



Easy Maps

Final Status and Future Prospects

cd-059

Aseer Chowdhury, Muhammad Zaheer Hashmi, and Ammol Singh

1. Step 1.5 m away from your screen

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

E L F

**Snellen
Fraction* [1]**

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.

Easy Maps' Goals

Usable

Accessible

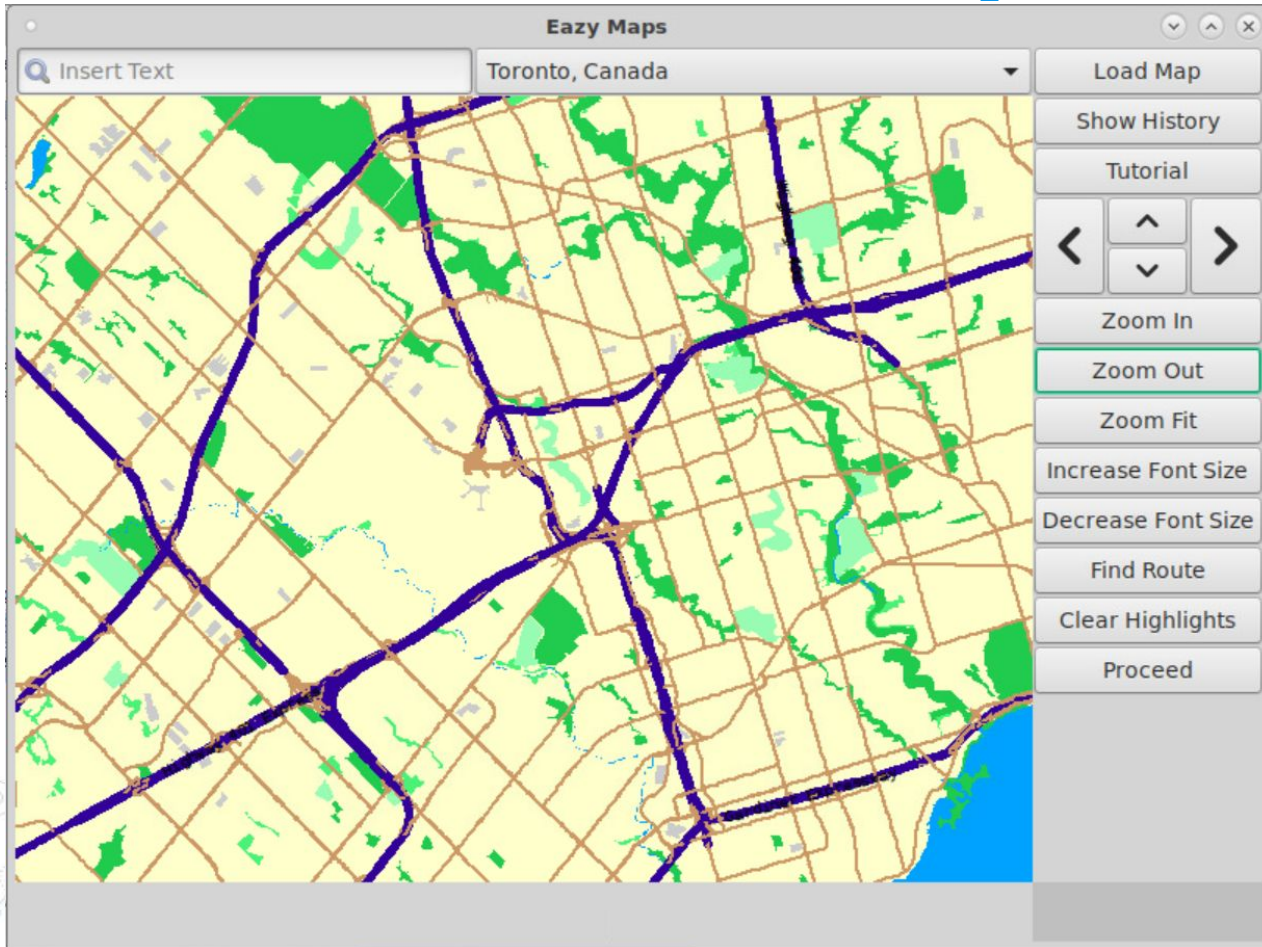
Convenient

Simple

A decorative network diagram in the top-left corner, featuring a cluster of interconnected nodes. Some nodes are represented by solid grey circles, while others are concentric circles with a grey outline and a white center. These nodes are connected by thin, light-grey lines, forming a complex web-like structure.

