Assistive Technologies for People with Dementia: Personal Review

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Chapter 10 Daily Assistance by Virtual Agents and Robots

Contents

10.1 Support by Agents System

Necessity of Conversation: Conversation is a very high-level cognitive activity and involves large brain areas, language understanding, language production, and so on (Huang, Matsushita, Kawagoe et al., 2014). A conversation is a common and enjoyable activity for most people. Individuals with dementia, however, tend to be isolated with few opportunities to converse, particularly for individuals living alone at home (Yasuda, 2009). Therefore, one of the most important interventions for them is to provide them with opportunities to converse with people. However, provision of such conversation opportunities requires human resources. As one of the interventions to resolve this problem, a remote conversation have been proposed, which connect an individual with dementia and a conversation partner by using a telephone or a video phone.

Since the number of individuals with dementia is rapidly increasing, it is getting difficult to find enough conversation partners, even with remote conversations. In the last decades, many talking dolls and toys for the elderly have been available in markets. However, the number of categories and topics to be spoken by dolls and toys are narrow and limited. The conversation with them is simple and fragmentary so that a reminiscent or theme-oriented conversation such as life review is difficult to perform. This limitation may frustrate individuals, especially with mild and moderate dementia. Recently, several talking robots have been developed.

Necessity of Agents: Aiming to reduce the caregiver's physical and mental burden and help the patients to keep their mental stability, several researchers proposed a conversational agent for people with Dementia. While some recent studies used conversational humanoid in caring elderly people and using in healthcare, little has been studied in conversational agent for people

with Dementia (Sakai, Nonaka, Yasuda et al., 2011).

People are increasingly interacting with computerized agents. Examples include autonomous and tele-presence robots in homes, healthcare, or search and rescue, virtual characters in the expanding gaming industry or for serious games, and agents representing other people through on-line social and interactive meeting places. HAI will gather researchers from fields spanning engineering, computer science, psychology and sociology, and will cover diverse topics, including: human-robot interaction, affective computing, computer-supported collaborative work, gaming and serious games, artificial intelligence, and more (HAI, 2015).

Required Functions for Agents: Only humans communicate using language and carry on conversations with one another. And the skills of conversation have developed in humans in such a way as to exploit all of the unique affordances of the human body. We make complex representational gestures with our hands, gaze away and towards one another out of the corners of our centrally set eyes, and use the pitch and melody of our voices to emphasize and clarify what we are saying (Cassell, McNeill, & McCullough 1999).

Cassell et al. (1999) propose a model of conversational function. In this framework, four features of conversation are proposed as key to the design of embodied conversational agents: the use of several conversational modalities, such as speech, hand gestures, facial expression, the importance of timing among conversational behaviors, the distinction between conversational behaviors (such as eyebrow raises) and conversational functions (such as turn taking).

Review of Various Researches on Agents: The development of embodied conversational agents as ***Companions*** brings several challenges for both affective and conversational dialogue. These include challenges in generating appropriate affective responses, selecting the overall shape of the dialogue, providing prompt system response times and handling interruptions. Smith, Crook, Boye et al., (2010) presented the implementation of a companion integrating all the above aspects into a single prototype.

The Companion presents itself as an embodied conversational agent with which the user can engage in a free conversation, albeit on a select set of topics. They opted for a scenario in which the user, a typical office worker, returns home and talks about the day's events. They refer to this as the "How was your day?" scenario. The system currently supports over 40 work-based conversational topics. Conversational flow in natural dialogues tends to be quite fluid, with partners frequently interrupting each other rather than observing the strict turn-by-turn structure of most current spoken language dialogue systems. The system has been extensively tested in the lab, in excess of a thousand sessions, and has demonstrated a regular ability to withstand meaningful dialogues of more than 10 minutes.

