# Mentally Soothing Robot "Paro"
## – How Developed & How Assisting Therapy –

*By Dr. Shibata Takanori*

Photo: National Institute of Advanced Industrial Science & Technology

Seal-shaped Paro is available in gold and white versions.

## 1. Introduction

I began research and development on personal robots in 1993 with the aim of creating commercial robots that could become a part of people's lives. What I had in mind was not an industrial robot to assist people in physical labor but a new kind of "mentally committed" pet-like robot that could comfort and entertain people, and enrich their hearts. There were two purposes for the robot. One was to be a substitute for a family pet. The other was to offer "robot therapy" as an alternative to animal therapy at medical and welfare facilities.

Based on the results of psychological tests, we decided to pursue a robot with an appearance not familiar to the public, and created a seal-shaped robot. Named Paro, we repeatedly made modifications and tested its effects through demonstration experiments at various medical and welfare facilities.

In this article I would like to describe the process of our R&D that has led to commercializing Paro. I would also like to touch on robot therapy at medical and welfare facilities in Japan and abroad, and the results of surveys on people in Japan who own Paro as pet substitutes.

## 2. R&D Process in Commercializing Paro

### 2–1 Survey on Needs

Through surveys conducted on the needs and marketability of robots coexisting with people, we discovered that household pets have become popular, spawning a large market, and that animal therapy at medical and welfare facilities is indeed beneficial. However, we also found that many households and medical institutions are unable to have animals as pets for various reasons such as animals causing allergies, dangers of bites and scratches, transmission of viruses, and time required to look after them. Based on these findings, we conducted R&D on a robot that could coexist with people and meet the two primary objectives of becoming a pet substitute and having therapeutic effects.

### 2–2 Creating Robot Meeting Needs

To be a substitute for an animal pet, it was of course important for the robot to have autonomous mobility, act in response to stimulation, and move like an animal. Also, since animal pets often live with people for around 10 years or more, the robot needed to have long-term interactive mechanisms in order to be a pet substitute in daily life.

To find the right function and shape for the robot, we consequently embarked on many studies including psychological tests, elemental technology research, test production of various robots, tests on interaction between robots and people, and long-term tests on robot therapy at medical and welfare facilities.

To make a robot that would appeal to people, we decided to create it in the shape of a seal. We wanted a robot that would look cute, but would not be easily compared to the appearance of a real animal. We repeatedly made modifications to this model, giving the robot elementary functions expected to become necessary in the various situations where it would be used. Evaluating these functions through actual tests, we enhanced or eliminated some aspects of elementary technology, and undertook new R&D. By the time an eighth-generation model was developed, we had succeeded in equipping the robot with functions that were well balanced and fit for

practical use.

The result of our efforts was a robot that looked and moved very much like an animal. The robot's whiskers and body had a multitude of sensors, including those for sensing touch, light, sound, posture and temperature. It had a decentralized control network through two 32-bit RISC chips and eight 8-bit microcomputers, and had artificial intelligence for learning names and actions. In short, it was a sophisticated, durable and reliable robot that could communicate with people on a long-term basis.

Since people would form their feelings for the robot through direct contact, we knew that Paro should be warm and cuddly like a furry animal, and that the human senses should be taken into account in the design and manufacturing process. Paro is thus equipped with a temperature control system and, to ensure that it is pleasant to touch and hold and of the highest quality, its fur and eyelashes are sewed on each robot by hand.

Taking hygiene into consideration, the robot's artificial fur is specially processed to make it resistant to bacteria and dirt or stain, and does not easily come off as does real animal fur. From the standpoint of safety and reliability, we equipped the robot with an electromagnetic shield to make it safe for pacemaker patients to use. We also tested the robot for resistance to voltage, using 20,000 volts, and subjected it to falling tests. To ensure durability for long-term use, we stroked the robot's fur a total of more than 100,000 times and conducted usage tests spanning more than two years. To make it easy for everyone to use, we installed just one switch into the robot, and gave it a pacifier-shaped battery charger.

Since we wanted a robot that would inspire affection and be difficult to tire of, we made a robot that would gradually build relationships with people through interaction such as learning names and actions. Paro is designed to weigh 2.7 kg so as to evoke the feeling of holding a baby or a pet. With women, the brain stimulation that the physical weight brings is particularly beneficial as it helps bring back memories of child-drearing.

## 3. Robot Therapy & Robot As Pet Substitute

### 3–1 Robot Therapy

Studies on animal therapy have shown that the benefits of being with animals fall into the following three categories:

(1) Psychological effects: The user becomes more cheerful and motivated, etc.