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].

Muhammad Zaheer Hashmi7

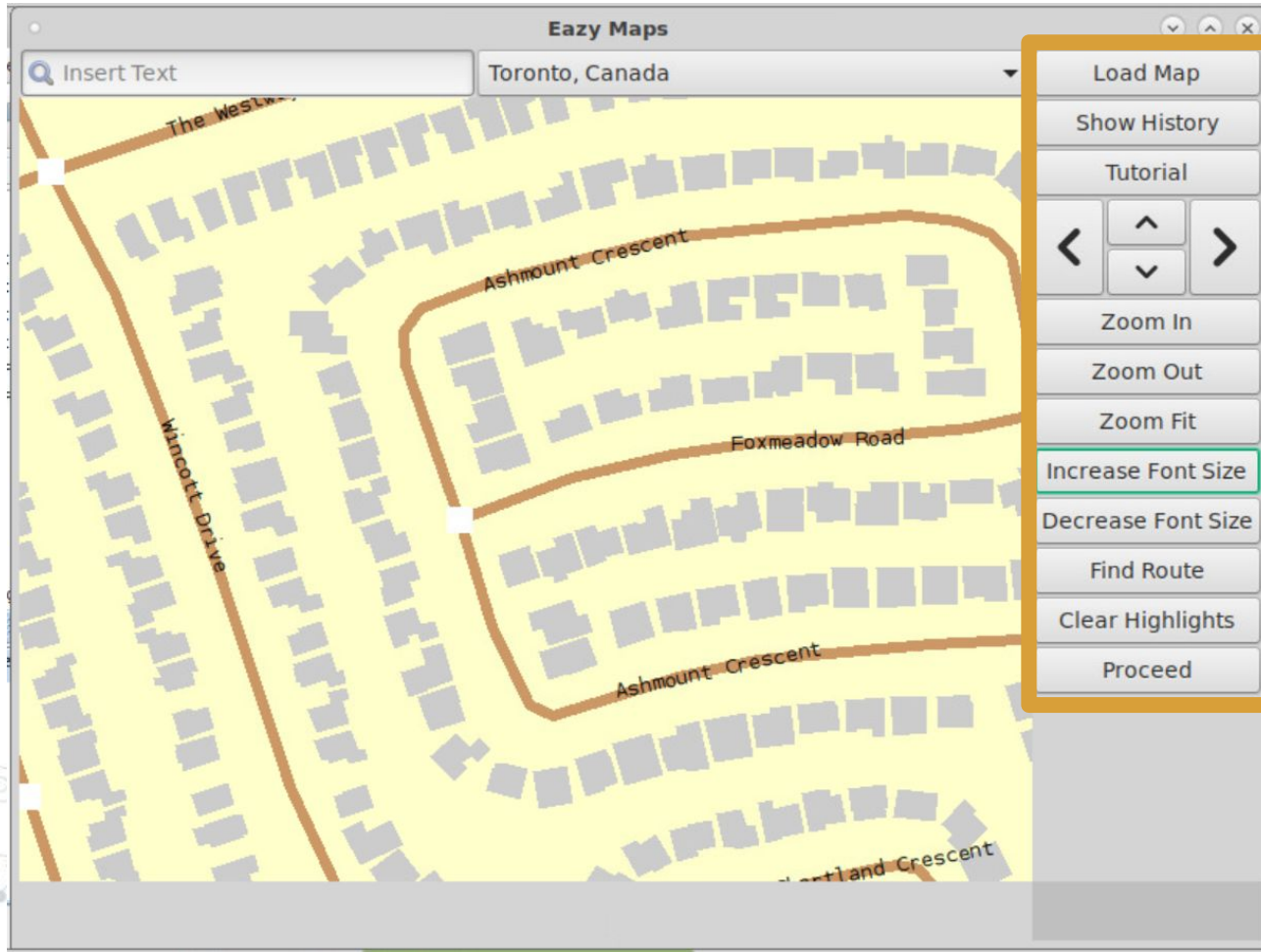
Colour Scheme Improves Visibility

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

Find Route Between Intersections

Enter the street names associated with each intersection below to find the most efficient route between them:

Use selected intersections on the map: ☐

Walking/driving turn penalty (s):

Pathfinding Type:

Starting Intersection:

Ending Intersection:

Choose a walking speed and a walking time limit:

Walking Speed (m/s):

Walking Time Limit (s):

Error messages:

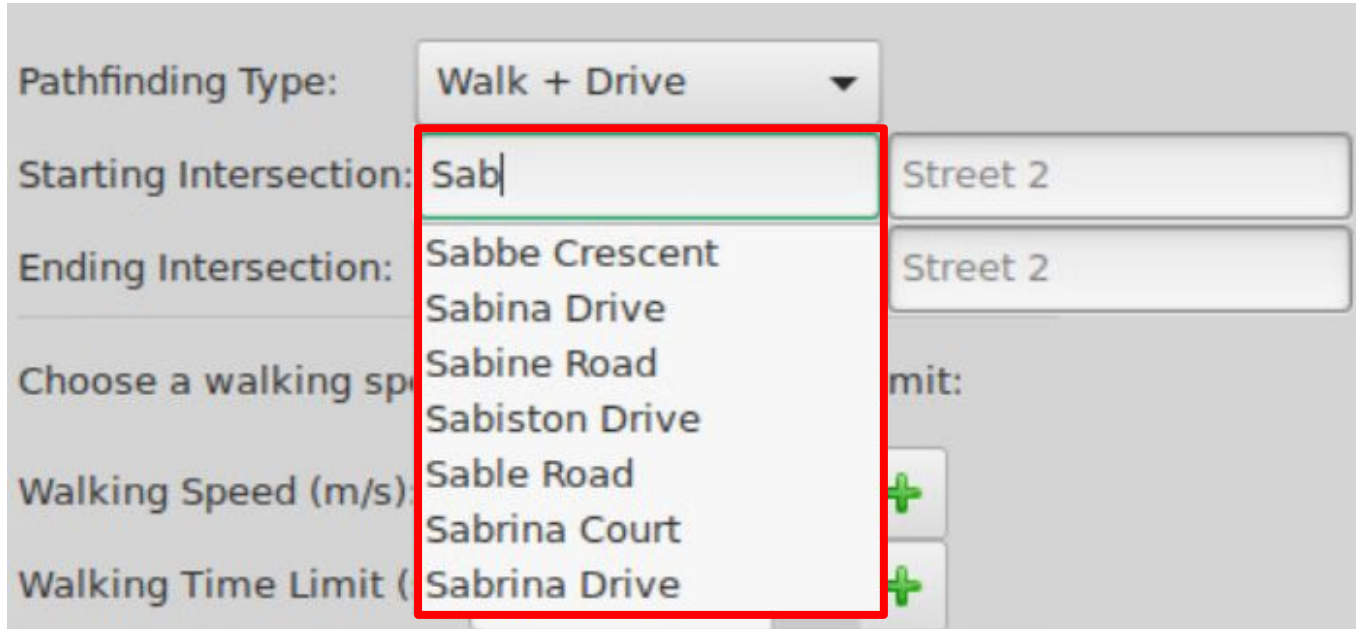
Directions:

⊙ Autocomplete

⊙ Detailed

Directions

Autocomplete Allows for Convenient Data Entry



The screenshot shows a software interface for pathfinding. It includes a dropdown menu for 'Pathfinding Type' set to 'Walk + Drive'. Below this are input fields for 'Starting Intersection' and 'Ending Intersection', both containing the text 'Street 2'. A red rectangular box highlights an autocomplete dropdown menu that appears below the 'Starting Intersection' field. This menu lists several street names: 'Sabbe Crescent', 'Sabina Drive', 'Sabine Road', 'Sabiston Drive', 'Sable Road', 'Sabrina Court', and 'Sabrina Drive'. The first item, 'Sabbe Crescent', is highlighted with a green border. To the right of the input fields are two more 'Street 2' labels and a 'mit:' label. At the bottom, there are fields for 'Walking Speed (m/s)' and 'Walking Time Limit (', each followed by a green plus button.

