

LUCREZIA GRASSI

Robotics Engineer



PROFILE

I am a Master's Doctor in Robotics Engineering, currently attending a Ph.D. in Bioengineering and Robotics on Cloud Robotics and multi-party interaction between humans and artificial agents. My interests include Social Robotics, autonomous conversation systems, and mixed and virtual reality. During the master's degree courses, I took part in several group projects gaining a good experience in teamwork. I am very curious and eager to learn new and interesting things.

SKILLS



EDUCATION

2020 - today	Ph.D. in Bioengineering and Robotics The Ph.D. program in Bioengineering and Robotics of the University of Genoa is leading edge in education and research, covering multi-disciplinary scientific and technological domains from advanced robotics, to biomedical engineering, to humanoid and interactive technologies and applications. My Ph.D. project focuses on the development of Cloud services for multi-party interaction between humans and artificial agents.	DIBRIS - University of Genoa
2018 - 2020 110/110 cum laude	Master's Degree in Robotics Engineering Robotics Engineering is a study program associated with the project European Master on Advanced Robotics (EMARO) and the Japan-Europe Master on Advanced Robotics (JEMARO). The first year is dedicated to strengthening the basic engineering background and the integration of heterogeneous skills, whereas the second year is dedicated to the acquisition of advanced, robotics-related knowledge, and to an extended, important, thesis work. The degree program encompasses the field of advanced and intelligent robotics, including mathematical modeling, control engineering, computer engineering, and mechanical design.	DIBRIS - University of Genoa
2015 - 2018 110/110 cum laude	Bachelor's Degree in Computer Engineering The course integrates the essential elements of scientific disciplines with the tools and methods to design, develop and manage hardware and software technologies in application areas such as management and information processing, computer networks, software production and management, modeling of complex systems, and automatic controls.	DIBRIS - University of Genoa
2010 - 2015 100/100	High School Diploma Scientific Diploma	Liceo Scientifico M.L. King

TEACHING ACTIVITY

2022 - 2023	Fundamentals of Computer Science (ING-INF/05) Preparation of the material for the assignments and tutoring activity for the Fundamentals of Computer Science course held during the first year of the B.Sc. in Computer Engineering for a total of 40 hours.	DIBRIS - University of Genoa
2021 - 2022	Biomedical Robotics (ING-INF/06) Preparation of the material for the assignments and tutoring activity for the Biomedical Robotics course held during the second year of the M.Sc. in Robotics Engineering for a total of 25 hours.	DIBRIS - University of Genoa
2021 - 2022	Ambient Intelligence (ING-INF/05) Preparation of the material for the assignments and tutoring activity for the Ambient Intelligence course held during the second year of the M.Sc. in Robotics Engineering for a total of 25 hours.	DIBRIS - University of Genoa

CONFERENCE PRESENTATIONS

- 2022 **AixIA AIRO 2022** Udine, Italy
Presentation of the paper "Multiparty Verbal Interaction Between Humans and Artificial Agents"
- 2021 **AixIA AIRO 2021** Virtual Conference
Presentation of the paper "Cloud Services for Social Robots and Artificial Agents"
- 2021 **I-RIM 2021** Rome, Italy
Presentation of the paper "Cloud Services for Autonomous Interaction With Social Robots and Artificial Agents"
- 2020 **I-RIM 2020** Virtual Conference
Presentation of the paper "A Knowledge-Based Conversation System for Robots and Smart Assistant"
- 2020 **AixIA AIRO 2020** Virtual Conference
Presentation of the paper "Knowledge-Driven Conversation for Social Robots: Exploring Crowdsourcing Mechanisms for Improving the System Capabilities"

AWARDS

- 2019 **Acknowledged Top-5 Student** DIBRIS - University of Genoa
I received a merit-based fee reduction as I was part of the top-5 students in my course with the highest grades.
- 2018 **Acknowledged Top-5 Student** DIBRIS - University of Genoa
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- 2017 **Acknowledged Top-5 Student** DIBRIS - University of Genoa
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- 2016 **Acknowledged Top-5 Student** DIBRIS - University of Genoa
I received a merit-based fee reduction as I was part of the top-5 students in my course with the highest grades.
- 2015 **Acknowledged top-ranked high school student** DIBRIS - University of Genoa
I received a merit-based fee reduction as I graduated from high school with a vote of 100/100.