(2) Physiological effects: The user's blood pressure and heart beat become stable, stress levels are lowered, and rehabilitation is enhanced, etc.

(3) Social effects: The user is able to start a conversation, and becomes socially activated, etc.

At medical and welfare facilities where robot therapy was tested using Paro, the same benefits were seen. In the children's ward, the presence of Paro helped uplift the feelings of long-term patients or patients in isolated quarters. Patients who interacted with Paro became more interested in leaving the hospital, and conversation between patients and nurses increased. There were also cases where rehabilitation was made naturally. For example, a child who would not move because of pain in the muscles began moving to cuddle and stroke Paro. Improvement in communication skills was seen in children with autism as well as children with Down's syndrome. At the University Hospital of Siena in Italy, rehabilitation programs are being developed using Paro.

Meanwhile, many long-term tests involving elderly persons and Paro are being conducted both in Japan and abroad at daycare centers, nursing homes and care houses, and the same results as for animal therapy have been proven. There were the same psychological benefits for the elderly. They would move of their own accord using wheelchairs or sticks to talk to and touch Paro. The pleasure derived from interaction with Paro served as their motivation, and helped lift depression.

Physiological benefits were also confirmed. Urine tests showed that stress levels were down due to the release of hormones. Blood tests also showed that stress was reduced and that the immune system improved. As for social benefits, it was noted that the number of conversations between people gradually grew. The elderly began talking more among

Photos: National Institute of Advanced Industrial Science & Technology

*Sewing Paro's eyelashes*

*Trimming Paro's fur*

*In creating Paro, various procedures are carried out by hand to ensure the highest quality.*

themselves and to nurses not only about Paro, but about their former pets, and about their children and grandchildren.

The presence of Paro also had an effect on the people looking after the elderly. The caregivers became more light-hearted, and their stress was reduced because they found it easier to start a conversation. These benefits were not short-lived, but were found to be lasting over the years as the relationship with Paro stabilized.

In the neurosurgery field, brain wave tests conducted on patients with dementia showed that playing with Paro helped improve brain functions. The benefits were more marked with people who liked Paro and enjoyed playing with the robot. These results suggest that healthy people can also benefit from interaction with Paro as their brain will be stimulated and help prevent dementia.

In an aging society, dementia is a large problem for the person suffering from it as well as for the family involved and society as a whole. In Japan, we have a nursing insurance system for the care and support of people with dementia, but it is hugely costly for local governments, and preventive care to forestall dementia and thus ward off the need for nursing is called for. The cost of nursing insurance for a dementia patient comes to around ¥4 million a year per person, and the average life expectancy of such a patient is roughly eight years. By interaction with Paro, healthy elderly people can hope to prevent dementia.

The city of Nanto, Toyama Prefecture, has acknowledged the value of Paro and uses the robot at eight daycare centers. The city has many elderly citizens, with the proportion of people aged 65 and above in the population at about 28%. It is the first time for an administration to use Paro with the aim of preventing the need to provide nursing for the elderly. Nanto has subsequently drawn worldwide interest, with media from countries such as the United Sates, Sweden, Germany and Denmark coming to the city for interviews and information gathering. More and more local governments in Japan have also come to adopt Paro at facilities for the elderly. Studies on the care for the elderly using Paro are also being conducted in countries such as Sweden, Italy and the United States, and their results show that the robot is highly beneficial.

Photo: National Institute of Advanced Industrial Science & Technology

*The presence of Paro makes elderly people relax and happy, producing the same psychological benefits as does animal therapy.*

### 3–2 For Home Use

Sales of Paro in Japan so far are about 700 units. In a survey on Paro owners in which we received 72 replies, we found that roughly 80% were individual owners. Ages of the owners ranged from the 40s to 80s, but most were in their 60s. Almost all the owners were animal lovers. They said they would like to have pets but were unable to have them for reasons such as the burden of looking after them, or because they travel or are too busy with work, or because of residential hurdles.

To introduce Paro overseas, there are safety regulations that we will have to consider for each region such as the UL and CE markings, but these are challenges we are preparing to overcome.

## 4. Conclusion

After taking more than 10 years to develop Paro, we have finally succeeded in commercializing it, and the robot seems to have taken one step forward into being accepted by society. Nonetheless, our work is far from complete, and we would like to pursue further studies and do our part in making Paro and robot therapy more widely accepted in society. JS

**Congratulations!**

The seal-type robot Paro was among 10 robots shortlisted by the Ministry of Economy, Trade & Industry as candidates for the Robot Award 2006.

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