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## ▶ Seal-Type Robot "PARO" to Be Marketed with Best Healing Effect in the World

- New Version of "PARO" to Be Leased from AIST Venture -

( Translation of the AIST press released on September 17, 2004)

### Key Points

- A new version of seal-type robot "PARO" (8th generation) is developed with highest therapeutic effect in the world.
- The intellectual property right for "PARO" is licensed by the AIST to a newly founded venture enterprise, Intelligent System Co., Ltd. to commercialize the seal-type mental-committed robot "PARO"
- Based on a control theory using photonic crystals, the feasibility of new technologies will be opened in areas of optical communications and quantum computer.

### Synopsis

The Intelligent Systems Research Institute (ISRI) of the National Institute of Advanced Industrial Science and Technology (AIST), an independent administrative institution, has developed a new version (8th generation) of seal-mimetic mental-committed robot PARO (Fig. 1) in collaboration with Microjennics Co., Ltd. (MJ). The intellectual proprietary right regarding PARO will be licensed to the Intelligent System Co., Ltd. (ISC) to be inaugurated on September 17, 2004 under the auspices of the Startup Development Strategy Task Force of the AIST Innovation Center for Start-ups. PARO will be commercialized by ISC, and will be provided from ISC to welfare facilities for aged persons on the lease basis starting on September 20, 2004, Respect-for-the-Aged Day, one of national holidays of Japan.

The ISRI-AIST has proposed the robot therapy since earlier, and has been dedicated to R&D of seal-mimetic mental-committed robot "PARO" from 1993. Each machine of PARO has different looks owing to hand-made process, and even holds individuality acquired through learning process to recognize its own name and behavior pattern favored by its owner.

A series of verifying experiments for robot therapy have been executed with PARO at a health service facility for aged people, "Toyoura", Tsukuba, Ibaraki from August 2003 to September 2004 (Fig. 2), demonstrating its psychological effects, such as remedy of depressive state, cheering up and motivation; physiological effects, such as remission of stress as proved by urine test; and social effects such as increased interaction among the aged and with care personnel. Moreover, PARO has proved to be effective for reducing care-laden stress of helpers. Throughout this series of experiments PARO has been happily treated with adequate affection for over a year without causing failure nor trouble.

In addition to medical and welfare facilities in Japan, the robot therapy with PARO has been tried at the Karolinska Institute and the National Institute for Handicapped Persons, Sweden; the Siena University Hospital, Italy; the Kerpape Hospital, France; and the Stanford University Hospital, USA, achieving very good results.



Fig. 1. Seal-mimic robot PARO

Fig. 2. Robot therapy at a nursing facility for the aged.

With the achievements in these verifying experiment recognized, PARO entered the Guinness Book of World Records in February 2002. See the Certificate shown below.

Based on the results of the robot therapy experiment, PARO has been improved successively by adding antibacterial, stain-resistant, and electromagnetic shield features, resulting in a new version (8th generation) with enhanced safety and durability. The intellectual proprietary right for PARO will be licensed to an AIST-sponsored venture, ISC, to be installed on September 17, 2004, and commercialized by ISC.

Currently, PARO is exhibited at TEPIA, Aoyama and Water Frontier, Tokyo from September 10, 2004 to July 2005, and at National Museum of Science and Technology, Sweden for three years from May 2003. Further, it will be exhibited at the 2005 Japan International Exhibition (Aichi Banpaku) from March 25 to September 25, 2005.



Guinness World Record Certificate  
PARO was certified as the most therapeutic robot in February 2002,  
and entered the World Records in the 2003 edition.

## Background

Many of advanced countries are moving toward dwindled birthrate and an aging population. In Japan, 26 % of the population is expected to be 65 years or older in 2015, according to the statistics provided by the Statistics Bureau, Ministry of Internal Affairs and Communications (MIAC). It is anticipated that increasing number of people will need nursing, to augment the number of cases requiring support based on the nursing care insurance and to skyrocket the social cost. It is desired, therefore, to reduce the nursing needs by upgrading the "quality of life" of the aged and to enhance the quality of nursing works at home and facilities for medical care and welfare. The animal therapy is one of promising remedial measures: keeping contact with pet animals provides excellent psychological, physiological and social amelioration. Keeping pets involves, however, allergy, infectious diseases, biting and scratching troubles, which makes it difficult to introduce animal therapy in the medical care and welfare facilities. Under such a circumstance, the ISRI-AIST has proposed the robot therapy and started R&D of animal-mimic robots and verifying studies on its therapeutic effects.

