PET-TYPE ROBOT COMMUNICATION SYSTEM FOR MENTAL CARE OF SINGLE-RESIDENT ELDERIES

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Abstract: This paper presents a pet-type robot communication system for mental care of single-resident elderies. The robot can communicate with the people autonomously, and also it is Internet-accessible and so that allows the people to communicate with others, directly or using the communication server. The system consists of pet-type robots and the information center. The pet-type robot can treat not only as an information terminal, but as a pet, which can talk to user(s), give information of the local communities, watch over them and send some information to carers at the information center if needed. Considering necessity and sufficiency, the robot has four motors; one for both ears, one for both eyes, one for the nose, and one for the neck. Motions generated by the motors symbolize emotions of the robot, which is essential for our object. We have demonstrated and examined some features of this robot system for elderies and got some good evaluation.

1 INTRODUCTION

Recently, the rate of elderies is getting higher and higher and, in accordance with that, welfare facilities and tools using advanced technologies have been developed(Bolmsj et al., 1995; Clarkson et al., 2003). Many of them are, however, for aiding persons with manipulation disabilities, or for supporting physical works of carers and elderies, but for mental activities. Especially in Japan, single-resident elderies tend to be isolated with local communities which may lead loneliness of those, and so it is very important to communicate those elderies with others on mental aspect. Pet-type robot system is one important candidate to solve those sorts of humane problems, and there have already been several researches(Matsukawa et al., 1996; Maeda et al., 2002; Ohkawa et al., 1998; Maeda et al., 2003), though they are not focussed enough. We here introduce a new pet-type robot communication system which consists of pet-type robots and the information center.

In this paper we explain some concept and features of our system, and later we discuss some examination. We here have demonstrated and examined some features of this robot system for elderies, using some of the robots, and certified some effects of our system.

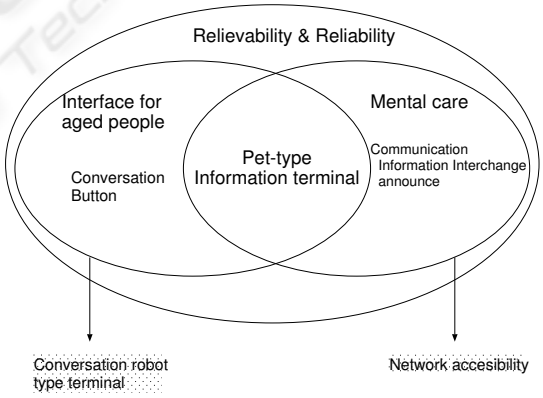

Figure 1: System concept.

2 CONCEPT OF PET-TYPE ROBOT COMMUNICATION SYSTEM

Figure 1 shows the basic concept of our system. In the following subsections, we explain each aspect in detail.

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2.1 Interface Usability

Pet-type robots should satisfy following requirements with view of elderies' usability:

(i) They should not give a feeling of machines, or electronic equipments. For elderies, those "Hard" equipments are very tough to touch, and that causes not to use frequently.

(ii) They should be able to give some conversation with contact and/or speech, that let users feel kind, or easy to communicate.

(iii) They should not force users to use.

To solve above problems, we introduce the following features:

(i) We designed robots body as stuffed toy bears. That enables robot to be more emotional, which is essential for pet-type robots(Fujita, 1999).

(ii) We have developed speech input (recognition) and speech output (synthesis or construction), and other multi-modal interface for conversation (explained below). Those techniques realize behavior of pets, and also offer affordance(Gibson and Walk, 1960).

(iii) We designed user interface as easy and simple as possible. For instance, a user does not need to operate any mechanical equipment for telecommunication such as making a telephone call (discussed below).

2.2 Elderies' information terminal

The robot should, furthermore, treat as an information terminal as well as a fake pet. For realizing those requirements, the robot is net-accessible and that feature allows the people to communicate not only with carers, but also with relatives, friends, etc. That is quite important for elderies, especially single-resident, not to feel alone. As described, communication is very important for our system and we discuss as below in details.

3 COMMUNICATION FEATURES

Figure 2 shows the network diagram of our system. All robots, or terminals, are connected to Internet, which means the robots are regarded as Internet-accessible terminals. Furthermore, those treat a telephone if required. In the following subsections, functions are described.

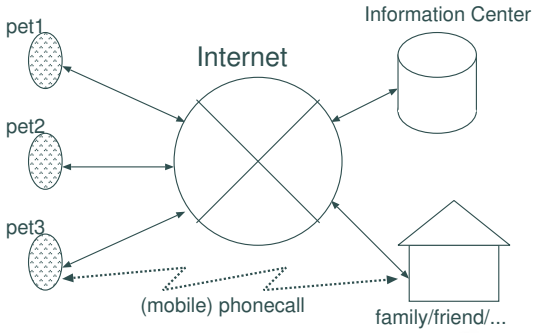

Figure 2: System network diagram.

3.1 Internet connectivity

We have several versions of robot systems. Some are connected to Internet by cable TV networks, and others by cellular phone. The latter systems are aimed for portability as pseudo-pets.

3.2 Communication for surveillance

The robot has a camera to watch over user(s). Images can be taken by the camera, and are sent to the information center via Internet. That helps carers to get informations easily for watching over. The robot can send images in regular intervals, and that offers some of continual watching, or lifeguard.

