



Limitless Wand

An Elevator Protraction Device for *Limb-Girdle Muscular Dystrophy, Type 2D*

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Problem Statement and Background

Our friend Marilu Ramos, was diagnosed with *Limb-Girdle Muscular Dystrophy, Type 2D* at the age of eight. This term (LGMD) describes a group of diseases that cause a weakness and wasting of the muscles primarily in the pelvic region, shoulder girdle, arms and the legs [1]. Once diagnosed, the weakness in Marilu's body started increasing as time passed, and she lost the strength in her feet to walk at age eleven and was confined into a wheelchair. She lasted 1.5-years with the manual chair but as her disability regressed, she was given a power wheelchair because her hands no longer had enough strength to push herself from place to place. Although her hands had become weaker, she was still able to raise them slightly. At this time the weakness in her body was stable and not increasing. Unexpectedly at age 15, she was diagnosed with Scoliosis. The severity progressed quickly, and within one year—doctors urgently said she had to fix it or else she would be in need of a permanent breathing tube. After careful consideration, Marilu ultimately decided to take a huge risk and get the spinal fusion. After 12-hours in surgery, her spine was broken/straightened with 2-rods and 32-screws. The risky surgery was a success, and it allowed her to sit straight without the assistance of a breathing tube. The surgery was a success, but new side-effects were that she lost much of the movement she once had in her arms/hands.



Because of these weaknesses associated with the Muscular Dystrophy, Marilu lost movement in her upper-extremity because the screws in her back extremely limited the flexibility a healthy spine would normally give. This restricted movement definitely impacted her mobility as she lost the dexterity she once had in her upper extremities. She no longer had the strength to lift her hands anymore so she couldn't feed herself, and she could no longer do anything that required her lifting her arms more than a few inches. This included pushing elevator buttons.

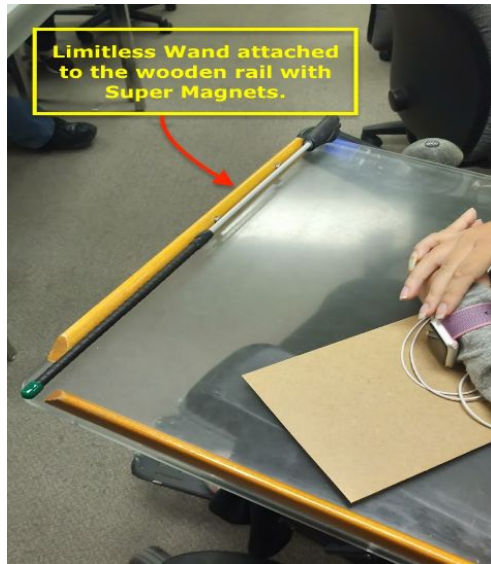
Methods, Approach and Solutions Considered

To approach our design, we had to research products that had the similar intentions as our elevator protraction device. In the market products that we found were e.g. (E-Z Grabber Reaching Aid) which was a device to assist those who are unable to reach items in difficult places. Also (Dr. Joseph's Foot Brush), a device that assists those who are not able to access their feet for cleaning. Research concluded that there were no devices being sold for individuals constrained to a wheelchair with Muscular Dystrophy. Marilu confirmed this, this gave our team the opportunity to create a unique device that had not been created.

Our target consumer/collaborator for this build-out was based on Marilu Ramos's physical limitations due to (LGMD). Most importantly, this device also had to be long enough to reach over her desk and onto the elevator buttons; needed to be lightweight for easy maneuverability; possible have wrist lanyard to keep from dropping; possible collapsible design; rubber-tip foot edge for the spot of impact with elevator buttons. All these materials that can easily be found online or at a hardware store.



As we created our first prototype we encountered a few issues. First issue was the collapsible feature would just be too difficult for Marilu to operate. The lanyard would also have to be removed as Marilu stated it slowed her down and was a distraction. Lastly, the rubber tips had to be modified since they were sliding off the elevator buttons too often. Although the product appeared to function sometimes, it did not meet the high standards this device required. Noting these initial problems, we would have to make adjustments as necessary until Marilu was satisfied and our product worked effectively each and every time.



