

Meso-Scaled/Micro-Scaled Walkability Analysis

BIA-Centered Sentiment Analysis



Canadian
Urban
Institute

Institut
Urbain du
Canada

Table of Contents

1. Walkability Analysis

- Introduction
 - Methodology
 - Technical Breakdown
-

2. Sentiment Analysis

- Introduction
 - Methodology
 - Technical Breakdown
-

3. Potential Use Cases

Walkability Analysis

Meso-Scaled/Micro-Scaled Walkability Analysis is inspired by the work of Bon Woo Koo, Assistant Professor at Toronto Metropolitan University, School of Urban and Regional Planning.

[\[link\]](#)



Walkability Analysis — Introduction

Current Methodology

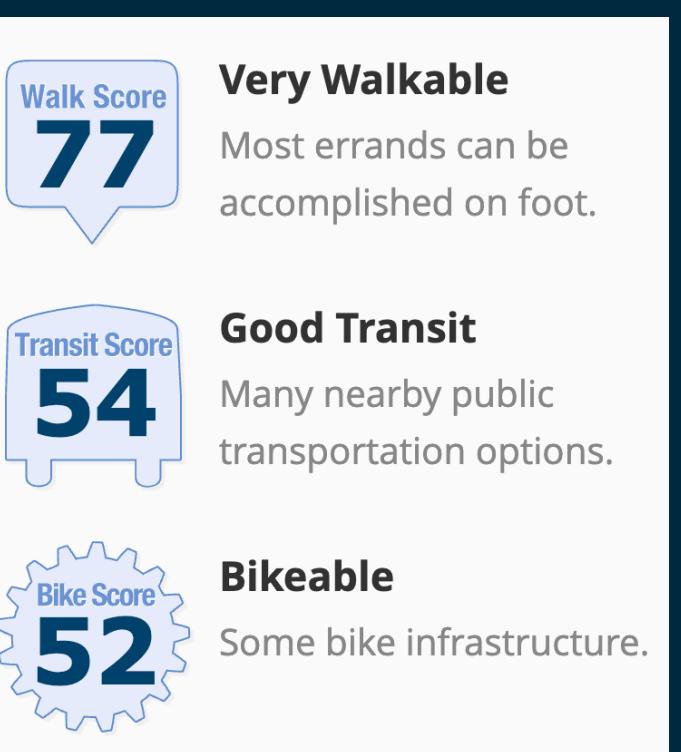
- The conventional Walk Score, a numeric measure scores the walkability of any address, is measured based on geographic and statistical analysis as below:
 1. Distance to amenities in each category
 2. Number of amenities within a 5 minute walk
 3. Population density
 4. Road metrics (block length and intersection density)



Dundas St. East, Mississauga

Current Pain Points

- Since this measure does not take pedestrian experience into account, it often provides misleading Walk Score.
- Though Dundas Mississauga is more car-friendly rather than pedestrian-friendly, it is classified as “very walkable”