Conversation Agent for the Elderly: Heerink, Krose, Evers et al., (2006) focused on the acceptance of a relational agent appearing on a computer screen and functioning as a health advisor for older adults. People with cognitive impairments have problems organizing their daily life autonomously. A virtual agent as daily calendar assistant could provide valuable support, but this requires that these special user groups accept such a system and can interact with it successfully. Yaghoubzadeh, Kramer, Pitsch et al., (2013) presented studies to elucidate these questions for elderly users as well as cognitively impaired users. Acceptance can be increased by way of a participatory design method. Actual interaction studies with a prototype demonstrate the feasibility of spoken-language interaction and reveal strategies to mitigate understanding problems.

Previous studies on the acceptance of such an agent by elderly people reported that it is important for the agent to display social signals, like smiling and head nods; this enables the agent to gain the patient's trust and enhances intimacy (Huang et al., 2014). Kanoh et al. (2011) investigated user acceptance of a robot in recreational use inside health care facilities for elderly people. Although the participants showed positive reactions to the robot, the interaction between the participants and the robot was seldom observed. The effects of verbal and non-verbal empathic behaviors of a 2D graphic agent was investigated and found that the subjects did rate the agent more caring if it shows those behaviors. Leite et al. (2010) investigated a robot cat showing empathic behaviors on the players of chess game. Smith et al. (2010) proposed the integration of affective dialogue with a deliberative architecture. These studies showed that the display of empathic behaviors can usually make the conversational

artifacts better accepted by users, which is a requirement of artificial companions.

However, other studies try to model episodic memory which is essential to maintain the dialogue with users in long-term relationship. Sieber and Krenn (2010) proposed a W3C RDF based presentation of past interaction and user preferences. In order to achieve higher efficiency and more realistic dialogue, Lim, Aylett, Ho et al., (2009) integrated "forgetting" feature into their episodic memory model (Huang et al., 2014).

Acceptance of virtual agents by patients: To accomplish research goal, we should confirm that people with dementia accept a conversational agent and recognize it as a communication partner. For this purpose, as the first step, Sakai, Nonaka, Yasuda et al., (2011) set up a Wizard-of-Oz experiment to investigate whether people with dementia are willing to communicate with a virtual character. All were female subjects. The average age was 79.8 years, and the mean MMSE was 12.2. The conversation was successfully carried out. All the subjects were satisfied with the conversation with the agent, and the agent's capability of returning feedback such as nod and acknowledgment seemed effective in facilitating the conversations. The subjects were happy to communicate with the agent.

Conversational Agents for Interacting with Patients with Dementia (Sakai, Nonaka, Yasuda et al., 2011): Sakai, Nonaka, Yasuda et al., (2011) proposed a conversational agent for people with dementia. In a preliminary analysis, the subjects did not ask any questions to the agent. Thus, the agent's asking questions in proper timing may be more effective than just waiting for the user's input. Therefore, it may be necessary to monitor the end of the subject's speech to avoid utterance overlaps. They implemented the system which need to be able to automatically detect the subject's speech ends, and start speaking after the user finishes up her/his utterance. All the patients replied and were satisfied with the conversation with the agent. However, when the agent's questions overlapped with the patient's speech, they quitted their utterance. Therefore, the waiting time between the end of speech and the agent's next question was found to be very important.

Grandchild agent (Yasuda, Aoe, & Fuketa, 2013): Sakai et al. (2012) developed a computer agent system that could serve as a conversation partner for hospitalized patients with dementia in clinical setting. At any rate, above agent systems cannot perform the long conversations such as 30 minutes reminiscence talk or life review. The short conversation is not enough to satisfy with and stabilize individuals with dementia. In order to perform the long conversation, we have developed another computer agent system for individuals with dementia which shows an animated face of a child. 180 reminiscent questions (450 questions in 2020 version) were prepared for general settings such as homes and institutions, not limited to hospitals. The system can also automatically detect the end of an individual's reply to a question. We investigated the effectiveness of this agent conversation system.

Methods*:* The computer screen showed an animated face of the child agent which resembled "a five-year-old grandchild." When the subject speaks, the agent reacts to them with generating nods, mouth movement, and acknowledgement automatically. We prepared 12 sets of 15 (total 180) reminiscent questions such as parents, home town, school life and so on. These were spoken by the synthesized voice of the agent.

