Single Arm Myoelectric Exoskeleton (SAM-E) and Modular Leg Exoskeleton (MLX)

INTRODUCTION

Exoskeletons are usually aimed more towards medical purposes, but our team has been working to create exoskeletons that enhance strength. We have two exoskeletons, Lexo, and SAM-E. Lexo (Leg Exoskeleton) is designed to offload a weight of at least 70 lbs to the ground. While offloading the weight, it still allows the user to move in the same way as without the suit, completely unhindered. Meanwhile, SAM-E is the second prototype of our upper-body exoskeleton system. It was designed with the goal of increasing the strength of the elbow proportionally to muscle signals from the biceps and triceps.

MECHANICAL DESIGN: SAM-E

The second prototype of SAM-E focuses on using pnematic air muscles to mirror arm muscles and enhance the wearers arm strength. A new frame was designed to accomodate the air muscles for optimal positioning and to better and more comfortably secure the frame to the wearer's arm.

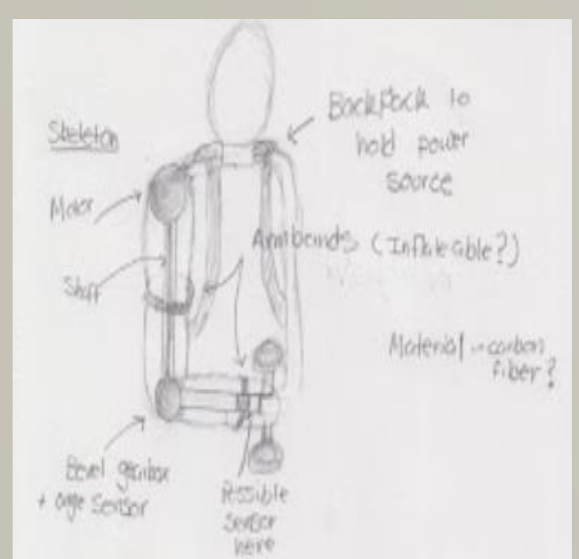

Figure 1. Bledsoe extender arm post-op elbow brace that inspired our design, in particular the malleable cuffs with padding and the adjustability.

Figure 2. Current SAM-E design containing malleable cuffs with padding, as well as adjustability.

MECHANICAL DESIGN: MLX

For the mechanical design of the exoskeleton, focus was placed on the adjustability of the frame, making it more sleek, and designing it to be modular and have components be easily adapted. It uses motor actuation at knees and hips, and it has a spring ankle design that will ensure a continuous load-path to the ground.

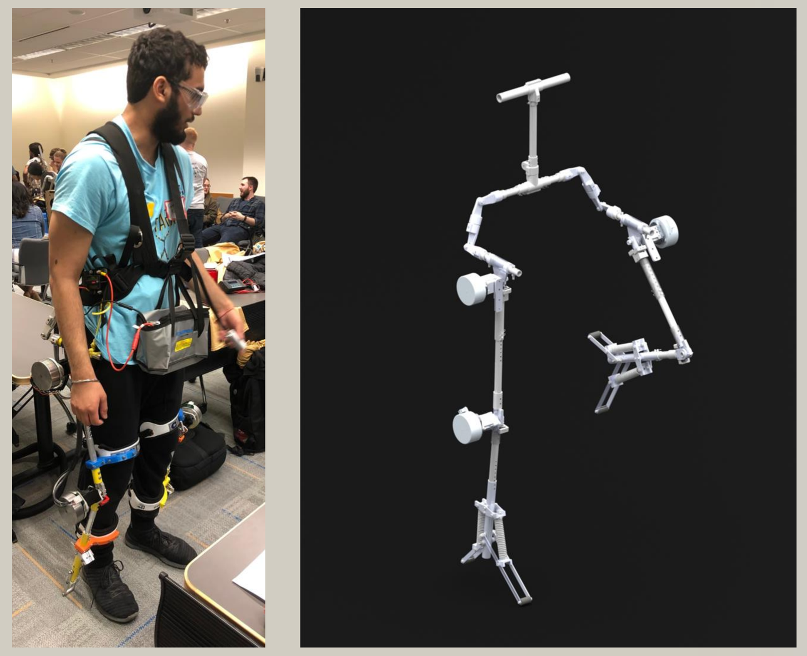

Figure 3. Rendering Image of Lexo 2.0. The frame is designed to fit more naturally around the user's hips/waist for ease of walking.