Impacts

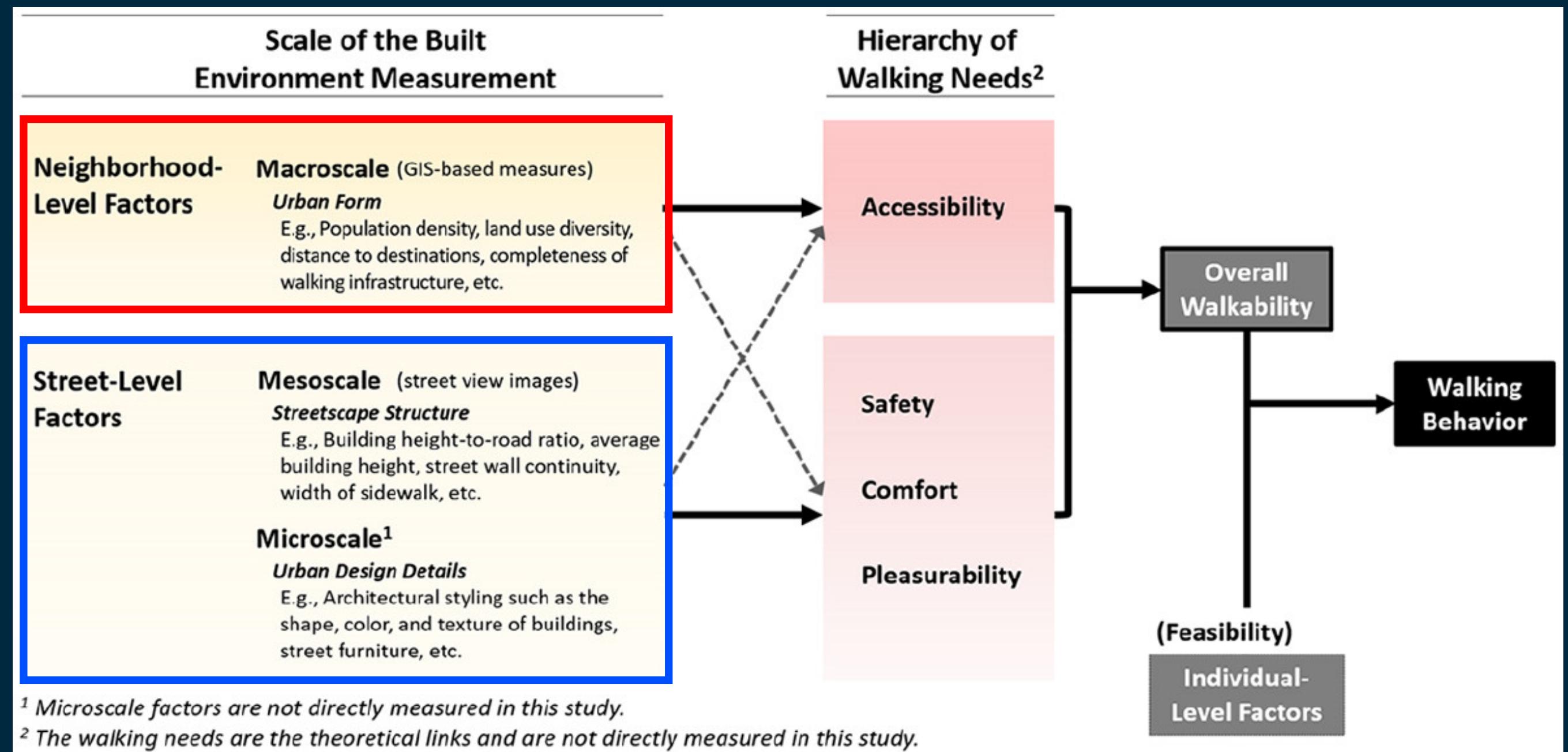
Misallocation of Resources:

A high walk score could lead to less investment in improving pedestrian infrastructure, green spaces, and public amenities in that area, under the assumption that these aspects are already sufficient.

Walkability Analysis – Introduction

New Methodology

- As opposed to the conventional Walk Score, this new walkability analysis is focused on the actual pedestrian experience.
- Meso/Micro-Scaled + Image-based analysis.



Crossing	Is a pedestrian walk signal present?
	Is there a ramp at the curb(s)?
	Is there a marked crosswalk?
Segment	Type of land use?
	How many public parks are present?
	How many public transit stops are present?
	Is there a designated bike path
	Are there any benches or places to sit?
	Are streetlights installed?
	Are the buildings well maintained?
	Is graffiti/tagging present?
	Is a sidewalk present?
	Are there poorly maintained sections of the sidewalk that constitute major trip hazards?
	Is a buffer present?
	What percentage of the length of the sidewalk/walkway is covered by trees, awnings, or other overhead coverage?

<https://journals.sagepub.com/doi/full/10.1177/00139165211014609>

[BonwooKoo/Auto_MAPS/README.md](#)

Walkability Analysis – Methodology

Powered by:



Google Maps

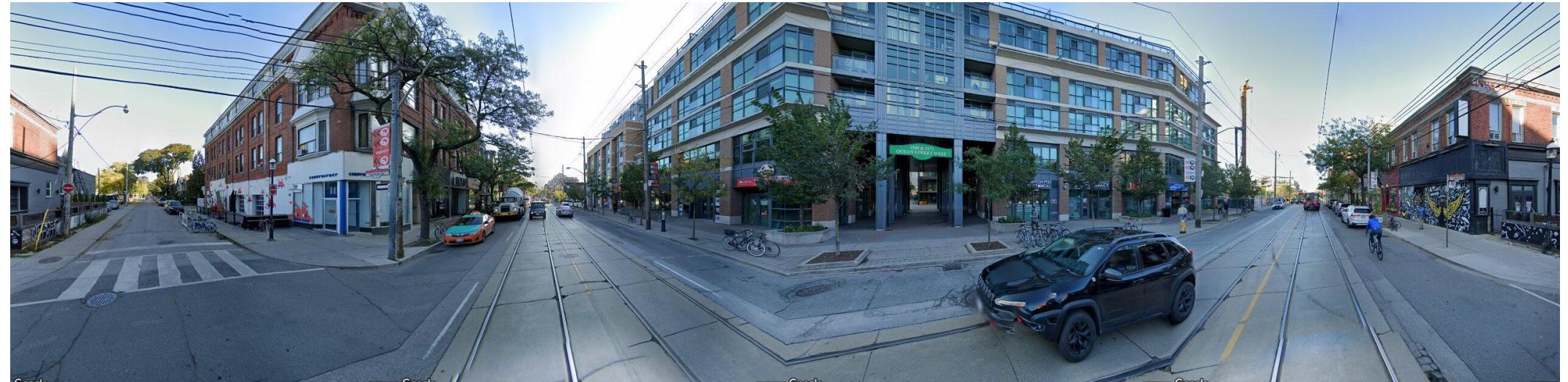
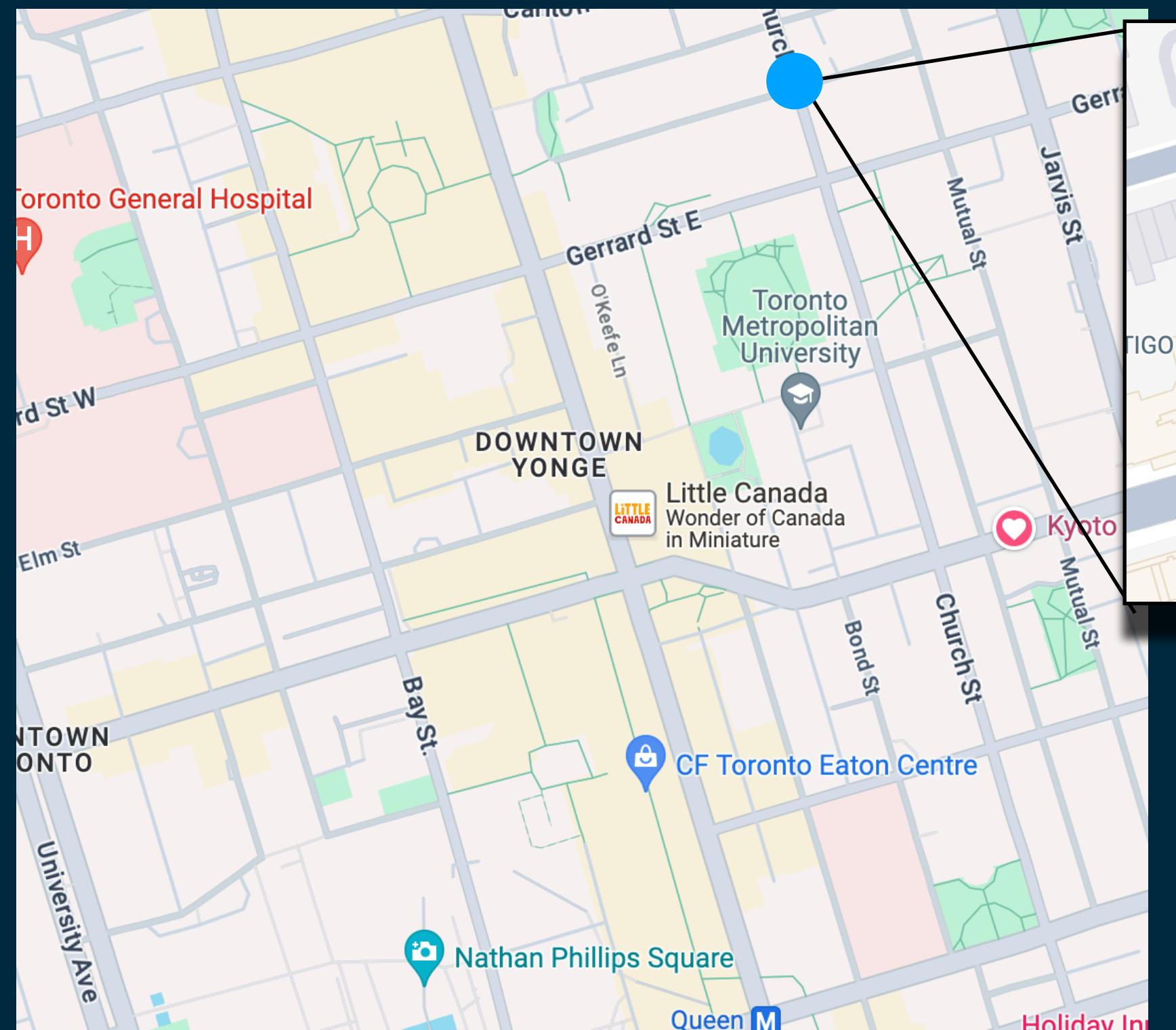


