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# exoSTANCE

## *Exoskeleton Segway -- Redefining the Limits of Mobility*

AFFILIATIONS

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## *01. Introduction*

Our goal is to design and create a product that is lighter and more maneuverable than traditional assistive technology while improving the livability of needing to use an assistive mobility device.
The device needs to take the user from sitting to standing while fully supporting them and keeping them upright in turns and uneven terrain. The device needs to be put on while sitting and to be able to fit into a car.
The device should be lightweight, comfortable, maneuverable, easy to disassemble, waterproof, and have long operation life.


https://walmart.com


https://chronusrobotics.com


https://www.matiamobility.com/tek-md#specifications

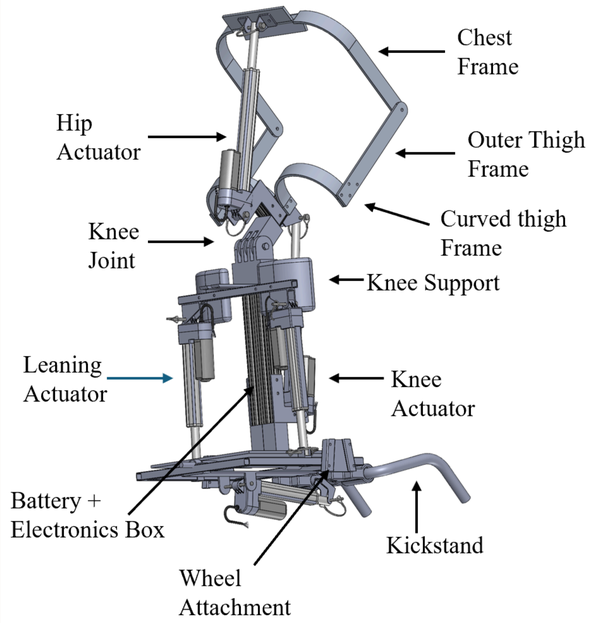
| | | | | |
|---|---|---|---|---|
| Standing Health Benifits | ✗ | ✗ | ✓ | ✓ |
| Ability to Disassemble or Collapse | ✗ | ✓ | ✗ | ✓ |
| Ability to Make Tight Turns | ✗ | ✓ | ✗ | ✓ |
| Maneuverable Base<br>*Navigating crowd and through doorways* | ✗ | ✓ | ✗ | ✓ |
| Battery Lasts All Day<br>*Charging will not always be available* | ✓ | ✓ | ✗ | ✓ |

## *03. Design Description*

The design has a **frame** that acts as an exoskeleton allowing the user to stand. The **knee actuator** and **knee joint** work together to extend and contract the user's knee, and the **hip actuator** allows bending at the hip. The **kickstand** is used to prevent the user from falling over backward when the self-balancing wheels are turned off. Using the kickstand, knee actuator, and hip actuator along with their respective frame components, the user can stand up and sit down while wearing the device.

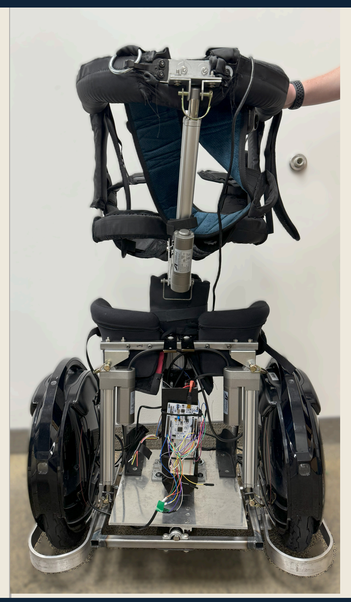
The two **leaning actuators** allow tilting to keep the user upright on uneven terrain and turns. The frame includes strapping to ensure the user is securely fastened to the device. The wheels are attached to the base of the frame with two **v-locks** for easy attachment. The two wheels chosen are **INMOTION** electric unicycles with self-balancing and driving capabilities.

The user controls turning, standing, and sitting with a **joystick** connected, along with all other electronics, to a box on the front lower leg portion of the frame. The user controls driving by leaning forward or backward depending on the desired direction of travel.




## *02. Performance Review*

| Requirement | Measurement | Target | Threshold | Predicted Performance | Actual Performance |
|---|---|---|---|---|---|
| Lightweight and Easy to Lift<br>*Can be lifted into a vehicle for transporting* | Weight (lbs)<br>Battery Weight(lbs)<br>Collapsed Volume(ft^3) | 25<br>3<br>1.52 | 30<br>5<br>2.12 | 30<br>2.2<br>4.23 | 51.4<br>2.2<br>8.54 |
| Ease of Disassembly<br>*For entering or exiting a vehicle* | Time (sec) | 120 | 300 | 120 | 300 |
| Water and Dust Proof<br>*Able to withstand light rain* | Ingress Protection (IP) | 56 | 44 | 56 | 56 |
| Maneuverable Base<br>*Navigating crowd and through doorways* | Width (in)<br>Base Volume (ft^3) | 24<br>4.5 | 30<br>8.47 | 28<br>5.24 | 28.75<br>4.64 |
| Fits Under Table<br>*Can sit under desk without removing* | Height (in) | 4 | 6 | 6 | 6.75 |



## *04. Conclusion*

**Success:** Our device can move from sitting to standing to the minimum extent of a person, hold a person, keep the user upright, and is fairly comfortable.
**However...** the device has difficulty with a wide range of motion from sitting to standing, weight, fitting under a table, and fitting into the car due to the available load, length, and weight of the actuators.
**Lesson Learned:** It takes a lot more time to build parts. Drill holes before bending metal, mimicking the motion of the human body while standing up and sitting down is difficult, and think of all the customer's constraints and requirements when building.

**Future Work:**

- Make the device easier to disassemble and assemble
- Reduce the weight of individual pieces through redesigning and material selection
- Select actuators with more appropriate lengths.