The continual questioning by the agent may in the preliminary study yield an atmosphere like "a police interrogation". In order to improve this atmosphere, each question was composed with two parts. First part was introductory comments by the agent. The agent introduced his own reminiscent experiences. e.g. "I used to eat watermelon in the summer". The second part was the question for subjects. e.g. "what kind fruits do you like?" The pause between the comments and questions was fixed for one second. The introductory comments and questions were also shown in written form at the lower part of the screen for the visual confirmation of questions and compensation for hearing difficulty.

On the analysis of Sakai et al. [2012] and our preliminary trials, the waiting time was fixed to 3.5 second in this investigation. If following speech sounds were not detected during the 3.5 second's waiting time, the agent moved to the next question, or spoke "do you have any other experiences?"

Eight subjects with mild Alzheimer disease participated in this evaluation experiment; the average age was 78.5 years old and

the mean Mini-Mental State Examination (Folstein et al., 1975) score was 22.2. To evaluate the effectiveness of this system, subjects replied to the questions by the agent (agent condition) and a human conversation partner (human condition). The human partner was a speech therapist whom all subjects were acquainted with. In both conditions, the almost same 15 questions were asked, although some introductory comments were slightly modified in human condition. Each conversation took about 20 minutes.

***Results**:* All the subjects uttered 5494 (74%) syllables in the agent condition, compared with 7406 (100%) syllables in the human condition. This system was sometimes disturbed smooth transfer to the next question by the agent by picking up non-speech uttering such as, sigh, cough of subjects, and environmental noise(door's closing, footsteps in the corridor and so on). After the experiment, a simple interview was conducted to ask the impression for this conversation system. Most of subjects had a favorable impression for the agent. A woman was moved to tears while conversing with the agent, because it's too enjoyable. A man with early onset dementia said "When I talk with normal people, I am always worrying about the difficult question which I cannot reply, or the repetition of answers which I already made. But, in this system, I can talk freely with this agent without above hesitation or anxiety.

***Discussion**:* The system could succeed to elicit 74% utterances from the individuals with dementia. This system may be practical and valuable to introduce as an alternative way of a conversation when no human conversation partner exists. Nonetheless, all of subjects could accomplish 20minuute' conversations with the agent. Much longer conversation with this system is easy to perform. This kind of artificial talking system is needed for such individuals to provide enough talking chances without any hesitation and worries.

In this study, the waiting time was fixed to 3.5 seconds. Needless to say, the appropriate waiting time is different from each subject. The future study will reveal the effectiveness on the elicitation of speeches from subjects when the waiting time is adjusted to the subjects.

Recently, several robots and smart phones are installing a speech recognition system to converse with people such as "speaking concierge". However, its robustness for speech recognition is still unstable. Furthermore, the subjects do not always clearly pronounce. Since the robustness is definitely important for the practical use of this system, they employed the sound recognition system as same as Sakai et al. [2012] which was simple but more stable ways. As might to be expected, this system was forced to pick up non-speech uttering such as sigh, cough of the subjects, and environmental noises. However, this system could work well under quiet circumstances.

The repetitive questionings by the agent will work for maintaining or reminding various memories of individuals with dementia. It will be a more natural way of measuring the cognitive status, when the agent system can assess the individual's cognitive status through conversations (Wang, 2009). If this system can be integrated with these functions, the agent will become a "remote concierge" system for a subject. If these devices are stored in to dolls, and robots, the individuals can converse with the agents through them.

YASUDA, FUKETA, & AOE (2014) observed a multi-party conversation between the agent and two participants with dementia or mild cognitive impairment. Their average age was 75.9 years and the mean MMSE score was 24. Five participant pairs conversed with this agent, or without the agent. We evaluated the influence of the agent on their conversation using original psychological five-scale ratings. For the experiment, two participants conversed well with this agent.