OpenAI

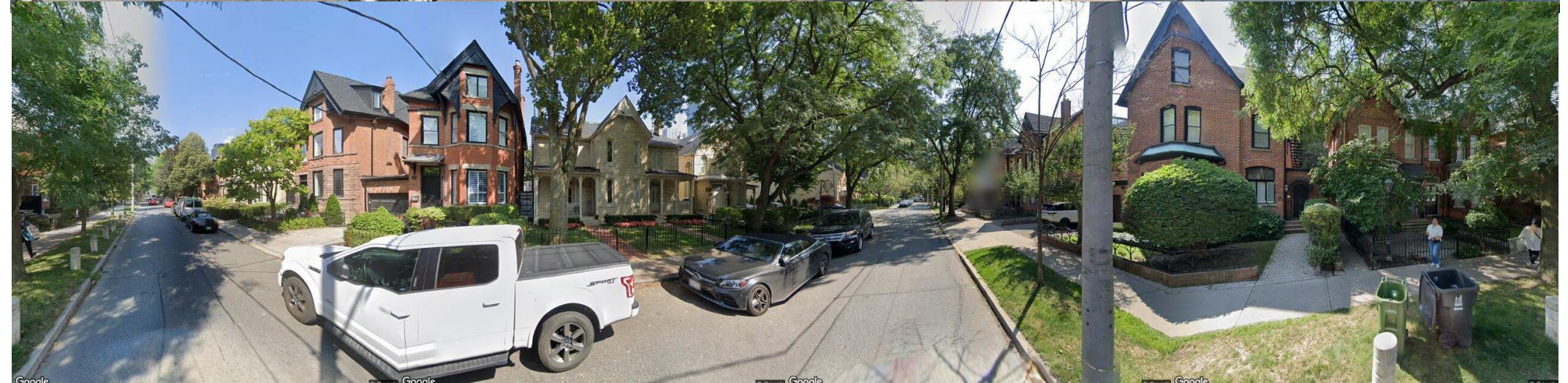
Implemented with



python™



West Queen West



Yorkville Avenue



Canadian
Urban
Institute
Institut
Urbain du
Canada

Walkability Analysis — Methodology



Walkability Analysis – Methodology

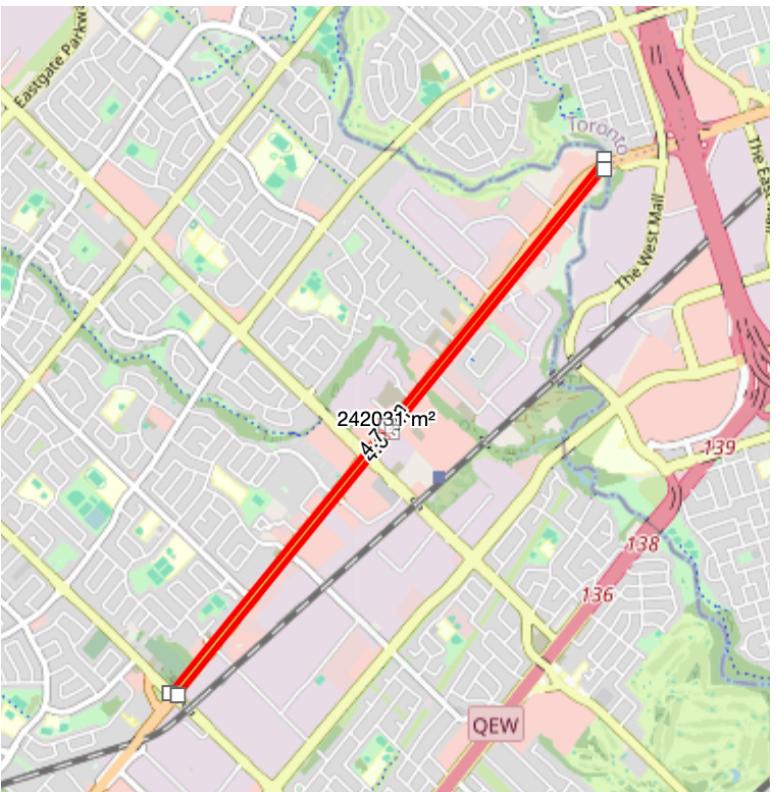
Sample Output

```
{  
  "Walkability Score": 76,  
  "Explanations": [  
    "- Pedestrian Infrastructure: The analyzed area generally has pedestrian walk signals and marked crosswalks, which improve the safety and convenience for pedestrians. However, several construction sites and areas with graffiti were noted, suggesting some disruptions and visual clutter that can detract from the walking experience.",  
    "Sidewalk Conditions: Sidewalks are present, but significant sections are poorly maintained with evident road cracks and pavement issues that pose trip hazards. Overgrown grass was observed near the sidewalks, indicating lack of regular maintenance.",  
    "Parks and Public Spaces: The area includes a few public parks, but not in every image. The presence and condition of these parks suggest some available green spaces for recreational activities, enhancing walkability slightly.",  
    "Transit Stops and Bike Paths: There are public transit stops, which facilitate multimodal transportation options. Designated bike paths are minimal or non-existent in some images, indicating limited infrastructure for cyclists.",  
    "Streetlights and Benches: Streetlights are installed, enhancing safety during nighttime; benches and places to sit are scarce, thereby reducing pedestrian convenience, especially for longer walks.",  
    "Building Maintenance: Several buildings display signs of poor maintenance, including graffiti. This can impact the perceived safety and aesthetic appeal of the streets.",  
    "Buffers and Overhead Coverage: In many areas, buffers between sidewalks and streets are missing or inadequate, increasing pedestrian exposure to vehicular traffic. Tree coverage and awnings providing shade are sparse, resulting in less comfortable walking conditions, especially on hot or rainy days.",  
