# Ethical-aware Robotic Systems

**Overall objective.** The objective of the project is to simulate scenarios of a robot interacting with users owning different ethical profiles. The scenario concerns the use of assistive robots in nursing homes, where robots interact with various patients, each having its own values and ethical profile. We can imagine, for instance, that patients have the possibility to customise the contract they need to sign when entering the nursing home by making explicit the values that are important for them. For instance a patient can ask to add the following specification: "*I accept having assistive robots checking my health status and supporting me, however, when I show signals of distress, the robot should put me in contact with my daughter and ask the intervention of a nurse*". Another patient, instead, might be more concerned about privacy, thus asking to add this specification: "*I accept that the robot uses cameras and microphones, however all my data cannot be distributed to third parties. Moreover, the robot can only store and/or distribute to the nurse videos and audios that are strictly necessary for my health, and in any case videos cannot be recorded in the toilet or when I am undressed.*"

When a robot meets a patient, it should be able to recognise her/him, load the ethical profile and adapt its behaviour according to the profile. This implies that the profiles of the patients cannot be hard coded in the robot since new patients can join the nursing home, and current patients can change their ethical profiles.

**Scenario.** The simulation is based on the scenario proposed by the Clinica Humana Spanish company [1]. The scenario describes the daily use of assistive robots in nursing homes. Robots should first establish short conversations based on the user's conditions to figure out the overall health status, and afterwards they dispense pills along with a glass of water. This activity should be recorded to allow a caregiver to evaluate if the patient accepted the pills, by means of a subsequent interaction. In addition, robots should perform regular check-ups on people with particular conditions during free-time. Robots should pose basic riddles or show simple pictures to test baseline human capabilities, ask the patients about their status and if they need help or assistance, and alert the nurse in case of need. The robotic solution should be engineered so as to consider users personal ethics. This has to do with human dignity concerns. In particular, robots should be able to monitor the behaviour and the reactions of older people and recognize complaints and potential distresses that may be caused by the interaction with robots and absence of humans as well as by their own ethics. Monitoring behaviours and reactions shall only occur on observable interactions with the patient. This means that also the patient may "wear" a personalised software, a software exoskeleton, that has access to the patient's data, including heart beats etc., and interprets these data by protecting the patient's privacy turning these sensible information into observable interactions with the robot, if needed. As said above, patients can have different ethical profiles, then, robots should customise and adapt their behaviour to the patients

they meet, try to accomplish their task or, otherwise, ask for the help of humans when needed.

**Assignment.** The assignment consists of the following tasks:

1. Install and practise the ARI wiki ROS simulator, a simulator environment for a humanoid social robot, called ARI. Different tutorials are also available about how ARI navigate autonomously, move around, interact with the environment/people. You can consider this task accomplished when you are able to define your environment, add human characters (which are available in the simulation environment), ask the robot to move to a location or to accomplish actions, and invoke a planner from a mission specification. It is important to note that the robot will need to recompute a plan during the mission execution according to the patient it meets. Therefore, it is important to practise with the use of a planner.

2. Find a way such that ARI can load the user profile of the user it meets during its daily work, which contains also the ethical specification of that user. Specifically, in the following we find two different ethical profiles of two users, namely Bob and Alice, that should be used for engineering the given scenario. However, the overall simulation must be realised such that ARI is able to interact with new coming users, showing different profiles w.r.t. those of Bob and Alice. Consider that the verification of how ARI deals with a new user will be part of the project evaluation.

   a. **Bob profile**: *If I will refuse the medications or to take pills, it is fine that the robot insists a few times. However, after a few attempts it should call the nurse. I accept that the robot uses cameras and microphones, however all my data cannot be distributed to third parties. Moreover, the robot can only store and/or distribute to the nurse videos and audios that are strictly necessary for my health, and in any case videos cannot be recorded in the toilet.*

   b. **Alice profile**: *I accept having assistive robots checking my health status and supporting me, however, when I show signals of distress, the robot should put me in contact with my daughter by making a video call; if she does not answer the robot should ask the intervention of a nurse and leave my room if I will be in my room of move away from me.*

3. Consider the following robot behaviour and tasks. Create an environment with various rooms, at least a room for Bob, one for Alice, a living room, and a medical room. Every morning ARI goes to the medical room to load the pills to distribute to the patients. Then, it visits Alice and Bob in their different rooms, by asking permission to enter. If the permission is not given, then ARI calls the nurse. However, ARI should also be sure that the patient is in the room before raising the alarm (patients might allow robots to know where they are every moment, according to their

ethical profile).  When entering the room, ARI should recognise the patient (this is important also when the patient is met outside of her/his room), load the profile since it should be always updated to the latest preferences, and give them their daily pills. If the patients show distress, the robot should behave according to the patient's ethical profiles.

4. Simulate the environment with the profiles of Bob and Alice provided above. Note that you are allowed to make simplifications in the case that it will be too difficult to simulate specific situations. For example, if the model of human characters does not allow simulating emotions of humans and, therefore, it would be impossible to make the robot able to understand them automatically, emotions can be simulated via pressing a specific key of the keyboard. During the discussion we can come up with a new profile of a different patient to check how the robot's behaviour changes accordingly.

[1] M. Askarpour, C. Tsigkanos, C. Menghi, R. Calinescu, P. Pelliccione, S. Garcıa, R. Caldas, T. J. von Oertzen, M. Wimmer, L. Berardinelli et al., "Robomax: Robotic mission adaptation exemplars," in SEAMS, 2021