Speech-capable Augmented Reality avatars to assist humans in daily activities

Tutors:
Alessandro Carfì
Fulvio Mastrogiovanni

Department:
Department of Informatics, Bioengineering, Robotics and Systems Engineering, University of Genoa Web: www.dibris.unige.it

Description:
In the past few years, we have witnessed a renovated interested in Augmented Reality (AR), and in the related capabilities mediated by see-through displays to superimpose various forms of information on a human-centred first-person view. This perspective opens up unprecedented possibilities as far as the interaction between humans and cognitive systems is concerned, e.g., to design new forms of communication allowing such a system to better share its intentions to humans, or to provide them with context-aware instructions about how to cooperate with it or similar systems.

In this PhD research proposal, we want to investigate the role of speech-enabled AR avatars as mediators between a human wearing a see-through display and a cognitive system, which may be an intelligent, autonomous robot, an intelligent environment, or a non-embodied artificial intelligence agent. We want to enrich the communication experience between a human and a cognitive system by introducing an intelligent, context-aware AR avatar verbally and gesturally interacting with humans. Beside the appearance of the AR avatar, the PhD research project will focus on key linguistic theories to enforce the fruitfulness of the interaction, and in particular on aspects related to Politeness Theory [1, 2].

Starting from the work done in the context of the HoloBot project (web: https://github.com/ActiveNick/HoloBot), PhD candidates will have to achieve a set of milestones:

1. Design and develop the new generation of a cognitive architecture, initially developed for intelligent environment, to be deployed as a core component for intelligent robots, intelligent environments, or other classes of cognitive systems.
2. Formalise a computational framework considering relevant aspects of Politeness Theory in selected use cases involving interaction with a wide range of cognitive systems.
3. Encode using formal languages the previously developed computational framework, e.g., using logic-based (Boolean or Fuzzy Ontologies) techniques, or such probabilistic approaches as forms of graphical models.
4. Deploy the models within suitable chatbots-related technologies, such as for example the Google Meena framework [3].
5. Integrate the resulting chatbot with AR avatars.
6. Perform real-world validation in the developed use cases.

The PhD student will work within an engaging, stimulating, and multi-cultural environment. He or she will be involved in the activities carried out by the TheEngineRoom team. This will involve also helping the team supervise MSc students in their thesis work, most notably students from the UniGe's Robotics Engineering program. To conduct the research activities, the PhD student will use state of the art dual arm manipulators (a Baxter robot from Rethink Robotics and Tiago++ from PAL Robotics, the latter provided with a dexterous 10-DOF hand), mobile robots (an autonomous robot from Husqvarna and a Kuka YouBot), a system of multiple RGB-D devices, motion capture systems (two combined OptiTrack systems), wearable devices (both commercial and custom IMUs, custom data gloves), AR/VR equipment (an Oculus Rift, a Hololens2), as well as different instances of intelligent environments based on Kibi technology from Teseo srl, a spin-off company from the University of Genoa.

Requirements:

- Notions related to computational linguistics and ontology engineering.
- Software development in Python. ⧠ Experience with chatbot technology is a plus.

References:

[1] P. Brown and S.C. Levinson. Politeness: some universals in language usage. Cambridge: Cambridge University Press, 1987.

[2] L. Buoncompagni, A. Capitanelli, M. Cristofanini, A. Giuni, F. Mastrogiovanni, Carola Motolese, A. Nisticò, A. Sperindè, R. Zaccaria. Persuasive and polite sentences to drive human-robot interaction in smart homes for elderly care. Proc. of the 7th Italian Workshop on Artificial Intelligence and Robotics (AIRO), November 2020.

[3] https://arxiv.org/abs/2001.09977

Contacts:

Email: alessandro.carfi@dibris.unige.it, fulvio.mastrogiovanni@unige.it.