Further application of Grandchild agent (Yasuda, Fuketa, Morita et al., 2016): Videophone conversation was effective in increasing psychological stability of individuals with dementia. We also developed an anime agent system to serve as a conversation partner for individuals with dementia. The computer screen showed an animated face resembling "a 5-year-old grandchild." The agent was programmed to ask any of 120 pre-set reminiscence questions, automatically detect the ends of replies, and follow with new questions. In the third experiment, the remote multi-party conversation system Skype™ was integrated with the agent system. The agent participated as a presenter of conversation topics for the multi-party interaction. Three

pairs conversed under two conditions: conversation of two subjects and a chairperson (human condition) and conversation in which the agent participated as a topic presenter to the above groups (agent condition). The quality of the conversation was scored by three evaluators. The average score of the evaluation was 3.9 (78%) in the agent condition and 4.9 (100%) in the human condition.

Discussion*:* The number of individuals with dementia is rapidly increasing; it is very difficult for them to engage in conversation at all times. Frequent and regular videophone conversation is becoming difficult to perform. As a possible resolution of these situations, we incorporated an agent as topic presenter in the videophone conversation. Although a prototype has been proposed, this is the first clinical trial of the participation of an agent in a videophone conversation.

We observed a multi-party conversation with an agent (agent condition) and without an agent (human condition). The time required to conduct these conversations was almost the same. Although operational procedures prevent intrinsic comparison on the quality of conversations between two conditions, all average scores of the quality of conversations were better in the human conditions. However, the percentage of the scores was 72% for the agent condition compared with 100% for the human condition. We consider that this percentage means it is worth applying this system in supporting group conversations via a videophone.

From the number of encouragements, conversations in the agent conditions seemed to need more prompts, particularly encouragements for another subject to talk, than those in the human conditions. In the agent conditions, some subjects may have felt hesitation from speaking at will. In future revisions, encouraging words should be used to prompt more reserved participants to talk, such as "how about another person?" as well as "please explain in detail."

Direct conversation between subjects occurred naturally in the human condition of pair C. To compensate the technical insufficiency of the agent system, direct talking between participating subjects should be augmented by prompts such as "Let's talk to each other." Furthermore, to increase the benefit of the agent system or of ICT interventions, use of various internet resources such as pictures, music, and short movies will be greatly beneficial. Future revision will incorporate the above prompts and functions in the agent system to increase the usability of this system.

Most individuals with mild or moderate dementia still have the ability to talk to each other. They also say that "I would like to make a social contribution, even though I have dementia." Talking volunteers are one of the few remaining employments for them. Indeed, they are even more suited to be talking volunteers for other individuals with dementia. They easily forget what has been already said; therefore, they are not annoyed by repetition by other individuals with dementia. However, it is often difficult to recollect topics because of their degraded recall abilities. This agent system can work as a topic-providing system for them.

Most families in advanced nations have computers and access to the internet. Younger seniors with dementia who are accustomed with the operation of PCs and smart phone are increasing. The operation of Skype™ will not be difficult for such individuals. An anime agent participated in multi-party videophone conversations as a conversation topic presenter. Although further improvements are required, this agent system may become a promising intervention for assisted conversation of individuals with dementia (Yasuda, Fuketa, Morita et al., 2016).

Morita, Fuketa, Aoe, & Yasuda (2015) presented a dialogue communication system for individuals with dementia by using cloud-based approaches. The presented method proposes a dialogue-controlling algorithm that can break communication if individuals with dementia go into a hyper excitable state. Videos with school songs are utilized to mitigate the impacts caused by hyper excitable state. In the cloud systems, a text mining module is combined in order to analyze personal orientation from communicated utterances of individuals with dementia. From experimental results for a total of roughly 327 individuals with dementia, it turns out that the presented method can make conversations smooth in comparison with the previous approaches.

Jaana, Imabuchi, Prima, Ito, & Yasuda (2015) developed an interactive conversational agent software to ameliorate the symptom of dementia patients. This software works as a speech therapy tool, which acts as a conversation partner to a patient. They defined three sets of reminiscent questions into the software. Each set contains 15 questions. The software utilizes constrained local model (CLM) and voice detections to determine the utterances of patients. Once the CLM recognizes a patient's

facial landmarks, it starts to ask him using the pre-defined questions. The software will continue to ask using subsequent questions when it doesn't detect utterances from either distance changes between mouth landmarks or changes of voice of the patient. The voice detection solely enables utterance detections in a low environmental noise while the CLM succeeds to detect utterances regardless of the environmental noise.

