

Robot Assisted Activity Using Robotic Pets in Children Hospital

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Abstract – Trial of RAA (robot assisted activity) using robotic pet for hospitalized pre-school and school aged child in children hospital was carried out in order to investigate the influence to mood and consider “human-robotic interaction” and the possibility of child inpatient’s QOL (quality of life) improvement. By DV-cam observation, it was found that human (companion: our student staff) - human (subject; child inpatient) interaction is quite important to enhance robotic-human (subject) interaction. By effectively introducing companionship, child retained his interest for long time and eager to join every time RAA. Questionnaire was administered after RAA in order to assess mood and a state of mind of child inpatient. It is found that most of child inpatients and their parents felt positive mood and RAA assisted increased communication among inpatients or between child and nurse.

I. INTRODUCTION

In the end of 19th century, robotics has been made remarkable progress and many type of industrial robots have been realized and widely applied to mass production. Today, in the early 21st century, robotics entered a new phase, so-called “companion-type robot” has been developed to make use in daily life as subsidiaries with human at home, for example, biped entertainment robot “SDR-4X” (SONY-ERC), biped-walking humanoid “ASIMO” (HONDA), and well known pet-type “AIBO” (SONY ERC). They will hold equal relationships with people, giving people pleasure and relaxation by enriching and hearing our heart. AIBO is designed to conceive a fully autonomous companion to accompany and entertain man in day-to-day life, and equipped with AIBO-ware (control software) enables AIBO to entertain and communicate with man, having learning and growing, and can grow variously through the treatment and communications with human from babyhood to adulthood at home. It is thought that AIBO is not expensive toy, but he is recognized as a substitute of companion-animal, dog, cat and so on, because he is social, autonomous, communicative, and he can recognize owner’s face. By these specifications, AIBO has been partly popularized as companion at nursing home for elderly and as playmate in hospital for child inpatient.

Recently, physiological response of human / companion animal bonding was reported by Baun et al [1]. They found that there was a significant reduction over time in the heart rate and blood pressure during petting a dog with whom a companion bond has been established. Friedman et al reported that companion animal ownership was correlated with one-year survival of elderly after discharge from

coronary care unit [2]. Moreover, there are several other researches of the bereaved elderly have found evidence of an association of companion – animal ownership or attachment and physical, psychophysiological symptoms or emotional status [3] – [6]. Therefore, it is conceived that companion animals assumed to be associated with some positive health benefits, directly to enhance health and emotional well-being and/or indirectly by buffering the impact of stressful life events.

Animal assisted activity (AAA) for elderly residents at nursing home and care facility has been attracted much attention. Dogs, cats, rabbits – their movements, sounds, nature, their softness are attractive to human. Animals provide more than stimulation to human. It seems they have an intrinsic value in sharing affection, feelings, and defraying fear. Human-animal interactions may provide many benefits. For example, mental stimulation occurs because of increased communication with other people such as volunteer takes their dogs and cats to a nursing home, recalled memories. It is thought that the presence of an animal itself can be entertaining. When dogs and cats come to visit a care facility, there is more laughter and interaction among residents than during any other entertainment time. The presence of animals encourages socialization. Therefore, AAA can improve quality of life (QOL) and AAA was effective to get rid of stress and heal by providing comfortable time, touching, petting and holding dog or cat in arms closely. But there are a few problems has been pointed out as follows, microorganism are present in great numbers in animal, animal can carry vermin, it is doubt to mediate infection or some kind of virus between men and beasts, and animal it’s self would be under stress.

Robot assisted activity (RAA) was started for a few years ago, using various kinds of pet-type robot as “robotic pet” and animal type robot as artificial emotional creature instead of companion animals in AAA. Robot is clean, free from worry about common infectious disease between men and beast, injury for example biting and scratching, and one can fully controlled by programming. Using robot give us great advantages to meet requirements of these activities by designing freely moving and sensing function, and body shape. It is expected that robotic pet can establish some degree of bonding, inspire positive emotions and only self-activated robot like as companion animal can engage positive interaction with people, provide laughing, communication, entertain time, so that RAA would able to

alleviate emotional stress among people, especially reduce mental poverty of child inpatient by manpower shortage of nursing staff. Some of trial research about RAA using robotic pet or animal type robot for elderly people at nursing home [7][8], for child inpatient in a pediatrics ward [9][10][11] and with child inpatient undergoing psychiatric care with therapeutic goals [12] (AIBO was used in “play therapy”). Psychological investigation using AIBO for child also reported [13]. All these works focus human-robotic interaction and the mood of subject based on subjective evaluation.

