DIY In-Home AntiGravity Harness

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Abstract

Children with disabilities often experience difficulty interacting with their surroundings or peers due to problems with mobility. These missed interactions are crucial for developing early life skills that enable them to grow into healthy adults. Diseases such as Cerebral Palsy and Muscular Dystrophy are the most common inhibitors of typical growth for children in the United States. This project aims to aid this population of children in forming necessary interactions through the use of an In Home Gravity Harness. This system can be built by anyone regardless of engineering knowledge and budget by reducing the amount of weight needing to be carried by the disabled child. The end product adheres to DIY standards and should enable children to explore their environments and form essential relationships.

Project Goals

1. **Create a physical product capable of supporting a child up to age 5 with mobility disability**
2. **Make the product low cost with DIY emphasis**
3. **Supply an instruction manual to guide users' parents with step-by-step construction**

Engineering Requirements

	Requirements
Safety	Non toxic materials, no choking hazards, no sharp points, structurally stable
Ease of Assembly	No specialized parts, <20 parts and <100 fasteners, assembly time minimized
Size	Storage size <5ft^3, expanded <12ft^3
Cost	Parts for assembly cost <$400 and tool budget < $150
Aesthetics	Offer options that appeal to small children and encourage use

Figure 1. Muscular Dystrophy

Background

Children with limited mobility often do not receive the much needed exposure to socialization to appropriately cognitively develop [1]. Existing research shows that enabling young children with self control of their own environment can have meaningful impacts on the long term outcomes given such impairments as cerebral palsy or muscular dystrophy. One place to start and increase mobility is in the home. Imagine you are a toddler, who isn't yet able to walk or crawl on your own, and you want play with a toy on the other side of the room. How would you accomplish that without being able to walk or crawl?

Figure 2. Cerebral Palsy

Final Product

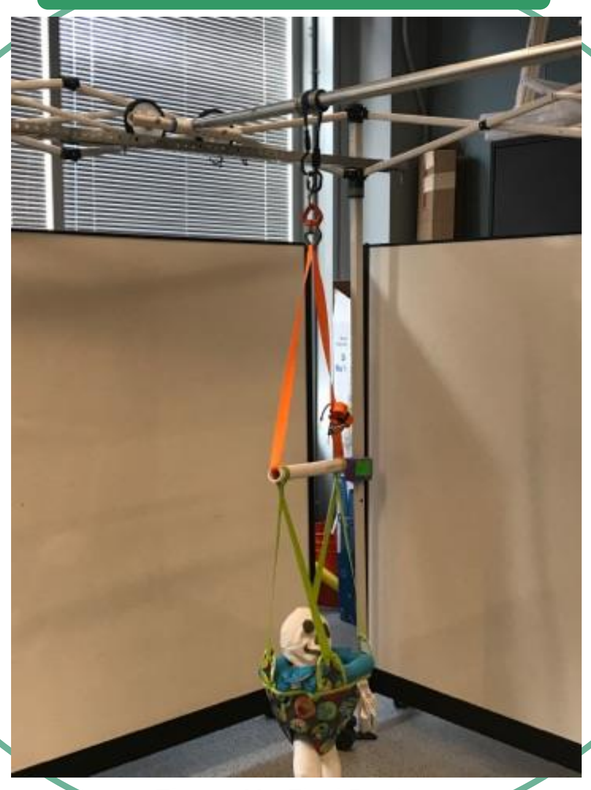


Figure 11. Final Product

Testing

Physical Test	Procedure
Safety	Check EPA for toxic materials; use soft cloth to find sharp edges and pinch points
Device Dimensions	Measure storage (5'x5') and in use (12'x12') area with measuring tape
Comfort	Use calipers to measure padding (>0.5")
Durability	Load system with 40lbs and move across area of use, device weighs <70lbs
Ease of Assembly	Record time needed to assemble; count fasteners (<100)

Results

- Toxic materials (steel, polypropylene, polyester) not an issue with proper use
- Avoid lead paints, attempt to use ~60% water based products
- Sharp corners of Easy Up covered with pool noodles
- Device weighed 57.2lbs
- Unfolded device size 9.8ftx9.8ftx9.8ft
- Collapsed size 48"x8.5"x8.5"

Figure 9. Sharp Edge Cover

Design Process

The design process was broken up into different subsystems:

A) Frame B) Guide Rail C) Middle Bar D) Bearing Attachment E) Harness

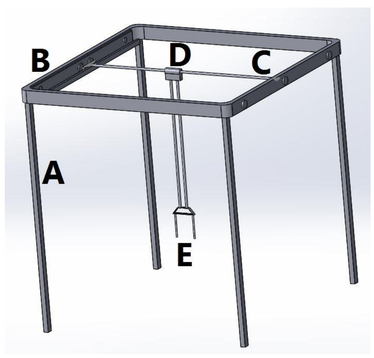


Figure 3. Final Solidworks Model

A) Frame

- Easy Up Frame commonly used for tailgating
- Made from steel
- Assembly time <10min with two people

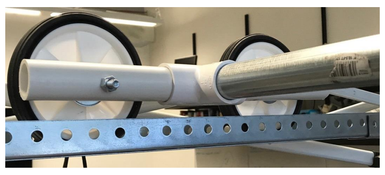
Figure 4. Easy Up Tent Frame

B) Guide Rail

- Guide rails completely DIY from Home Depot
- Fastened with basic screws and bolts to create 10ft+ section

Figure 5. Guide Railing

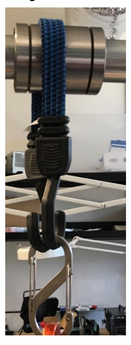
C) Middle Bar



- Training wheels bolted to PVC connections
- PVC connected to ~10ft steel fence post

Figure 6. Wheeled Middle Bar

D) Bearing Attachment



- Linear ball bearing attached using bungee cord to swivel
  - Bungee cord allows jumping movements

Figure 7. Bearing Attachment

E) Harness

- Jumper harness from Target
  - Different weights and sizes available
- Tow strap with easy release clip through PVC bar
- Rock climbing swivel enables turning motions

Figure 8. Harness

Future Work

Potential Improvements Before Capstone End

- Attach safety tether to catch middle bar in case of failure
- Change bearing bungee cord for stronger material that minimizes elasticity
- Investigate options to accommodate larger children

Side Project

- Wheel chair concept developed with the help of Dr. Cole Galloway

Figure 10. Side Project

Acknowledgements

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References

[1] S. Logan, M. Schreiber, M. Lobo, B. Pritchard, L. George & J. Galloway. 2015, Pediatr Phys Ther, 27, 433.

Engineering Design