Seal Robot, PARO as Neurological Therapeutic Medical Device for Dementia Patients

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Therapeutic Seal Robot: PARO
Contents

- Seal Robot, PARO
- Robot Therapy
- Results of Clinical Tests
- PARO in Disaster Areas in Japan
Animal Assisted Therapy/Activity

- Psychological Merits
  - Cheer
  - Motivation

- Physiological Merits
  - Stress Reduction
  - Rehabilitation

- Social Merits
  - Encourage Communication
Problems of Owning Animals

- Allergies
- Bites
- Infection
- House regulation

Difficult to introduce!
Therapeutic Robot
Paro

National Institute of Advanced Industrial Science and Technology
AIST
Model: Baby of Harp Seal
Seal Robot, Paro, for Therapy 8th Generation

CPU
32bit RISC
Voice Recognition
Learning Functions:
• New Name
• Change Behavior

Size:
L:550 x W:290 x H:180 mm

Weight: 2.7 kg

Touch
• Ubiquitous Surface Tactile Sensor × 12
• Whisker Tactile Sensor
• Artificial Fur (Anti-biotic)

Actuator × 7
neck(2), each front fin(1), rear fins(1), each eyelid(1)

Audition
Microphone × 3

Vision
Light Sensors × 2

Posture Sensor
PARO’s Inside (X-ray in NY, 2006)
Safety and Dependability
CE, RoHS, and other regulations

- Anti-bacterial, Hair-Loss Prevention, and Soil Resistant Finish in Artificial Fur
- Electromagnetic Shield
- Coping with Strong Force by Humans
- Easy Usage and Maintenance
  - One Switch and Pacifier Type Battery Charger
- Tough Structure
- Drop Test
- Stroking Test (100,000 times)
- Anti-Electrostatic Voltage Test (20,000 Volt)
Technical Points

Ubiquitous Surface Tactile Sensor

Automatic Chip Mounter

Six Layered Print Circuit
Aesthetic Points

z Kansei (Sensibility)
  y Touch: Texture and Softness
  y Holding: Wight, its Balance, and Warmness

z Design
  y Appearance
  y Sound sampled by a real baby harp seal in Canada

z Handmade for its Quality
  y Eyelash
  y Trimming: Each Paro has its own Face
Paro Factory
Toyama, Japan
Japanese Alps in Toyama
Japanese Alps from Ocean
Mountains
UNESCO World Heritage
Michelin ★★★★
Integration of Art and Technology 1 in Nanto, Toyama, Japan

Japanese Paper
1200 years old
Gokayama, a World Heritage

Shosoin
(Emperor's Treasure Warehouse)
in Nara

和紙
1200年以上の歴史
奈良・正倉院にも保管されている
日本に和紙が伝わった直後には
五箇山での生産が始まっている
Integration of Art and Technology 2 in Toyama, Japan

Festival of Decorated Floats with Gold, Silk, Woodcraft, etc. 300 years old

Karakuri Doll
Integration of Art and Technology 3 in Toyama, Japan

Woodcraft 260 years
Aesthetic Points
Handmade for Quality

Eyelashes

Trimming
Museum of Modern Art (MoMA) NY
Feb. 21st and 22nd, 2009
Japan EXPO in Paris, France
July 7-8, 2012
Expectation to PARO by Questionnaires to 2000 people in 7 Countries

- Japan
- Korea
- US
- Brunei
- Sweden
- Italy
- UK

Pet

Therapy
Paro on the World Map
(in about 30 countries)

- Place where Paro has been used
About 3000 PARO\'s in Practical Use

- 2000+ PARO\'s in Japan since 2005
  - 60% are individuals, and 30% are institutions
- About 300 PARO\'s in Denmark since 2009
  - 70%+ municipalities adopted PARO\'s
- NL, SE, DE, CH & other European countries
  - 100% are institutions
  - Seminar and Certification
  - Health Insurance of Niedersachsen, Germany
- In the US, since Dec. 2009
  - Medical Device by FDA
Robot Therapy at Karolinska Hospital in Stockholm, Sweden (Oct. 2003 - )

Astrid Lindgrens Pediatric Hospital

LIVA
Boston Higashi School for Children with Autism (Feb. 26, 2009)
20 Women with Ovarian Cancer (49-71: ave. 67)
Chemotherapy for 3 – 5 hours
Interaction with PARO reduce
  - Pain ($P = .04$), Fatigue ($P = .034$), Anxiety ($P = .036$)
  - 9 factors of Quality of Life on Health ($P = .03$)
UC Irvine and Long Beach Memorial Hospital, CA, USA
(Society of Gynecologic Oncologists (SGO) 44th Annual Meeting on Women's Cancer, 351, 2013)
Aging Societies