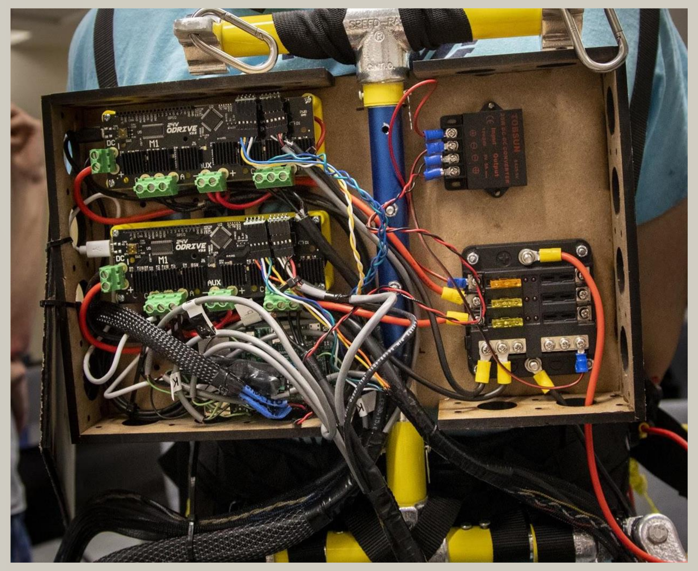

Figure 4. LEXO 2.0 electrical system which includes motor controllers, a Raspberry Pi, and a fuse box

Electrical Work with MLX:

The electrical work for LEXO 2.0 is still in progress, but at this point motor transparency has been achieved. This lets the user move freely without the motors inhibiting movement. The next steps for the electrical team is working on a control algorithm for actuating the hip motors during the gait cycle to aid with walking and controlling the knee motors to be used as dampers.

ELECTRICAL DESIGN: SAM-E

The electrical design of SAM-E focuses on the use of myoelectrics to detect electric signals from muscle contraction and flexion and actuate the frame based on arm movement. A control system was designed to process the signal and inflate the pneumatic muscles with high pressure air that forces the air muscles to contract. Further work is being done to improve the response time between arm movement and muscle actuation as well as improving the precision of the air muscle activation.

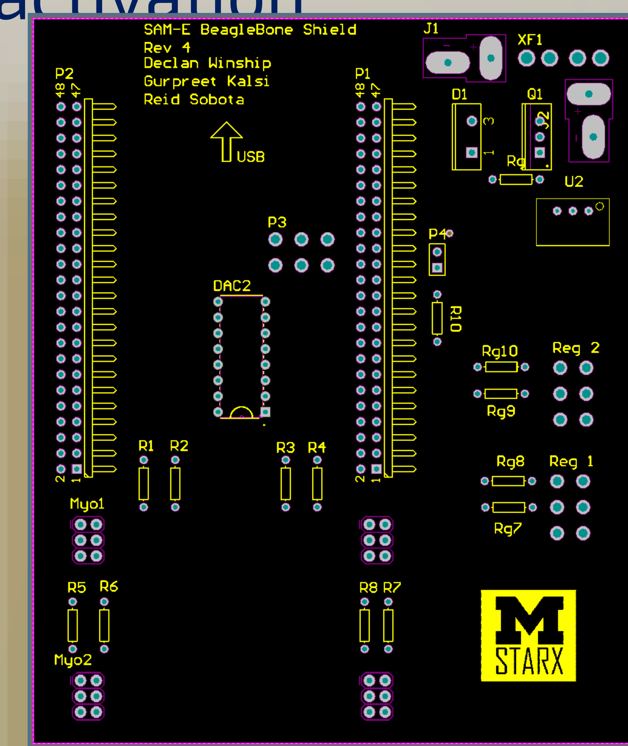

Figure 5. SAM-E PCB Board Layout
Team's first experience implementing a PCB

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