

# Designing an emotive robotic face to inspire trust in autonomous rehabilitation activities

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Introducing robots into physical rehabilitation can both decrease costs and improve outcomes[1]. However, regardless of technical ability, if the patient is unwilling to cooperate with the robot, it will ultimately be ineffective. We wish to introduce Lil'Flo, a robot whose central point of expression is an LED-based emotive face. We outline the design decisions made in constructing Lil'Flo's face, highlighting how each feature fulfills our two core design goals: making sure Lil'Flo can both be easily assembled and disassembled, as well as be a comforting presence that patients will be willing to engage with.

## Introduction

- Millions of people suffer from motor impairment disorders, such as Cerebral Palsy (CP) in the U.S. [2]
- Rehabilitation for these disorders is costly and requires supervision by clinicians, making constant care difficult
  - These problems are exacerbated for patients in remote areas, who have limited access to clinicians
- To increase effectiveness, as well as decrease overall cost, we are working to introduce robots into the process
  - Initially through telepresence interactions, where the robot, under clinician supervision, can work directly with the patient
- If successfully integrated, the robots will lighten the burden on people working in rehabilitative fields, increasing overall efficiency of the process, while also opening new possibilities for interaction
- For the robot to be effective, the patient must be able to accept and cooperate with the robot
  - Design of the robot is crucial in patient acceptance

## System Design

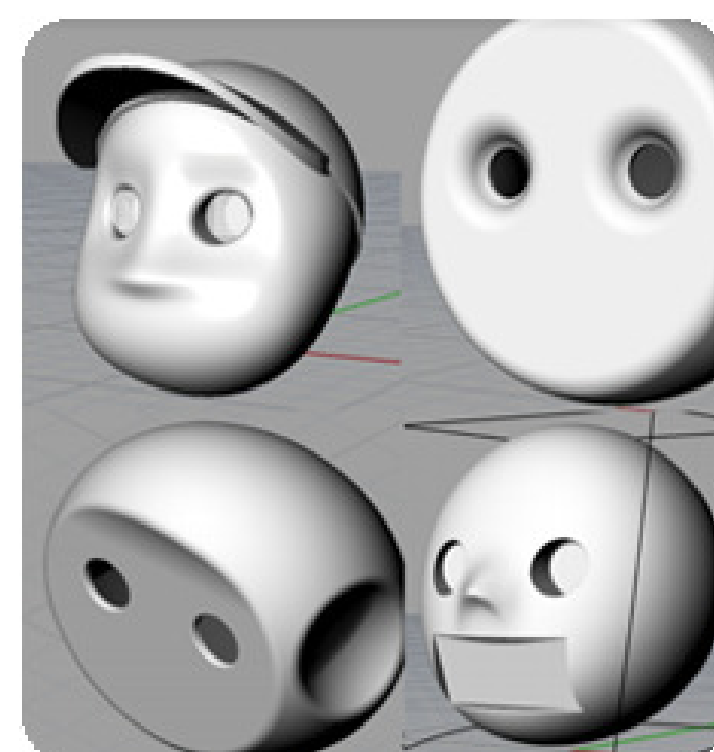
- System is split into two major components, a mobile base and humanoid
  - The base collects data (audio, visual) and physically supports the humanoid
  - The humanoid interacts directly with the patient
- LED-Based digitally emotive face enables variety of expressions
  - Design puts focus on simple, abstract face, which conveys friendliness [3]
- The successor to a previous project, named Flo
  - Key Difference: Lil'Flo is produced in-house, allowing us to tailor its functionality to only what's required, reducing costs [1]



Lil'Flo's (Left) general shape juxtaposed with Flo's (Right)

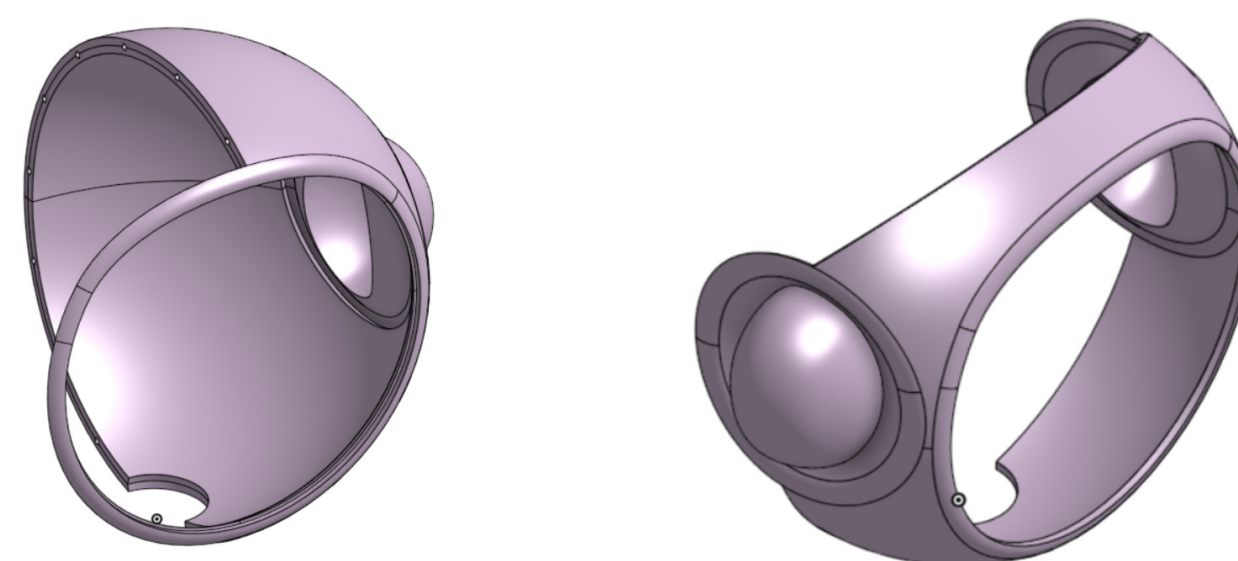
## Methods

- Face is designed to be presentable and modular
  - Human-Like Face to evoke comfort, but simple and abstract to avoid uncanny valley[4]