## History of Research Work

The ISRI-AIST has started R&D of animal-mimic robots since 1993, setting a target model on seal which may be easily accepted without causing odd feeling over the animal-robot difference owing to lack of immediate contact in daily life, in contrast from dog and cat. The seal-type robot has been designated as "PARO" and R&D works have been directed to the commercialization of PARO. From the 3rd generation PARO, the collaboration with the MJ has started, focusing efforts on upgrading element technologies of sensors and actuators, as well as the integral robot system. In this way, the 8th generation PARO has been completed. The robot therapy with the new version of PARO has been tired at welfare facilities for the aged, such as day-care centers, nursing care facilities and special nursing homes, and at pediatric wards of hospital, to demonstrate the merit of robot therapy on the basis of scientific data.

The study on PARO has been accepted as one of R&D projects under the task force target "Long-Term Symbiotic Mental-Committed Robot" at the Venture Development Strategic Research Center (VDSRC) in the framework of the program "Cultivation of Strategic Research Stronghold" under the Promotion and Coordination Fund for Science and Technology, Ministry of Education, Science and Technology. With the support from VDSRC, the Intelligent System, Co., Ltd. (ISC) will be inaugurated on September 17, 2004. The intellectual proprietary right for PARO will be transferred to ISC and the commercialization of PARO will be advanced by ISC.

The present R&D works have been carried out under the support from the Personal Research Initiative "A Study on Man-Robot Symbiosis and Learning" (FY2001~2004) under the Strategic and Creative Research Promotion Program of the Japan Science and Technology Agency (JST), another independent administrative institution.

### Details of Research Work

The effects of robot therapy were evaluated from psychological, physiological and social aspects. The psychological assessment was based on POMS (questionnaire with multiple items), face scale (expressing the frame of mind with a series of facial expression from smiling to crying) and GDS (evaluation of depressive conditions). The physiological effect was evaluated by determining the concentration of two kinds of urinary hormone: 17-KS-S and 17-OHCS. The social assessment is based on the amount of communications by the subject, as read out of video recording, and the comment of nursing personnel. In this way, the contact with PARO proved to be therapeutically effective: psychologically, cheering up (Fig. 3), exhilarating, and improving the depression (Fig. 4); physiologically, remitting stress (Fig. 5); and socially, augmenting interaction among the aged and with nursing personnel and bringing bright atmosphere. The normally tight-lipped elderly become smiley and willing to talk about pet animal he/she had kept before. The conversation with nursing person was activated, despite the paucity of shared topics owing to large difference in age. The diagnosis of burnout syndrome on the part of nursing personnel proved the reduction of strain of worry (Fig. 6).

