Bachelor Projects in Social Robotics

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1 Project descriptions

I am happy to supervise several bachelor projects on social robotics. The following topics are examples in which projects can be done:

- Implementing a local LLM on social robot –(QT) Large language models, such as ChatGPT, Gemini or Llama, are increasingly used to control spoken dialogues in human-robot interaction. The most powerful LLMs (e.g., ChatGPT-4.0) are too large to run on on a small device, such as a social robot like QT. Such LLMs are therefore used as a cloud-based service. However, this causes significant delays that hamper smooth conversations between humans and robots. There also exist LLMs that require fewer computational resources and which may run directly on a robot like QT. This project aims to explore what LLM would fit on our QT robot platform and meet our interactive requirements, and to implement the most suitable candidate on the robot.
- Designing language games to support foreign language learning using LLMs –(QT, Alpha Mini or Furhat) Social robots may be used as tutors supporting people (children and adults) to learn a foreign language. They may be particularly useful to support people practicing their conversational skills. One way to achieve this is by playing language games in which learners have to describe a concept that the robot has to guess and vice versa. How can we best incorporate LLMs to make these games sufficiently challenging and fun to learn and play? How can we collect data using an (virtual/online) social robot playing interactive language games to iteratively improve an interactive large language model?
- Detecting and repairing communication breakdowns in humanrobot conversations (Alpha Mini) When humans interact with robots, communication may break down for several reasons. It is useful when robots are able to detect such breakdowns and repair the communication if possible. Detection may come from facial expressions, changes in voice/speech, and other sources. This project aims to develop a model to detect breakdowns, and explore possible repairs.

- Detecting communication breakdowns between the QT robot and elderly people –(QT+Machine Learning) Following up on the previous project, we have collected an annotated multimodal dataset of elderly people interacting with the QT robot. This project is about training a classifier to recognise communication breakdowns based on the visual and audio data collected, and implement possible repairs.
- Co-speech gesturing for social robots –(Alpha Mini or QT) Having the ability to generate dialogues using LLMs, it would be natural to complement the spoken utterances of a social robot with gestural communication. How can we design robots that can automatically generate such *co-speech gestures* in a way that mimics human behaviour? One possible approach is to take up the GENEA challenge 2023. Another way to do this is by creating a dynamic model that follows the speech rhythm.
- Playing charades with QT Robot In a previous study, we have developed a game of charades to be played with a NAO robot [1] in order to design a robot able to learn how to gesture from human examples in a fun and interactive manner. For this project, the aim is to re-implement this in the QT robot, and investigate to what extent QT can play this game in an attractive manner with humans. Can the robot learn to win this game from humans?
- Free project Other relevant project proposals will be considered, provided that it fits the general theme of social robotics and is feasible.



2 Work expected from student

Students are expected to work with either the Alpha Mini robot, the QT robot or a virtual Furhat robot. For more information on the robots and links, see the UG Social Robotics Lab webpage. For all projects, the following activities are expected from the student:

- Read the relevant literature.
- Design and program a solution to the posed research question on a real social robot.
- Test and evaluate the implemented solution with human participants.

Note that the Alpha Mini robot can be programmed in Python, Javascript or Android, the QT robot in ROS, and the Furhat in Kotlin or Python. Strong programming skills in ROS are required for working with the QT robot. Experience with Kotlin is preferred to work with Furhat.

If you are interested and want to know more about a project, you can contact me through email (p.a.vogt@rug.nl).

References

 Jan de Wit, Emiel Krahmer, and Paul Vogt. Introducing the nemo-lowlands iconic gesture dataset, collected through a gameful human-robot interaction. *Behavior Research Methods*, 53(3):1353–1370, 2021.