Description Of Final Approach and Design

With the help of Marilu our collaborator, we were able to go through various processes in order to eventually find what suited her best. We presented her with various ideas while trying to meet her ideal needs. Originating from our brainstorming we were able to create a device that would give Marilu ultimate success when using elevators. The re-designed Limitless Wand would allow Marilu to press the button on elevators to whatever floor she desires without having to wait for the assistance of others. We researched available devices in the market, but once discussed with Marilu, she mentioned that most of these items were heavy for her to handle due to her not having enough strength. However, she mentioned she felt more dominant pushing and pulling, so we felt that our device should be set at a certain length. We then came across the concept of having a wide range for the tip of our device to facilitate the pushing of buttons. This would at the same time increase the accuracy of where to specifically place the device on the buttons to ultimately be capable of using the least amount of strength as possible. Marilu our collaborator also mentioned that she felt more capable of holding/grasping something in her hand when it was at a smaller diameter. From this process, we gathered that she would need something that would be light, about 17 – 20 inches in length, small diameter for her to grip well enough, and have a special tip for the pushing of elevator buttons. The 19-inch rod/tubing was agreed upon, and would be out of Aluminum with silicon tape wrapped around one end to give her a better grasp on the device. After much trial and error, the tip that would be used to push the button was decided to be out of Leki Rubber Tips which ended up fitting perfectly onto our Aluminum tubing.

The final device as seen below is what the end product came out to look like. When we were thinking about where the product should be placed we decided with the help of Marilu that it would be in her best interest to have it in front of her. We came up with different concepts however one of the biggest issues we came across was that it needed to be something that would be easy enough for her to unattached from her table due to her MD. Thus, we came up with the suggestion of using magnets as the source of attachment for the product. It was then tested to see if she would be able to pull the product off of magnets and it was a success, and thus decided that magnets would be the product that would be used. We then with her permission drilled two holes into her desk and used Gorilla Super Glue Gel to snug fit the Super Magnets Imanes-AImants into her desk. The product was then placed where the magnets lay and stayed on. With this

product we designed, Marilu will be able to access elevators and press the buttons all on her own taking her to where ever she needs to go. This is something she's desired from the start and with her "Limitless Wand" she now has the freedom to move about without any restrictions.



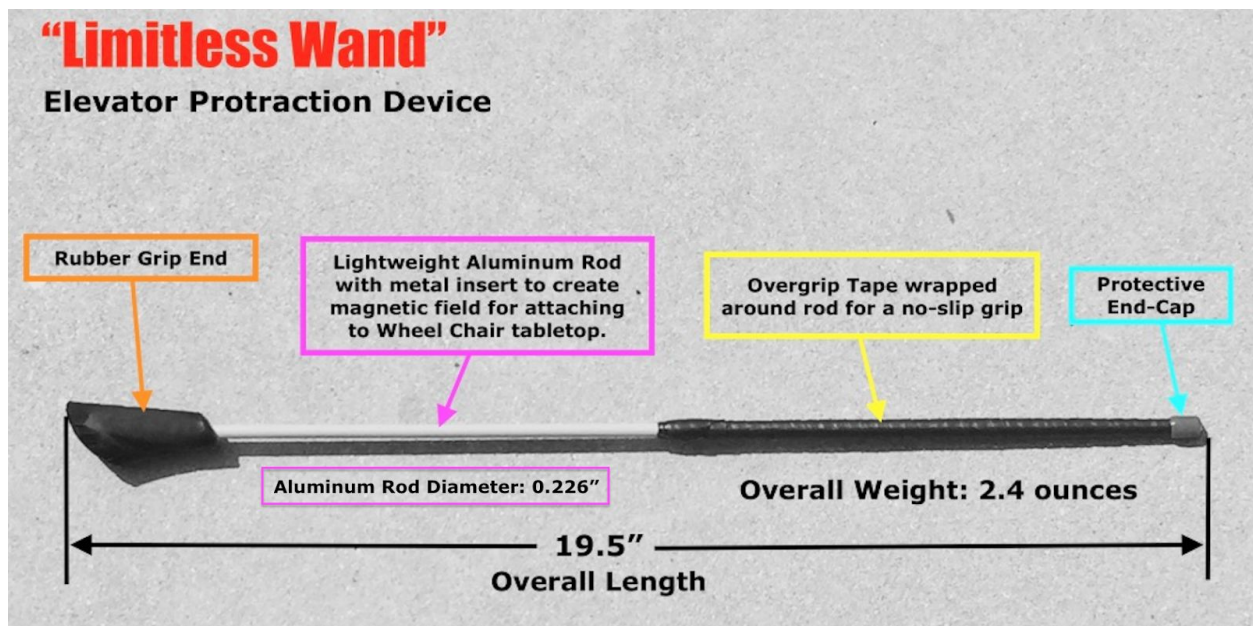
(Outside of elevator)



(Inside of elevator)

Outcome

When our final prototype was finished, it was given to our collaborator Marilu to test it out and give us feedback. After a few uses she reported that the Limitless Wand worked flawlessly, and stated that the change in rubber tip improved her ability to depress the elevator buttons tremendously. She also mentioned that the (19.5-inch) length fit perfectly onto the back wooden rail of her table top. Even better she enjoyed the "super-magnets" embedded into the wooden rail that securely fastened her Limitless Wand to the tabletop. Marilu really liked the magnets because the ease of use when it came taking the device on/off to use. The final overall weight of (2.4 ounces) was light enough for her to carry and maneuver easily. We used tennis over-grip tape around the (0.226-inch diameter) handle to make sure it offered a no-slip grip. Overall our team and Marilu we're very happy with the outcome.