In this work, RAA was carried out using robotic pet and interactive stuffed animal toy in playroom at children hospital in order to investigate the influence to mood and consider “human-robotic interaction” and the possibility of child inpatient’s QOL (quality of life) improvement during hospitalization for pre-school and school aged child inpatients, and a better way of RAA.

II. FIELDWORK DETAILS

A. Pet-type robot used RAA

Various types of pet-type robot; “robotic pet” and interactive stuffed animal toy were used. Robotic pet used RAA are listed in table I. Most of them are AIBO, the 210 series (second generation of original AIBO), cuter 311/312 series and more futuristic 220 series. AIBO enable smooth movement for friendly interaction. AIBO equipped several features such as touch sensors on the head, bottom of feet and tail that respond to stimuli as well as sound, voice and image recognition from embedded stereo microphones and CMOS image sensor (camera) capture. AIBO can recognize as many as 50 simple voice commands such as “sit,” “stand up,” and “Yes/No,.” AIBO can play musical sounds, and emit both of whining and joyful sounds when “ignored” and “content”, and perform movements to express a variety of emotions such as happiness, sadness and anger for intimate interaction with people. Many kind of software (AIBO-ware) are available on the market that give different personality, features and ways of interacting. We used four kinds of software, one can speak in japanese by a young girl voice and play games, the other can perform acrobatic actions, and another one can move active, dancing. The wireless controller (AIBO handy viewer) was also used occasionally in order to maintain or enhance an interest for school age inpatient. One can control AIBO with command-driven mode and communicate interactive information, for example, one can see AIBO’s chattering on LCD display of this controller. AIBO is usually used the software having autonomy, learning, growing, so that human communication and the surrounding environment may alter the basic personalities of AIBO. But, these functions did not available during RAA, because RAA was held for only one hour once a week. We also used PC-based programmable software that allows us to customize AIBO behavior though an easy-to use programming interface. It allows us to create and edit original motion with blinking full color LED and emotional sound.

“Necoro Cat” have synthetic fur gives it a feline appearance, so it feels natural to treat it like a cat, stroking and hugging it. We expect that subject would able to develop

attachment to it through physical interaction. He can responds to human movement and express its own emotions, and 48 different cat sounds can be vocalized. He has feelings and desires, and its personality will adjust to its owner.

“Capriro”, BN1 is cheaper robotic pet, which has a slightly more conventional appearance, being a cat-like robot containing eight outward infrared sensors, allowing it to sense nearby objects and five different motors. It expresses emotions through the eyes, which can display different symbols.

Each robot has on clothes with a name tag, and put on seasonal accessories, a scarf in winter, for example. Typical appearance of robotic pet used in this work is shown in Fig. 1.

We also used interactive stuffed animal toys (cats and dogs). They can recognize a few voice commands and have simple mechanical touch sensor. All of them have synthetic fur as shown by Fig. 2.

TABLE I. Robotic pet used in this work.

Type	Version		manufacturer
AIBO	ERS-210A	1	SONY-ERC
	ERS-220	1	
	ERS-311/312&B	4□7	
	ERS-311L	2	
Necoro		1	OMRON
Capriro	BN-1	1	BADAI



Figure 1. Appearance of robotic pet used in this work

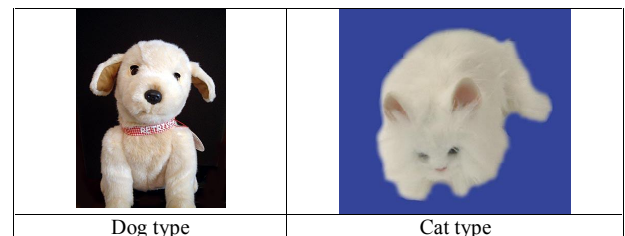


Figure 2. Appearance of interactive stuffed animal type toy used in this work

B. RAA field work details

One of the most important ethical rules governing research on humans is that participants must give their informed

consent before taking part in RAA. Nurse provides both parents and child inpatient with complete information of RAA, including an explanation of the purposes of this research, any benefits to the subject which may reasonably be expected from the research, participation is voluntary, refusal to participate will involve no penalty or loss of benefits. Nurse interprets various type robotic pets (including interactive stuffed animal toys) as artificial emotional creatures as if robotic pet have hearts and feelings. RAA was

children hospital for long term inpatient (typically, hospitalized for over six months), there was no child who denied RAA. Only there are a few cases that their mother worried about the condition of her child's sickness. These situations suggest that robotic pet is still uncommon and the shortage of playing in hospital. Fig. 4 shows RAA in playroom at Hachiouji children hospital. Age distribution of participants is shown by Fig. 5 (Hachiouji children hospital) and Fig. 6 (Kiyose children hospital). Numbers of participant is the total number of child inpatients.