    "Land Use: The predominantly mixed-use nature of the area means there are both residential and commercial activities, which can support a variety of walking purposes but also lead to fluctuating pedestrian traffic volumes and noise levels.\n\nOverall, while there are positive aspects such as pedestrian signals and parks, the area suffers from significant issues with maintenance of sidewalks and buildings, limited seating, inadequate buffers, and sparse overhead coverage, leading to a moderate walkability score."  
}
```



Walkability Analysis – Methodology

Dundas Mississauga



Very Walkable

Most errands can be
accomplished on foot.



Good Transit

Many nearby public
transportation options.



Bikeable

Some bike infrastructure.

Conventional methodology does not take into account whether a piece of a road is car-centric or pedestrian centric.

In macro-scale analysis of this conventional walkability analysis which does not focus on detailed pedestrian experience, since this is a flat, well-paved, straight road, the score is high.

Score Contextualization / Scale

New Methodology	Correspondence to the conventional	Implication
≥80	≥90	Very walkable, pleasant.
≥70	≥80	Moderately walkable
≥60	≥70	Somewhat walkable
≥50	50~60	Walkable, unpleasant
≤50	≤50	Cars preferred

Walkability Analysis — Technical Breakdown

Models Used

- AI Processing Model:
Latest GPT-4o (up to May 13, 2024)
- Image Retrieving:
Google Maps API

Model	Input	Output
gpt-4o	\$5.00 / 1M tokens	\$15.00 / 1M tokens
gpt-4o-2024-05-13	\$5.00 / 1M tokens	\$15.00 / 1M tokens

Street View Image: \$7 / 1k Requests

Prompts:

- For the optimal performance of the AI model, prompt engineering was done to guide detailed analysis.
- Moreover, models were trained as the analysis continue; thus it is able to make much more detailed analysis as the input capacity increases.

In conclusion, it costs about \$5 in average per BIA.

Sentiment Analysis

Sentiment Analysis – Introduction

Current Pain Points

- Though feedbacks on user experience regarding a place necessary for efficient urban planning, collecting them is costly.
- Once these feedback are collected, we need a efficient measure to evaluate a place to allocate resources accordingly.

