

Bachelor Projects in **Social Robotics** and **Human Behaviour Understanding using Machine Learning**

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I am happy to supervise several bachelor projects on social robotics and on human behaviour understanding using machine learning. The following topics are examples in which projects can be done:

Social Robotics

- **Developing HRI for people with aphasia** There are many people who suffer from aphasia, mostly as a result of a stroke. These people might benefit from a social robot to support them recovering their speech [1]. This project aims to explore how social robots can support this group of people, and develop a prototype interaction between a robot and People with Aphasia (PwA). This project will become part of a new multidisciplinary collaboration with speech therapists, researchers and students from the UMCG and the Hanze University of Applied Science. **Main method: User-Centered Design; Social Robotics; Multidisciplinary teamwork**
- **Optimising HRI with a new prototype social robot** We are currently developing a new social robot to be used in our education (e.g., social robotics practical) and research. The first prototype is ready and needs to be tested and evaluated. The main task is to design, implement and evaluate some human-robot interaction that involves all features of this new robot. **Main method: HRI design, Robotics**
- **Second language tutoring with social robots** Generative AI offers many new opportunities to investigate how social robots can contribute to people's language learning. In this topic, you can think of designing and carrying out an experiment in second language education, either for children or adults. A few ideas:
 - Last academic year, we explored how AI-generated music can be used to teach children new vocabulary using a social robot. In this project, the aim is to replicate this study in a larger experiment.
 - Design games for learning/teaching specific grammar/vocabulary elements to children or adults.

- Design games involving interactions mediated by a tablet interface using the QT robot.

Main method: Human-Robot Interaction Experiments

- **Open project** It is possible to explore own ideas relating to social robotics and human-robot interaction, especially if they concern 'grounding communication'.

Human Behaviour Understanding using Machine Learning

- **Detecting communication breakdowns in HRI through machine learning** [together with Dr Matias Valdenegro-Toro] People send various social signals when communication is disrupted (e.g., lowering eye-brows, opening mouth, changing posture and producing sounds). We have a corpus of video data with elderly people interacting with a social robot [2]. During the interaction, communication is disruptions occur regularly. The aim of this project is to train a machine learning model that can reliably recognise communication breakdowns from both audio and visual cues. **Main method: Machine Learning**
- **Analysing children's multimodal communication from video** Communication between humans is essentially multimodal (i.e. involving not only speech, but also hand and body movements, facial expressions and more). It is widely believed that non-verbal aspects of communication aid in meaning formation, allowing –among others– children to learn language. From 2009-2011, I collected a large video corpus of children interacting with their social environment (parents, siblings and other family members) in different cultures [3]. These data have been manually annotated, but to what extent can we use modern AI techniques to carry out similar –or even more sophisticated– analyses to study how children's multimodal behaviour supports language learning. The aim of this study is to explore how to apply state-of-the-art AI techniques to analyse multimodal communication from these videos (see, e.g., EnvisionBox.org for inspiration). **Main method: Behaviour Understanding; Machine Learning**

What is expected from students?

For the HRI studies, students are expected to work with either the Alpha Mini robot or the QT 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: 1) Read the relevant literature. 2) Design and program a solution to the posed research question. 3) Test and evaluate the implemented solution, either with human participants or as a standard ML evaluation.

Note that the Alpha Mini robot can be programmed in Python, Javascript or Android. Some programming skills in ROS with Python or C++ are required for working with the QT robot.

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

References

- [1] Peggy van Minkelen, Emiel Krahmer, and Paul Vogt. Exploring how people with expressive aphasia interact with and perceive a social robot. *International Journal of Social Robotics*, 14(8):1821–1840, 2022.
- [2] Paul Vogt, Yara Bikowski, and Matias Valdenegro-Toro. Confusion detection from facial expressions in elderly-robot interactions. In *Companion of the 2026 ACM/IEEE International Conference on Human-Robot Interaction*, to appear.
- [3] Paul Vogt and J. Douglas Mastin. Anchoring social symbol grounding in children’s interactions. *Künstliche Intelligenz*, 27:145–151, 2013.