Ratio of people 65 years old and over against total population

%  
- Japan
- USA
- France
- Germany
- Sweden
- UK

UN, World Population Prospects: The 1996 Revision
Dementia

In Japan
4.6 M People with Dementia
4.0M Mild Cognitive Impairment
Observed Effects for Elderly with Dementia

- Improved Communication
- Improved Sociability
- Reduced Aggression
- Reduced Wandering
Alzheimer Patient with Anxiety
(Italy, since Feb. 2005)
Wandering Person by Dementia (Italy, since Feb. 2005)
Sundown Syndrome
(Alzheimer's Disease, 97y Female)

*ご利用者データ [Aさん]*
年齢: 97歳
性別: 女性
要介護度: 3
認知症: アルツハイマー型認知症
周辺症状: 夕方になると帰宅願望が出現する。この方は他のご利用者のお世話をしたがる傾向にあり、他のご利用者も影響されて帰宅願望が出現してしまうこともある
PARO for Sundown Syndrome

高齢者の履歴・行動を分析:
・最初はパロを嫌がった
・過去に犬を飼っていた
・「さぶろう」という名前の犬
・パロに「さぶろう」の名前
・「さぶろう」のお世話を依頼
・定期的なふれあいを開始

帰宅願望時
・パロとのふれあい
・不安の軽減
・精神的安定
・介護者の負担を軽減
・他の利用者へも目配り
Suppression of BPSD
(Behavioral and Psychological Symptoms of Dementia)

Dementia Behavior Disturbance Scale (DBD)

- BPSDがひどく家族が介護困難に
- GHへ、家族は面会拒否
- パロによりBPSDを抑制
- 家族の面会が再開した
Robot Therapy for Demented Elderly

DIMENTION:
EEG Method for Estimating Neuronal Impairment
Procedure of Experiment

EEG recording (3 min) → Robot Therapy (about 20 min) → EEG recording (3 min)
Dementia $\Rightarrow$ non-uniform neuronal impairment

$\Rightarrow$ unstable distortion of the scalp potential

distortion parameter=$D_\alpha$; instability parameter=$D_\sigma$
Experimental Results
(IEEE EMB Magazine)

7 patients were improved!
Relationship between Impression of Paro and its Efficacy on 11 Patients

<table>
<thead>
<tr>
<th>Subject (Gender, Age)</th>
<th>A (M, 72)</th>
<th>B (M, 80)</th>
<th>C (M, 84)</th>
<th>D (F, 80)</th>
<th>E (M, 76)</th>
<th>F (F, 82)</th>
<th>G (F, 74)</th>
<th>H (F, 81)</th>
<th>I (F, 79)</th>
<th>J (F, 81)</th>
<th>K (F, 81)</th>
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</thead>
<tbody>
<tr>
<td>Score of impression of Paro</td>
<td>-3</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>
Study design

Participants:
10 healthy participants (8 males and 2 females)
Aged 21-33

Method
- Set up the NIRS probes on the participants’ head mainly frontal lobe area
- Examined brain activity of 35 channel areas by fNIRS (OMM2001, Shimazu Corporation)
Study design2

- **Stress task**: Word association
  - It was conducted to balance the participants’ brain activity
- **Experimental tasks**: Paro ON/OFF
  - Participants were instructed to interact with Paro physically and verbally
- **Each task** had one minute and there were one minute rests conditions before and after the tasks
Brain activity during Paro ON compared with before the task

Channel 5, 11, and 12 were significantly activated (p<0.05) in PARO ON task compared with before the task.
Recovery of Speech by Biofeedback through interaction with PARO

An immigrant from the eastern EU who lost speech in Danish by dementia

Patient talks to PARO in Danish

She can talk with others in Danish
From 2006 to 2008, PARO was tested. 70 out of 98 municipalities have been using PARO.
PARO in Denmark
Jun 2011 (NHK Today’s Close Up)
Seminar for Therapists and Care Givers by DTI
Users Meeting in Denmark

Collection of Data
DTI
AIST
Other Area (in Denmark)

Down Syndrome & Dementia

Brain Injured Patient
The Usage of PARO for Elderly who need Help at Home

- In the beginning of 2012, 12 PARO’s were introduced in the home care service.