Pathfinding Type: Walk + Drive ▼

Starting Intersection: Sab|

Ending Intersection: Sabbe Crescent
Sabina Drive
Sabine Road
Sabiston Drive
Sable Road
Sabrina Court
Sabrina Drive

Choose a walking speed

Walking Speed (m/s)

Walking Time Limit (

Street 2

Street 2

mit:

+

+

- 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

Directions:

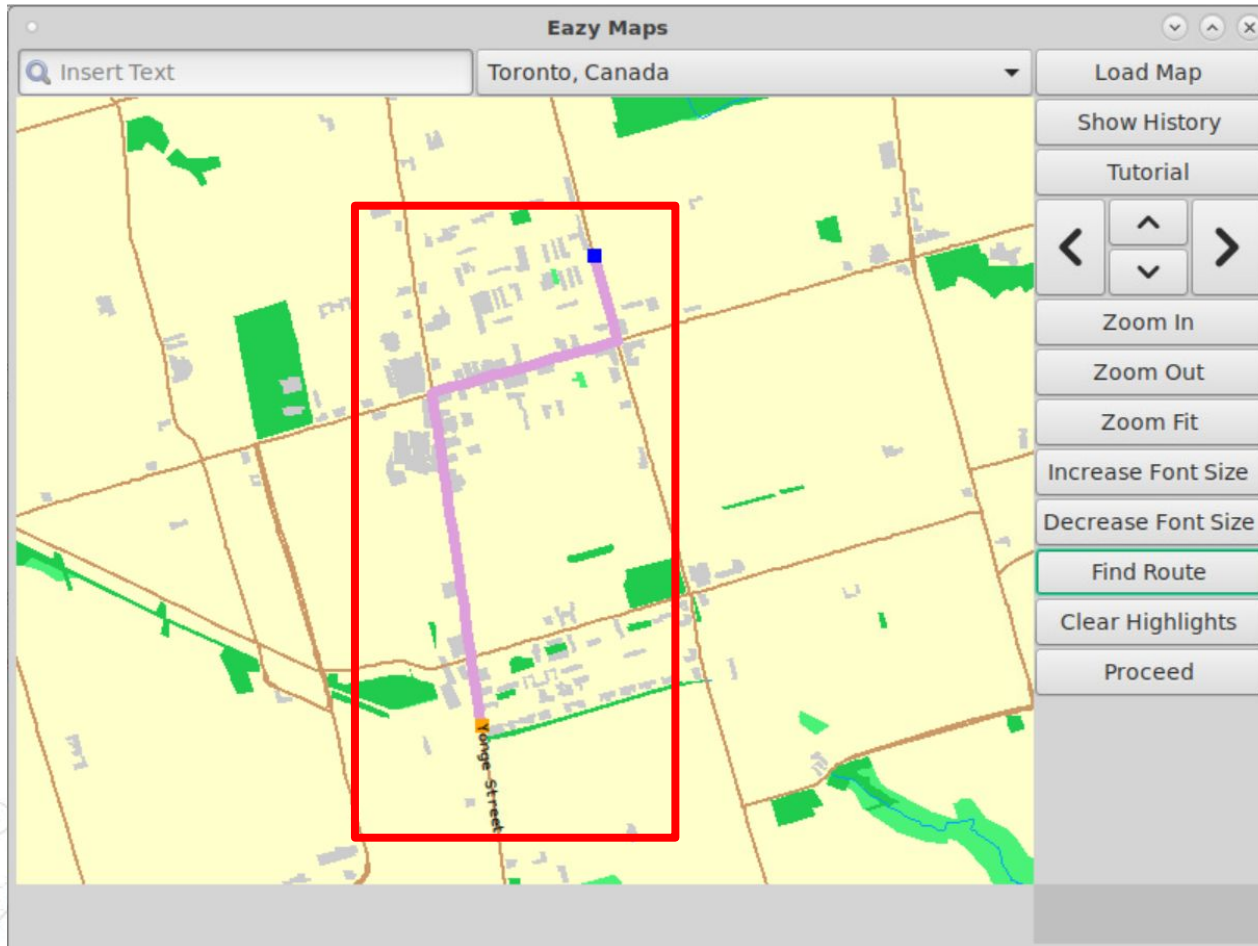
Starting at Bayview Avenue & Argonne Crescent & Ruth Avenue.