New Approach

- We are able to retrieve most of the reviews from Google Maps through its API, then filter those that are deemed representative by Google and its users.
- Those reviews can be sent to GPT-4o to process sentiment analysis.
- With various different versions of prompt, we are able to tailor-made the program for specific use cases.

Anna Zheleznia
5 reviews

★★★☆☆ 4 months ago

I found the Customer service and new guests welcoming are extremely poor at the reception.

This place had more than half of the restaurant's tables empty, and they didn't provide a sitting table for one person. All tables in half of the restaurants can't be booked for the same time on a casual mid-day on Wednesday

Kevin Fouillet
Local Guide · 50 reviews · 54 photos

★★★☆☆ 6 years ago

The place is very nice and fancy. Food is really good. However the service is not logical. When you order an antipasti with wine you expect it to be served BEFORE your main dish.. well we got our main pasta before.. the wine and antipasti after.. seriously guys, just think a little bit before doing. An antipasti is a starter! In the word starter, you have START. So I suppose it should come BEFORE the main dish.

Anyway, except that, the food was delicious.

Loosing 2 stars for the none-sense service

Jessica Lee
7 reviews · 5 photos

★★★★★ 5 days ago NEW

Today was my first time visiting, and I love this place. The food was great, the server was very kind and I liked the atmosphere the most.

It was a hot day, but the spacious outdoor patio area with the shades and big trees was very cool :) [More](#)



Sentiment Analysis – Methodology

Powered by:



