Improving non-verbal communication in Socially Assistive Robots through expressivity

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Introduction

The Interaction Lab focuses on Socially Assistive Robots (SAR), which approach helping people with differences in a social instead of physical way. Socially Assistive Robots can provide support for people with disabilities such as Autism Spectrum Disorder (ASD) and Attention Deficit / Hyperactivity Disorder (ADHD). For example, college students with ADHD face a difficult transition from home life to college, with personal responsibilities and school work. It is challenging for these students to adapt to a new environment such as college. They struggle with accountability and consistency. Robots are a great way to add stability to their lives, but how these robots approach these students creates challenges. It is important that they are able to communicate with these students in a visual way in addition to a speaking. Robots are able to communicate through facial expressions.

Objective & Impact of Dr. Matarić's Research

Dr. Matarić's research has focused on Socially Assistive Robots or SAR. Dr. Matarić started her career focusing on helping people who need help to help themselves. She wants robots to provide the guidance necessary for people to help themselves. At the beginning of her career, she focused on cardiac and stroke rehabilitation. Then she focused on Autism research and K-12 outreach.
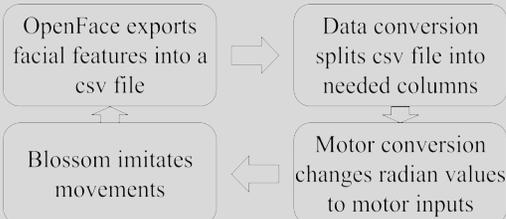

Fig 1. This is the process Blossom uses to imitate facial movements

Skills Learned

Fig 2. Below are logos of software programs I used during SHINE

PC: Python Software Foundation
PC: Tensorflow Blog
PC: 1000logos.net

Throughout our project, I learned how to:
- Code in Python
- Code in Arduino
- Work with the terminal
- Wire basic electrical components
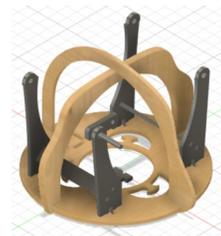- Splice wires
- Work in Fusion 360

Fig 3. Blossom's structure for its eyebrows in Fusion 360

How This Relates to My STEM Coursework

In our work, I was able to use concepts from:
- Programming experience
- Physics and engineering knowledge
- Trigonometry and Calculus concepts math
- CAD experience

And I can apply these ideas:
- As a designer and programmer for my school's new FRC Robotics Team
- Through computer science clubs and activities
- In computer science courses

Results and Conclusions

My work at SHINE can be separated into two parts: building the expressiveness directly into Blossom's face and the head pose imitation. Both these parts helped build expressiveness into Blossom[1]. For the physical communication, we added eyebrows to Blossom to help add different emotions; by adding eyebrows, we created three different positions, neutral, upward, and downward. These positions triple the different motions the head can produce.

Fig 5. Blossom imitating facial positions

Fig 4. Blossom with eyebrows

For imitating facial positions, we used an open-source software called OpenFace. OpenFace allows us to track the facial positions of any person. The software then exports the data to a CSV file, which opens as a spreadsheet. This file has over a million data points, and we only need four columns. In order to extract the data we needed, we used Google CoLab. This free python service allowed us to get the columns we needed. One at a time, we graphed the data points to the motors. Finally, we took the last line from the constantly updating CSV file to have real-time imitation. Figure 1 describes the real-time imitation.

References

1. Tiago Ribeiro Universidade Técnica de Lisboa, et al. "The Illusion of Robotic Life: Proceedings of the Seventh Annual ACM/IEEE International Conference on Human-Robot Interaction." *ACM Conferences*, 1 Mar. 2012, https://dl.acm.org/doi/abs/10.1145/2157689.2157814?casa_token=CmRRR0lX3y4AAAAA%3A UF7DEk_KF0DJCQyP4me6knsCJzEoDXP9m1 gPdDICqtKFh46MCuZwtGc5zrT7MbzKRtRJrxG K1gIoOg.

Click on the link in the folder to watch Blossom imitate someone's movements!

Acknowledgements