PROJECTS

- 2020 – present **Robot-Induced Group Conversation Dynamics** DIBRIS - University of Genoa
The objective of this work is to evaluate the impact of the presence of a robot within a conversation with multiple participants. Specifically, the project aims at analyzing whether, and to what extent, a robot can influence the level of participation of participants in a group conversation. In addition, we want to determine how the different approaches under consideration impact participants' perceptions of the robot.
Python / HRI / Multiparty interaction / Group conversation dynamics
- 2020 **A Knowledge-Based Conversation System for Robots and Smart Assistants** DIBRIS - University of Genoa
My master's thesis work has been developed in the ambit of the H2020 EU-Japan CARESSES project, whose goal is to design a culturally competent Socially Assistive Robot to assist elderly people. In this project, the humanoid robot Pepper has been exploited as a robotic platform for interacting with elders in care homes. This work is part of the H2020 EU-Japan CAIRGIVER project, which expands the CARESSES themes. My objective was to improve the dialogue capabilities of the system in two directions: (1) the system shall be able to purposely ask the user to talk freely in order to detect in real-time concepts and relations which are not yet encoded in the Ontology, as well as the personal view of the user about these concepts. New concepts, properties, and instances of concepts and properties will be used to enrich the ontology and ultimately make the conversation more engaging; (2) the system shall be able to correctly understand, by analyzing the utterances of the users through Linguistic and Statistical tools, the conversation topic that the user wishes to talk about, thus allowing context-dependent "chit-chatting" about concepts in the Ontology.
Python / Ontology / NLP / Dialogflow / HRI

- 2020 **Goal Scoring with a 4WD Mecanum Wheel Robot** DIBRIS - University of Genoa
 This project consisted in assembling and programming a 4WD Mecanum Wheel Robot Kit. This omnidirectional robot has been equipped with an Arduino, a Raspberry, four motors, a RaspiCam, and batteries to power everything. I had to deal with omnidirectional navigation and target tracking as the goal was to make the robot able to detect a ball and kick it inside the football goal. The color of the ball was known, so that it could be recognized through the previously calibrated monocular camera, mounted on the robot. The dimensions of the football field were given, thus the position of the football goal was known. The position of the robot w.r.t. the world was always available thanks to markers placed in the environment. This information allowed us to compute the robot's desired position and orientation to properly be able to score a goal.
 ROS / Python / Gazebo / RViz / Wiring
- 2019 **Virtual Robot Assistant for Elderly Care** DIBRIS - University of Genoa
 Android application featuring a Virtual Character Assistant for Elderly Care in the spirit of CARESSES, the main purpose of which is to make robots culturally competent. The robot is able to talk about different topics while adapting to the individual's preferences during the interaction which occurs through the smartphone screen. The assistant not only chats but also takes care of elderly people assisting them in several tasks. The Virtual Robot Assistant, even if not originally included in the CARESSES work plan, has been successfully presented at the final review meeting of the project, and gave rise to two publications (one of them under review).
 Java / Android Studio / Python / CARESSES
- 2019 **Components Greasing with Doosan M0609** Ultraflex Group
 The company asked me to program the newly arrived Doosan M0609 Robotic Arm to automatically perform a task that was previously accomplished by a worker. This cobot has 6 degrees of freedom and a total reach of 900 mm. The aim was to employ it for putting grease on bushings and washers of different types of cylinder link arms: the only thing that the worker had to do was dispose of the components in a predefined configuration, and specify the link arm type before running the program. Once the robot completed the greasing of all the elements, it returned to its resting position, waiting for the worker to replace the components.
 Python
- 2018-2019 **Gesture-based Interface for Baxter robot** DIBRIS - University of Genoa
 Control of Rethink Robotics Baxter robot play/record capabilities with the aid of a graphic, menu-based interface. The latter is browsable by a fully configurable and extensible input layer, originally designed for natural discrete interactions such as smartwatch gestures. The system detects the presence of a user and monitors his head orientation in order to determine the attention level, and thus improve safety.
 / ROSC++17 / Qt5 / Python / Gazebo / RViz
- 2018 **UniPlanner** DIBRIS - University of Genoa
 Android Application developed to make easier and more intuitive the management of the University career. It offers services like a weekly schedule, customizable reminders for upcoming exams, and an overall view of the career including the average mark and the projection of the final grades based on the result of passed exams.
 Java / Android Studio
- 2018 **BookSwap Website** DIBRIS - University of Genoa
 Website dedicated to people who like reading books. BookSwap allows users to register and communicate through a chat for organizing book exchanges. The website shows, for each book, a list of the people who are sharing it; in this way, another user who desires that book can contact someone who owns it. The search results on the website are provided by the Google Books API which supplies a wide range of choices and numerous details on each title (cover, plot, ISBN, publication date, pages, etc.)
 HTML / CSS / JavaScript / PHP

