

Design of a Kiosk Type Healthcare Robot System for Older People in Private and Public Places

Bruce MacDonald (b.macdonald@auckland.ac.nz)

Ho Seok AHN, I-Han Kuo, Chandan Datta, Elizabeth

Broadbent, Ngaire Kerse, Rebecca Stafford, Kathy Peri

CARES, Robotics Laboratory, ECE

The University of Auckland, New Zealand

uniservices

ETRI
www.etri.re.kr

YUJIN ROBOT

ED Corporation **IS ISAN SOLUTION**

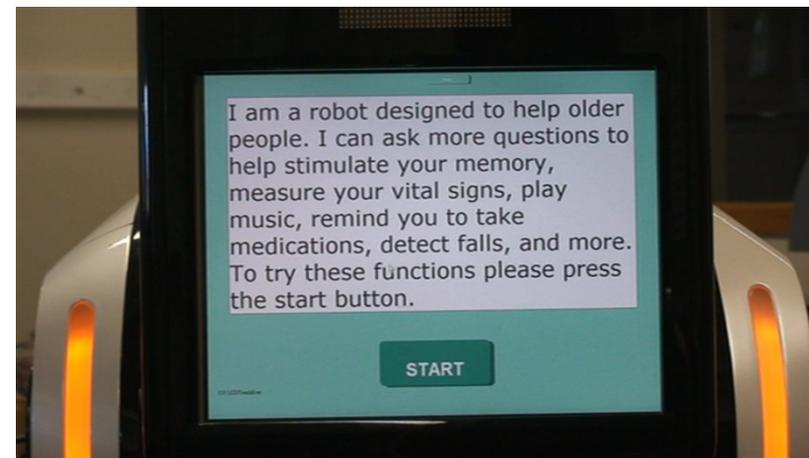
The Selwyn Foundation

THE UNIVERSITY OF AUCKLAND
FACULTY OF ENGINEERING

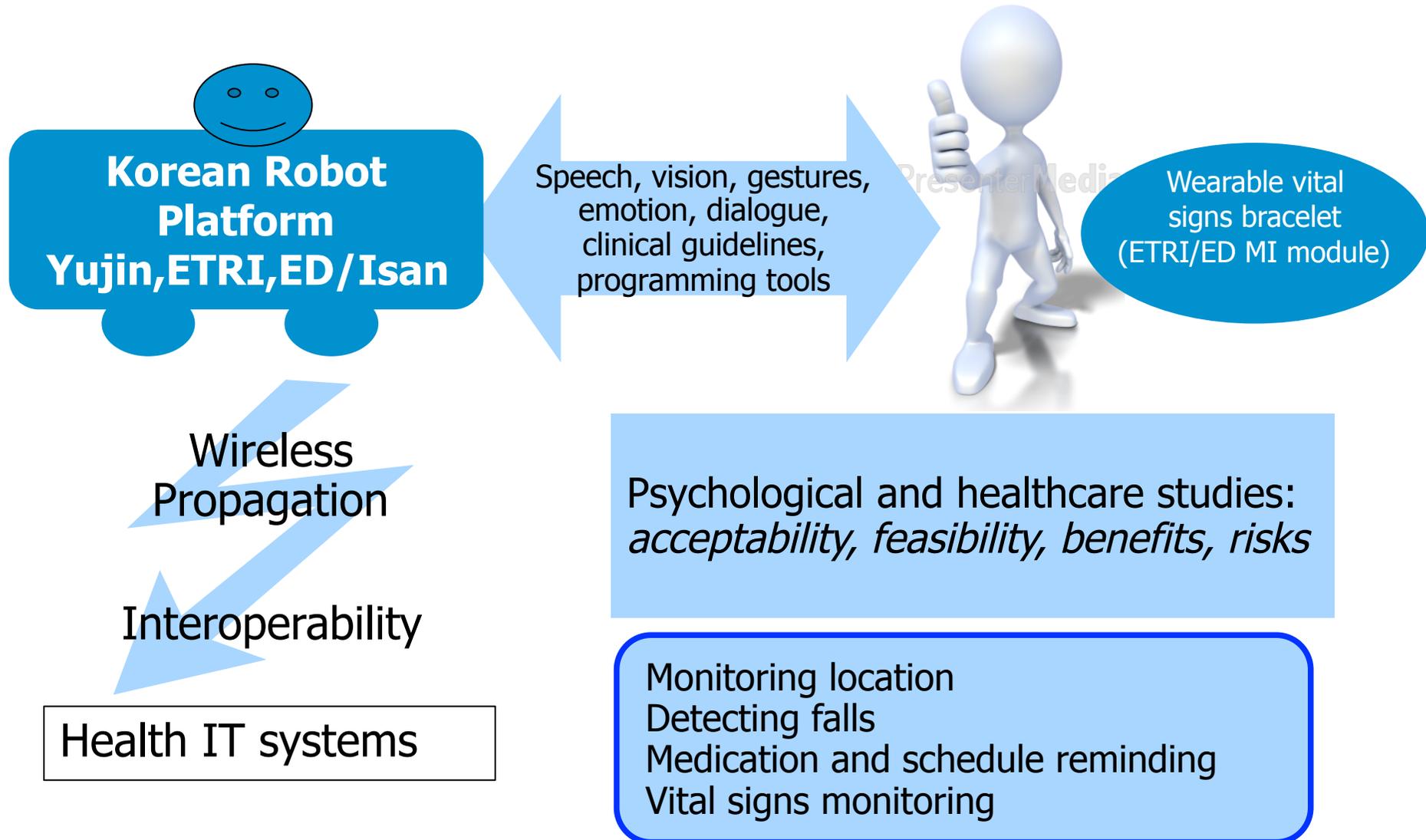
October 2014

1.1 Outline

- South Korea-NZ government funded programme in **2008-12**
- Robots to help care for older people: "aging in place"
- Korean robots + UoA Software framework and applications
- Multidisciplinary team (robotics, computing, psychology, health care)
- Cognitive assistant robots
- Robotics Healthcare platform
- Evaluation in field trials
- Our Third User Trial
- Results from Studies 1, 2



1.2 Robotic Healthcare platform



2.1 Acceptability study (Q4 2008)

- Questionnaires & Focus groups
 - Staff, residents, relatives
- Key tasks
