User-Centered Development of a

Braking System For Manual Wheelchair Users

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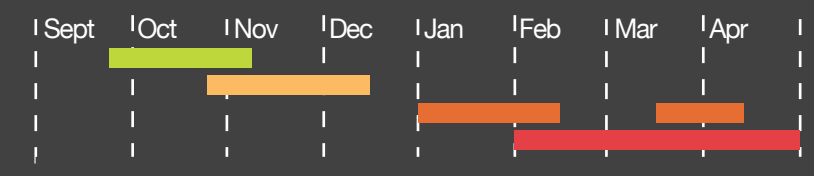
It started with a simple observation, slowing down and/or maintaining speed in a manual wheelchair can be quite a challenge. Ramps and sloped sidewalks can present a significant barrier to independent and safe mobility for manual wheelchair users. Generally speaking, a user slows down using by applying friction with their hands on the wheels, either at the tires or push rims. For persons with poor hand strength and/or sensation, this braking action can be difficult or impossible. The inability to control chair speed places the occupant at risk of collisions, falls and/or tips. A need exists for a braking system for manual wheelchair users who do not have full upper extremity function. Through a user-centered design approach, a "hands-on" brake has been developed allowing users to maintain control of their wheelchair, while maintaining direct contact with the push rims.

Process ->
- Background – what has been tried before: prior art, other products?
- Exploration – how do similar devices in other applications work?
- Users – what are users' wheeling experiences: the good, bad, and ugly?
- Design – how can I improve a users' experience: safety and ease of use?

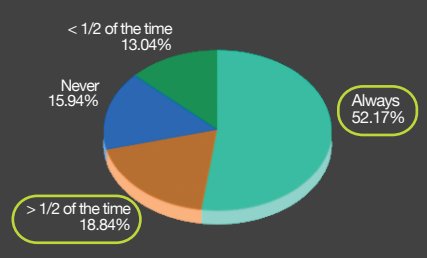


Users

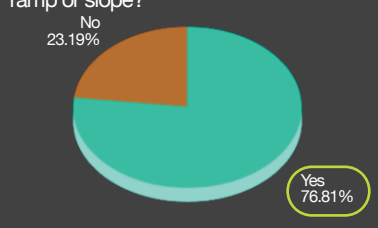
In addition to speaking with clinicians and therapists, a fifteen question survey was sent to almost four hundred individuals in North America and Australia who self-identified through the CATEA Consumer Network as having a mobility impairment. The survey targeted manual wheelchair users, and received 86 responses. The questions were divided into three categories: wheelchair setup, functional abilities and propulsion ability, and perception of need for a braking system. The responses were used to validate the need for a brake and to establish an understanding of potential users.

Seventy-two percent of the respondents propel outdoors without aid either all or more than half of the time. Over three-quarters of the respondents have felt a loss of control of their wheelchairs either during or after going down a slope or ramp. More than ninety percent of the respondents feel that a need exists for an improved braking system for manual wheelchairs, and four out of five said that they would use such a device. Cross tabulation of the of the responses indicated that over half of those that propel independently outdoors have experienced a loss of control, and two-thirds of those same responses feel there is a need for an improved system.

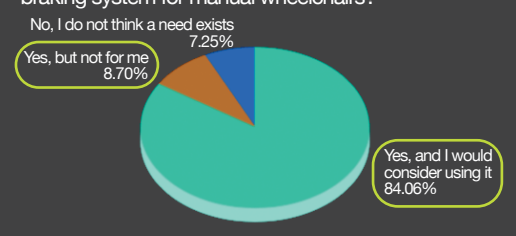
8. How often do you propel individually while outdoors?



13. Have you ever felt a loss of control of your wheelchair either during or after going down a ramp or slope?



15. Do you feel that a need exists for an improved braking system for manual wheelchairs?



	Questions	Have you ever felt a loss of control of your wheelchair either during or after going down a slope of ramp?		Do you feel that a need exists for an improved braking system for manual wheelchairs? (check one)		
Questions	Options	Yes	No	Yes, and I would consider using it	Yes, but not for me	No, I do not think a need exists
How often do you propel individually while outdors? (Check one)	Never, I am always pushed while outdoors	73% 8	28% 3	91% 10	10% 1	-
	Less than half of the time	89% 8	12% 1	89% 8	-	12% 1
	More than half of the time	93% 13	8% 1	100% 14	-	-
	Always, I always propel myself while outdoors	70% 25	31% 11	75% 27	14% 5	12% 4
		54% 38		66% 46		

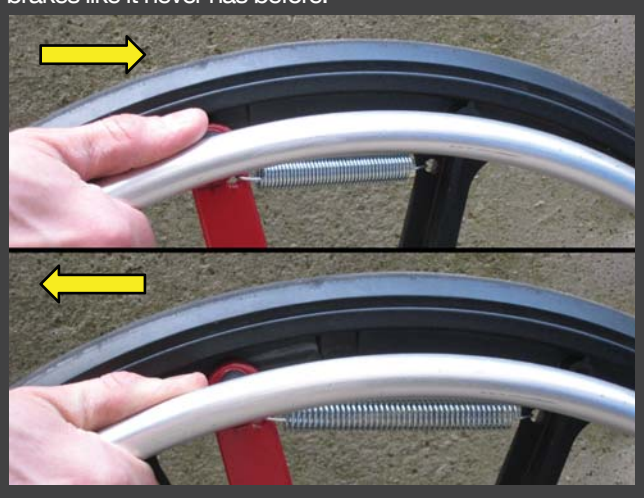
Design

Develop an intuitive "hands-on" braking system, that does not interrupt normal propulsion to operate, and allows independent operation by the user. The wheel/brake maintains the standard width and weight of the chair, does not use obtrusive levers to operate, and atache via standard hardware. The brake requires no more than minimal dexterity, minimal grip strength, and minimal user force to operate.

Forward - There is a positive engagement between the pushrim and wheel, the pushrim remains static, and the wheelhair propels as it always has.

Backward - The applied force to the pushrim is less than the spring force between the pushrim and wheel, the pushrim remains static, and the wheelchair reverses as it always has.

Braking - The applied force to the pushrim overcomes the spring force between the pushrim and wheel, the pushrim rotates backwards, engaging the brake, and the wheelchair brakes like it never has before.



Testing

5 wheelchair users and 3 clinicians tried out the new braking system in varied terrain: sloped sidewalks, parking garages, steep driveways, long residential grades, and grass hills. The users were able to slow down and come to a complete stop quicker and easier than by braking with conventional wheels. Maintaining speed on long descents was significantly easier as well, with no burning sensation in the hands. This setup reduces fatigue and discomfort while increasing safety.

While wrapping up, the users were asked three simple questions. What do you think of the concept? Who would benefit from this device? Is the perceived benefit greater than the hassle of using it?

"This would be great for quadrapleagics who don't wheelie."
"This would be great for parapleagics who are risk adverse."
"I can use it to open the door."
"This is perfect for walking the dog!"

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