ROBOTS I WORKED WITH

- 2020-present **NAO**
 Robot-Induced Group Conversation Dynamics
 Knowledge-Grounded Dialogue Flow Management for Social Robots and Conversational Agents
 Knowledge Triggering, Extraction, and Storage via Human-Robot Verbal Interaction

2019-present	Pepper Robot-Induced Group Conversation Dynamics Knowledge-Grounded Dialogue Flow Management for Social Robots and Conversational Agents Knowledge Triggering, Extraction, and Storage via Human-Robot Verbal Interaction A Knowledge-Based Conversation System for Robots and Smart Assistants Enhancing Conversational Capabilities of Social Assistive Robots
2019-2020	4WD Mecanum Wheel Robot Kit Goal Scoring with a 4WD Mecanum Wheel Robot
2019	Doosan M0609 Robotic Arm Component Greasing with Doosan M0609
2018-2019	Baxter Gesture-based Interface for Baxter robot

PUBLICATIONS

Revision requested	Sustainable Cloud Services for Verbal Interaction with Embodied Agents <i>Grassi L., Recchiuto C.T., Sgorbissa A.</i>	J4
	<p>This article presents the design and the implementation of a cloud system for knowledge-based autonomous interaction devised for Social Robots and other conversational agents. The system is particularly convenient for low-cost robots and devices: it can be used as a stand-alone dialogue system or as an integration to provide "background" dialogue capabilities to any preexisting natural language understanding ability that the robot may already have as part of its basic skills. By connecting to the cloud, developers are provided with a sustainable solution to manage verbal interaction through a network connection, with about 3,000 topics of conversation ready for "chit-chatting" and a library of pre-cooked plans that only needs to be grounded into the robot's physical capabilities. The system is structured as a set of REST API endpoints so that it can be easily expanded by adding new APIs to improve the capabilities of the clients connected to the cloud. Another key feature of the system is that it has been designed to make the development of its clients straightforward: in this way, multiple robots and devices can be easily endowed with the capability of autonomously interacting with the user, understanding when to perform specific actions, and exploiting all the information provided by cloud services. The article outlines and discusses the results of the experiments performed to assess the system's performance in terms of response time, paving the way for its use both for research and market solutions. Links to repositories with clients for ROS and popular robots such as Pepper and NAO are available on request.</p> <p>Intelligent Service Robotics</p>	
2023	Robot-Induced Group Conversation Dynamics: A Model to Balance Participation and Unify Communities <i>Grassi L., Recchiuto C.T., Sgorbissa A.</i>	C12
	<p>The purpose of this research is to study the impact of robot participation in group conversations and assess the effectiveness of different addressing policies. The study involved a total of 300 participants, who were divided into groups of four and engaged in a dialogue with a humanoid robot. The robot acted as a moderator, using information obtained during the conversation to determine which speaker to address. The study found that the policy used by the robot significantly impacted the conversation dynamics. Specifically, the robot provided more balanced attention to each participant and reduced the number of subgroups.</p> <p>IR0S 2023</p>	

2023

Diversity-Aware Verbal Interaction Between a Robot and People With Spinal Cord Injury c11

Grassi L., Canepa D., Bellitto A., Casadio M., Massone A., Recchiuto C.T., Sgorbissa A.