- Robot characteristics:
 - Metallic, non-humanlike appearance
 - 1.25m high
 - No head
 - Large touch screen



2.2 Trial 1 (Q4 2009)

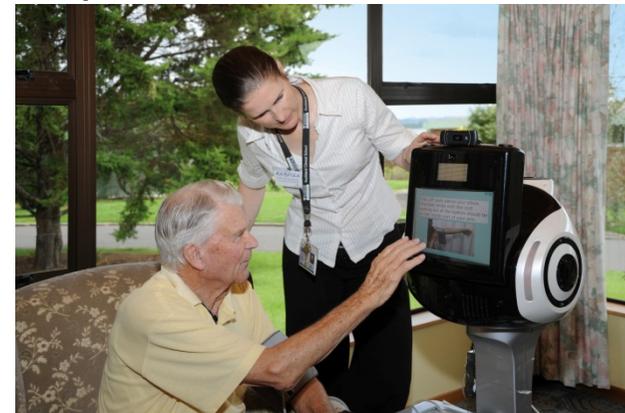
- Acceptability
- 53 participants: residents and staff
- Short interaction
- Location: display apartment
- Selwyn village
- A non-profit retirement complex in Auckland, New Zealand.
- The 26 acre village has around 650 residents



➔ **Results: robot is acceptable to older people**

2.3 Trial 2 (Q4 2010 – Q1 2011)

- Experiments in
 - 2 weeks in a rest home spaces
 - 2 weeks in independent living spaces
 - 2 weeks in independent living apartments reminding all medications 24/7
- Functions
 - Greeting, speech, touch screen, user authentication (camera)
 - Medication reminding
 - Vital signs measurement: BP, HR, SpO2
 - Skype calls
 - Entertainment: music videos, pictures, quotes
 - Brain fitness game
 - Telepresence
 - Fall detection including ETRI MI module
 - Location and activity monitoring (iPad) + robot responds



→ **Feasibility:**

A robot can be deployed in a retirement village and interact with staff and residents