Figure 3. Questionnaire using face scale

carried out once a week in evening for 60 minutes (5:00PM – 6:00PM) before supper in playroom at Tokyo metropolitan Hachiouji children hospital and Kiyose children hospital. Usually, in this time, child inpatient can watch TV beside bed at every evening in each ward. Companions (students in our laboratory) instruct how to handle and play with robots for child participant during RAA. DV-cam and digital camera were used to take video and picture in order to observe child behavior or reaction against robot behavior; human-robotic interaction. A questionnaire about RAA was administered after RAA in order to evaluate child's mood or a state of mind. Fig.3 shows a part of questionnaire sheet using face scale [14]. The face scale using this work was modified. It contains 5 drawings of a single face, with each face depicting a slightly different mood state. They are arranged in decreasing order of mood, and numbered from 1 to 5, with 1 representing the most positive mood, and 5 representing the most negative mood. Face scale is very useful because, a sequence of pictorial faces does not require reading literacy, so that pre-school age child (2-6 years old) can easily express ones own mood before and after RAA by select one from a sequence.

III. RESULTS AND DISCUSSIONS

A. General results (Problems of robot and RAA)

All child inpatients were very interested in robotic pet and interactive stuffed animal toy and RAA as providing information of RAA to child and parents in order to give informed consent before RAA, and became eager to go playroom and play robotic pet. RAA has been carried out 20 times at Hachiouji children hospital for short term inpatient (typically, hospitalized for one week), and 8 times at Kiyose



Figure 4. RAA at playroom in pediatrics

The videos showed that all participants gently touched or petted robot's head, hold Necoro cat or interactive stuffed cat in their arms and child's utterances were most frequently intended to attract the robots attention, "Shake!", "Sit!", and "Macy (one of AIBO name) ! Look me!" for example, and in many cases they asked robots about their internal states or situations. When children talked about robot's internal states, they most frequently mentioned robot's emotion. Sometimes, a child narrated the "story" about AIBO's behavior with each other. But the voice recognition system works quite poorly in noisy environment of RAA by chattering of participants and our staffs and various sound emitted from robotic pets, and handling of robot is not so easy for pre-school age child, so that most of children lost their interest about for 30 minutes if companions were not in playroom. While, child retained interest for long time (60 minutes) by instructing what function is equipped, how to handle and play game with robotic pet and interpreting their motions. These "human-human" interactions are necessary to have a good time during RAA and this is quite important. Any difference of child reaction was not observed between kinds of AIBO. While in the case of "Necoro cat" and stuffed animal type

toys, it is often observed that they were held in child's arms, because synthetic fur gives it a feline appearance, so it feels natural to treat it like a real cat (or dog). But for a few children, Necoro is fearful because of its real appearance as starting of RAA. Most of children looked happy and are expressive, well communicated each other, tended to evaluate robotic pet highly. "Capriro BN-1" is not preferable because it runs away fast, diverting a child's attention from a Capriro. It is noteworthy that, some of them were expressionless, they only show "low-level interaction" to other participants (they say only "Yes" or "No") by asking what do you feel playing with robotic pet, but most of case, these children felt much interest and concentrate robot's behavior (Fig. 7), and usually they want to join next RAA time. Therefore, it is difficult to guess child's subjective evaluation by the observation of their outside expression during RAA, so that questionnaire for researching child's mood and their evaluations of robotic pet during RAA is very important.

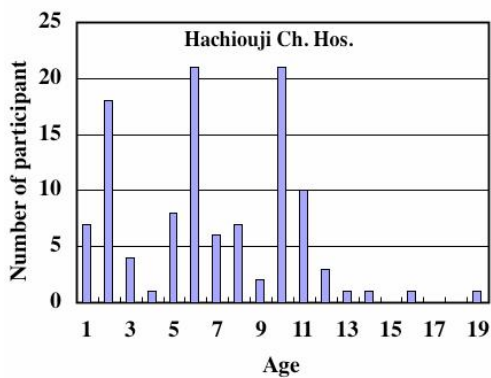


Figure 5 Distribution by age of participant of RAA at Tokyo met. Hachioji children hospital

