Module 4 TRN CULTURAL COMPETENCE, Learning Unit 4.1 Practical Skills

Carmine Tommaso Recchiuto, Antonio Sgorbissa, Università degli Studi di Genova.

THEORETICAL COMPONENT

Principles and Values

This learning unit will provide a basic knowledge of the must-have practical abilities that users interacting with social robots should possess. Indeed, interacting with robots may seem scary for people that have never done it before. What should I do if the robot does not turn on? The robot is supposed to listen and understand the user's speech, but it is not doing that: what is happening? Why cannot the robot find its way to the next room? These are just an example of the high number of questions that inexperienced users may ask in their first attempts at using a social robot in real life. In this topic, participants will find answers to some of these common questions. It may be argued that those practical skills are strictly related to the type of robot used: however, this topic does not want to be a sort of tutorial for a specific type of robot. In fact, a set of general abilities may find application regardless of the robot used. Moreover, the same rationale applies to the common problems and malfunctions that can arise using those complex machines: while all robots are different, and hence they may experience different problems, these problems usually are provoked by similar causes, generate similar consequences, and, more importantly, may be solved with similar solutions.

The principles and values that guide this tool include:

- Effectiveness
- Innovation
- Professionalism
- Learning.

Aims

This learning unit aims to make participants aware of the practical skills and general abilities needed for interfacing themselves with robots and artificial agents. This course does not focus on a specific kind of robot, so information that may apply to a wide range of social robots will be part of this unit. This learning unit also addresses possible issues and malfunctions that can arise during using robots, which may cause concern in inexperienced users to deal with those situations without panicking.

Learning outcomes

Active participation in this training will allow students to:

- Know the main functionalities of robots and artificial agents, with the awareness of their limits and their capabilities.
- Develop the basic skills needed to interact confidently with social robots, focusing on the must-know aspects of human-robot interaction.
- Identify the most common problems that can arise during the interaction with robots, being aware of their causes and consequences.
- Know how to overcome the most common problems related to the interaction with robots.

Relevant definitions and terms

Actuator. An actuator is a component of the robot (Brooks, 1990) responsible for controlling a robot part and making it move, typically converting energy into a mechanical force that helps the robot achieve mechanical movements. An electrical motor is a very common type of actuator in robotics, which can be used to control robotic arms, hands, or wheels – if the robot is wheeled. Actuators usually require a significant amount of energy to move mechanical parts, and for this reason, all robots have limited energetic autonomy and need to be periodically recharged. For the same reason, many SARs have wheels, even if their upper body may have a humanoid shape in order to better communicate with people using gestures: wheels are more energetically efficient than wheels (and, obviously, biped locomotion may incur a higher risk of falling).

Artificial Agent. While robots are characterized by a specific embodiment (hence at hardware and software level), artificial agents are generically defined as a software agent (Wooldridge and Jennings, 1995, ch. 1), which can exist in a virtual world (e.g. chatbot or smartphone applications) or be integrated with a specific hardware, either very simple (e.g., vocal assistants) or complex (e.g. humanoid robot). In any case, even pure virtual agents may possess many characteristics typical of social robots, such as the ability of understanding and interacting with humans using natural language.

Network Connectivity._Almost all robots (and artificial agents) need to be connected to the internet to work properly. In some cases, the network connectivity is strictly necessary for letting the robot interact with the users: in other words, the robot does not work at all without an internet connection. In other cases, the internet connectivity may improve or enable some robot's capabilities, for example by making it able to convert the user's speech to text.

Robot Hardware. All physical components of a robot. It includes *sensors and actuators* (see below), but also joints (the "movable" components of robots), links (the rigid components, which connect adjacent joints), electronic boards, wires, the external cover. All these components together constitute the "body" of the robot, and in some sense influence the way in which the robot behaves (e.g., a robot with wheels will be probably able to move in the environment, while a robot with arms will be probably able to grab objects). However, these components alone are not enough: we need something that analyses the output of sensors, makes decisions, and finally controls the movements of the actuators and joints: the *robot software*.