3.1 Trial 3

- **Large Trial 3 at Selwyn Village (and Selwyn Heights)**
 - Purpose: evaluate benefits/risks for robots (quality of life, staff satisfaction)
 - 32 robots (4 kinds of healthcare robot, Paro)
 - Robots in independent living, rest home, hospital, medical clinic, cafe, reception, dementia unit
 - Falls and activity monitoring (mainly data collection)
 - Overall: 6 investigations
 1. **Crossover RCT with independent residents (robot vs no robot)**
 2. **Between groups non-randomised trial of robots vs no robots in residential care (residents and staff)**
 3. Observational study of robots in public places (café, medical centre, reception) 50 people in each place (residents, staff, visitors)
 4. Observational study in dementia unit (5 staff, 5 residents, 5 relatives)
 5. Observation study of Paro at Selwyn Heights (40 residents)
 6. Accelerometer validation and activity data collection, with some live monitoring (30 residents)
- Same functions as Trial 2

3.1 Trial 3

Robots from: Yujin, ED, Isan in Korea



Paro

Public & Private places

New Cafero

Private places

iRobiQ



Friend



Public places

Guide



3.2 Investigation 1: Cross over RCT independent residents

- **Overview**

- 29 participants
- Functions
 - Medication management
 - Vital sign measurement
 - Entertainment: photos, songs, quotes, brain fitness game, Skype
 - Text message sent to researcher if medication missed or resident reports unwell.
 - Retirement village web information
- Measures
 - GDS, SF-12, adherence, diaries, interviews



3.2 Investigation 1: Cross over RCT independent residents

- **Results**
 - Overall, no significant effects on adherence, depression, quality of life
 - **Perceived robot agency significantly decreased after period with the robot**
 - **Most useful: medication management and entertainment**
 - On average 6 medications to be reminded (small robot)
 - On average 36 days spent with small robot, 30 with large robot
 - 94% took medication themselves (small robot)
 - BP taken about once every 2 days (small robot)
 - **Application ratings mostly good or excellent**
 - **Enjoyed using the robot: mostly “Quite a lot”**

3.3 Investigation 2: Robots vs no robots in residential care

▪ Overview

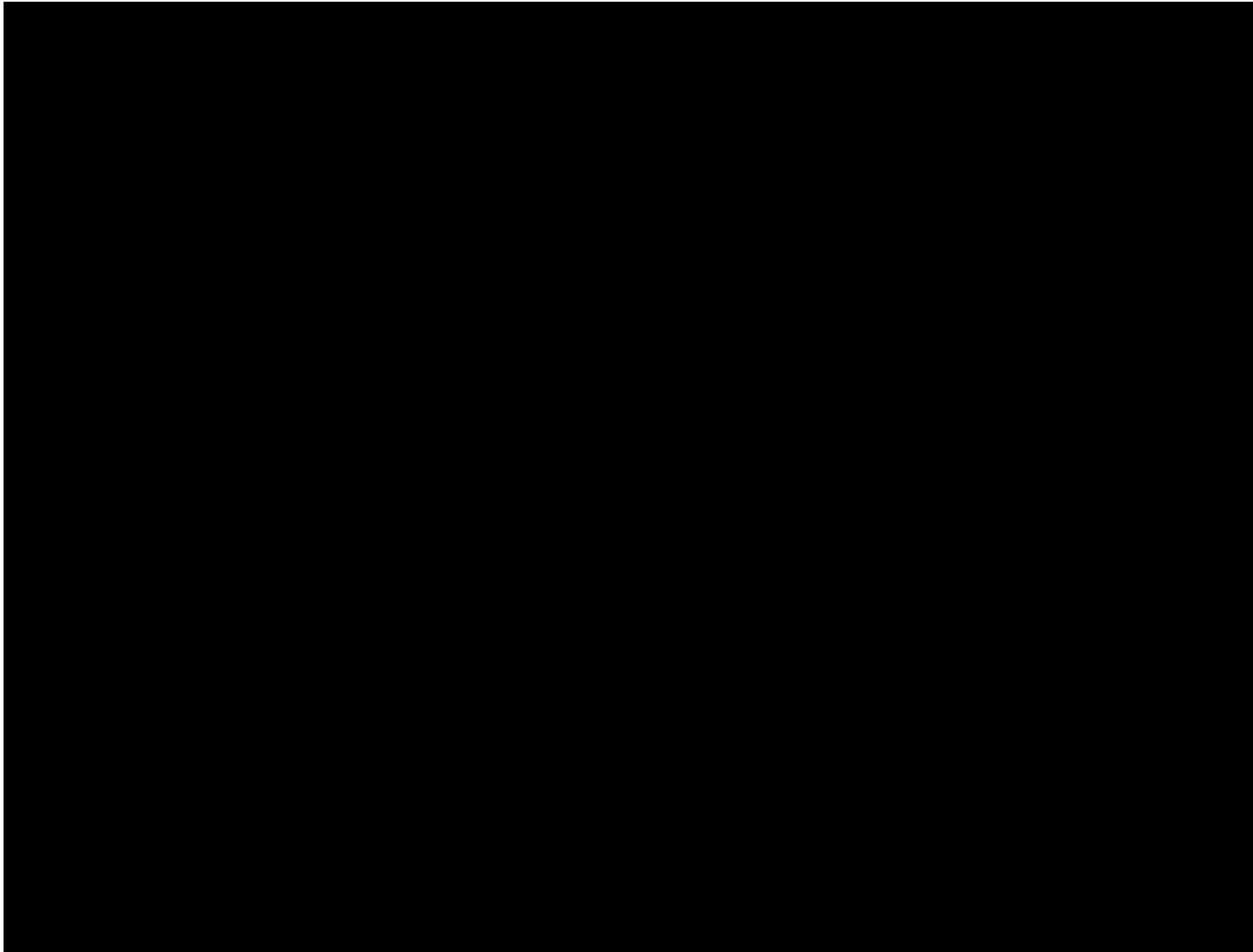
- 64 staff, 68 residents participated
- Two hospital and two rest-homes
- Functions
 - Medication management
 - Vital sign measurement
 - Entertainment: photos, songs, quotes, brain fitness game, Skype
 - Retirement village web information
- Measures
 - Staff: SF12, job morale, robot mind perception
 - Residents: QOL-AD, GDS, observations



