Eazy Maps

Final Status and Future Prospects

cd-059

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1. Step 1.5 m away from your screen

2. Cover one eye and read the letters on each line

Snellen Fraction* [1]

E L F	20 / 120
Q O P Z D A	20 / 80
I K L F J X Y	20 / 40
O F C L P T E D	20 / 20

*Adapted to the perspective of a 20/40 Snellen Fraction

[1] J. Morrison, J. Zander, “Determining the appropriate font size, and use of colour and contrast for underwater displays,” April 2008. [Online Serial]. Available: https://www.researchgate.net/publication/253433795_Determining_the_appropriate_font_size_and_use_of_colour_and_contrast_for_underwater_displays. [Accessed April 13, 2020].

Agenda

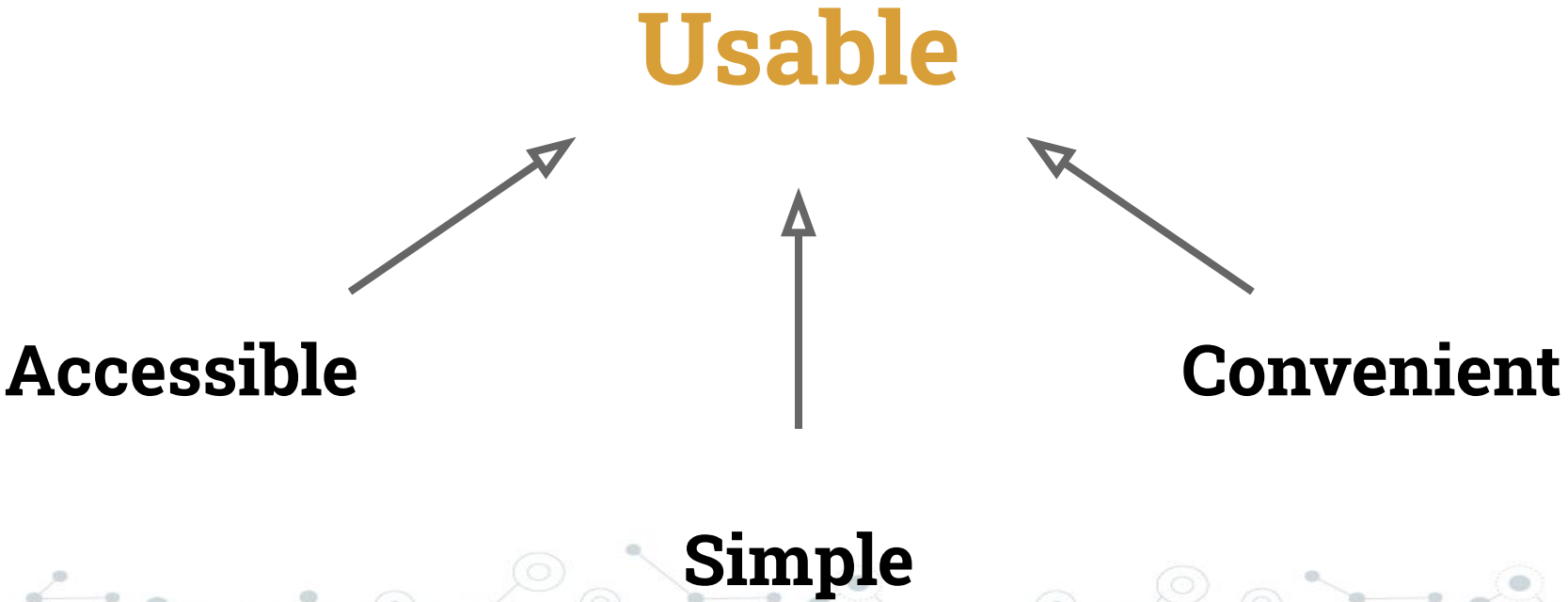
- Design Achievements
  - Visual and Motor Accessibility
  - M3 User Interface and Performance
  - M4 Performance

- Future Implementation of Assistive Technologies

What is Eazy Maps?