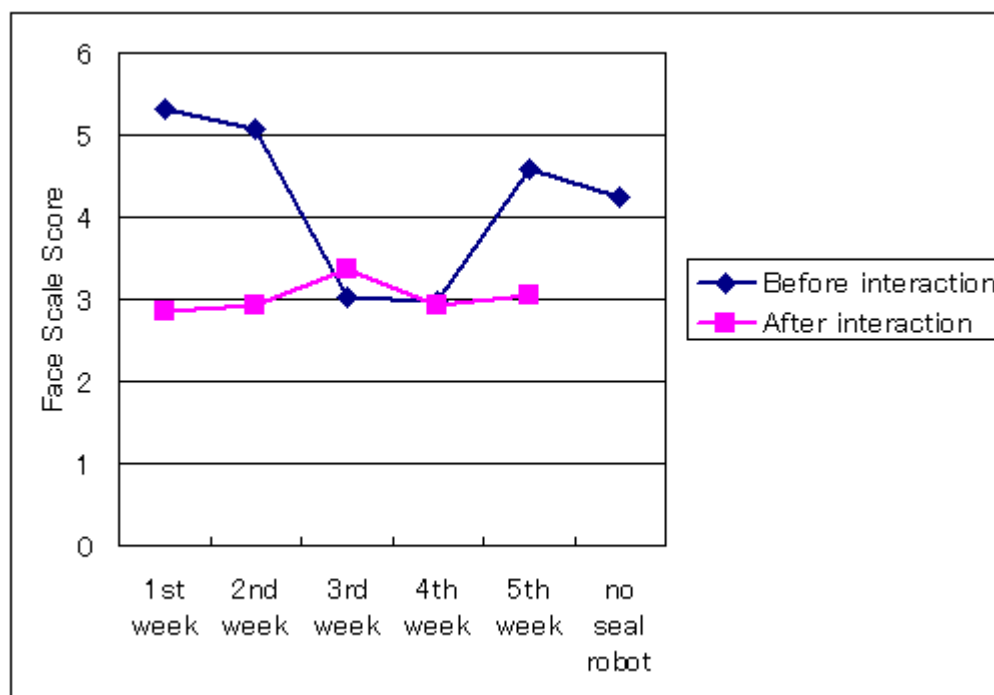


Fig. 3. Face scale assessment at an elderly day-care center  
Before the contact with PARO, subjects were either cheerful or depressed.  
The lower value demotes cheerful state (smiley) while the higher value depressive state (crying).

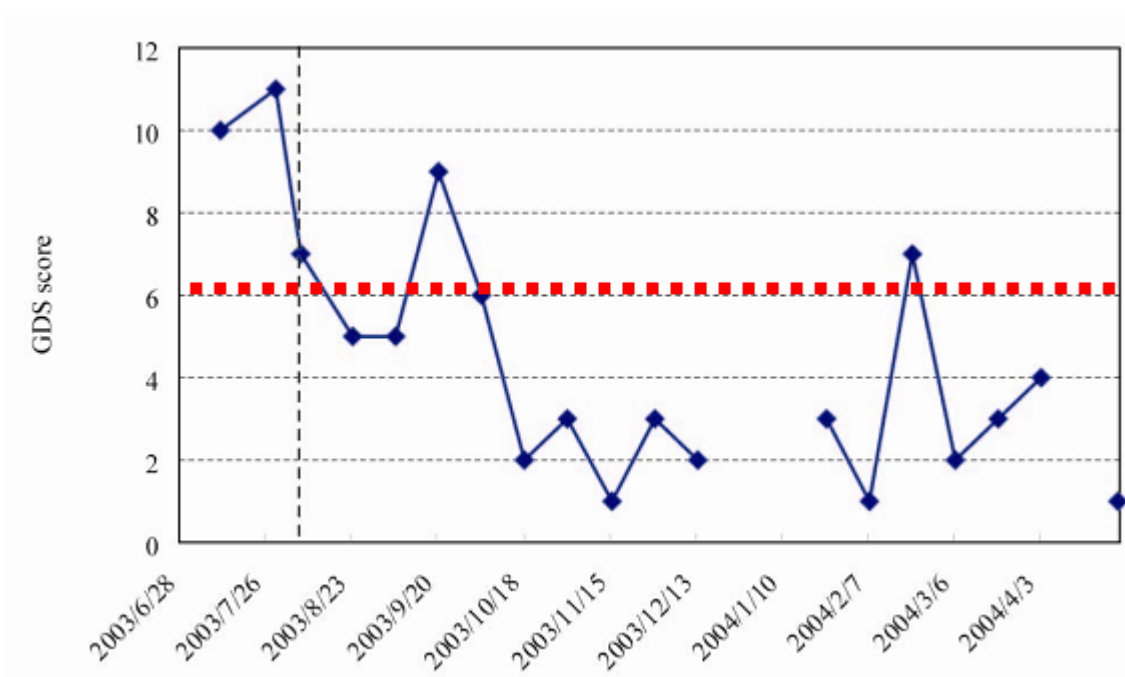


Fig. 4. Changes in GDS assessment in 10 months at a nursing care facility  
 Numeric values greater than 6 denote the depressive state.  
 The depression was eliminated by the contact with PARO.