3.3 Investigation 2: Robots vs no robots in residential care

- **Results**
 - Most used the robot 2-3 times, 1 person daily, some not at all
 - No significant differences between groups: QOL, Depression, staff morale
 - Feelings about robot presence: mixed
 - Staff used the robot more than residents
 - Perceived agency higher for people with robots, and decreased for both groups
 - Application feedback mostly good or excellent
 - High ratings of the robot in general
 - **When robot was present:**
 - **Observed interactions increased**
 - **Residents slept less**
 - Music video entertainment was popular

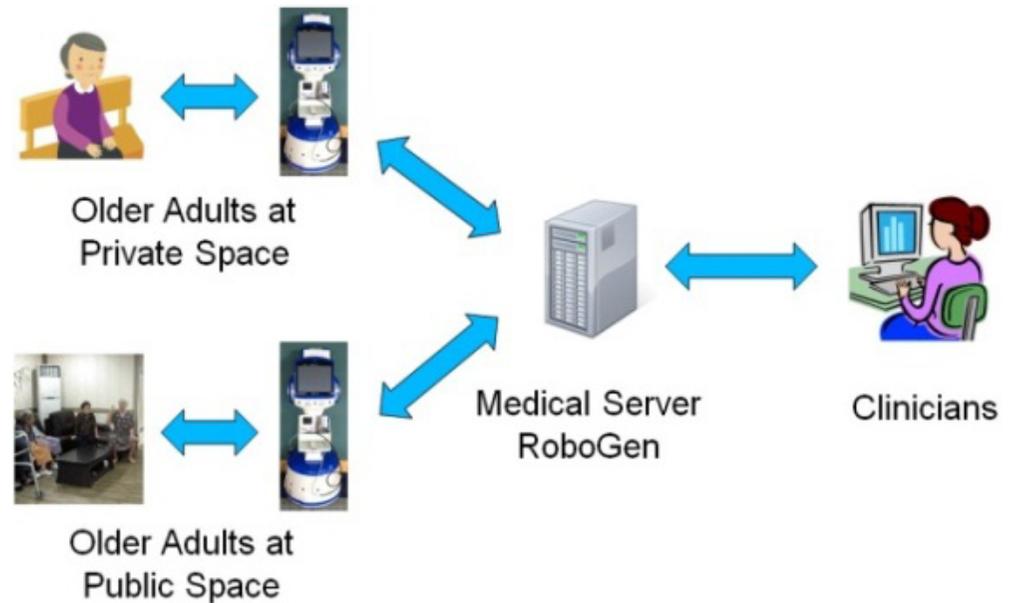
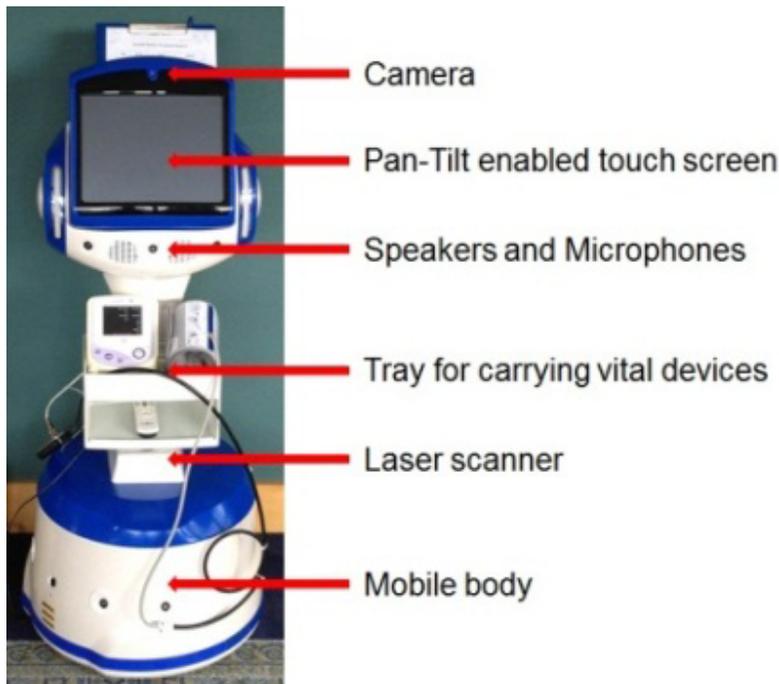
3.8 Video