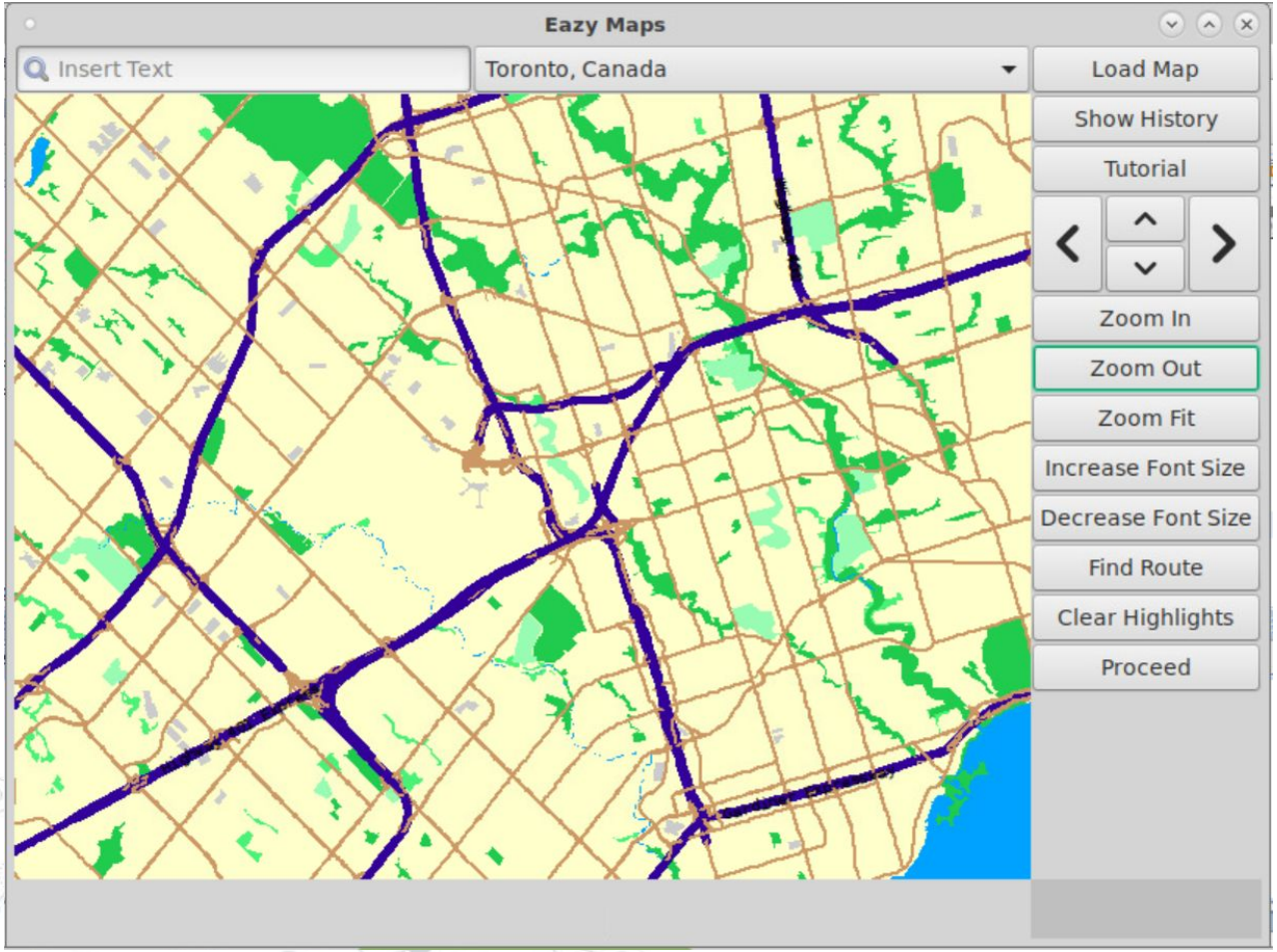
A mapping application that EVERYONE can use.

Eazy Maps' Goals



Design Achievements

Colour Scheme Improves Visibility



- Colour scheme affects ability to distinguish colours [2]
- Accessible
- Easy to interpret information

[2] P. Gabriel-Petit, “Ensuring Accessibility for People With Color-Deficient Vision,” *uxmatters.com*, Feb. 6, 2007. [Online]. Available: https://www.uxmatters.com/mt/archives/2007/02/ensuring-accessibility-for-people-with-color-deficient-vision.php. [Accessed Mar. 10, 2020].