Robot Software. Software is the complete set of instructions that determines the robot's behaviour. These instructions, usually coded in specific programming languages, are executed on the robot's electronic boards, or they can run in a different computer that communicates with the robot. In any case, these instructions usually analyse the data coming from the sensors onboard the robot, processing them to acquire knowledge about the environment and eventually taking decisions about the movement of the actuators. Ultimately, the robot software constitutes the intelligence of the system, defining its behaviour and the way in which it interacts with the surrounding world.

Sensors. Sensors are physical devices capable of measuring and recording a physical quantity as it evolves with time (Brooks, 1990). Some examples of commonly used sensors in robotics are: cameras (to capture images or videos); RGB-D or stereo cameras (to acquire 3D information about the surrounding environment); microphones (to capture audio); ultrasound sensors (to measure the distance from the closest obstacles); laser rangefinders (to measure the distance from obstacles with a higher resolution, usually to build a map of the environment); touch sensors (to detect collisions or allow people to physically interact with robots); encoders (to measure the movements of robotic parts).

Social Robots. A robot designed to interact with humans, with the ability to explicitly engage on a social and emotional level (Campa, 2016; p.106): for this reason, it should follow social rules and interact in a socially acceptable fashion. For example, a robotic butler for humans would have to comply with established rules of good service. It should be anticipating, reliable, and most of all discreet.

A social robot is typically characterized by some (or full) autonomy when communicating and cooperating with humans, eventually making decisions. Social robots usually have a human-like appearance or at least some typical characteristics of humans: a human-like embodiment may signal to users that the agent affords social interactions, hence usually increasing the robot's acceptability. Zoomorphic and pet-like robots are also considered social robots. They may be used in different fields based on their capabilities: social robots are mainly used as educators for children and assistants for the elderly.

One of the most well-known social robots is Sophia, developed by Hanson Robotics. Sophia is a social humanoid robot that can display more than 50 facial expressions. Other popular social robots are NAO and Pepper by SoftBank Robotics.

Social robots such as NAO, Pepper, Paro, Huggable, Tega, and Pleo have been increasingly used in healthcare settings. Other notable examples of social robots include ASIMO by Honda, Jibo, Moxi, and Kaspar, designed by the University of Hertfordshire to help children with autism learn responses from the robot through games and interactive play have. Individuals with cognitive impairments, such as dementia and Alzheimer's disease, may also benefit from social robots. Because of their supportive element in health care settings, some social robots are labelled as "assistive," giving birth to the term Socially Assistive Robot (SAR).

What the research says

Given the focus of this learning unit on practical skills, the scientific papers listed below focus on analysing how non-roboticists perceive robots and the main limitations for their widespread usage. Although investigating slightly different aspects, all reported references deal with the problems related to incomplete knowledge of the robots' practical skills: this may cause a limited willingness of people to use robots in their work (References 1 and 2), to purchase them (Reference 3), and excessive trust in their capabilities, which may ultimately have inauspicious consequences (Reference 4), or a lower confidence level in their safety (Reference 5). Even if not directly analysed in the presented literature, it can be inferred that a basic knowledge of practical robotic skills may be extremely useful also in the healthcare domain.