Home living support agent: To support the individuals with dementia, a wide variety of reminder services are provided. However, existing reminder service has following three problems, lack flexibility, only providing the robotic interaction and difficulty adjusting to the individuals with dementia. Hence, to cope with the above problems, the new system architecture for real-time personalized Memory-Aid Agent Service for people with dementia was started.

The proposed architecture provides the real-time positioning detection, rich VA interaction and personalized reminder service for the users. To achieve above architecture, three services were integrated based (Tokunaga, Horiuchi, Saiki et al., 2015; Horiuchi, Tokunaga, Saiki et al., 2015). The memory aids service based on time and location for people with dementia. The service consists of three services, location detection service, forget-things registry service and agent service. This service aims to assist the individual based on individual's context (i.e. schedule and current location). Moreover, this service could interact with a conversation for example if the person goes to the hospital the service assists that "Do you have proof of insurance?" and so on. This service obtains the rough individual's location information using some electronic device, so as to detect where the dementia people are in the house.

Secondly, forget-things registry service which stores the usual schedule for the people with dementia. So, the caregivers or families could register the schedule such as daycare. Moreover, they register the information when the dementia people go out. Based on the registered information, the service reminds not only notify the schedule, but also could prevent from wandering around in the midnight. Finally, agent service enables people with both voice and text interaction that enables to easily understand and confirm to prevent forget-things. Concretely speaking, when the individual goes to hospital, the service displays the list of forget-things (e.g. insurance, wallet) on the screen and also confirms to the individual with a voice.

Review of Other Agent Researches: Wiratanaya, Lyons et al., (2007) described the design and implementation of an interactive character animation interface. The system ***iMime*** analyzed the attentive state and aspects of the affective behavior of a viewer using input from a video camera and uses this to control the behavior of a cartoon-like animated character. Using the interaction metaphor of a mime artist, they designed the system to encourage viewer attention and interaction, with adaptation using an online reinforcement learning based on the viewer's attentive state.

It is essential to make the agent memorize not only past interactions but also the daily life of the patients, to allow them to feel that the agent is together with them. Huang et al. (2014) then propose a set of recording devices (digital video recorder and an IC audio recorder) which are put in a wearable way and are operated by the patient himself / herself, the memory vest. This is used to log the user's daily activity for memory recall of both the user and the agent after then. We are then developing the integration with an Android smartphone into the memory vest. The current prototype recognizes the user's moving status (walking, running, bicycle, car, or train) and location when she/he is outside home and periodically updates the user's latest status to a server hosting the activity history database of the user. After the development of the technique to transform the log data to appropriate memory and knowledge presentation, they plan to integrate the database as the back end of the listener agent and thus allow it to engage the dialog involving the context of the user's daily life. In addition to the listener agent as the front end to the patient, we also plan to integrate the front end for medical institutions and the relatives of the user to monitor the user's recent condition or to input instructions from remote.

During a meal, families have the chance to catch up on what is happening in each other's lives and to strengthen the bonds of the family. Therefore, Yuasa et al. (2013) proposed a table-talk agent that can enjoy talking and eating with others and create a pleasant atmosphere. The purpose of the research is to investigate understandable and appropriate nonverbal behavior and its timing in order to develop table-talk agents and robots. They developed embodied agents that can use a synthetic voice, hand

gestures, and chopsticks using the TVML tool kit. Cameras set around a display allow the system to detect the head orientation, and the height of the human's hand is detected using a colored marker attached to a finger or chopstick. The system can be arranged such that when a participant puts up his/her chopstick, the agent also puts up his chopstick and starts to speak.