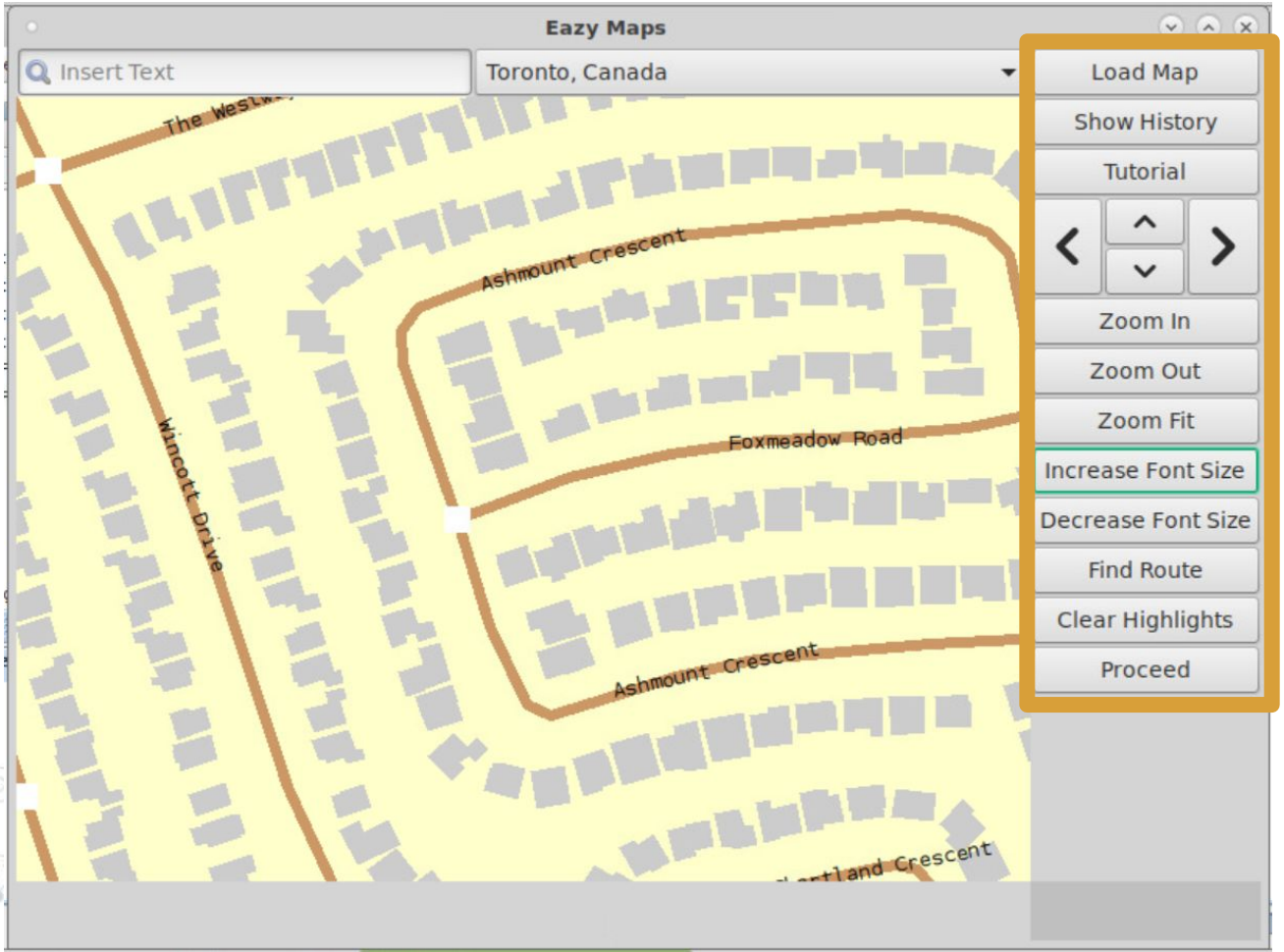
Colour Scheme Improves Visibility

Table 2—Dichromatic color schemes with high value contrast, as perceived by dichromats

High-Contrast Dichromatic Colors		Colors Perceived by Dichromats					
Normal Color Vision		Protanopia		Deuteranopia		Tritanopia	
burnt umber	north-light blue	T	T	T	T	T	T
burnt umber	pale violet	T	T	T	T	T	T
incarnadine	midnight blue	T	T	T	T	T	T
incarnadine	dark blue-violet	T	T	T	T	T	T
pale brown	midnight blue	T	T	T	T	T	T
pale brown	dark blue-violet	T	T	T	T	T	T
pale cadmium yellow	midnight blue	T	T	T	T	T	T
lemon ice	dark blue-violet	T	T	T	T	T	T
lemon ice	charcoal gray	T	T	T	T	T	T
midnight blue	silver	T	T	T	T	T	T

[2] P. Gabriel-Petit, “Ensuring Accessibility for People With Color-Deficient Vision,” *uxmatters.com*, Feb. 6, 2007. [Online]. Available: https://www.uxmatters.com/mt/archives/2007/02/ensuring-accessibility-for-people-with-color-deficient-vision.php. [Accessed Mar. 10, 2020].