Google Maps



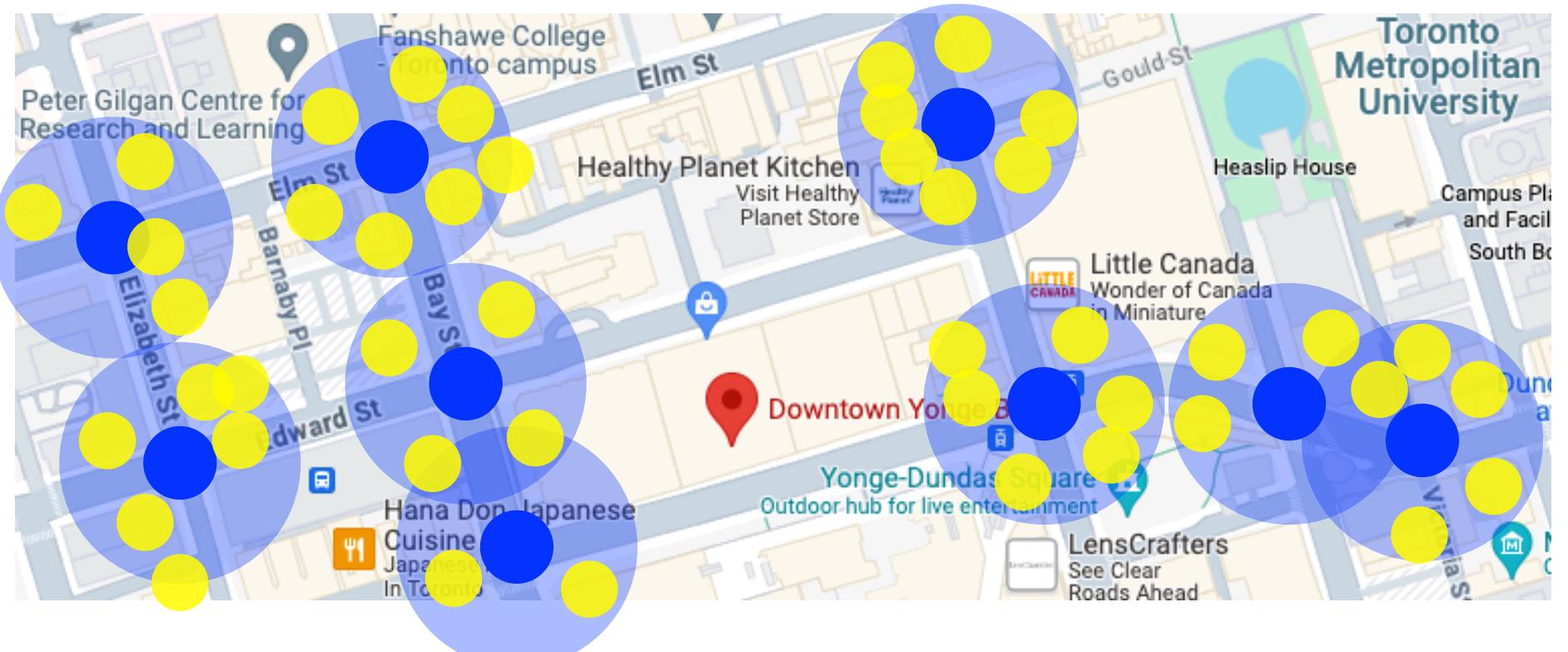
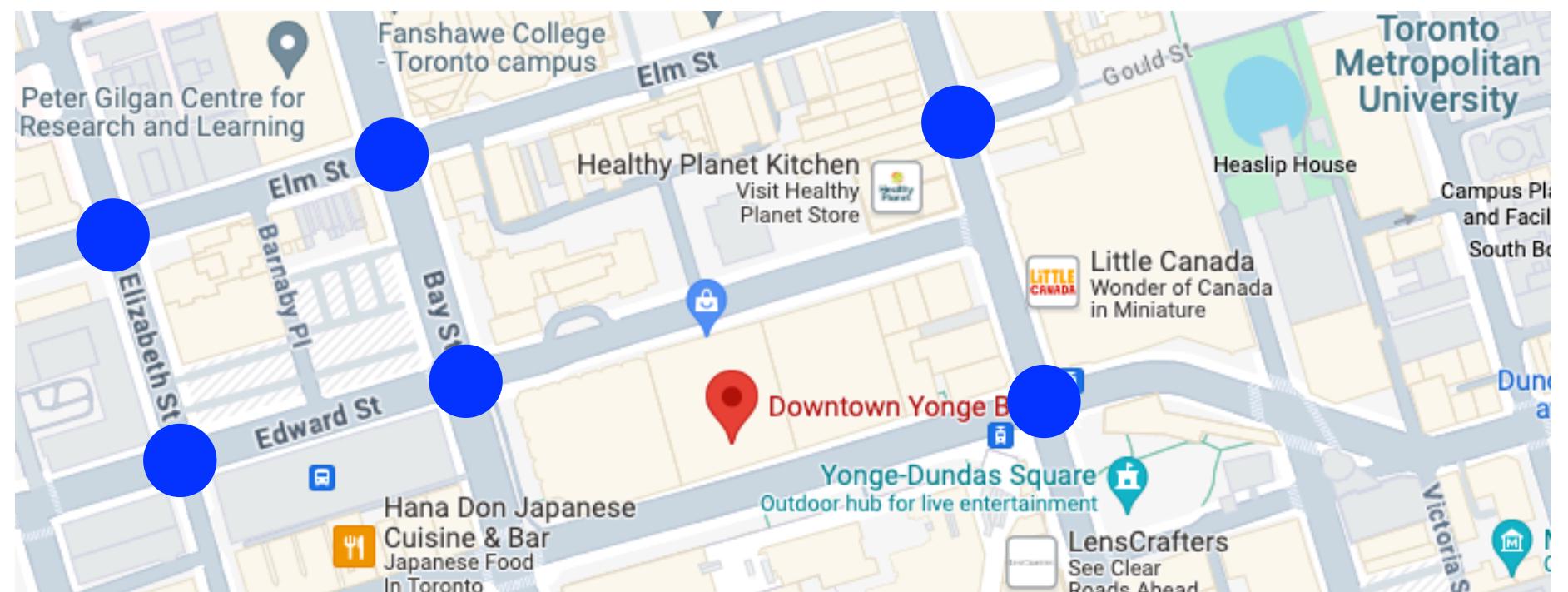
OpenAI

Implemented with



python™

1. This methodology requires 2 input shape files
 - Road Network
 - Region of Interest (BIA)
2. Automatically searches for road intersections contained in the provided region polygon and lists them up with their lat & lon pair.
3. Process Nearby Search (Buffer Geoprocessing) to get business information around those intersection points.
4. Retrieve reviews for each and process sentiment analysis



Canadian
Urban
Institute
Institut
Urbain du
Canada

Sentiment Analysis – Technical Breakdown

Anna Zheleznia
5 reviews

★★★★★ 4 months ago

I found the Customer service and new guests welcoming are extremely poor at the reception.