Potential shapes for Lil'Flo's head. The chosen shape is in the bottom left

- Initial head partition made assembly difficult
  - Switched to current design to allow for easy and consistent assembly
  - Inadvertently created a crude "hairline", improving aesthetic value of Lil'Flo



The initial and current partitions for Lil'Flo's head and face

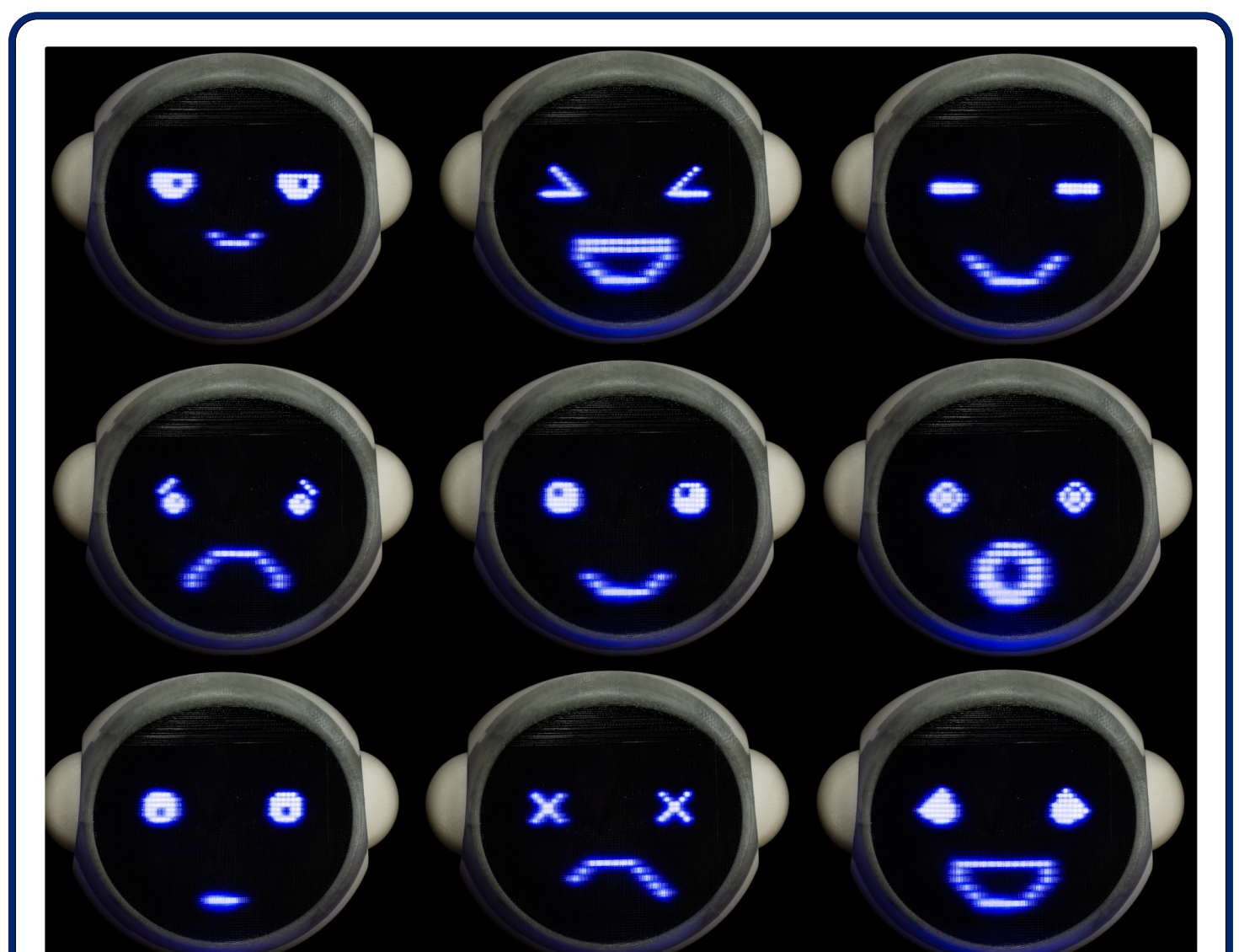
- Shell: 3D Printed with dark epoxy cast directly into the print to create the face front
  - Colorant is diluted to obscure internals while letting LED shine
  - Main goal in designing shell internals: Robustness in dis/reassembly



Isometric view of Lil'Flo shell, showing internals

## Future Directions

- Plans to conduct an experiment that determines the effectiveness of the emotive face
- Two phase experiment, between static and emotive face
  - Simple exercise games, mainly designed to gauge patient reaction to Lil'Flo
- Data collected includes subjective surveys, pulse rate, and video data
  - Surveys concern subject engagement, cooperation, and trust in Lil'Flo in the context of the games
  - Pulse data and video footage will address irregularities in data



Some of Lil'Flo's potential faces to be utilized during activities. Center face is for static-testing

## Acknowledgements

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## References

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