(An Overview of the design)

Cost

| Part Description | Place of Purchase | How Part Was Used | Cost |
|--|-------------------------|--|----------------|
| Steel Square Stock 1095 Spring Steel Machine Key Stock 1/16" x 1/16", 12" Long | McMaster-Carr | Square Stock was used inside the extruded aluminum rod as an attractant for the "super-magnets." This allowed the elevator-extension-rod to be securely fastened to the wheelchairs tabletop when not in use. | \$0.97 |
| Rnd. Aluminum Tube (Grey Powder Coated) 0.226" \varnothing x 12" | Garage Sale | Aluminum tubing taken from a dish rack device was used as the main extension-rod for pressing the elevator buttons. | \$0.99 |
| Gamma Supreme Power Over-grip | Amazon | This (tennis) over-grip tape was used on the upper-handle of the aluminum rod to give maximum grip when using the elevator-rod. | \$3.74 |
| Leki Fitted Tract (Rubber-Tip) | Amazon | (Fitted Tract Rubber Tips) we repurposed these tips to fit onto the elevator-rod. After much testing, these proved to give the best overall grip when depressing various types of elevator buttons. | \$10.98 |
| Super Magnets (Neodymium Discs) 0.3" \varnothing x 0.11" | Orchard Supply Hardware | Super Magnets used for securing elevator-rod device to the wooden rails of the wheelchair tabletop. Magnets allow self-registering placement of the elevator-rod, & allows the user easy on/off access when needing to use. | \$0.68 x (4) |
| Gorilla Super Glue Gel (15-gram bottle) | Orchard Supply Hardware | Drilled out holes in wooden rails on wheelchair/tabletop so we could counter sink the super magnets flush with the rail surface. Super Glue Gel was used as an extra layer of attachment, to keep magnets from vibrating out of place. | \$2.58 |
| Gorilla Duct Tape (1" x 10-yd roll) | Orchard Supply Hardware | Gorilla tape was used to build up the diameter around the bottom of the aluminum rod where the rubber tips were then fitted tightly to rod and securely glued into place. | \$2.99 |
| Protective Vinyl End Cap 5/16" (Inside \varnothing) | Orchard Supply Hardware | Used this end cap to cover/protect the top/end of the elevator-rod. | \$0.36 |
| | | PROTOTYPE: TOTAL COST | \$25.32 |

Note: The materials invested in this project were used to build one single product. If this device were to be produced on a large scale, the cost of production would come down significantly because of the reduced cost of purchasing materials in bulk. With reduced manufacturing costs, the final price per unit could come down some 40% compared to the cost of our prototype. Our team is optimistic that our final "Retail-Price-Point" to be around \$15.00.

Significance

The Limitless Wand is a tool that gives our friend Marilu the capability to be very independent. Our protraction device seems simple but believe it or not, there is nothing like it on the market that caters to the specific needs of individuals diagnosed with *Limb-Girdle Type 2D, Muscular Dystrophy*, or other disabled individuals with similar symptoms. This product is significant because it will allow people in wheelchairs with upper mobility (hand/grip) dexterity restrictions to operate elevator-buttons on their own without having to rely on other people for assistance. Our product will help a large multiplicity of individuals who are disabled by this (LGMD) degenerative disease. The Limitless Wand has a very thin grip, it's lightweight and has the perfect rubber-grip-tip that adheres onto elevator buttons easily. Because of the unique specifications stated above, this product again will allow people to move from point A to B with success, and that was our ultimate goal!



(Misc. parts utilized to create device)

Acknowledgements

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- **Dr. Paul Cheng-Hsin Liu, Ph.D., Professor CMfgE, CQE, Six Sigma Green Belt**
 - Industrial Technology Professor for our TECH 4951 Senior Project I & II class—at Cal State University of Los Angeles.

References

- [1] <https://ghr.nlm.nih.gov/condition/limb-girdle-muscular-dystrophy>