Walking, Agent and wandering prevention: Recently, walking exercise is becoming popular. People are able to exercise with enjoying the surrounding environment changes and the strolling around wherever they like. Takase, Yoshida, Doi, Nakano, Sakai, & Yasuda (2016) believed that these enjoyments, are called wandering, are essential elements of the walking exercise. On the other hand, there are also many people exercising with a walking machine int the indoors, such as a sports gym. However, the exercise with a treadmill is tedious for users. In this study, they proposed a novel support system for walking exercise with the wandering experience by using google street view. In addition, we introduce a companion agent to act as a route guide and improve the enjoyments of walking. As a result, users can stroll around the world or visit wherever they want with the agent during exercising. By means of the system, users will be able to exercise in the indoors with the similar wandering experience in case of walking in the outdoors.

10.2 Robots

Robots and Aging Society: In the coming decennia, the industrialized countries face a dramatic growth in the elderly population combined with labor shortages in the healthcare sector. This has inspired a number of researchers to explore the applicability of intelligent systems in general and robotic products in particular to be used in assisted-living environments. For robots, the functionalities are related to supporting independent living by supporting basic activities (eating, bathing, toileting, getting dressed) and mobility, providing household maintenance, monitoring of those who need continuous attention and maintaining safety. Recent studies on interaction with robots stress the importance of social intelligence even more so in a health- and eldercare environment (Heerink, Krose, Evers et al., 2006).

The main issues facing older people are physical decline, cognitive decline, health management, and psychosocial issues. To reduce barriers to acceptance, robots designed to provide physical and healthcare assistance should have a serious appearance. On the other hand animal-like robots can address psychosocial issues and function like pets. However more focus could be placed on developing preventative interventions, multifunctional robots, greater educational content and motivational aspects of appearance and interaction style (Robinson, MacDonald, & Broadbent, 2014).

Review of Robots for Elderly Assistance: Since there are many problems associated with pets for the elderly, Robot Assisted Activity (***RAA***) has recently been attempted using a pet robot, not an animal. A robot has much less possibility than an animal of hurting an elderly person requiring long-term care or causing infectious diseases, and it does not need to be taken care of, either. In addition, anyone can use the robot at any time in the same way without any need of breeding or training it (Kanoh, Oida, Nomura et al., 2011).

Research involving explicit tests of robots or agents with elderly users has been carried out. These studies concerned a seal shaped robot named ***Paro*** that was positioned in a group of elders where they could interact with it, mainly by caressing and talking to it. Another experiment that took place in an eldercare institution concerned a robot named ***Pearl*** by several researchers. The experiments with Paro and Pearl both registered a high level of positive excitement on the side of elders. However, it is not clear what aspects of the robot interface caused the users' positive attitude and whether such a robotic aid would ensure actual use on a longer-term basis (Heerink, Krose, Evers et al., 2006).

At present, some robots can communicate with people and alert them when it is time to take their medication. ***Palro*** is a small, autonomous humanoid robot which can have an intelligent conversation and walk on two legs. ***Pepper*** is a humanoid robot that can converse with a person, recognize and react to their emotions, and move and live autonomously. ***Emopa*** is a smartphone service that talks a user of this smartphone like family or friends (Oshima, Yasuda, Machishima et al., 2015). ***iCat*** was tested in a Wizard of Oz experiment where the robot was controlled remotely by an experimenter. The participants were asked to program a

DVD-recorder and to participate in an online auction, by using the iCat interface. The extravert iCat was indeed perceived to be more socially intelligent.

It seems that research on robot can be subdivided into two areas: acceptance of the robot in terms of usefulness and ease of use (functional acceptance) and acceptance of the robot as a conversational partner with which a human or pet like relationship is possible (social acceptance). The experiments with Paro were more focused on social acceptance while the experiments with Pearl and iCat focused more on the acceptance of the robot regarding its functionalities (Heerink et al., 2006).

The Future of Assistive Technologies for Dementia: Borka and SARAH are examples of robotic technologies that perform tasks while providing companionship. The LIREC group is also striving to make robots more companion-like by observing canine behaviors. Robots will be able to detect human expressions (facial and body language), adapt accordingly and even mimic them through the interface. Feelix Growing is working towards this direction (Peterson, Prasad, & Prasad, 2012).