4. Healthcare Robot System: HealthBots

- We selected the robot platform according to the purpose of the study
- We used a Kiosk type robot for investigations 1 & 2 (private and public places)

Cafero Robot: Charlie



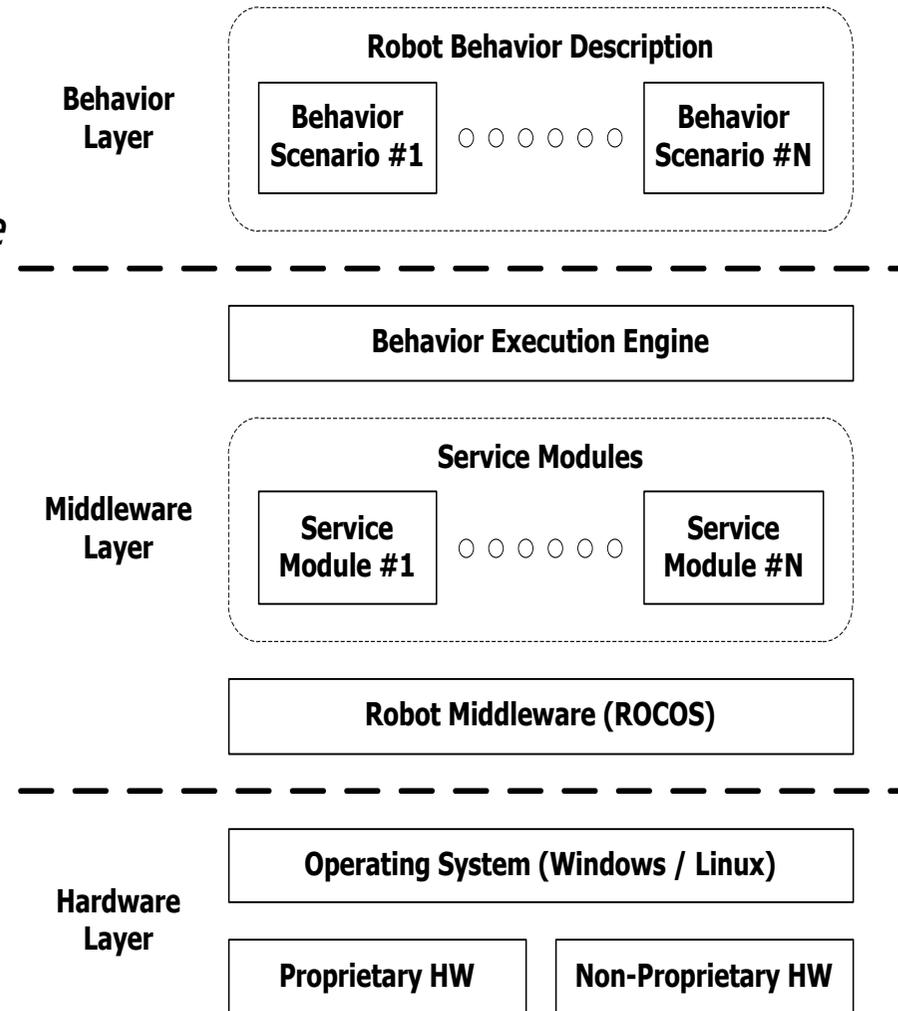
5. Experiments in private and public places using a Kiosk type robot