- ***Conti, D., Cattani, A., Di Nuovo, S. and Di Nuovo, A., 2019. Are future psychologists willing to accept and use a humanoid robot in their practice? Italian and English students' perspective. Frontiers in psychology, 10, p.2138.*** The paper investigates the attitude of Italian and British-English psychology students towards the use of robots in their future work. In this work, their confidence in having the necessary skills and their lack of confidence have been considered. Generally speaking, both Italian and English students felt that they did not have enough knowledge or practical skills to use the robot. However, Italian students were more inclined to take risks, perceiving the usefulness of robots and being more willing to use them. The study concludes that teaching basic computer programming skills even in psychology education may be beneficial to facilitate the use of social robots in this field. Available here.
- ***Kennedy, J., Lemaignan, S. and Belpaeme, T., 2016. The cautious attitude of teachers towards social robots in schools. In Robots 4 Learning Workshop at IEEE RO-MAN 2016.*** The article addresses the views of both the general public and education professionals towards the use of robots in schools. Although the overall attitude was quite positive, the authors have identified a set of problems that may limit their acceptance and have proposed some solutions. Among them, they call for a greater exposure of teachers to robotic systems to better comprehend their capabilities, their current limited performance, and their possible future applications. Available here.
- ***Mark La Pedus, 2016. Ready for Social Robots? Semiconductor Engineering,.*** The article analyses the obstacles toward a widespread diffusion of social robots in everyday life. The author underlines how the most recent social robots are still far from being humanoid-like intelligent robots, and they are functionally and socially limited. Indeed, the lack of practical skills, such as manipulation, has been the major limit of social robots so far. However, new technological solutions, such as Artificial Intelligence and more powerful hardware, may pave the way for a new generation of robots to meet market needs. Available here.
- ***Aroyo, A.M., De Bruyne, J., Dheu, O., Fosch-Villaronga, E., Gudkov, A., Hoch, H., Jones, S., Lutz, C., Sætra, H., Solberg, M. and Tamò-Larrieux, A., 2021. Overtrusting robots: Setting a research***

agenda to mitigate overtrust in automation. Paladyn, Journal of Behavioral Robotics, 12(1), pp.423-436. This very recent scientific paper deals with a relevant issue: the trust that users place in Artificial Intelligence and robotics. Indeed, individuals without a background in computer science and robotics may think that technology is more capable than it really is, and this may have different consequences. For example, the tendency to follow robots' suggestions even if they have earlier expressed faulty behaviour. Their conclusions suggest that robotic literacy should be included in all educational settings where robots are possibly employed, and that user manuals could stress the risks linked to overtrust. Available here.

- ***Rubagotti, M., Tusseyeva, I., Baltabayeva, S., Summers, D. and Sandygulova, A., 2021. Perceived Safety in Physical Human Robot Interaction--A Survey. arXiv preprint arXiv:2105.14499.*** The article focuses on how users perceive social robots in terms of safety. Indeed, the authors point out how robots should not only be inherently safe: they should also be perceived as safe. Not surprisingly, the survey underlines how, in the reported experiments, subjects with prior experience interacting with robots report having a higher confidence level in their safety. Available here.

What do national legislation and international/European treaties and conventions say on the topic?

- **ISO 13482:2014, Robots and robotic devices — Safety requirements for personal care robots.** International standards exist to guarantee compliance of robots with safety requirements, which are covered by ISO13482:2014 Robots and robotic devices – Safety Requirements for personal care robots. Overall, the standard specifies requirements and guidelines for the inherently safe design, protective measures, and information for the use of personal care robots. While the standards generally define requirements and guidelines for mobile servant robots, physical assistant robots, and person carrier robots, specific safety requirements for social robots include hazards related to charging batteries, robot motion, contact with moving components, robot stopping functions. Available here.
- **Expert Group on Liability and New Technologies, Liability for Artificial Intelligence and other emerging technologies, 2019.** In November 2019, the European Commission published a very important document, "Liability for Artificial Intelligence and other emerging technologies." The report addresses the problems raised by autonomous, intelligent behaviour when damage occurs and victims seek compensation. Specifically, the report discusses how the capability of robots to autonomously perceive the environment and take decisions accordingly can make the existing regulations inadequate or obsolete. Only regulation to determine the so-called "strict liability" is harmonized at the EU level: strict liability covers all cases in which damages are caused by a defective product, which turns out to be inappropriate in the case of intelligent systems and robots in particular. For example, a SAR may not be defective when it exits from the factory, but it may learn and adapt its behaviour as it acquires new information during usage. To which extent will the producer (or a third-party operator that uses the robot) be liable, in this case? The report discusses this and other aspects that should be taken into account to allow AI and robotic technologies to become part of our lives, suggesting the use of obligatory insurance schemes for AI programs and robots and other possible solutions. Available here.
- **The Topol Review – Preparing the healthcare workforce to deliver the digital future (Topol, 2019).** This review is an independent report on behalf of the UK Secretary of State for Health and Social Care, presented in February 2019. While the report generally underlines how digital developments will change the roles and functions of the clinical staff in the near future, it also has a dedicated section on Robotics. The report underlines how clinicians will need to understand the technology and be trained to use it in the right manner and with confidence by possessing the fundamental skills neded to maximize its potentials. Available here.

