Infrastructure for autonomous in-home Socially Assistive Robotics

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Objective

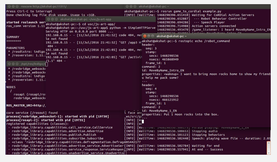
Creating robust and easy-to-use infrastructure for conducting autonomous long term in-home studies for Socially Assistive Robotics

Introduction

- The goal of Socially Assistive Robotics (SAR) is to create close and effective interaction of a robot with a human user for giving assistance and achieving progress in convalescence, rehabilitation, learning etc.[1]
- SAR focuses on assisting people through social, rather than physical, interaction
- Children with ASD have communication deficits and difficulties in social interaction, however SAR has promise as a therapeutic tool because children with ASD express interest in interacting socially with machines [2,3]
- Conducting long-term studies with robots kept in the homes of kids with ASD for extended durations of time requires a very robust infrastructure base that is easy to use, friendly and most importantly, secure.

Containerizing full software stack

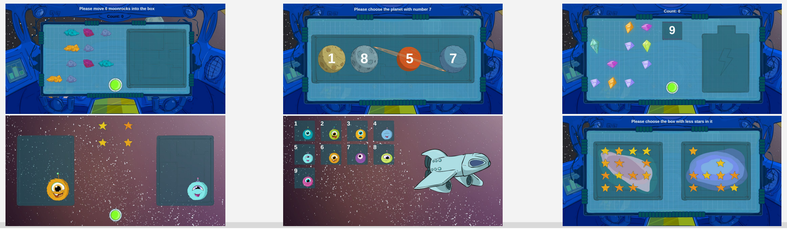
- Packaged and containerized all dependencies for CoRDial, games, ROS interface and NGINX, ensuring **easy installation** and **complete portability** across all operating systems
- **Graceful startup and shutdown** of the entire software for in-home study through **Docker**
- Starting the software is as easy as writing a **single command**!
- Robot prompts the child to play the game, receives the child's touch interaction and responds with appropriate facial expressions, body movements and language.
- Modifying the software even during the study made very simple



```
$ docker-compose up
```

Number concepts game

- Developed a Javascript based **platform-agnostic** game targeting ordering and sequencing skills in children[4]
- Developed the game's interface with the Sprite robot through CoRDial
- Developed a **child-proof** Android launcher application
- The child has to recognize **number symbols**, understand relative magnitudes, arrange objects in a sequence
- The robot acts as a knowledgeable peer, giving **auditory and visual response** based on the child's attempts



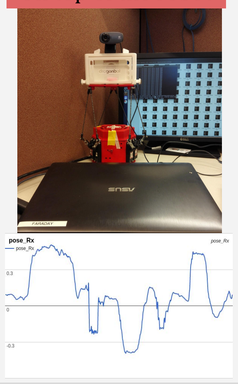
Facial Recognition

- Working on integrating facial recognition[6] into OpenFace
- Will enable robot to distinguish between different children as well as their parents, allowing it to modify its behavior accordingly.
- Will also allow **annotation** of collected visual data with the **participant names** for in-depth analysis by researchers and will open more avenues for research

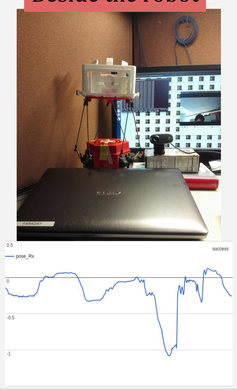
Facial Analysis

- **OpenFace**[5] is a state of the art **facial analysis** suite for head pose estimation, eyegaze tracking, facial landmark detection, and facial action unit recognition.
- Developed a **ROS wrapper** for OpenFace which publishes all the data obtained from OpenFace on ROS topics, hence creating an interface with the robot for **real-time use.**
- Developed a plugin for tracking the **child's attention** by using head pose estimation and determining whether child is looking at the tablet, or at the robot, or elsewhere
- Found the **optimal position for the camera** in the Expeditions study set-up, based on clarity of results from head pose estimation at different camera angles

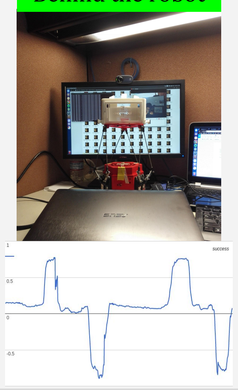
On top of the robot



Beside the robot



Behind the robot



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[6] Amos, B., Ludwiczuk, B., & Satyanarayanan, M. (2016). OpenFace: A general-purpose face recognition library with mobile applications.

Acknowledgements

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