Tamura et al. (2004) used ***AIBO-R*** and a battery powered toy dog for occupational therapy sessions. AIBO is a robot pet simulator that can walk, respond to commands, and sense its environment through touch, sight and hearing. The battery-powered dog was covered in a plush fabric, could wag its tail and sit, but did not respond to commands. The residents with dementia responded with interest to AIBO but they responded more readily to the battery-powered toy dog. Residents were reluctant to touch AIBO, even when it was dressed in furry "clothes".

The responses of nursing home residents was compared to a robotic cat ***NeCoRo-R*** and a plush toy cat. Both cats showed a significant effect on some behaviors. The robotic cat evoked a significant increase in pleasure and interest. However, few residents held the robot cat, although it had a furry outer covering, while most held the plush cat. There was a correlation between increasing dementia and decreasing engagement with both cat substitutes.

Heerink et al. (2006) examined the influence of social abilities of a robot on elderly user's attitude towards and acceptance of the robot ***iCat***. Experiments were set up in a Wizard of Oz experiment. Participants who were confronted with the more socially communicative version of the robot felt more comfortable and were more expressive in communicating with it. The more socially communicative condition would be more likely to be accepted as a conversational partner. The socially communicative condition exhibited: it listened more attentively (by looking at the participant and nodding while the participant was speaking), it smiled during the interaction, it remembered and used the name of the participant during the interaction, it was showing more facial expressions and it would apologize for making a mistake.

Kanoh, Oida, Nomura et al., (2009) have developed a Robot Assisted Activity (***RAA***) program for recreational use in health care facilities for elderly people. The program applies a standard classroom model, starting with homeroom and including lessons in the Japanese language, music, gymnastics, arithmetic, and other subjects. All participants have a favorable impression of the robot and nearly all have a positive opinion of the RAA program. However, in spite of the overall success of the RAA program, we seldom observe interaction between participants and the robot.

Kanoh et al., (2011) uses a YORISOI ***Ifbot*** robot with the conversation communication function to attempt the development of an RAA program to be available as an activity in facilities for the elderly. It has a height of 44.5 cm, which can remind them of their past. This can lead to the expectation of the effect of reminiscence therapy. First, the Ifbot directs an utterance to the participants. If the participants answer the question, the assistant tells the Ifbot the answers. As the scenario progresses, the Ifbot produces facial expressions appropriate to the content of the utterance.

Almost all participants were accompanied by care providers. All participants except one out of 10 participants positively participated in riddles, did arithmetic, and sang songs. Additionally, participants were not often observed talking with each other during the progress of the RAA, but the results of the FGI have shown links between participants. This RAA program will serve to provide topics for conversations between participants outside the activity, thus increasing their socialization. When a robot talks to a person and asks for a hug or other physical contact, it increases familiarity, and the average distance between the robot and the person gradually decreases.

Care-O-bot3 Robots are started to be developed for aged care populations and some of these have been made into commercial products that have been well received.

Older people were invited to use a prototype robot with healthcare functions. The cognitions older people hold about robots may influence their decisions to use robots (Stafford, MacDonald, Jayawardena et al., 2013).

Teleoperated androids, which are robots with humanlike appearances, are being produced as new media of human relationships. The potential of humanoid robots how they affect people when they are employed to express a telecommunication presence and a sense of `being there'. ***Telenoid*** was used, a teleoperated android, to see how the elderly with dementia respond to it. Telenoid elicited positive images and interactive reactions from the elderly with mild dementia, even from those with severe cognitive impairment. They showed strong attachment to its child-like huggable design and became willing to converse with it (Yamazaki, Nishio, Ogawa et al., 2012). The elderly assumed positive attitudes toward Telenoid, and their positivity and strong attachment to its huggable minimalistic human design were cross-culturally shared in Denmark and Japan (Yamazaki, Nishio, Ishiguro et al., 2012).

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