- Overview of Charlie use
 - Five Charlie robots deployed
 - 1st investigation
 - Private apartments (6 older adults)
 - 2nd investigation
 - A rest home (60 older adults) and a hospital (33 older adults)

4. Healthcare Robot System: HealthBots

HealthBots software architecture

- Behavior layer consists of a number of behavior scenario files, which represent the workflow of the application and experiment. *A key aspect for development, deployment, modification.*
- Middleware layer consists of three parts: a robot middleware (ROCOS), service modules, and a behavior execution engine (Flash/ActionScript/C++)
- Hardware systems layer, which consist of the operating system and two different types of hardware



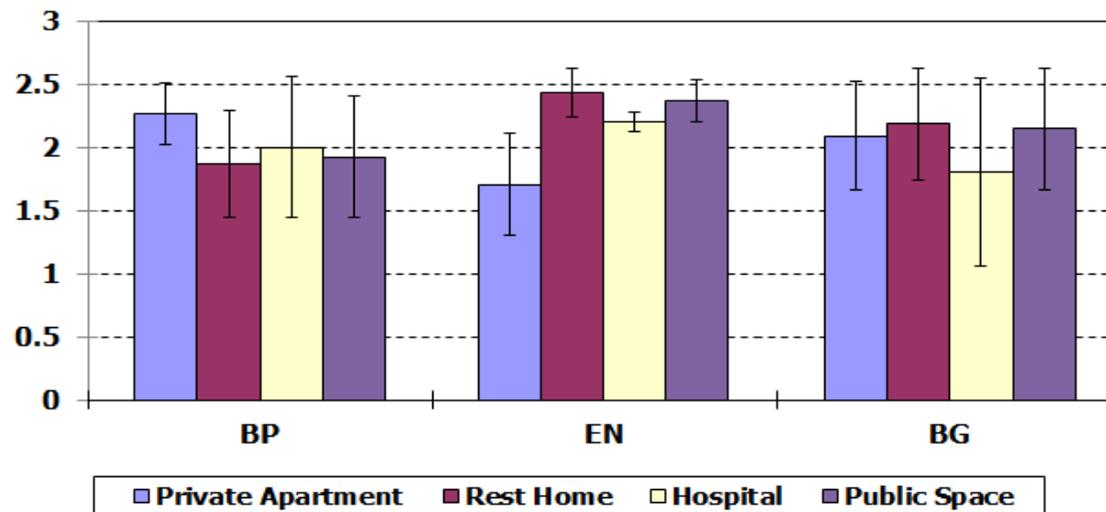
5. Experiments in private and public places using a Kiosk type robot

Questionnaire

Measure	Scale instructions	Items				
Usage of healthcare service module (same in BP, EN, BG)*	Please circle the number that best corresponds to how useful you find the healthcare service module. I think this service is ...	0	1	2	3	
		Poor	Acceptable	Good	Excellent	
User satisfaction about the robot in private space (1 question)	Q1. Please circle the number that best corresponds to how much you enjoyed using the robot today.	0	1	2	3	4
		Not at all	A little	Moderately	Quite a lot	Very much
User satisfaction about the robot in public space (4 Questions)	Q1. Please circle the number that best corresponds to how much you enjoyed using the robot.	0	1	2	3	4
		Not at all	A little	Moderately	Quite a lot	Very much
	Q2. Please circle the number that best corresponds to how useful you found the robot.	0	1	2	3	4
		Not at all	A little	Moderately	Quite a lot	Very much
Q3. Please circle the number that best corresponds to how you would rate your interaction with the robot.	0	1	2	3	4	
	Not at all	A little	Moderately	Quite a lot	Very much	
Q4. Please circle the number that best corresponds to how much you would like to interact with the robot again.	0	1	2	3	4	
	Not at all	A little	Moderately	Quite a lot	Very much	

