Wheelchairs are great! But...

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THE PROBLEM

- 70 million people need a wheelchair worldwide, only 5% to 15% have access to one [1]
- Over 1.2 million wheelchair users in the United Kingdom [2]
- Only 10% of the total effort during handrim wheelchair propulsion goes directly into moving the wheelchair [3]
- Continuous and excessive handrim propulsion leads to:
  1. Shoulder pain, 42% to 66% incidence [4,5]
  2. Rotator cuff muscles injury [6]
  3. Bilateral carpal tunnel syndrome [7]
- ***We do not know if the support provided by current handrim propelling assistance devices available is what manual wheelchair users actually need and expect.***

WHAT HAVE WE DONE?

- Interviewed 12 manual wheelchair users with different ranges of experience in using power assist devices and different disabilities for an average of 1.5 hours regarding:
  1. Barriers to wheelchair propulsion
  2. Manual wheelchair users needs
  3. Knowledge and experience on wheelchair propelling assistance
  4. Expectations on propelling assistance
- Reviewed the power assist devices available in the UK market.

WHAT HAVE WE FOUND?

Barriers to manual wheelchair propulsion are: inaccessible built environment, lack of wheelchair propelling skills, other people, weather, the length of a journey in distance, propelling assistance devices that change the socially accessibility of the manual wheelchair and negative emotional experiences

Lack of awareness or incorrect understanding, and lack of interest regarding: alternative methods of wheelchair propulsion and handrim propelling assistance devices

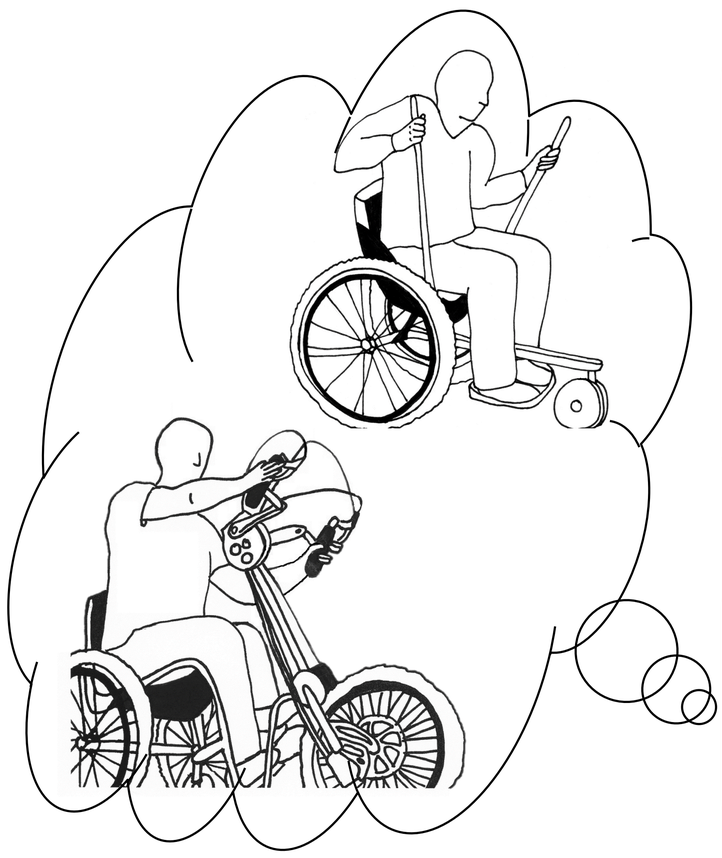
Six power assist devices predominate the UK market and are unaffordable, costing around £4k ($4.9K). These vary in the method of attachment to a manual wheelchair. These are: (1) behind and below the seat, (2) replacing rear wheels and (3) in front of the seat converting the wheelchair into a tricycle.

Users would like handrim propelling assistance devices to preserve the current social and functional accessibility of a manual wheelchair.

"I would like them to look like and work closer to what a manual wheelchair is like"

The NHS already struggles to provide wheelchairs thus has no capacity to meet the needs of manual wheelchair users that are struggling with handrim propulsion

PROPOSED SOLUTIONS



NEW DEVICES REQUIRED

- ✓ Call to researchers and designers to create an affordable and high quality manual wheelchair propelling assistance device that preserves the social accessibility of current handrim propelled manual wheelchairs
- ✓ First a fully mechanical design and later a powered option
- ✓ Parallel research for an open source design that can be manufactured anywhere with basic tools and materials, including 3D printing, is desirable
- ✓ Encourage technology users to modify the design to satisfy their individual needs. Avoid technology abandonment by enabling a participatory making and modification process through DIY forums locally and worldwide online [8]

NEW JOINED-UP SERVICES

- ✓ WHO: help raise awareness of alternative wheelchair propulsion mechanisms in comparison with the inefficient handrim wheelchair propulsion
- ✓ Wheelchair delivery services: offer mechanical or power wheelchair propelling assistance BEFORE offering electric/power wheelchairs when possible

FUTURE WORK

Future work should consider the role of caregivers/support workers/personal assistants which push and pull wheelchairs and that could benefit from using either mechanical or power assist devices to make their caring work easier.
A core design challenge of assistive technology in the future will be in reducing device weight, which we believe can be achieved using modular power options.

ACKNOWLEDGEMENTS

We thank all the volunteers. The research is funded by the Engineering and Physical Sciences Research Council (EPSRC) in partnership with the Queen Elizabeth Olympic Park, and forms part of the founding projects of the Global Disability Innovation Hub (GDIHub).

REFERENCES

[1] World Health Organization. Assistive Technology, Fact Sheet. 2016 [cited 2017 11th April]; Available from: http://www.who.int/mediacentre/factsheets/assistive-technology/en/.
[2] Wheelchair Leadership Alliance. NHS England - Improving wheelchair services. 2017 [cited 2017 26th April]; Available from: https://www.england.nhs.uk/ourwork/pe/wheelchair-services/.
[3] de Groot, S., et al., Consequence of feedback-based learning of an effective hand rim wheelchair force production on mechanical efficiency. Clinical Biomechanics, 2002. 17(3): p. 219-226.
[4] Dalyan, M., D. Cardenas, and B. Gerard, Upper extremity pain after spinal cord injury. Spinal Cord, 1999. 37(3): p. 191-195.
[5] Fullerton, H.D., J.J. Borckardt, and A.P. Alfano, Shoulder Pain: A Comparison of Wheelchair Athletes and Nonathletic Wheelchair Users. Medicine & Science in Sports & Exercise, 2003. 35(12): p. 1958-1961.
[6] Akbar, M., et al., Prevalence of Rotator Cuff Tear in Paraplegic Patients Compared with Controls. The Journal of Bone & Joint Surgery, 2010. 92(1): p. 23-30.
[7] Asheghan, M., et al., The prevalence of carpal tunnel syndrome among long-term manual wheelchair users with spinal cord injury: A cross-sectional study. The Journal of Spinal Cord Medicine, 2016. 39(3): p. 265-271.
[8] Hurst, A. and S. Kane, Making "making" accessible, in Proceedings of the 12th International Conference on Interaction Design and Children. 2013, ACM: New York, New York, USA. p. 635-638.