

Human exoskeleton: the near future

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Abstract

A human exoskeleton is an artificial external skeleton that can protect, support, and assist humans with their movement. This particular research is significant, as it allows us to understand the complexity of the movement in the human leg and try to recreate and simplify it.

This research will help understand different joints in the leg, which is more focused in the knee and in the ankle which will be simplified by keeping their movement to a one degree of freedom using pulleys.

Air-based artificial muscles will create the forces needed to lift up the shin and the ankle. This is significant because it would demonstrate that air-based artificial muscles can be used with a human exoskeleton regardless of the complexity to be able to mimic the same movements of a human leg.

Introduction

The ability to assist humans through an exoskeleton is what researchers have been thriving for. Many different exoskeletons for various body parts have been developed to try and assist human movements efficiently.

This research proposes the development of a passive lower limb exoskeleton to assist the human through ambulation while carrying a substantial payload. To help with the movement, pneumatic artificial muscles (PAMs) are added with the exoskeleton. PAMs require low power and use air for contracting and expanding to mimic human muscles.

Methodology

- Studying the stress acting on a human leg
- Studying the anatomy of a human leg
- Drawing the prototype with dimensions
- Create the pieces and exoskeleton in CAD (Solidworks)
- Print the different pieces on advanced 3D printer
- Machining the pieces and build the prototype
- Add PAMs to mimic real muscles and test the prototype



Figure 1 : Dimension SST (3d printer used)



Figure 2 : Side view of exoskeleton

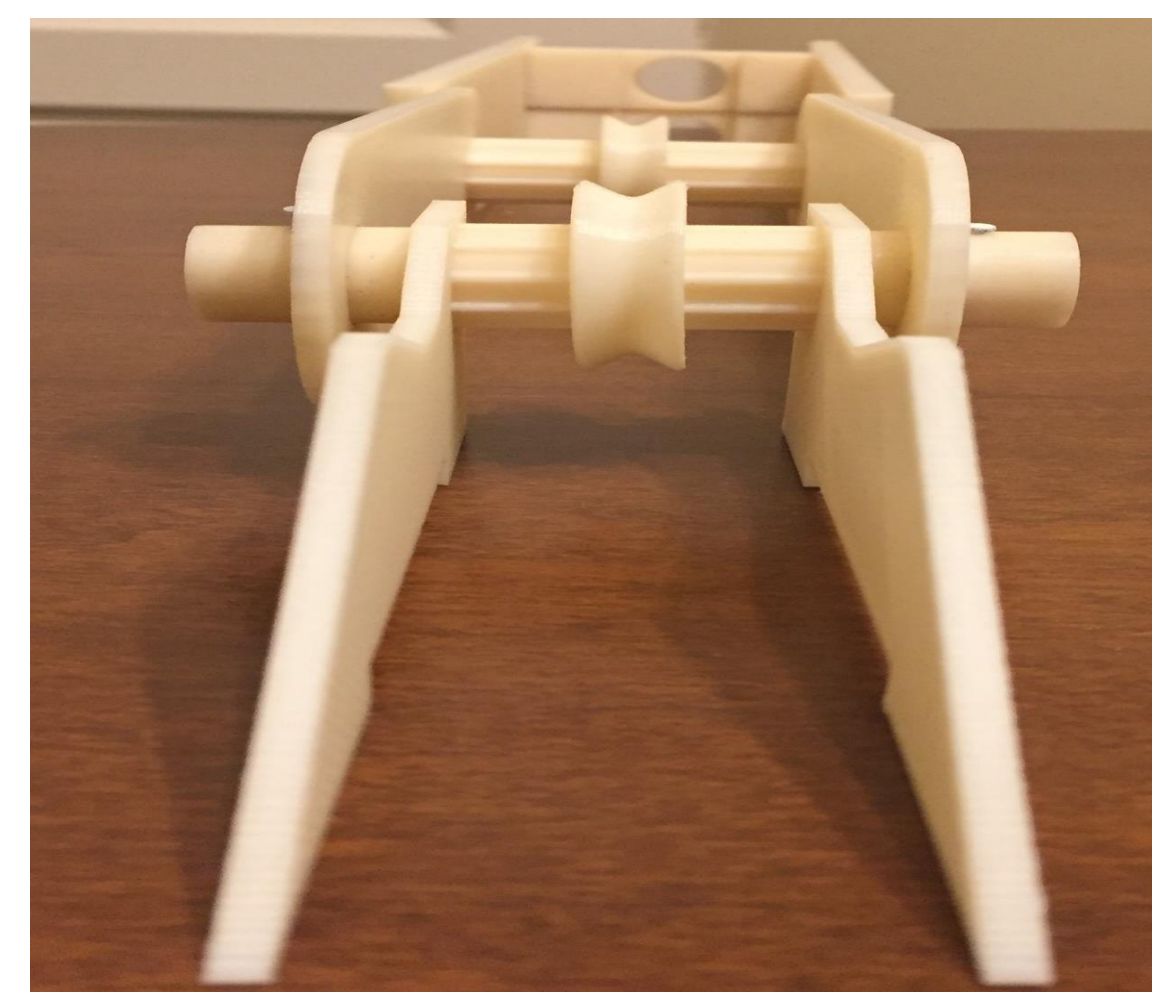


Figure 3 : Front view of exoskeleton



Figure 4 : Pneumatic artificial muscle

Conclusion

Modeling and building the exoskeleton leg was a challenge. Many difficulties were encountered during the process. Integrating the PAMS onto the exoskeleton, the printer's limited platform for printing, designing and fabricated the exoskeleton were all difficulties that had to be overcome.