Driving instructions:

1. Drive East along Argonne Crescent for about 700 m.
 2. Turn right onto Fleming Drive.
 3. Drive along Fleming Drive for about 90 m.
 4. Turn left onto Cummer Avenue.
 5. Drive along Cummer Avenue for about 1.5 km.
 6. Head straight onto McNicoll Avenue.
 7. Drive along McNicoll Avenue for about 140 m.
- You will have arrived at McNicoll Avenue & Patina Drive.

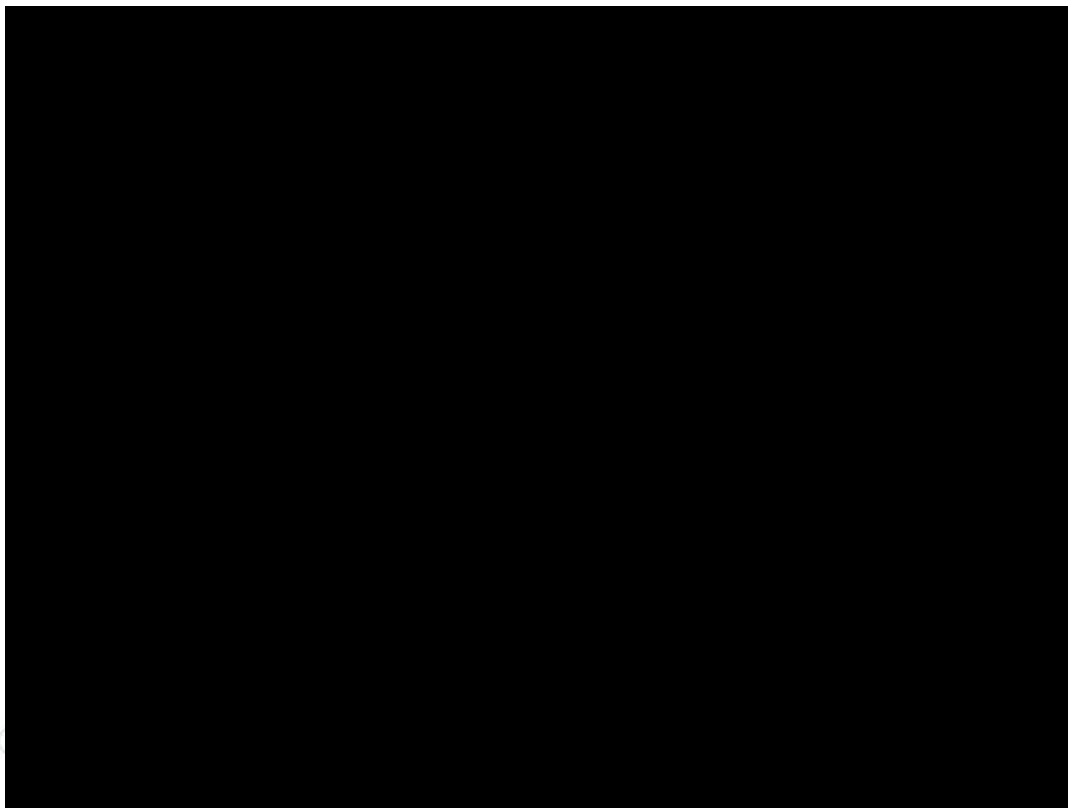
- Relative turn directions
- Distances before turn

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]