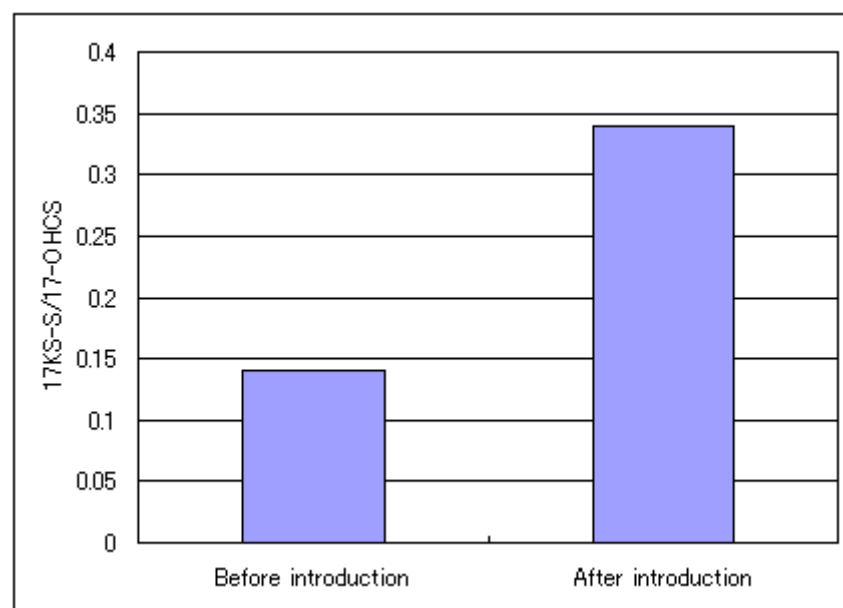


Fig. 5. Results of urine test at an elderly day-care center  
 Stress was mitigated by starting the contact with PARO.  
 Higher values represent reduced stress.

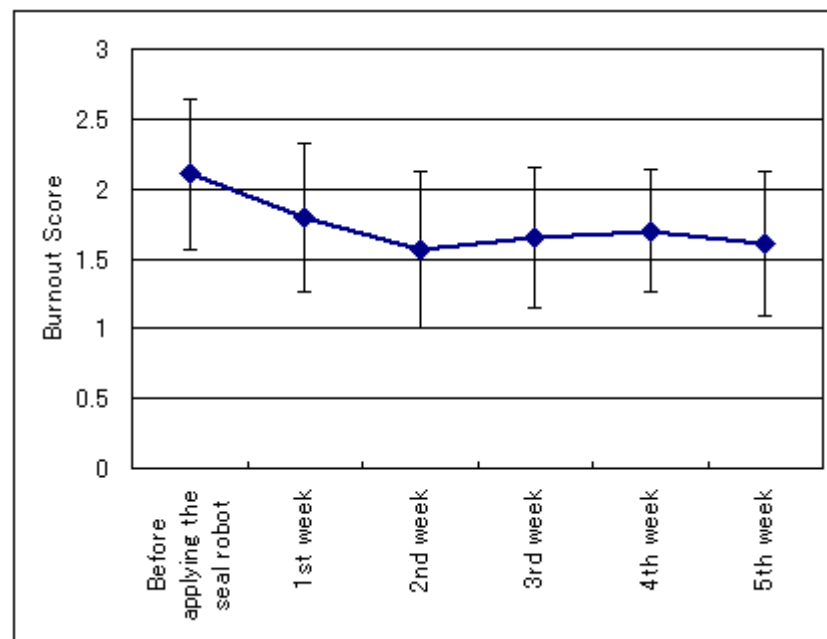


Fig. 6. Diagnosis of burnout syndrome for nursing personnel in an elderly day-care center  
 Strain of worry on the part of nursing personnel was reduced when PARO was introduced.  
 The lower value denotes reduced stress.

Technical Data of New Version (8th Generation) PARO	
Model Animal	Baby of harp seal ( <i>Phoca groenlandica</i> ). Habitat: north-eastern area of Canada. Behavioral survey carried out on the ice field off Madeleine Island.
Size and Weight	Length 57 cm, weight: 2.7 kg
Fur Coat	Synthetic, off-white color, antibacterial treatment
CPU	32 bit, RICS chip
Sensors	Ubiquitous surface contact sensor, whisker sensor, stereoscopic optical sensor, microphone (voice recognition, 3D source orientation), temperature sensor (to control body temperature), posture sensor
Actuators	Eyelid (2), Upper body (4, top-bottom, left-right), Front paw (2), Hind-limb (1)
Battery	Rechargeable nickel-hydrogen cell, continued operation 1.5 hours (when fully charged)
Charger	Pacifier type
Output Behavior	Responses to various stimuli, daily rhythm: morning-midday-nighttime, animal-mimic behaviors generated by three internal states corresponding to the mood. Learning capability: recognizing newly given name, cheerful response to caressing, and adapting to owner's liking

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