The exoskeleton built is able to move with ease do to the quality of material and to the simple and efficient build. However, this project has limited the exoskeleton to help in a one degree of freedom at the knee and at the leg for simplicity for the project. In real applications, the exoskeleton is obligated to be able and assist the human movement needed in every direction just like if it were a shell for the limb. The future for this research is to enhance the design to accommodate the different movements and not to be limited to one degree on freedom.

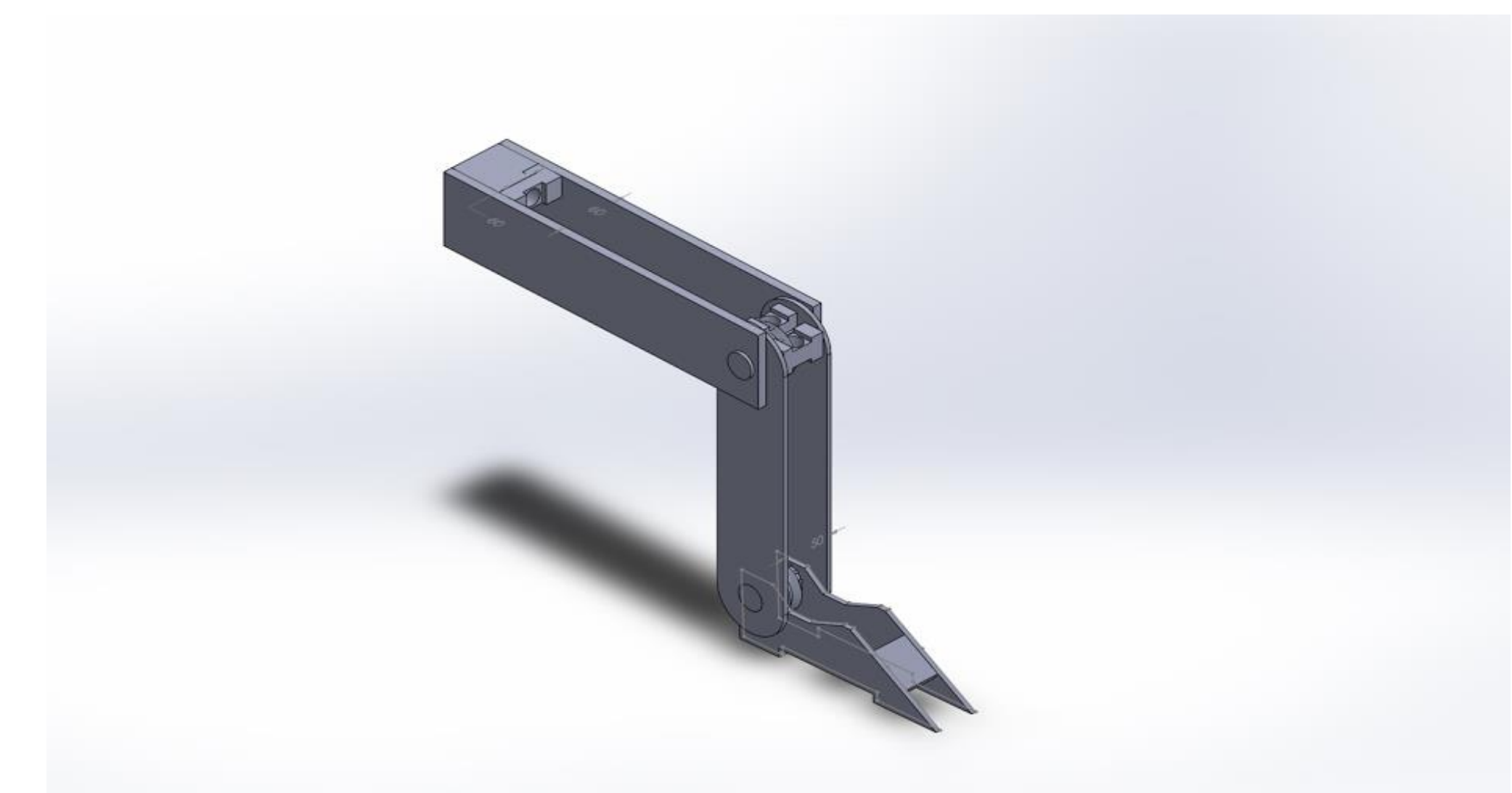


Figure 5 : Isometric view of exoskeleton in Solidworks

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