This article explores the acceptance of a humanoid robot designed to engage in conversations with clinicians and individuals with spinal cord injuries in a hospital environment. Building upon prior research, we introduce the concept of "diversity-aware" robots, which possess the capability to interact with people while adapting to their culture, age, gender, preferences, and physical and mental conditions. These robots are connected to a cloud system specifically designed to consider these factors, enabling them to adapt to the context and individuals they interact with. Our experiments involved the NAO robot interacting with both clinicians and individuals with spinal cord injuries. Subsequent to the interaction, participants completed a questionnaire and underwent an interview. The collected data were analyzed to assess the system's acceptability and its persistence beyond the initial novelty effect. Furthermore, we investigated whether clinicians exhibited a lower predisposition towards the system and expressed greater concerns than end-users about using the robot, which could potentially hinder the adoption of the system.

RO-MAN 2023

2023

Emergency Management Through Information Crowdsourcing J3

Grassi L., Ciranni M., Baglietto P., Recchiuto C.T., Maresca M., Sgorbissa A.

This article proposes a new framework to model a scenario in which First Responders, citizens, smart devices, or robots explore the environment in an emergency situation, i.e., after an earthquake, assessing damages and searching for people needing assistance. While moving, the agents observe events and exchange the information collected with other agents encountered: to this end, they use messaging systems purposely adapted to use point-to-point network connections to allow local data exchange between agents even when global network connections are not available. As is common in Delay Tolerant Networks, exchanged messages are locally stored: when a global network is available, the agents can upload all the information collected by themselves and other agents they encountered to a Control Room or a database in the Cloud. Differently from traditional DTN algorithms such as Epidemic and Spray&Wait, we propose a solution that keeps track of agents that shared information along the path and assess the quality of the information collected by multiple agents through a reputation-based mechanism that is safer than majority voting. A simulator compatible with OpenStreetMap is presented, as well as simulated experiments in two Italian towns to validate the feasibility of the approach.

Information Processing & Management

2022

Multiparty Verbal Interaction Between Humans and Artificial Agents c10

Grassi L., Recchiuto C.T., Sgorbissa A.

The study of verbal interaction between multiple humans and robots is an almost unexplored research field. This kind of interaction has been primarily analyzed in the literature focusing on cooperation to achieve a common task or on more technical aspects such as active speaker recognition. The presented work proposes a holistic approach to solve the problem: a cloud architecture that allows social robots and artificial agents to interact verbally with a group of people. The system can recognize the active speaker and decide whom to address based on the developed policies while correctly keeping track of the conversation state.

AIxIA AIRO 2022

2022

Gestural and Touchscreen Interaction for Human-Robot Collaboration: A Comparative Study c9

Bongiovanni A., De Luca A., Gava L., Grassi L., Lagomarsino M., Lapolla M., Marino A., Roncagliolo P., Macciò S., Carfi A., Mastrogiovanni F.

Close human-robot interaction (HRI), especially in industrial scenarios, has been vastly investigated for the advantages of combining human and robot skills. For an effective HRI, the validity of currently available human-machine communication media or tools should be questioned, and new communication modalities should be explored. This article proposes a modular architecture allowing human operators to interact with robots through different modalities. In particular, we implemented the architecture to handle gestural and touchscreen input, respectively, using a smartwatch and a tablet. Finally, we performed a comparative user experience study between these two modalities.

IAS-17

2022

Knowledge-Grounded Dialogue Flow Management for Social Robots and Conversational Agents J2

Grassi L., Recchiuto C.T., Sgorbissa A.

The article proposes a system for knowledge-based conversation designed for Social Robots and other conversational agents. The proposed system relies on an Ontology for the description of all concepts that may be relevant conversation topics, as well as their mutual relationships. The article focuses on the algorithm for Dialogue Management that selects the most appropriate conversation topic depending on the user's input. Moreover, it discusses strategies to ensure a conversation flow that captures, as more coherently as possible, the user's intention to drive the conversation in specific directions while avoiding purely reactive responses to what the user says. To measure the quality of the conversation, the article reports the tests performed with 100 recruited participants, comparing five conversational agents: (i) an agent addressing dialogue flow management based only on the detection of keywords in the speech, (ii) an agent-based both on the detection of keywords and the Content Classification feature of Google Cloud Natural Language, (iii) an agent that picks conversation topics randomly, (iv) a human pretending to be a chatbot, and (v) one of the most famous chatbots worldwide: Replika. The subjective perception of the participants is measured both with the SASSI (Subjective Assessment of Speech System Interfaces) tool, as well as with a custom survey for measuring the subjective perception of coherence.

