Trends in ‘Smart’ Wheelchairs:

Past, present, and future

Pooja Viswanathan, PhD

CEO and Founder

Braze Mobility Inc.

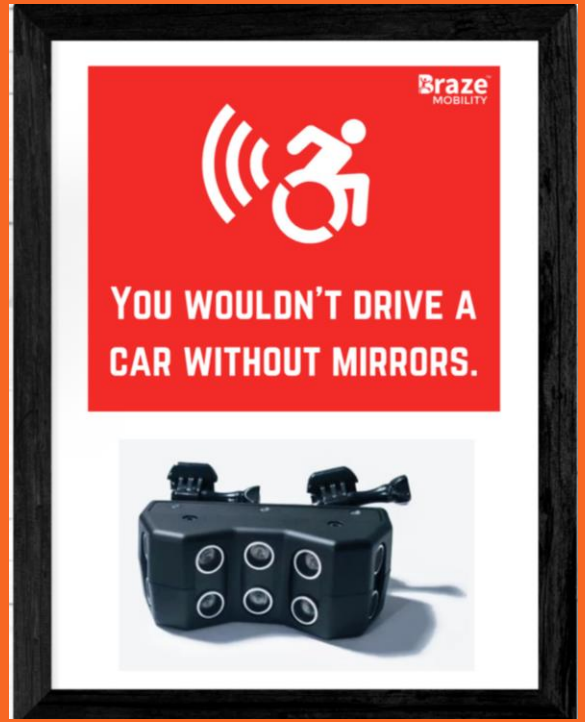
20%

experience 1+ major collision in a year

11%

of these users are hospitalized

Why now?



3.7M+

Wheelchair Users

91%

can benefit from ‘smart’ wheelchairs

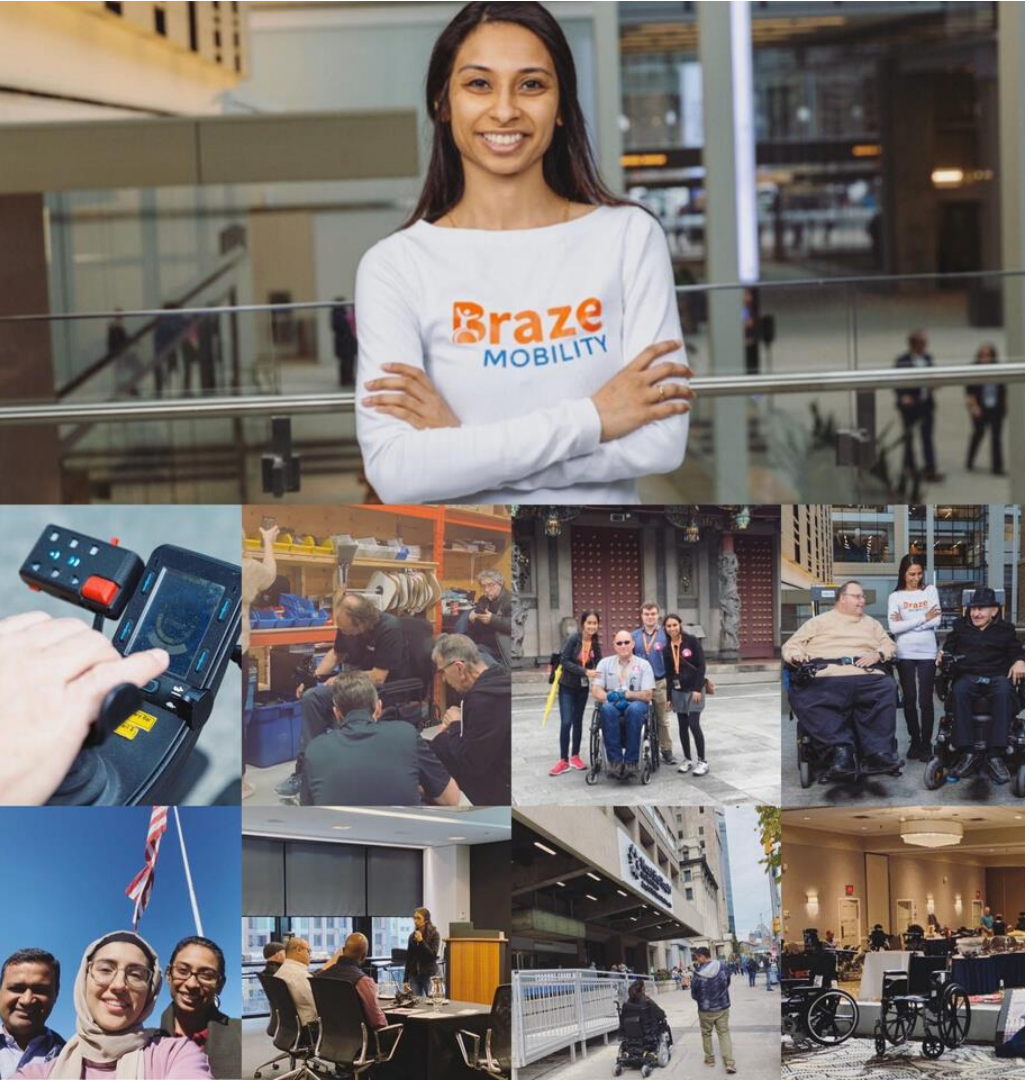
(North America)