UI Layout reduces Physical Exertion

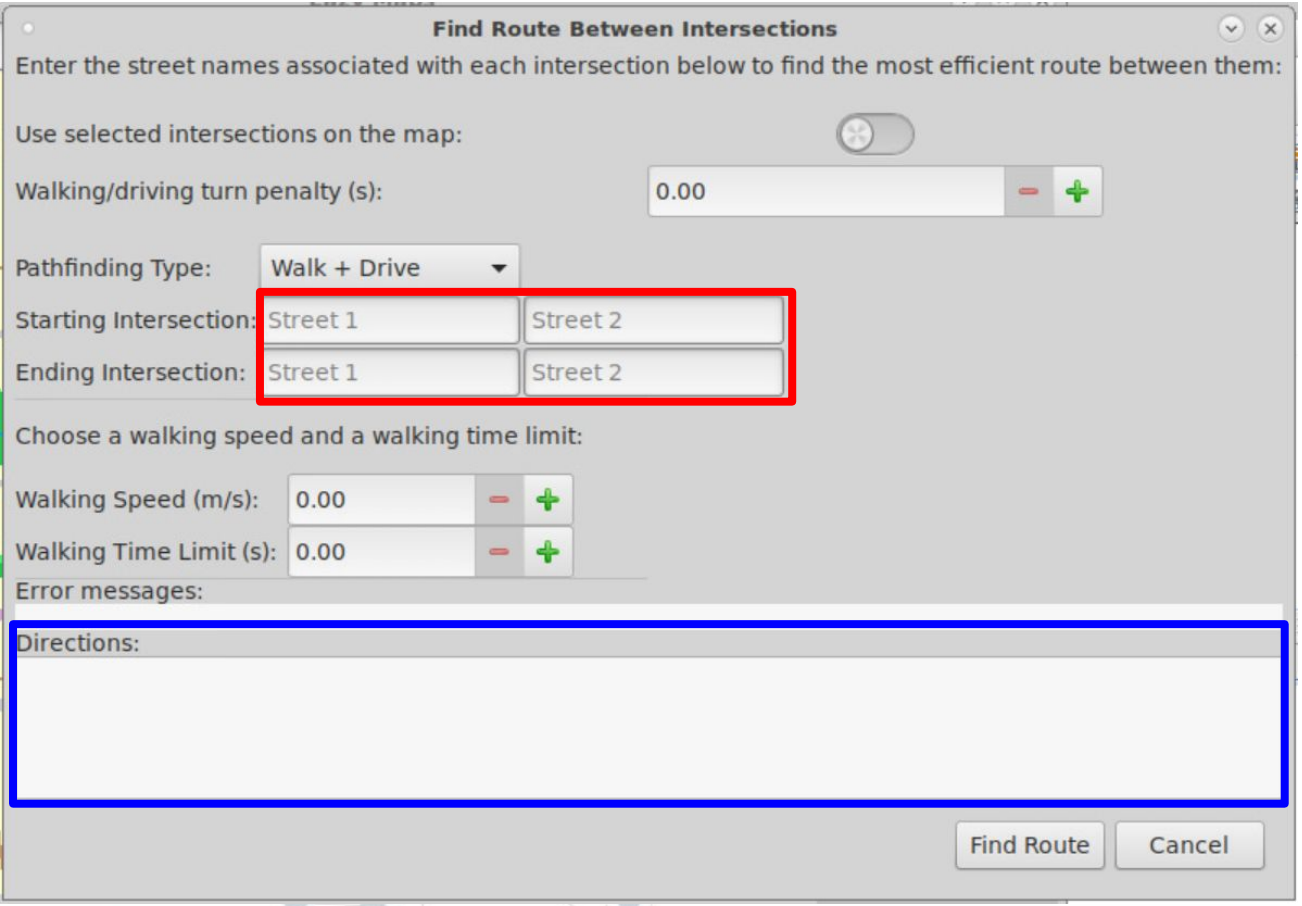


- Minimal Movement
- Comfortable Hand Gesture [3]
- High Clicking Tolerance [4]

[3] D. Rempel, M. Camilleri and D. Lee, "The Design of Hand Gestures for Human-Computer Interaction: Lessons from Sign Language Interpreters," *International Journal of Human-Computer Studies*, vol. 72, no. 11, p. 728, Oct, 2015. [Online Serial]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4447613/. [Accessed Mar. 10, 2020].

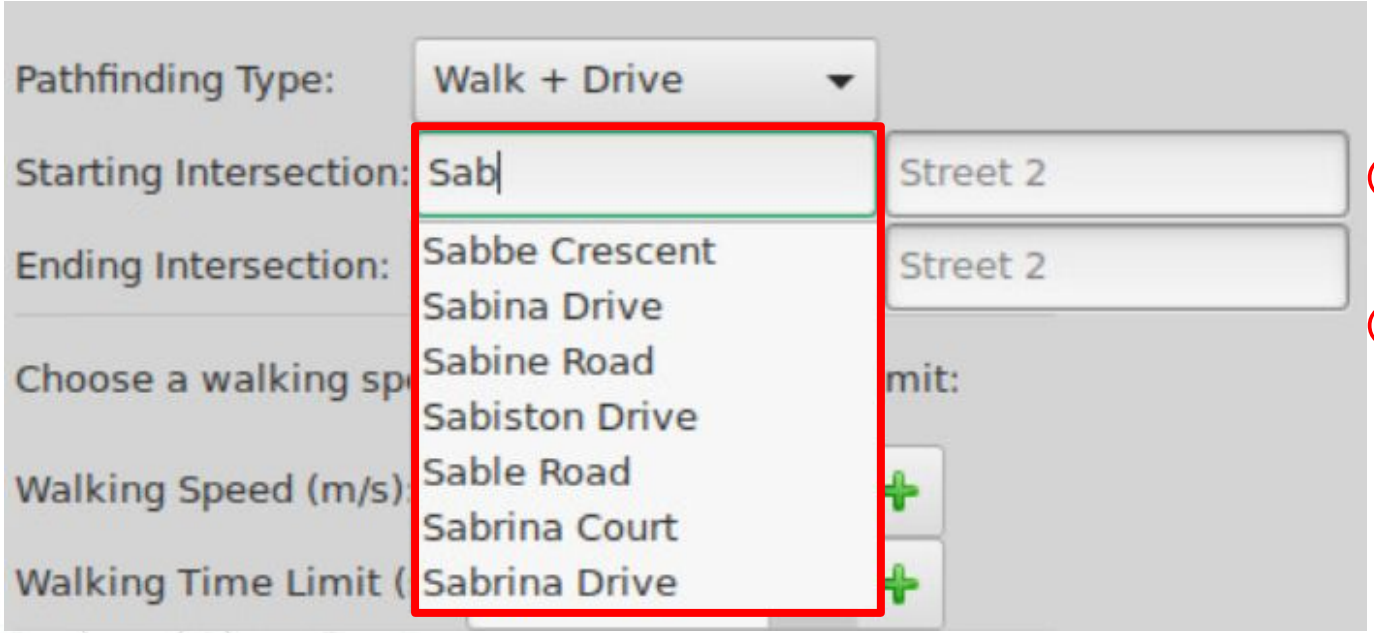
[4] S. Komine and M. Nakanishi, "Optimization of GUI on Touchscreen Smartphones Based on Physiological Evaluation – Feasibility of Small Button Size and Spacing for Graphical Objects," *International Conference on Human Interface and the Management of Information*, p. 80, 2013. [Online Serial]. Available: https://link.springer.com/chapter/10.1007/978-3-642-39209-2_10. [Accessed Mar. 11, 2020].