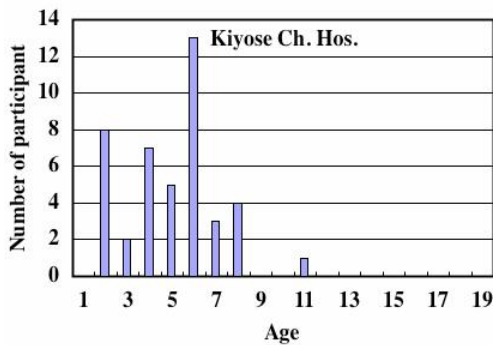


Figure 6 Distribution by age of Participant of RAA at Tokyo met. Kiyose children hospital

There was no child who recognized robot as inanimate object. Both children and our staffs (companions of robot) treated robot as living thing as if robotic pet has heart and emotions. Especially, we take into consideration to dream child's fantasy world with robotic pet as artificial emotional creature, so that we did not do technical or mechanical care of robot, for example, open panel or cover and take off battery, and turn on/off power switch in playroom during RAA. School age child deals with robot carefully like as real dog and cat. We noticed that child often said that "Where is Ms nurse taking care of AIBO...?". By detailed observation

of child behavior, it was found that this utterance means that she is a doctor who curing AIBO because AIBO felt ill and he came into hospital. This interpretation indicates that child identify AIBO's circumstance with his or her own circumstance.

B. Companionship and human-robotic interaction

It has been pointed out that the quality of intimacy (or relationship) between a household member and the companion animal, not just the ownership or the presence of a pet, is important factor to alleviate depression, social stress and enhance emotional well-being of the elderly, such notion is now a widely used recent research in psychosomatic medicine [3], therefore role of companion (our student staff and nurse) who intermediates between child inpatient and robot is thought to be very important. It is hard to have a good time in playroom without companion for one hour, because robotic pets that execute only a few kind of simple behaviors, predictable motions will lose their effect on children by evaluating it as stupid by their measures. Childs gradually became quiet and finally satisfied, if our staff does not interpret robot's motion and inner state (emotion) and



Figure 7. He has played with much interest at every RAA.

instruct how to handle and speak and play with robotic pet. It is effective to talk to child about something about daily life, favorite TV program, a hero in animation film, for example, in order to take a chance to talk familiar to child in RAA. Arrangement of staffs, robots and child inpatients in playroom is also important. Child feels uneasy when he or she comes into playroom with mother by seeing staffs and robots together in a group at center of playroom as beginning of RAA. It is not recommended that staffs, robots, and children localized in playroom as show in Fig. 8(a), because it is hard to talk each other. Therefore, staff who stands doorway to lead on and guide RAA with his smile, uniform arrangement of companion/robot pairs in room, and keeping proper distance (within 1 m) between companion and child are necessary. Fig. 8(b) shows a situation of RAA after these considerations. Comparing Fig.8(a) with (b), improvements of situation by these considerations about role of companion and arrangement is quite obvious. As shown in the Fig. 8(a), children and their family (most of case, their mother) is in a group near doorway of the room, while our staff, companions are apart from them and localized at opposite side of room, and there are robots between children and companion. It is difficult that companion talk unconcernedly to child at a distance, there is no interaction and communication between child and companion. Child can talk to only mother or father.

While, children and companions sit at random, two or three children surround a companion, simultaneously, there are one or two companions were near child, they can talk each other well as shown in Fig. 8(b). These situations can enhance social (human-human) interaction by talking each other. All of them can have a pleasant time by simply staying together in playroom. It can be expected to make positive change of child's mood by only join RAA.

C. Results of Questionnaire

Participants were asked to rate their mood, subjective evaluation of robotic pet, and influence to communication on a 5-point scale (Q1, Q2, Q4 - 6 are TYPE I; "a: excellent, b: very good, c: moderately, d: not so good, e: bad", Q3 is TYPE II; "a: extremely, b:..., e: not at all"). by questionnaires after RAA. We expected also collecting requests and impressions of RAA.



(a)



(b)

Figure 8 Arrangement of staffs, robots and child patients in playroom is also important, (a) children localized in playroom at the first stage, (b) a situation of RAA after reconsiderations of role of companion and arrangement of staffs.

Questionnaire was contrived by using color pictures of robot and illustrates, and premium semi gloss paper in order to get interest in questionnaire and get highly reply. An overall anonymously response rate is 100%. Total of reply for each question are listed in Table II and Table III.

Q1 "What do you feel about play with robotic pet (RAA) at playroom?"

In this case, "robotic pet" means both pet-type robot and

interactive stuffed animal toy. Most of subjects respond "a: excellent" ("a: excellent" + "b: good" = 95.2%, "a: excellent": 71.4%), indicating the insufficiency of playing during hospitalization.

