphone that was on the dog. We wanted to see if a person with dementia would respond to a human voice that seemingly came from a dog. Facility X is a day-care facility in Japan. People with mild as well as medium dementia attend the facility for a few days every week.

The director of this facility has two dogs, both female Pomeranians. One of them cooperated with the experiment. She is young and easily attaches to a person. She was equipped with a harness that had a smartphone in one pocket.

Eight people with dementia (the users) were enjoying a snack at the facility after taking walk. They sat in a half-circle in the garden and ate ice shavings from a cup. The author talked to different users for thirty minutes. Fig. 6 shows the users eating ice shavings while hearing someone talking to them through the smartphone on the dog. The staff of the facility were given an explanation of the situation and consented to our experiment. However, the users of the facility were not told that someone would try to talk to them through a smartphone.

B. Result

The dog accepted the harness the very first time. The dog walked around or sat at the feet of the users who were snacking on ice shavings.

Some users responded to the voice through the smartphone. We offer a few samples of conversations. “D” is the author speaking via the dog. “U” is one of the users of the facility. “S” is a staff member.

Phrases in parentheses indicate what the speaker was doing.

The following conversation took place with a male user (U1) having mild dementia.

D: Did you like it?
U1: Is it tasty? (He spoke to the dog.)
S: It just said “It’s yummy,” didn’t it?
S2: It said, “It is yummy.”
U1: Is it really tasty? (He spoke to the dog.)

The staff’s question elicited the user’s final response.

The next conversation occurred when a female user with mild dementia (U2) showed a cup of ice shavings to the dog.

D: What are you going to eat?
U2: We are going to eat this, here. (She showed a cup of ice to the dog.)

The dog was not furnished with a camera. The author could not see the cup. However, U2 showed the cup to the dog and
said “this” quite naturally.

The next conversation took place with a female user who had mild dementia (U3) and a twisted sense of humor.

D: I would like to eat ice shavings with you.
U3: Do you want to eat with me?
D: Yeah.
U3: I want to eat alone.

When U3 returned from her walk, and before eating the ice shavings, she heard a voice coming from nowhere. A staff member told her that it was the dog’s voice. U3 said “No, it is ghost-like, ha-ha-ha! ” She must have realized that the speaker was not a dog.

C. Discussion

Most of the users with mild dementia responded to the dog “speaking.” However, the user with medium dementia hardly uttered a word. We can think of some reasons for this. Even when a human unexpectedly talks to someone with medium dementia, he or she does not always react at once. Furthermore, it is not easy for one with medium dementia to comprehend every situation, especially if that situation is something unexpected such as a talking dog. They might be a little confused or avoid confronting the situation because their cognitive functioning has been reduced.

We think that U3 should have realized that the voice did not belong to the dog. Apparently she did not know or want to know where the voice was coming from. However, she seemed to enjoy responding to it.

A dog, as a medium of conversation, may allow a user to be more open with their feelings. U3 reacted to the dog with wry humor. But if the conversation partner had been a child, the child might have felt hurt. And if the conversation partner was a staff member, U3 would never have said such a thing. This result suggests that a dog allows elderly people to be more playful in their talk.

The day will soon come when a smartphone will be able to hold a conversation autonomously. The smartphone will also present topics of general interest during elderly people [19][20]. But for the present, a lack of psychological interaction means people with dementia are reluctant to talk with a smartphone. But when a dog carries the phone, these people may have an enjoyable conversation. A smartphone can do more than give people with dementia a lot of information. In the presence of a dog, it can offer such people the pleasure of conversation. In general, we talk to a dog and infer its feelings from its responses and actions. A voice from a smartphone will support this conversation. The smartphone will encourage new relationships between people and dogs who work for those with dementia every day.

One problem revealed in this study was that it is not easy to hear a smartphone outdoors. This problem is especially acute for elderly people whose hearing is diminished. This requires extra effort and cognitive ability to for anyone assisting elderly people. There were cases where the staff at the facility had to tell the users what the dog (the author) had just said. We need a better speaker that will allow the voice to be amplified in the same direction as the head of the dog. Although U3 heard the voice before eating the ice shaving, she did not know where the voice was coming from. This way, the users will easily recognize to whom the dog is talking.

VI. DISCUSSION

The symptoms of dementia are varied and increase with time. Some devices can compensate for the disabilities that arise with dementia. However, these devices must be kept on hand according to the person’s stage or symptoms of dementia. Today, many people possess a smartphone that can be equipped with many useful functions and applications. The smartphone offers a lot of possibilities to provide support through only one device. However, some people with dementia forget to carry their smartphone. Also, many of them do not like to perform the tasks instructed by their device.

The results in Section II showed that a person with a dog could enjoy the benefits of a smartphone, even if she did not have it in her possession. A dog can be trained to bring the smartphone to its owner whenever an alarm sounds. Our results showed that an owner is happier when the smartphone on the dog gave the alarm. We submit that a dog can overcome the problems of non-possession of the smartphone and disinclination of doing daily tasks.

In Sections III, IV, and V, we presented an application and two methods that can assist people with dementia. Generally, dogs love to accompany their owners. If an owner goes to another place, the dog will trot after him. He can then be reminded to input necessary information into a smartphone app. Dogs are good conversation partners. An app which presents topics of general interest during elderly people will support the conversation between the dogs and the people with dementia [19][20]. Moreover, a dog can be trained to go to a door when a specific alarm goes off, and deter a person from going outside. In this way a smartphone, with a little help from a dog, can offer superior support for people who need it.

These results suggest that the concept of having a dog carry a smartphone on its back will allow other applications [21] and devices for the people with dementia to become the more useful things of their daily lives.

VII. CONCLUSION

For this paper, we conducted an experiment to compare the effectiveness of a smartphone mounted on a dog’s back to that of a stationary smartphone. The results showed that, after a little training, a dog will rush up to its owner when the smartphone emits an alarm. Then, we presented an application that people with mild cognitive impairment can easily set to remind them what they are going to do inside of a few minutes. Because dogs usually follow their owners, these people can be encouraged to remember to input the necessary information into an application on the smartphone carried on the dog. We also proposed a method in which a dog runs up to a person who is trying to open a door and go outside. This dog is trained to run to the door when an alarm sounds on the smartphone. The dog then distracts the person’s attentions from the door until a caregiver shows up. For the last part, we conducted an experiment to examine how people with dementia respond to a dog who “talks” to them. People with mild (but not medium) dementia responded to the dog’s “voice.” We considered that
they would realize that the words were not coming from the dog. We posited that if a dog carries a smartphone, people with dementia might enjoy talking to it, thus overcoming the psychological barriers to such devices.

For the future, we plan to give a dog other devices; a small camera, a RFID tag, an acceleration sensor, and conduct experiments through the cooperation of a care facility and a home with a dog.

ACKNOWLEDGMENT

The contents of Section II was presented at the 16th International Conference on Human-Computer Interaction in 2014.

REFERENCES