3.3 Multi-modal interface

Speech techniques are, furthermore, used to some information exchange with the robot. Those speech operation makes those people feel naturally and friendlily, and then improves usability very much. The current system supports the following invocation of communication;

- "Telephone button ON!": by this speech command, a user can take a telephone call, or catch a call.
- "Tell!": supports voice mails. At that time, a user can choose "(normal) mails", or "special (messages)".
- "Bulletin board!": opens voice BBS. In the situation, a user can designate "Answer" for followup of others' message, or "Question" for invocation of new a thread (theme or topic) in the BBS.

Those are mainly for communication with others through Internet and/or telephone networks, which helps user(s) to communicate with relatives and friends easily, as there are still some amount of people who are not Internet-accessible.

3.4 Autonomous conversation

Besides networking communication, autonomous communication is strongly required for single-resident elderies user, as the pet robot could be a partner and then that may avoid the user from loneliness. Autonomous communication consists of speech recognition and speech generation. Speech media are very useful for elderies, who are not accustomed to use computers straightforwardly.

The robot at the moment can tell his name, current date/time to the user(s). The robot can also use over 200 Japanese words, including

- "Good morning!",
- "Wake up!",
- "Bye Bye",
- etc.

If a user talk to the robot "Wake up!", the the robot talks back to the user the greeting and gives one arbitrary health advice at random, which give user(s) some feelings of "live creature". Furthermore, for the purpose of getting friendly, the robot can sing several short songs.

Note that those speech is not synthesized but just composed from parts of speech pieces, which were previously recorded and edited from human speech. This composed method found to be more natural to listen to, and that leads quite important characteristics for elderies to be easy to communicate rather than synthesized ones.

4 SYSTEM ARCHITECTURE

To reinforce interaction, including communication with user(s), more naturally and friendlily, the robot has some sensors and motors.

Figure 3 presents functions of the robot skeleton.

Those components enable the robot to behave much more like a real (living) pet, which afford to be more friendly and easy to contact (Gibson and Walk, 1960).

Sensors work for catching some signals of friendliness, which makes the robot cheer up/down, as well as for interrupting its action, speech, etc. Considering necessity and sufficiency, the robot has four motors; one for both ears, one for both eyes, one for the nose, and one for the neck. Motions generates by those motors symbolize emotions of the robot, which is essential for our object. For instance, the head, followed by neck, can move vertically, which imply the emotion of bowing, and horizontally, which imply negation.

The robot consists of two units, stuffed toy unit and control unit, and those two are connected by a serial line. the toy (doll) part has motors and sensors, and

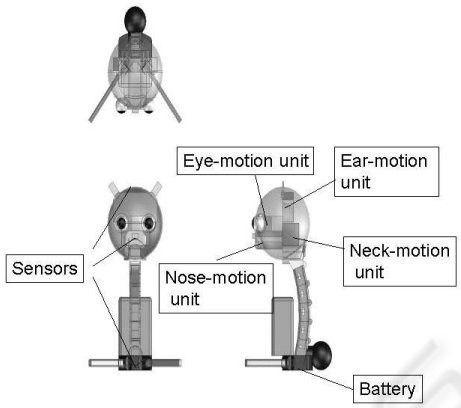

Figure 3: Functions of the skeleton.

motion commands and sensed signals are sent to the control unit. To afford user(s) to use easily, or pleasantly, a camera is embedded into a toy camera, microphones are set at both ears, and a speaker is set just under the mouth.

To/from the information center, communication, or information interchange is done through the Internet. Telephone calls are not to use VoIP protocol, but done using facility of cellular phones through public telephone network.

5 DISCUSSION

We have examined a field test in Ikeda-city in Japan. Targets are 7 single-resident elderies, 3 males (ave. 83 years old) and 4 females (ave. 78 years old). Each person use the pet-type robot ave. 62 days, and in that period we have done 4 interviews and 2 questionnaires.

Table 1 presents questionnaire results, where "Q" stands for Questions, "V" for "Very good", "G" for "Good", "N" for "Not so good", and "B" for "Bad". It actually shows our system can be used quite well, though it is not complete. Especially, the item of "understanding" is not of good point which may cause from insufficiency of speech recognition, and thus the function of speech recognition and autonomous conversation should be improved.

Table 2 shows statistics of conversation data, derived from log-messages in the center (server). The system is used Approximately each two days, which seems to be moderate. Users turn on the switch twice a day, which may causes from mail checking on morning and evening . Conversation time is about 6 minutes, and it may be enough for get and give information. Conversation success rate is counted by hand from logs of the server. 46.8 % is not so good

Table 1: Questionnaire results

Q	V	G	N	B
How frequently do you think the robot understand you?	0	0	6	1
Do you feel the design of the robot is good?	2	3	0	2
Does the robot speak well?	2	3	2	0
How do you feel by listening to the delivered messages from the center ?	4	2	1	0
Do you feel friendliness with the robot?	2	3	1	1
Do you think you feel lonely without the robot?	2	2	1	2

Table 2: Usability statistics.

Item	Average
Active rate (actual used days per monitored days)	49%
Power-on frequency (per day)	1.9 times
Conversation time (per one conversation)	5 minutes 55 seconds
Conversation success rate	46.8%

and we have to improve this factor.

6 CONCLUSION

We developed a pet-type robot communication system including the information center, and certify some of our system's effect.

We need more field tests for analyzing our system more precisely, as we have not done enough amount of examinations. Furthermore the contents, which consists of conversation sets and speech programs, should be reconsidered for the more comfortable and pleasant interaction.

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