Practical Component

Learning Activities

Activity 1: Digital skills of the future.

- Watch a video about the Topol report (available here, 10 min.) about the importance of digital and robotics literacy in the education of healthcare personnel.
- After watching the video, you are asked to answer a few questions (given below).
    - What digital skills do you believe will be more important in your profession?
    - For which of these skills do you think to be not enough prepared?
    - For which of these skills do you think to be already prepared enough?
- You are invited to discuss your answers with other participants on the social platform for collaborative learning. We encourage you to read the Topol report (Topol, 2019) for further information.
- Resources needed: YouTube video, social platform for collaborative learning.
- Duration of activity: 15 minutes.

Activity 2: Explore basic skills and common problems linked to the usage of social robots.

- This activity requires you to watch a video playlist (available here, 6 mins.) specifically created for this Learning Unit. The videos will show some practical skills and must-know instructions needed for the daily usage of social robots, in particular the humanoid robots NAO and Pepper (Softbank Robotics, 2021) (e.g., how to charge the robots, how to handle them, how to force them to stop, ...).
- You are encouraged to discuss the watched videos about what they have learned on the social platform for collaborative learning, also considering the provided elements of discussions.
    - What scares you the most about the practical usage of robots?
    - What are the videos in the playlist that look most useful to you? And why?
    - What are the practical skills needed to use those robots you already thought you had?
- Resources needed: YouTube playlist, social platform for collaborative learning.
- Duration of activity: 15 minutes

Activity 3: Working with robots. Finding solutions to common problems.

- You are invited to interact with a short textual game (a sort of multiple-choice adventure, available here) in which you have to do some activities with a robot and solve all the practical problems that need to be addressed. The game is structured with multiple choices to allow you to learn some new practical skills needed for interacting with robots.
- Resources needed: Adventure game website. You do not need to register/log in to play the game; just press the green button. The link also provides some additional instructions.
- Duration of activity: 10 minutes

Assessment Component

Assessment Activities

Activity 1: A simulated interaction with a social robot.

- You need to interact with a chatbot that simulates realistic situations that may occur when interacting with a robot (available here).
- Unlike practical activity 3, here you need to reply with open answers to the problems/situations that the chatbot will present. Based on your answers, the chatbot will give a positive or negative feedback. After three "wrong" answers, the chatbot will help you, giving you the possibility to proceed with the dialogue. The activity is completed when the chatbot announces that the dialogue is over. Please consider that the right/wrong answer detection is based on keyword: it may happen that you give the right answer, but the robot does not recognize it.
- Resources needed: chatbot website. You do not need to register/log in to play the game; just press the green button. The link also provides some additional instructions.
- Duration of activity: 10 minutes.

EVALUATION COMPONENT

Participants to evaluation

The online evaluation questionnaire of each Learning unit is completed by the MOOC participants (students and student/facilitators) on Survey Monkey

What to evaluate

The Learning Unit's evaluation criteria are: coverage of the identified learning needs, innovation, quality of the content and training materials, intuitive and friendly presentation, relevance of learning activities, and efficiency for achieving established learning outputs.

Please, complete this online evaluation of the learning unit by clicking on this link:

https://www.surveymonkey.com/r/LT2XXG6