International Journal of Social Robotics

2022

Knowledge Triggering, Extraction, and Storage via Human-Robot Verbal Interaction J1

Grassi L., Recchiuto C.T., Sgorbissa A.

This article describes a novel approach to expand in run-time the knowledge base of an Artificial Conversational Agent. A technique for automatic knowledge extraction from the user's sentence and four methods to insert the newly acquired concepts in the knowledge base have been developed and integrated into a system that has already been tested for knowledge-based conversation between a social humanoid robot and residents of care homes. The run-time addition of new knowledge allows for overcoming some limitations that affect most robots and chatbots: the incapability of engaging the user for a long time due to the restricted number of conversation topics. The insertion in the knowledge base of new concepts recognized in the user's sentence is expected to result in a wider range of topics that can be covered during an interaction, making the conversation less repetitive. Two experiments are presented to assess the performance of the knowledge extraction technique, and the efficiency of the developed insertion methods when adding several concepts in the Ontology.

Robotics and Autonomous Systems

2021

Cloud Services for Autonomous Interaction With Social Robots and Artificial Agents c8

Grassi L., Recchiuto C.T., Sgorbissa A.

This work presents the design and the implementation of CAIR: a cloud system for knowledge-based interaction devised for Social Robots and other conversational agents. The system is structured in a way that it can be easily expanded by adding new services that improve the capabilities of the clients connected to the Cloud. Another key feature of the system is that it has been designed to make the development of its clients straightforward: in this way, multiple devices (e.g., robots, computers, smartphones, etc.) can be easily endowed with the capability of autonomously interacting with the user, understanding when to perform specific actions, and exploiting all the information provided by services on the Cloud.

I-RIM 2021

2021

MEUS: A Framework for Management of Emergencies Through Ubiquitous Sensing c7

Ciranni M., Grassi L., Baglietto P., Maresca M., Recchiuto C.T., Sgorbissa A.

This article proposes a framework to model a scenario in which First Responders, citizens, and smart devices and/or robots explore the environment in an emergency situation, i.e., after an earthquake, assessing damages, and searching for people needing assistance. While moving, the agents observe events and exchange the information collected with other agents encountered, thanks to common network connections. When some conditions hold, the agents can upload the collected information to a Control Room/database in the Cloud. The model includes a detailed description of how data are exchanged between agents and stored in the database. A simulated experiment has been carried out in a real-world street network, with the aim of evaluating the feasibility and performance of the approach.