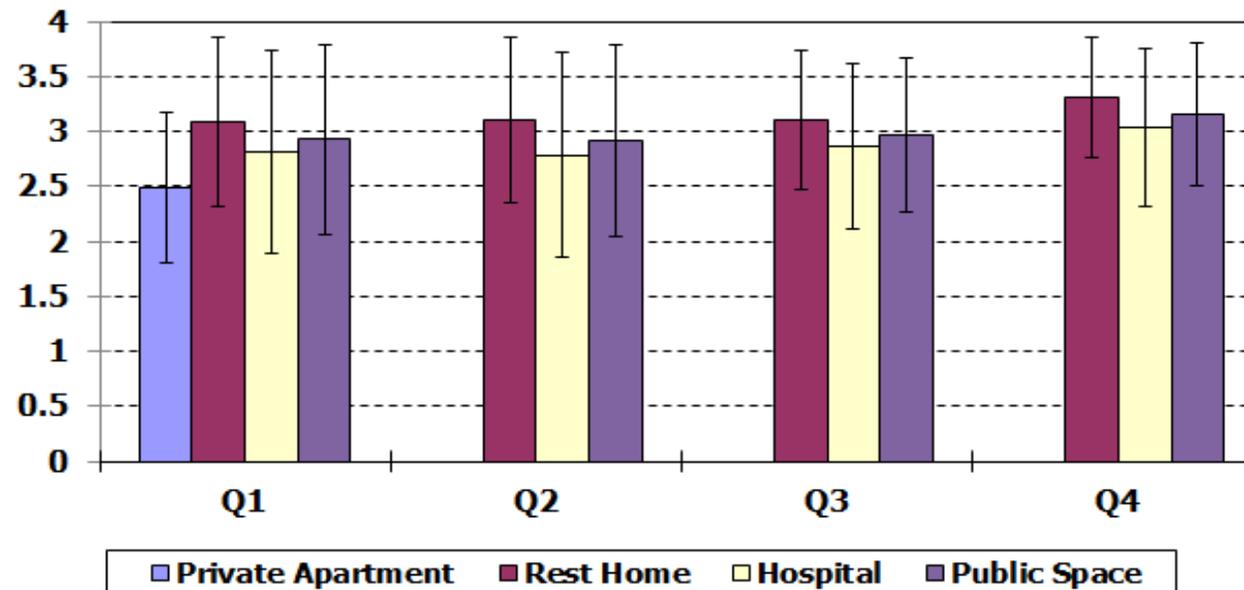
5. Experiments in private and public places using a Kiosk type robot

- Appropriate Healthcare Robot Functions according to location
 - Participants liked three healthcare services, but there were differences according to the location.
 - Participants in private apartments were more satisfied with blood pressure measurement and the brain fitness game, than the entertainment service.
 - Participants in public spaces were satisfied with the entertainment service.
 - Participants in the rest home were more satisfied with the brain fitness game service and entertainment service than those in the hospital.



5. Experiments in private and public places using a Kiosk type robot

- Suitability of using our Healthcare Robot System according to location
 - We evaluated the suitability of using the kiosk type healthcare robot system according to the place by measuring the user satisfaction with the robot
 - The participants in the public spaces were satisfied with using the kiosk type robot
 - But the participants in the private apartments did not give high scores although they enjoyed using Charlie.



6. Conclusion

- We completed a 12-week study on appropriate services of a healthcare robot system for older people in private and public spaces.
- We designed the healthcare robot system, HealthBots, and deployed it to Selwyn village.
- We used three Charlie robots in the private apartments, two Charlie robots in the public places, the rest home and the hospital, for the long-term studies.
- From the study, we found some important points, in addition to verifying that our software system was deployed and working on multiple, heterogeneous robots for a long period in different field environments.
- Older people in the private places used the healthcare service mostly for checking their health conditions.
- Older people in the public places used the entertainments functions most, especially in the rest home.
- In our latest research, we are studying a cost benefit analysis when healthcare robot systems are employed in a family doctor's practice and in peoples' homes in the community.
- Our software framework enables workflow development separately from the robot system development, and enables rapid workflow modification in the field, with domain experts

7. Current Study: Gore Health deployment

- Cost-benefit evaluation
- Purchased 1 Cafero and 3 small robots
- New Centre for Rural Health
- Healthbots are a main component
- Cafero is taking vital signs in the doctors waiting room: reduce nurses' and doctors' time
- IRobiQ's helping people at home
 - Goal: reduce community nurse time
 - Goal: reduce hospitalisations

