



PhD in Information Technology and Electrical Engineering

Università degli Studi di Napoli Federico II

PhD Student: Giovanni Ercolano

XXXIII Cycle

Training and Research Activities Report – Second Year

Tutor: Silvia Rossi



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

1. Information

I, the undersigned, Giovanni Ercolano, Ph.D. student in Information Technology and Electrical Engineering (ITEE) of the XXXIII cycle, have a Masters Degree with honors in Computer Science at the University of Naples Federico II. My master thesis is titled “Recognition of Activity of Daily Living for assistive robotics”. My tutor is prof. Silvia Rossi, assistant professor and Scientific co-chief of the PRISCA lab at the University of Naples Federico II. She is currently Coordinator and Principal Investigator of the National Project UPA4SAR “User Profiling and Adaptation for Socially Assistive Robotics”.

2. Study and Training activities

During the first year I followed the following courses, seminars and external courses:

Courses:

- Data Science and optimization, Lecturer: prof. Laura Palagi, prof. Enza Messina, dott. Claudio Sterle
- Intelligenza Artificiale ed Erica: prof. Roberto Prevete
- Fundamentals of deep learning for computer vision, Lecturer: Luigi Troiano

Seminars:

- Matlab onramp and sisotool, Lecturer: Eng. Francesco Orefice, Organizer: prof. Antonio Picariello
- Applying semi-supervised learning to app store analysis, Lecturer: Daniel Rodriguezg, Organizer: Roberto Pietrantuono
- Quasar-NTU collaboration talk, Lecturer: Amir Pourabdollah, Organizer: prof. Giovanni Acampora
- Innovation in medical robotics and the human-centred paradigm, Lecturer: dr. George Mylonas, Organizer: dr. Fanny Ficuciello
- Marked Point Processes for object detection and tracking in high resolution images: application to remote sensing data, Lecturer: prof. Josiane Zerubia, Organizer: prof. Giuseppe Scarpa

3. Research activity

My research activity during the second year is addressed to the PRIN 2015 research project UPA4SAR “User Profiling and Adaptation for Socially Assistive Robotics” as the first year. The main goal is the development and deployment of a well-accepted Active and Assisting Living (AAL) system based on a mobile social robot capable of deliver assistive services considering the profile and needs of home patients affected by Alzheimer’s disease. The robot must improve the acceptability through the adaptation of its social interaction to the patient based on personal factors and the cognitive state of the user.

We developed the robot assistive services that are managed by the Workflow Manager created by the ICAR-CNR, one of the UPA4SAR project collaborators. We used a new robot for the experimentations called Sanbot Elf, released by Qihan, a social multi-services robot. This robot has an affordable hardware cost and we saw that is more accepted than other robots. The four main challenging aspects were reached during this year for the experiments thanks to this robot: real

world environment test and production, acceptability, personalization and adaptation, cost-effectiveness. It was easier to access and use all the robot's components using its Android SDK, since the robot is controlled by an Android tablet. We implemented many robot behaviours modelled as independent, self-contained, self-scope, and self-responsibility microservices that compose the different system components. It is possible to choose a set of custom services to personalize the robot according to the needs and preferences of the user. The intent was to follow a Robot as a Service (RaaS) approach breaking complex behaviours in primitive functions. The robotic system is formed not only by a Sanbot Elf robot, but also by a Polar Android M-600 smartwatch to analyse the heartrate, the human pose and to detect the room where the patient is placed, the iBeacons to locate the smartwatch and the robot into the rooms, and an Android smartphone to notify some important information to the caregiver. An Intel NUC was used as robot server to run the Workflow Manager, a System Controller and the System Components of the robotic system. The System Controller and Components was implemented using "Node.js" while the communications between the Workflow Manager and the System Components with the System Controller was handled by the "Socket.io" library with an event-driven architecture. The message format was defined as JSON. A Control Interface was used for testing the System Components to check all the provided services. Three are the main group of Services developed into the robotic system: the Monitoring Services with activity recognition, pose recognition, emotion and disengagement recognition; the Navigation Services to approach the patient; the Interaction Services to provide audio/video entrainments and other multimodal human-robot interactions. Finally we tested in laboratory the Navigation Services, essential for the interaction of the companion robot with the patient with encouraging results, feasible execution times to deployment in real and uncontrolled environment.

The future work will involve the activity recognition in real time and a clustering approach based on the entropy to improve the face recognition of a patient and to reduce the number of images used for the comparison in the face recognition algorithm.

4. Products

Publications:

1. Di Napoli, C., Del Grosso, E., Ercolano, G., Garramone, F., Salvatore, E., Santangelo, G., & Rossi, S. Assessing Usability of a Robotic-Based AAL System: A Pilot Study with Dementia Patients.
2. Ercolano, G., Lambiase, Paolo D., Leone, E., Raggioli, L., Trepiccione, D., Rossi, S. (2019, October). Socially Assistive Robot's Behaviors Using Microservices.

5. Conferences and Seminars

I attended the following conferences:

- The 28th IEEE International Conference on Robot & Human Interactive Communication (IEEE RO-MAN 2019) held in Le Meridien, Windsor Place, New Delhi, India, from October 14 to October 18 2019

I presented the following paper:

- a. Ercolano, G., Lambiase, Paolo D., Leone, E., Raggioli, L., Trepiccione, D., Rossi, S. (2019, October). Socially Assistive Robot's Behaviors Using Microservices.

6. Activity Abroad

I visited the Sheffield Hallam University from 01/04/2019 to 01/07/2019 carrying out a research project on Activity Recognition in Human-Robot Interaction. The Responsible person of the visit was Alessandro Di Nuovo, Phd – Reader in Computational Intelligence and Robotics of the Department of Computing. The research was focused on the modelling and implementation of a deep learning model for the automatic gestures recognition of the children with autism. A deep model was trained on a dataset of human skeleton joints extracted from the videos recorded during the CARER-AID experiments. The OpenPose algorithm was used to extract the 2D human skeleton from the videos of the experiment. The model was tested on the NVIDIA Jetson TX2 to perform the gesture recognition in real time during an experimentation.

7. Tutorship

I have assisted in teaching for the course of “Sistemi per il Governo dei Robot” held by Dr. Silvia Rossi:

1. 1 hour for the description of the robots of the Prisca lab
2. 1 hour for a demonstration with Sanbot Elf robot.

On 15th February 2019, I have assisted Dr. Silvia Rossi for a Robotic and AI lesson at DIGITA Accademy.

From 21th to 24th November 2019, we participated to “Essere 4.0” at “Città della Scienza” where we experimented the human recognition of the emotion expressed by the robot via color leds, voice and movements.

	Credits year 1							Credits year 2							Credits year 3							Total	Check			
	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4	5	6	Summary	Estimated	1	2	3	4			5	6	Summary
Modules	18			5,4	6	3		14	19	1,2	0	0	0	0	1,9	3,1		0	6	0	2	3	3	14	32	30-70
Seminars	10	0	1,2	1,3	3	1,2	1	7,7	5	0	0,6	0	0,6	0,2	0,2	1,6		0,4	0	0	0	0,4	0	0,8	10	10-30
Research	40	10	8,8	7	7	8,8	9	51	40	10	8	14	4	8	6	50		7	7	7	4	7	7	39	140	80-140
	68	10	10	14	16	13	10	73	64	11	8,6	14	4,6	8,2	8,1	55	0	7,4	13	7	6	10	10	54	181	180