I-RIM 2021

- 2021 **Cloud Services for Social Robots and Artificial Agents** c6
Grassi L., Recchiuto C.T., Sgorbissa A.
- This work presents the design and the implementation of CAIR: a cloud system for knowledge-based interaction devised for Social Robots and other conversational agents. The system is structured in a way that it can be easily expanded by adding new services that improve the capabilities of the clients connected to the Cloud. Another key feature of the system is that it has been designed to make the development of its clients straightforward: in this way, multiple devices (e.g., robots, computers, smartphones, etc.) can be easily endowed with the capability of autonomously interacting with the user, understanding when to perform specific actions, and exploiting all the information provided by services on the Cloud.
 AIXIA AIRO 2021
- 2021 **Towards Ethics Training in Disaster Robotics: Design and Usability Testing of a Text-Based Simulation** c5
Battistuzzi L., Grassi L., Recchiuto C.T., Sgorbissa A.
- Rescue robots are expected to soon become commonplace at disaster sites, where they are increasingly being deployed to provide rescuers with improved access and intervention capabilities while mitigating risks. The presence of robots in operation areas, however, is likely to carry a layer of additional ethical complexity to situations that are already ethically challenging. In addition, limited guidance is available for ethically informed, practical decision-making in real-life disaster settings, and specific ethics training programs are lacking. The contribution of this paper is thus to propose a tool aimed at supporting ethics training for rescuers operating with rescue robots. To this end, we have designed an interactive text-based simulation. The simulation was developed in Python, using Tkinter, Python's de facto standard GUI. It is designed in accordance with the Case-Based Learning approach, a widely used instructional method that has been found to work well for ethics training. The simulation revolves around a case grounded in ethical themes we identified in previous work on ethical issues in rescue robotics: fairness and discrimination, false or excessive expectations, labor replacement, safety, and trust. Here we present the design of the simulation and the results of usability testing. The efficacy of the system will be tested once the simulation has been reviewed by experts in the field for realism and completeness.
 SSRR 2021
- 2020 **A Knowledge-Based Conversation System for Robots and Smart Assistants** c4
Grassi L., Recchiuto C.T., Sgorbissa A.
- The main objective of this work is to enhance the capabilities of a knowledge-driven conversational system, making them more natural and pleasant. Exploiting several Natural Language Processing (NLP) techniques, a set of algorithms has been developed to improve the quality of the conversation and expand the knowledge base in run-time adding new concepts recognized in the user sentence. Moreover, a mechanism to validate the newly added concepts has been developed.
 I-RIM 2020
- 2020 **Knowledge-Driven Conversation for Social Robots: Exploring Crowdsourcing Mechanisms for Improving the System Capabilities** c3
Grassi L., Recchiuto C.T., Sgorbissa A.
- Social robots and artificial agents should be able to interact with the user in the most natural way possible. This work describes the basic principles of a conversation system designed for social robots and artificial agents, which relies on knowledge encoded in the form of an Ontology. Given the knowledge-driven approach, the possibility of expanding the Ontology in run-time, during the verbal interaction with the users is of the utmost importance: this paper also deals with the implementation of a system for the run-time expansion of the knowledge base, thanks to a crowdsourcing approach.
 AIXIA AIRO 2020

2020

Physical Embodiment of Conversational Social Robots

c2

Gava L.*, Grassi L.*, Lagomarsino M.*, Recchiuto C.T., Sgorbissa A.

*equal contribution

Achieving natural and engaging verbal interactions is one of the main challenges faced by Social Robotics. In this context, the physical embodiment may be one of the most critical factors: indeed, previous work indicates that physical robots elicit more favorable social responses than virtual agents. However, the effects of physical embodiment have been analyzed only in some specific and limited scenarios, where verbal interaction was reduced to basic commands. The current work aims at investigating the effect of robots' physical embodiment in a pure conversation task, by considering some relevant aspects of social interaction, such as usability, speech interface quality, user satisfaction, and engagement. To this aim, a pilot experiment where participants were required to chitchat with a robot and a smartphone app, both connected to the same conversation framework, has been carried out. Preliminary results are presented and discussed, and they offer interesting insights into the positive effects of physical embodiment on some of the analyzed aspects.

My contribution to this article is related to the carrying out and the analysis of the results of the experiment.

RO-MAN 2020

2020

Cloud Services for Culture Aware Conversation: Socially Assistive Robots and Virtual Assistants

c1

Recchiuto C.T., Gava L.*, Grassi L.*, Grillo A.*, Lagomarsino M.*, Lanza D.*, Liu Z.*, Papadopoulos C., Papadopoulos I., Scalmato A., Sgorbissa A.

*equal contribution

This paper introduces a new Cloud platform providing services for culturally competent interaction, that has been developed to expand the capabilities of Socially Assistive Robots and virtual assistants interacting with older persons. The rationale behind the proposed architecture is discussed, by outlining key principles as well as the functionalities provided, with a specific focus on verbal interaction. Three case studies, the humanoid robot Pepper, a robotic medicine dispenser Pillo, and a custom-built Android-based virtual assistant, are analyzed in detail, by showing how robots and other assistants may easily access culturally competent Cloud services to expand their interaction capabilities. Transcripts of conversations are reported and commented to outline both the positive features and the limitations of the system.

I contributed to this article by developing the Android Application that communicates with the CARESSES Cloud. This application is characterized by a Virtual Assistant able to interact with the user by exploiting the connection with the Cloud and the Google Speech-to-Text API.

UR 2020

LANGUAGES

Italian - native
English - proficient (C1)
Spanish - basic
French - basic

INTERESTS

Programming
Nutrition
Psychology
Reading

HOBBIES

Gym
Yoga
Meditation
Piano and Guitar