Path Search Interface Maintains Simplicity



- Autocomplete
- Detailed Directions

Autocomplete Allows for Convenient Data Entry

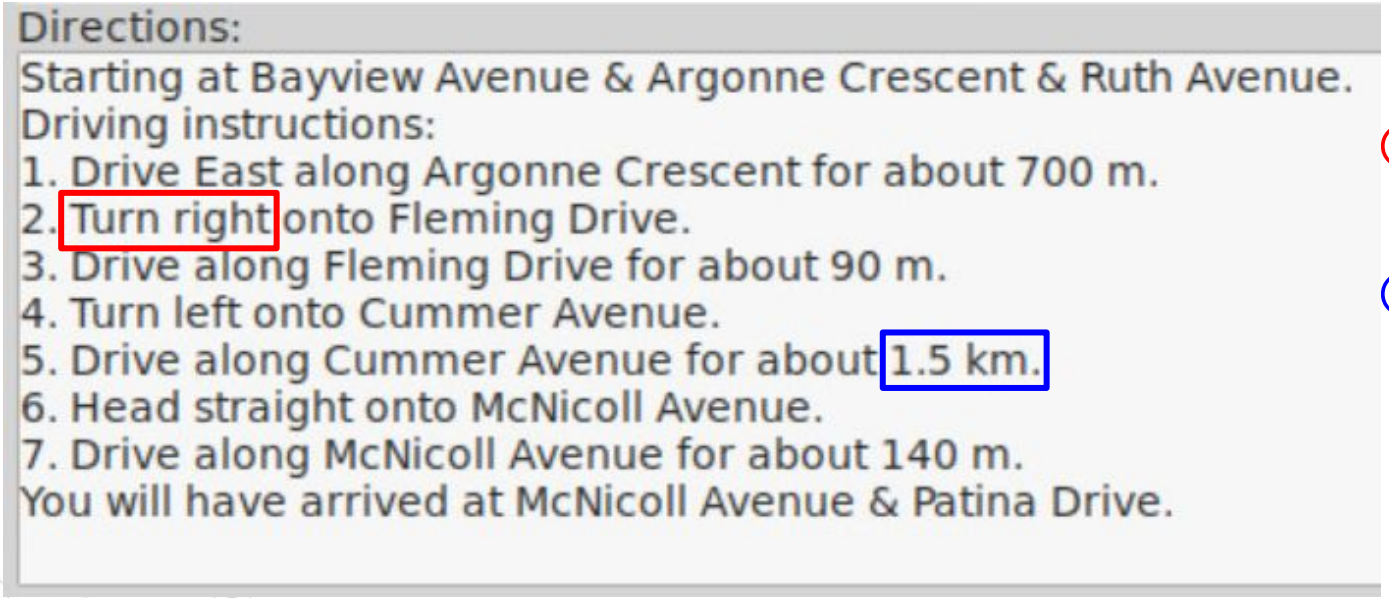


- Provides street name suggestions
- Implemented using GTK Entry Completion

Drive along Yonge Street for 3784.65 m.
Turn onto Snowdon Avenue.

