Developing Software Tools for the Analysis of ASD Child-Robot Interactions

Project Proposal for Juliette Grantham
Mentor: Chien-Ming Huang
Faculty Advisor: Brian Scassellati

I will be undertaking my semester-long senior project under the guidance of Chien-Ming Huang and the supervision of Brian Scassellati. My project will supplement the ongoing work of Chien-Ming by developing software tools that will facilitate the analysis of data recorded during interactions between a socially assistive robot and children with autism spectrum disorders (ASD).

A range of social impairments is common in children with ASD, but research has shown that early intervention therapy can significantly improve social skills in ASD children and consequently increase quality of life. Due to the rising prevalence of ASD, administering quality affordable care to all children who need it has become increasingly difficult, and thus the problem has attracted growing concern in recent years. Fortunately, research has shown that many children with ASD can benefit from therapy conducted with socially assistive robots, which increases the feasibility and affordability of administering extended care on a broad scale.

Chien-Ming has designed a socially assistive robot and interactive tablet software to conduct therapeutic interventions for children with autism spectrum disorders. The robot conducts the therapy by walking children through various activities, giving instructions, and providing feedback throughout therapy sessions. The robot also directs the gaze of children by facing its own eyes toward relevant stimuli, and the system includes cameras that track children’s eye movements.
This project is designed to assess and improve a range of social skills in children with ASD. Some activities require children to work with a parent or guardian and seek to promote taking turns in interactions. Other activities assess and develop children’s perspective taking skills and emotional understanding. Throughout all of the activities, the robot directs the gaze of the children toward the screen of the tablet or toward a guardian in order to develop tendencies to both follow gaze cues and to maintain visual joint attention.

My role will be to develop software tools to facilitate analyzing data collected during interactions between children with autism spectrum disorders and the socially assistive robot. Chien-Ming will be putting thirty robots in thirty homes for thirty days, and the software tools that I create will be used to help extract insightful information from the resultant corpus of data so that we can better understand the interactions between ASD children and the robot. These understandings will be useful in further improving the design of the system and thus increasing the quality of the therapeutic robot interventions.

The data will contain information on the accuracy with which ASD children complete various activities and on the direction of children’s gaze at different points throughout the therapy. All interactions will be video-recorded, so the system may also be made to detect and report a range of facial expressions. The software tools I create, likely in Python, will be used to extract this kind of information from the system log files and create graphs that allow visualization of general trends and patterns that characterize the children’s interactions with the robot. For example, we might gauge progress by how often children make eye contact with the robot, how frequently they pick up on or follow
gaze cues of attention, and how regularly they maintain joint attention. Gaze analysis can also be used to help determine which activities best facilitate social interaction and keep the children most engaged. We can interpret children’s accuracy scores to determine in which areas they excel, in which they may need more practice, and in which they show improvement. Additionally, the scores will allow us to gauge each child’s level of understanding of different emotions and social situations. Furthermore, data on facial expressions may help to determine which aspects of the therapy most engage children, which most frustrate them, and which they most enjoy. Since such a large amount of data will be recorded during the child-robot interactions, the software tools I develop will be valuable in detecting these kinds of trends by processing, interpreting, and illustrating the data in a way that is easy to analyze and that creates useful contexts in which to evaluate the interactions.

Overall, this project will involve considerable amounts of data mining with the goal of understanding the interactions between children with ASD and a socially assistive robot. The result will be useful in gauging the effectiveness of child-robot therapy, discovering ways in which the existing system can be improved to provide higher quality therapy, and providing information that could allow for the creation of more personalized therapy. This project is the first of its kind, and thus we are interested in observing as many aspects of the child-robot interactions as possible. We are interested in exploring all of the trends enumerated in the previous paragraph and likely more as we gain new insights along the way.

The results of the analysis of the child-robot interactions in this project will contribute valuable evidence to the investigation of the viability of using socially
assistive robots to conduct and support therapeutic interventions for children with autism spectrum disorders.