Human-robot collaboration in the medical field: new techniques of interaction and programming

PhD Candidate: Luigi Gargioni

Email: l.gargioni@studenti.unibs.it

XXXVIII Cycle

Tutor: Prof. Daniela Fogli

Co-tutors: Prof. Pietro Baroni, Ing. Dario Sala

Background

The research topic will concern the study and design of innovative techniques for interaction with collaborative robots and their programming by users not specialized in computer science or robotics.

Collaborative robotics is one of the most promising areas for the innovation of companies and processes. In particular, in the medical sector, several repetitive and low added-value tasks of healthcare workers can be identified, which could be delegated to collaborative robots. Therefore, it becomes crucial that such robots are easy to use and that their tasks can be defined by the users themselves.

Objectives

The interaction with collaborative robots needs to be redesigned, both in terms of the physical component and in terms of programming and use. As far as the physical aspect is concerned, considerable progress has been made: to the detriment of speed and efficiency, a collaborative robot is equipped with sensors that guarantee the safety of the people within its range of action, thus being able to become a collaborator to whom the most burdensome, tedious and precision tasks can be entrusted, while still retaining control of the entire process in human hands.

When it comes to programming and use, the most significant problem in this new branch of robotics arises. If collaborative robots are designed to be in close contact with the human operator in a work environment, they must also be easy to use by users who are not computer or robotics specialists. This concept is also easily extendable and probably most valuable in the medical sphere.

Methodologies

The techniques available in the field of Interaction Design will be used. User-centred design and/or participatory design approaches will be adopted by developing scenarios, personas, storyboards, wireframes, static and dynamic prototypes. It will then be necessary to carry out various experiments with users, to evaluate the validity of the proposed solutions and obtain the most truthful feedback possible on the progress of the development path taken.

Furthermore, various techniques from the field of artificial intelligence (AI), such as natural language processing and reinforcement learning, will be exploited. Also falling within the broad context of AI are the image processing techniques required to enable the robot to learn about and interact with its surroundings.

A more complete list of all the factors that come into play in Interaction Design is shown in Figure 1.
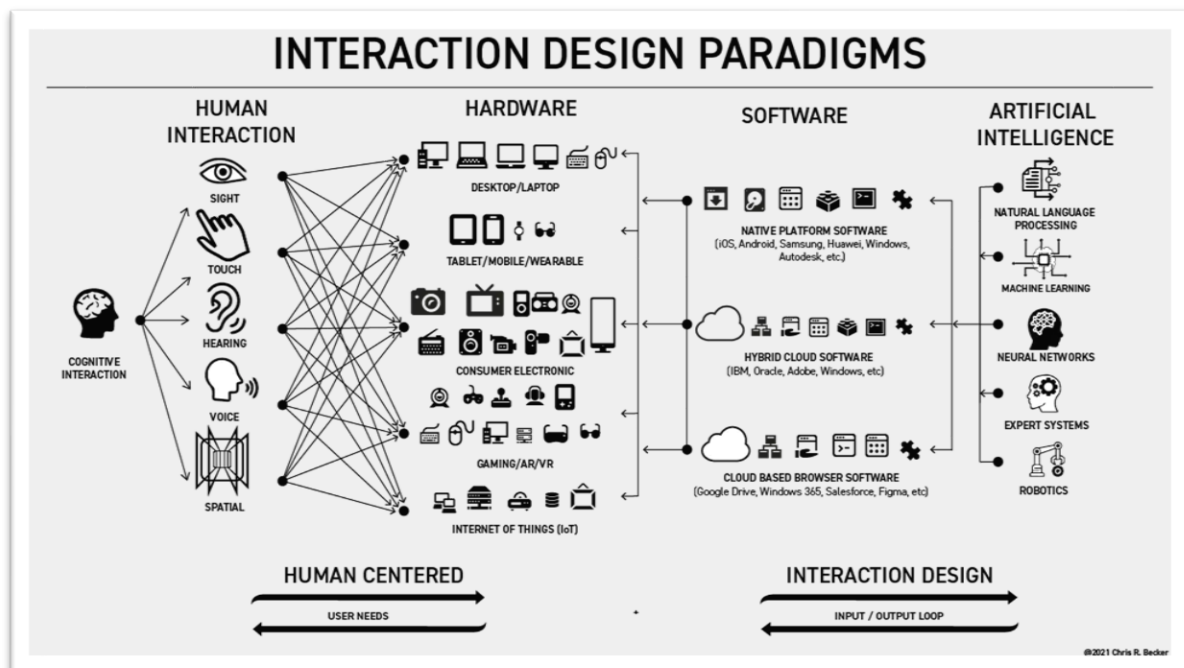

FIGURE 1 - A COMPREHENSIVE LIST OF HUMAN-COMPUTER INTERACTIONS: A REVIEW OF THE OPPORTUNITIES WITH HUMANS, COMPUTERS, AND SOFTWARE.
HTTPS://UXDESIGN.CC/A-COMPREHENSIVE-LIST-OF-HUMAN-COMPUTER-INTERACTIONS-D72EACA2C0DF

Expected Results and Impact

The research aims to train high-profile skills regarding one of the key technologies for the digital industrial transition, adopting a human-centered approach that enables its rapid and effective implementation.