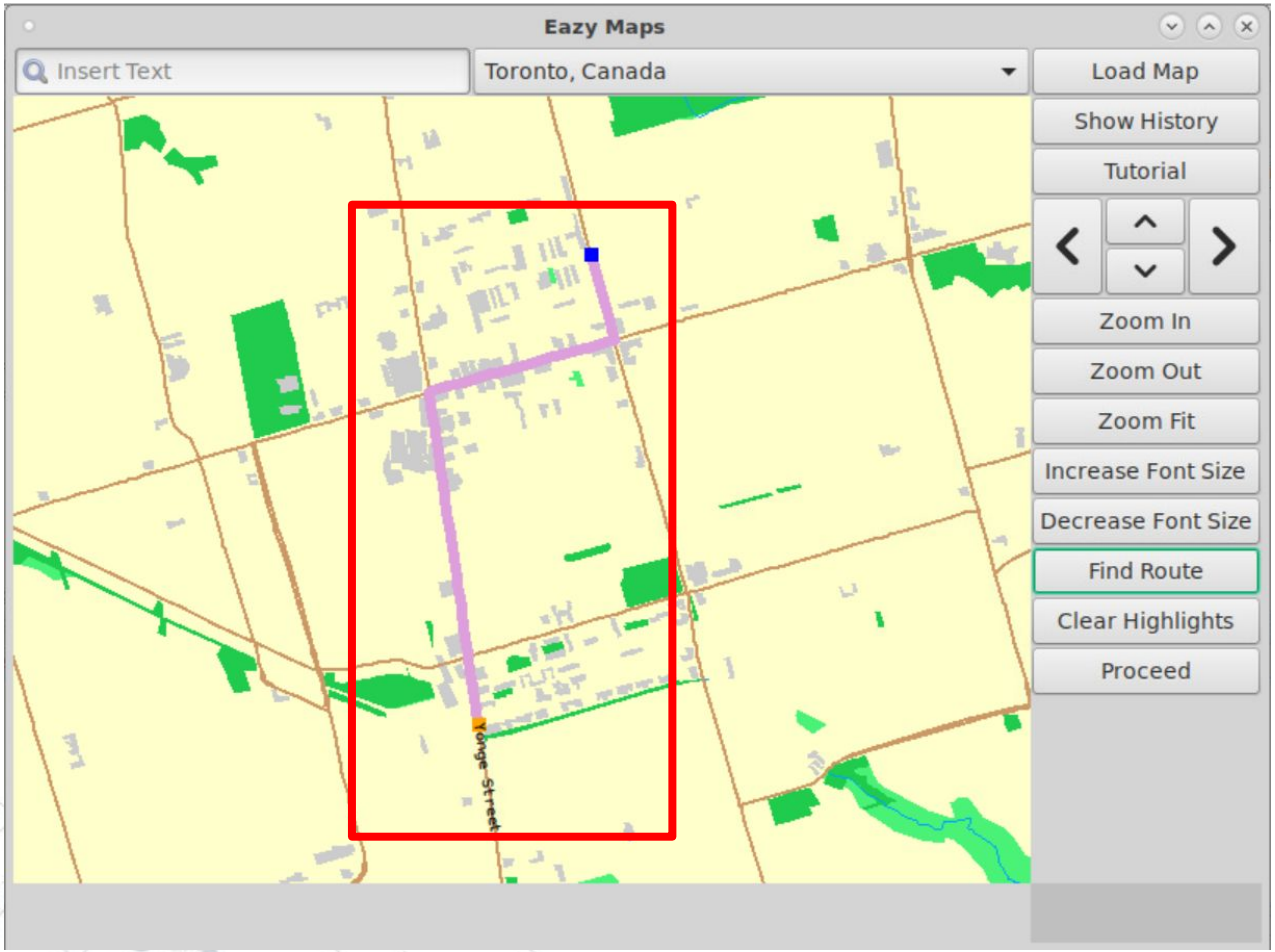
Drive North along Yonge Street for about 3.7 km.
Turn right onto Snowdon Avenue.

Given Directions are Simple and Easy to Follow



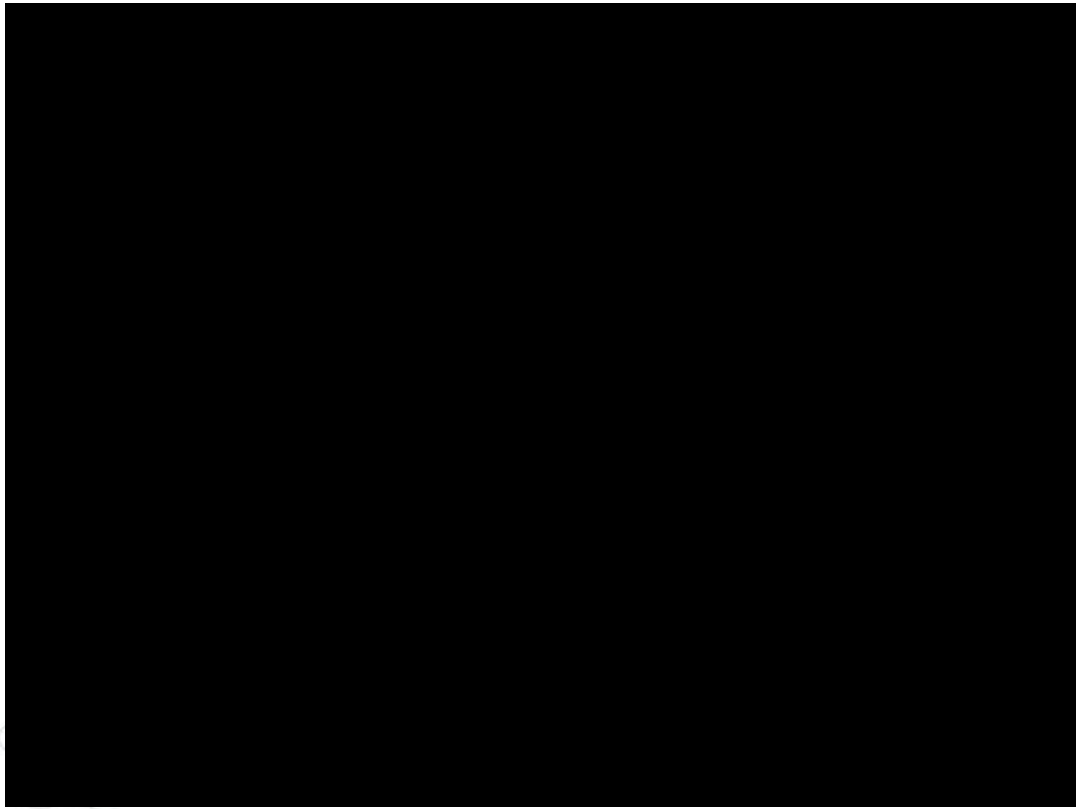
- Relative turn directions
- Distances before turn