Up to 91%

of wheelchair users predicted to benefit from "Smart Wheelchairs"

- Spinal Cord Injury
  - 66,240+ need wheelchair
  - Up to 100% would benefit (head/neck movement)
- Low vision and blindness
  - 383,232+ need wheelchair
  - Up to 100% would benefit (low vision/blindness)
- Parkinson's Disease
  - 89,400+ need wheelchair
  - Up to 90% would benefit (visual field neglect)
- Multiple Sclerosis
  - 251,500+ need wheelchair
  - Up to 90% would benefit (head/neck movement)
- Stroke
  - 645,000+ need wheelchair
  - Up to 82% would benefit (visual field neglect)
- Severe TBI
  - 47,700+ need wheelchair
  - Up to 60% would benefit (attention)
- Alzheimer's Disease
  - 600,000+ need wheelchair
  - Up to 48% would benefit (attention)
- ALS
  - 24,000+ need wheelchair
  - Up to 26% would benefit (head/neck movement)

Simpson (2008)

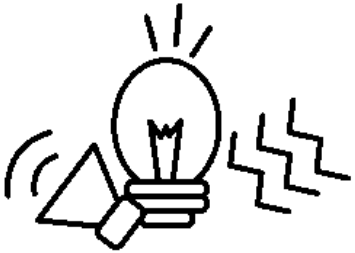


About me

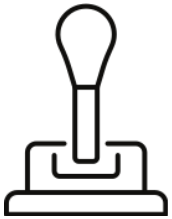
- Doctoral and postdoctoral research in robotics and assistive technologies
- Working with ‘smart’ wheelchair technology for over a decade.
- Key design considerations: *research evidence* and *affordability*

Sensor technologies

Monitoring



Feedback



Control

Monitoring technologies

- Example – Backup Cameras, Mirrors
- Monitor the environment and display information “as is”
- Advantage - low cost (less than $500)
- Disadvantage – tend to be visual interfaces only, not accessible to users with vision loss/blindness

Control technologies

- Example – Collision avoidance, crowd following, steering correct, self-driving, etc.
- Perform various driving tasks semi-autonomously or autonomously
- Advantage – can offer increased opportunities for mobility to those who cannot safely operate powered wheelchairs (cognitive limitations, motor control issues)
- Disadvantage – not appropriate for users who cannot understand when/why system takes control, cannot identify system malfunctions, and/or cannot override in time or at all (cognitive limitations, motor control issues)

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Paradox!

PUBLICATIONS

P. Viswanathan, R. C. Simpson, G. Foley, A. Sutcliffe, J. Bell (2017). "Smart Wheelchairs for Assessment and Mobility" (Book chapter). Robotic Assistive Technologies: Principles and Practice. Eds. P. Encarnação, A. Cook. CRC Press, Taylor & Francis Group.

Viswanathan, P., Zambalde, E.P., Foley, G., Bell, J.L., Wang, R.H., Adhikari, B., Mackworth, A.K., Mihailidis, A., Miller, W.C., & Mitchell, I.M. (2016). Intelligent Wheelchair Control Strategies for Older Adults with Cognitive Impairment: User Attitudes, Needs, and Preferences. Autonomous Robots. 1-16.

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P. Viswanathan, R. H. Wang, A. Sutcliffe, L. Kenyon, G. Foley, W. C. Miller, and the SWAT participants, "Smart Wheelchairs in Assessment and Training: Findings from a Consensus Workshop", (Oral presentation of extended abstract) 32nd International Seating Symposium, Vancouver, BC, March 2016.

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P. Viswanathan, R. H. Wang. C. Holloway, R. Black, J. Harris, "Assistive Technology Development and Translation into Clinical Practice", Workshop at Promoting Access to Assistive Technology RESNA/NCART 2016 Conference, Arlington, VA, July, 2016.

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P. Viswanathan, J. L. Bell, R. H. Wang, B. Adhikari, A. K. Mackworth, A. Mihailidis, W. C. Miller and I. M. Mitchell, "A wizard-of-oz intelligent wheelchair study with cognitively-impaired older adults: Attitudes toward user control," in IEEE/RSJ International Conference on Intelligent Robots and Systems. Workshop on Assistive Robotics for Individuals with Disabilities: HRI Issues and Beyond, Chicago, Illinois, USA, September 2014.

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Viswanathan, P., Little, J., Mackworth, A., How, T., Wang, R., and Mihailidis, A. (2013). Intelligent wheelchairs for cognitively-impaired older adults in Long-term care: A review. RESNA, June 20-24, Bellevue, WA.

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P. Viswanathan, T. Southey, J. J. Little, and A. Mackworth, "Place Classification Using Visual Object Categorization and Global Information," in Proceedings of Canadian Conference in Computer and Robot Vision, Halifax, Canada, 2011.

http://www.iatsl.org/people/pviswanathan.html

Feedback technologies

- Example – Blind spot sensors
- Detect obstacles and provide feedback regarding location and proximity through lights, sounds, and vibrations
- Advantage(s) – multi-modal (increased accessibility), affordable
- Disadvantage – not appropriate for users who cannot understand and/or respond to alerts (severe cognitive impairment)

World’s first blind spot sensors for wheelchairs

Braze™ MOBILITY

Braze™ MOBILITY

- Restores dignity and independence
- Reduces caregiver burden and stress
- Decreases property damage
- Increases safety

Data Analytics Platform

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