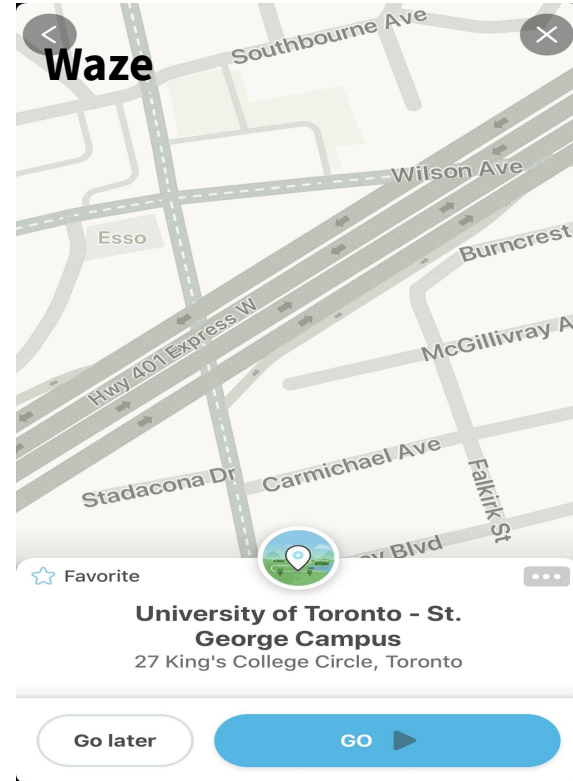
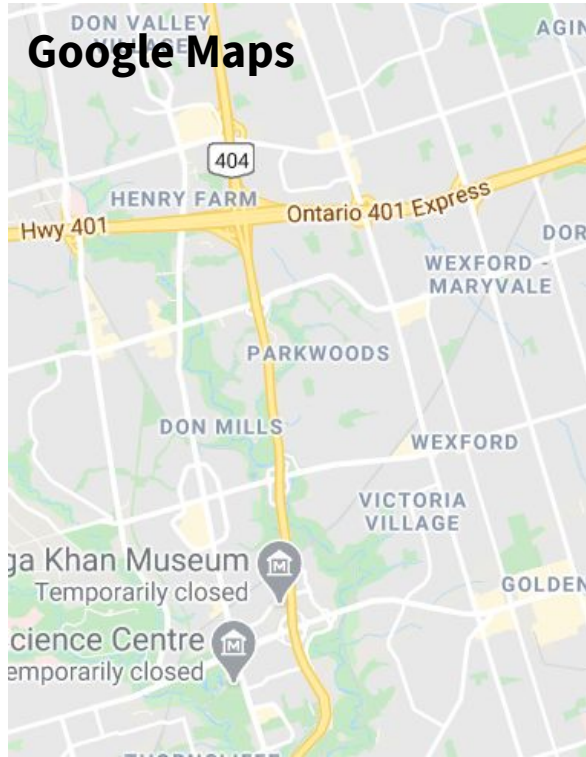
[9] S. Zimmermann-Janschitz, "The Application of Geographic Information Systems to Support Wayfinding for People with Visual Impairments or Blindness," *IntechOpen*, 11-Nov-2019. [Online]. Available: <https://www.intechopen.com/online-first/the-application-of-geographic-information-systems-to-support-wayfinding-for-people-with-visual-impai>. [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].

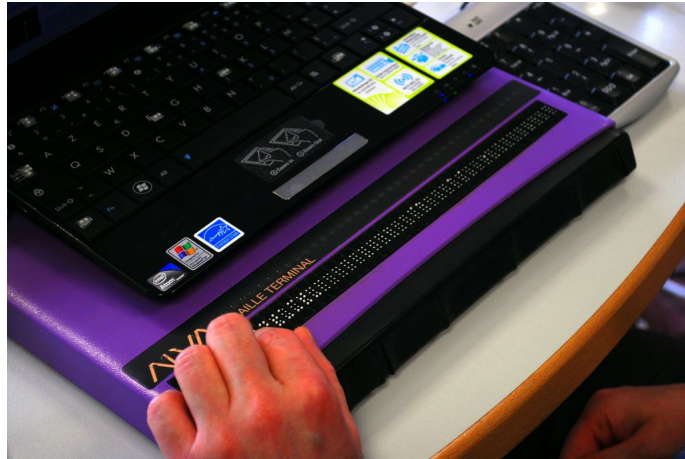
Solutions on the Market?



[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=dEbl5jvLKGG&feature=emb_logo. [Accessed: 14- Apr- 2020].

A decorative network diagram in the top-left corner, featuring a complex web of interconnected nodes and lines, with some nodes highlighted in blue and others in grey.

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