Highlighted Path is Clear and Accessible



- Contrasts with background
- Focusses path automatically

Eazy Maps Pathfinding Demonstration



Dijkstra's Algorithm with A* Makes a Fast Pathfinding Algorithm

- Quicker than a blink (100 - 400 ms)[5]

Map	Driving Pathfinding Time (ms)	D&W Pathfinding Time (ms)	Distance (km)
Toronto	4	5	8
	20	21	19
	7	8	40
Hamilton	5	5	8
	2	2	19
	7	7	40
London	8	12	8
	25	30	21
	54	66	36

D&W - Driving and Walking

[5] "Average Duration of a Single Eye Blink," *Bionumbers*. Harvard University, [Online], 2001. Available: https://bionumbers.hms.harvard.edu/bionumber.aspx?&id=100706&ver=4. [Accessed April 12, 2020].

Our Courier Delivery Routes Algorithm maintains Accessibility

- Fast, Accurate
- Technologically and Financially Accessible [6],[7]
- Iterative Improvement

[6] "Computers are becoming faster and faster, but their speed is still limited by the physical restrictions of an electron moving through matter. What technologies are emerging to break through this speed barrier?" *Scientific American*, Oct. 21, 1999. [Online]. Available: https://www.scientificamerican.com/article/computers-are-becoming-fa/. [Accessed April 13, 2020].

[7] United States Census Bureau, "Do People With Disabilities Earn Equal Pay," *census.gov*, Mar. 21, 2019. [Online]. Available: https://www.census.gov/library/stories/2019/03/do-people-with-disabilities-earn-equal-pay.html. [Accessed April 13, 2020].

M4 Initial Search Time

Map	Number of Deliveries	Initial Route Pathfinding (s)
Toronto	25	3.33
	100	13.41
	175	25.48
New York	25	4.94
	75	15.22
	128	25.75
London	7	1.95
	28	5.56
	66	13.48

15%

“Of the world’s population lives with some form of disability”[8]

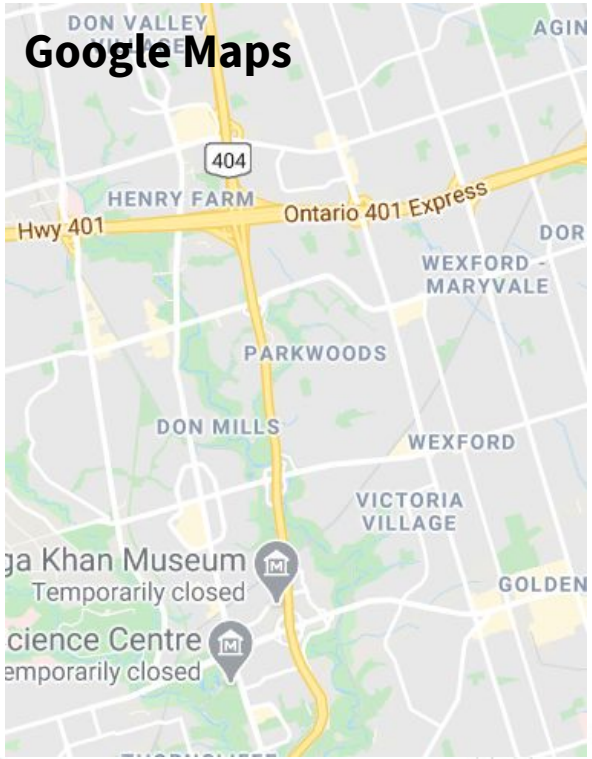
[8]"World report on disability", *World Health Organization*, 2020. [Online]. Available: https://www.who.int/disabilities/world_report/2011/report/en/. [Accessed: 14- Apr- 2020].

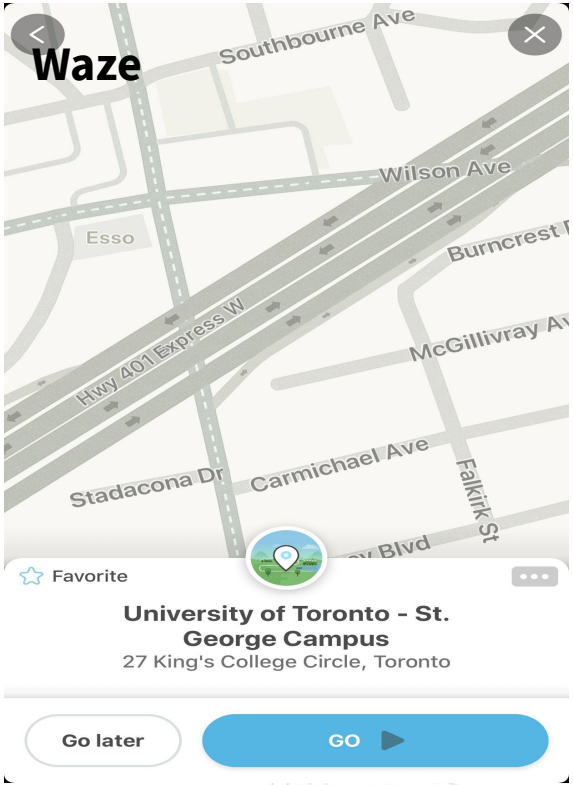
Lack of Navigation solutions

- Mobility solutions for the visually impaired are left as theoretical [9]
- The visually impaired suffer from lack of spatial information about their routes [10]
- Navigation solution around urban areas for individuals with mobility needs are limited [11]