- Procedure of introducing PARO in the home of elderly people who need help:
  - Identification of elderly citizens who may benefit from PARO
  - Inform and seek permission from relatives before introducing PARO
  - Bring PARO to the home of the elderly when visiting to provide a specific service related to personal or practical help

*Source: Danish Technological Institute*
Group Home in Amsterdam, Netherlands
Since July 2007

Distribution of PARO since 2011
100 Paros at about 70 institutions
Clinical Test by ZUYD Univ.

Six locations
- Proteion
- Hornerheide
- Lemborgh
- Zilverlinde
- St Jansgeleen
- Sevagram

Finished Juni 2013.
Nursing Homes in Germany since Nov. 2006

Christinen-Stift, Baden-Baden

Pflege- und Therapiezentrum, Lehre-Wendhausen
Pressemitteilung
Seelze, 23. September 2010
Beziehungen pflegen UG (haftungsbeschränkt), Seelze
Key Words: Altenpflege, Gesundheit, Ambient Assisted Living, Technologien, Robotik

Robbenroboter PARO vor kommerziellem Start in Deutschland!
Start-Up aus Hannover ist Ansprechpartner rund um PARO für Deutschland
Healthcare Insurance Covers Mobile Service with PARO in Land Niedersachsen

Wolfsburg AG, a subsidiary of Volkswagen, started to provide mobile service with PARO for elderly with dementia at home since May 2012.
Donation of Paro from BBVA to Queen of Spain, Sep. 21, 2009

Robots del BBVA para la lucha contra el alzhéimer

BBVA hizo entrega el lunes a la Fundación del Centro de Alzhéimer Reina Sofía Sofia de Madrid de dos robots terapéuticos para el tratamiento con enfermos de alzhéimer. El robot Paro, con forma de peluche de una foca, está dotado de microsensores que le permiten responder a estímulos como el tacto, la luz o la voz. En la imagen la ministra de Ciencia e Innovación, Cristina Garmendia; la reina Sofia; Ramón Monell, director de Tecnología y Operaciones de BBVA, y David Zafra, del Observatorio Tecnológico de BBVA, con el robot.
Certification of Medical Device by FDA in the US in Sep. 2009

Re: K091876
Trade Name: Paro Therapeutic Robot
Classification Regulation Name and Number: Biofeedback Device
21 CFR 882.5050
Regulatory Class: Class II Exempt
Product Code: HCC
Dated: June 22, 2009
Received: June 23, 2009
Vinson Hall, McLean, VA, US
Greenwich Woods Health Care Center, CT

Pictures by “Greenwich Time”
On July 18th, 2011

Others: Greenwich Post
Cases in the US

VCS Elderly Institution
In Pittsburgh

VA Medical Center
In Washington DC
Document System
News Video (Dec. 23, 2010)
Marian Manor, Pittsburg, PA
TOTAL RESIDENTS WHO TRIGGERED
(from Marian Manor and Vincentian Home)

![Bar chart showing the total number of residents who triggered in 1st Qtr and 2nd Qtr of 2010, with categories DEPRESSION and BEHAVIOR.]
VA Palo Alto Health Care System

PARO Study
- Clinical Test at Four Locations
- Development of Protocol of Usage

PARO Expansion in San Francisco Bay Area
Results at VA (presented APA 2012)

Negative Behaviors and PRNs

14 male residents
VA PAHCS in Menlo Park
47 Observation for 10 months
Visitation Therapy by Passage Hospices in Illinois and Michigan

Visitation Therapy: 400+ nursing homes
Elderly: about 6,000
Records: cases

Tower Hill Health Center
South Elgin, IL
(by Daily Herald)

Atrium Health Care and Rehabilitation Center
Cahokia, IL
RCT by Auckland Univ., NZ
N=40

PARO is capable of improving loneliness in older people
PARO should be considered in future care plan
Griffith Univ., Brisbane, AU

- RCT (Randomized Controlled Trials)
- N=18, QOL-AD and Pleasure are improved
- Large Scale RCT
Prof. Wendy Moyle

Board Member of ICD-11
Classification of Behavioural and Psychosocial Symptoms of Dementia
WHO
Dolphins, dogs, and robot seals for the treatment of neurological disease

A growing body of evidence suggests that animal-assisted therapies and activities involving all kinds of real and even robotic animals can have beneficial effects in people with neurological disease or mental illness. But what is the quality of that evidence and do these interventions really provide any health benefits? Adrian Burton investigates.
Shatin Hospital, CUHK

- Therapy for Out-patient Dementia by OTs
- Evaluation of Therapeutic Effects
- Developing Protocol
PARO as a Staff of Day Care Service Center, ELCHK
9th Generation of PAROs are coming soon
The End

paro.jp