Q2 "How do you think about AIBO and using AIBO for play (RAA) in playroom"

Parents of child inpatient tended to think better than using usual toys ("a: excellent": 65% for both questions).

Q3 "Is AIBO good toy for child?"
(TYPE II a: extremely, b:..., e: not at all)

Most of parents denied to give AIBO as a one of toy for child in dairy life at home, because AIBO is breakable and expensive. It is thought that using (breakable and expensive) robotic pet is good trial to give valuable experience for child inpatient.

TABLE II. Results of Q1 – Q3.

	a	b	c	d	e
Q1	15	5	1	0	0
Q2	13	7	0	0	0
Q3	7	12	1	0	0

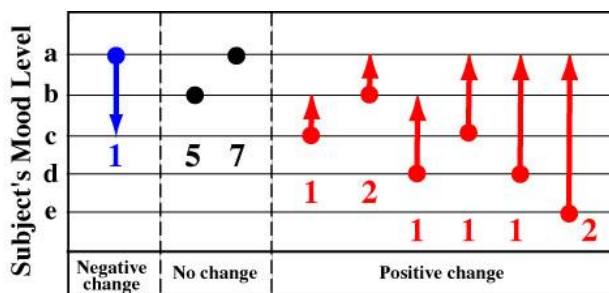


Figure 9. Results of Q4
Number in the figure means number of child

TABLE III. Results of Q5 – Q6.

	a	b	c	d	e
Q5	3	2	8	1	4
Q6	6	2	4	0	4

Q4 "Which is prefer level about your mood before and after play with robotic pets (RAA)?"

This question used face scale which contains 5 drawings of a face (showing in Fig. 3). For easy to reply for little child with parents. Child can reply by choice and mark a face which represents prefer mood. Results of Q4 show Fig. 9. Filled circles indicate mood level before RAA. Upward pointing arrows shown in the figure indicate positive mood change by participating in RAA, downward pointing arrow indicates negative mood change. "No change" means that child felt same mood (level "a" or "b"). Adding "No change" to positive change, 97% of child participants felt positive mood, indicating that they looked forward to participate in RAA, and they had a pleasant time during RAA as they expected. It is obvious that child's mood improved by participating in RAA.

There are several questions regarding communication among

people (family, nurse and child inpatient) in a ward. Results of Q5, Q6 is shown by Table III.

Q5 “My child talked about robotic pet among children after RAA”

Adding number of “b” to “a”, 28% of child talked about AIBO among children. Usually, there is no communication among child inpatients, therefore, this result is note worthy as effect of RAA on communication.

Q6 “My child talked about robotic pet with nurse after RAA”

37% of parents answered “a”, and adding “b” to “a”, 50% of children talked about robotic pet with nurse. It is proper result because child inpatient came natural to talk about robotic pet or RAA with nurse or doctor during dairy medical treatment. Therefore, RAA can encouraged children to communicate with each other.

A nurse comments that inpatients and their families communicated little each other in a ward. It was thought that the communication among children is essentially important for mental development from the view point of child psychology, and RAA is effective to make, give a topic and increase conversation in tedious time in hospital, and child can get rid of stress which is build up by medical treatment and fear to sickness.

We obtained another important comment from parents (most of case, mother) that their mental poverty by nursing in a ward all day long decreased because child spent their time by themselves during RAA with our staff (companion).

IV. CONCLUSION

Trial of robot assisted activity (RAA) using robotic pet (AIBO etc) in child hospital was carried out and the effect of RAA on child’s mood was investigated. It was found that role of companion is very important and RAA should make significant improvements in child mood and mental status. Increased-communication among child inpatients or to nurse was revealed. It was concluded that robotic-human (subject; child inpatient in this work) interaction emphasized by effectively introducing human (companion) - human (subject) interaction. Further work is necessary to research detailed psychological effect of RAA on mood or state of mind and social interaction for the inpatient during long-term hospitalization by the observation for long term period and how subjective evaluation is affected by the appearance of a robotic pet. Another experiment for bed-ridden child inpatient using “Mental commit robot – Paro” (seal robot) [8][10] is now planning because AIBO had strong stimulus but less emotional impact than real animals and “Paro” is designed more emotional to look like a baby harp seal.

AIBO equipped growing software would be able to provide a pleasurable daily activity like as companion animal, charging (= feeding), playing (walking with dog), talking to, and petting to grow good boy, and to assist appropriate sleeping along with adequate food intake by alleviate emotional stress, which is very important factor for inpatient. Comprehensive influence of a fully autonomous pet-type

or companion-type robot, having learning and growing, to QOL of child inpatient in hospital will become to clear by clinical application at each ward near future.

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