[9]S. Zimmermann-Janschitz, “The Application of Geographic Information Systems to Support Wayfinding for People with Visual Impairments or Blindness,” *IntechOpen*, 11-Nov-2019. [Online]. Available: https://www.intechopen.com/online-first/the-application-of-geographic-information-systems-to-support-wayfinding-for-people-with-visual-impai. [Accessed: 11-Apr-2020].
[10] S. Wong, “The limitations of using activity space measurements for representing the mobilities of individuals with visual impairment: A mixed methods case study in the San Francisco Bay Area,” *Journal of Transport Geography*, 07-Jan-2018. [Online]. Available: https://www.sciencedirect.com/science/article/abs/pii/S0966692317304684. [Accessed: 14-Apr-2020].
[11]L. Beale, K. Field, D. Briggs, P. Picton, and H. Matthews, “Mapping for Wheelchair Users: Route Navigation in Urban Spaces,” *The Cartographic Journal*, vol. 43, no. 1, pp. 68–81, 2006.
[12]"Top Manual Wheelchairs for Seniors | Updated for 2020 | AgingInPlace.org", *AgingInPlace.org*, 2020. [Online]. Available: https://www.aginginplace.org/top-manual-wheelchairs-for-seniors/. [Accessed: 14- Apr- 2020].

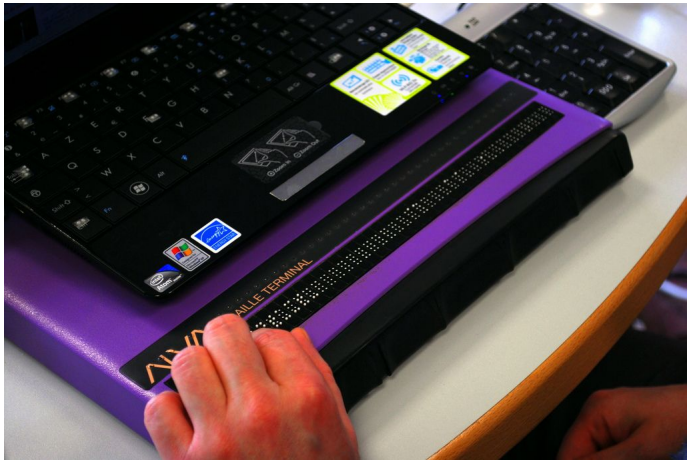
Solutions on the Market?





[13]M. Hashmi, *Waze Screenshot*. 2020.
[14]Muhammad Zaheer Hashmi, *Google Maps Screenshot*. 2020.

Low Awareness Leads to Lack of Assistive Technology Support [2]



Refreshable Braille Display

Sip and Puff

[15]"Refreshable braille display", *En.wikipedia.org*, 2020. [Online]. Available: https://en.wikipedia.org/wiki/Refreshable_braille_display#/media/File:Plage-braille.jpg. [Accessed: 14- Apr- 2020].
[16]S. Needs, P. Switches and S. Switches, "Sip and Puff Assistive Technology Switches", *Rehabmart.com*, 2020. [Online]. Available: https://www.rehabmart.com/product/sip-and-puff-assistive-technology-switches-32190.html. [Accessed: 14- Apr- 2020].
[17]"Screen Reader Demo for Digital Accessibility", *YouTube*, 2020. [Online]. Available: https://www.youtube.com/watch?time_continue=284&v=dEbl5jvLKGQ&feature=emb_logo. [Accessed: 14- Apr- 2020].

Long Term Goal

Promote Accessibility

Action Plan

1. Partner with Accessibility Specialists [18]
2. Consult with developers using Assistive Technology [19]
3. Implement Assistive Technology support
4. Go Open Source [20]

[18] K. Bell, “3 lessons from developers who have embraced assistive technology,” *mashable.com*, Jul. 26, 2015. [Online]. Available: https://mashable.com/2015/07/26/developers-assistive-technology/. [Accessed April 13, 2020].

[19] “Assistive Technology Software,” *chetu.com*. [Online]. Available: https://www.chetu.com/healthcare/assistive-technology.php. [Accessed April 13, 2020].

[20] C. Hoffman, “What Is Open Source Software, and Why Does It Matter?” *howtogeek.com*, Sep. 15, 2017. [Online]. Available: https://www.howtogeek.com/129967/htg-explains-what-is-open-source-software-and-why-you-should-care/. [Accessed April 13, 2020].

Implementation Challenges

- Standardized Development Tools [21]
- Assistive Technology Inputs [21]
- Installation and Support [21]

[21] International Telecommunication Union, “e-Accessibility Policy Toolkit for Persons with Disabilities,” *e-accessibilitytoolkit.org*. [Online]. Available: http://www.e-accessibilitytoolkit.org/toolkit/technology_areas/software. [Accessed April 13, 2020].

[22] Sync Living, “All about wheelchair ramps and how to buy the right one for your house,” *Sync Living.* [Online]. Available: https://www.syncliving.co.uk/buying-a-wheelchair-ramp/. [Accessed April 13, 2020].

Design for EVERYONE