This place had more than half of the restaurant's tables empty, and they didn't provide a sitting table for one person. All tables in half of the restaurants can't be booked for the same time on a casual mid-day on Wednesday

Kevin Fouillet
Local Guide · 50 reviews · 54 photos

★★★★★ 6 years ago

The place is very nice and fancy. Food is really good. However the service is not logical. When you order an antipasti with wine you expect it to be served BEFORE your main dish.. well we got our main pasta before.. the wine and antipasti after.. seriously guys, just think a little bit before doing. An antipasti is a starter! In the word starter, you have START. So I suppose it should come BEFORE the main dish.

Anyway, except that, the food was delicious.

Loosing 2 stars for the none-sense service

Jessica Lee
7 reviews · 5 photos

★★★★★ 5 days ago NEW

Today was my first time visiting, and I love this place. The food was great, the server was very kind and I liked the atmosphere the most.

It was a hot day, but the spacious outdoor patio area with the shades and big trees was very cool :) [More](#)



- Each word in every single review is being “graded” by the intensity of its sentiment from -100 indicating intense negative sentiments and 100 indicating intense positive sentiment.
 - In terms of the absolute values...:
 - “Hot” < “Stifling” < “Suffocating”
- AI then quantitative analysis on the frequency of those words, intensity, connotations...etc to give one measure per business.
- Finally, it outputs a 5-number summary for the entire region.

Sentiment Analysis – Methodology

Sample Output

Five Number Summary of Sentiment Scores:

Min: 18
Q1: 74.0
Median: 89.0
Q3: 95.0
Max: 99

Place ID: ChIJ8fQMwm3L1IkRCIuhgdxaeP0, Sentiment Score: 98
Place ID: ChIJ-3XJfYXL1IkRRXY9zwPlIJc, Sentiment Score: 43
Place ID: ChIJtcNMynbL1IkRkTsBy2Fs1dU, Sentiment Score: 69
Place ID: ChIJss9P13fL1IkRNAse1wCXo-w, Sentiment Score: 79
Place ID: ChIJqQr6y3bL1IkRHLGrGoMAD3Q, Sentiment Score: 18
Place ID: ChIJJfjHBnLL1IkRkqFvwaubvik, Sentiment Score: 98
Place ID: ChIJH7fUcXHL1IkRWmWMeArF_Ys, Sentiment Score: 77
Place ID: ChIJPcCaVYPL1IkRfCNVk0ZuYfg, Sentiment Score: 99
Place ID: ChIJscGaVYPL1IkRCJU6vjH3b_M, Sentiment Score: 96
Place ID: ChIJ4Q8dYp3L1IkRkDd8munn-jw, Sentiment Score: 94
Place ID: ChIJ50J6NnHL1IkRrSqRwTlIQ6w, Sentiment Score: 68
Place ID: ChIJkeMBZJ3L1IkR0aSVxIX8ABQ, Sentiment Score: 85
Place ID: ChIJ0Yi_5nbL1IkRIIY4o40T3jc, Sentiment Score: 95
Place ID: ChIJPcCaVYPL1IkRXZjqMp9jb8E, Sentiment Score: 71
Place ID: ChIJ0fDhJIPL1IkR7qd1oSuzY2o, Sentiment Score: 95
Place ID: ChIJ90qPjYPL1IkRzDFdYMMVcQI, Sentiment Score: 87
Place ID: ChIJS7ifVYPL1IkRXnHmCsIyMVE, Sentiment Score: 80
Place ID: ChIJJ-pAanHL1IkRfLhzre3oK8s, Sentiment Score: 95
Place ID: ChIJodUu1THL1IkRWEjt_i-Agqu, Sentiment Score: 85
Place ID: ChIJf0MrSHrL1IkRMfNXDH4Yl4M, Sentiment Score: 96
Place ID: ChIJhwMj2HfL1IkRfcxOUWeI1ys, Sentiment Score: 94
Place ID: ChIJZRRh2HfL1IkRHIOLY_QWDFs, Sentiment Score: 89
Place ID: ChIJKYjNUoPL1IkR60oS10MfVqI, Sentiment Score: 97
Place ID: ChIJPcCaVYPL1IkREYT0kId-klg, Sentiment Score: 74



Walkability Analysis — Technical Breakdown

Models Used

- AI Processing Model:
Latest GPT-4o (up to May 13, 2024)
- Image Retrieving:
Google Maps API

Model	Input	Output
gpt-4o	\$5.00 / 1M tokens	\$15.00 / 1M tokens
gpt-4o-2024-05-13	\$5.00 / 1M tokens	\$15.00 / 1M tokens

Nearby Search: \$17 / 1k Requests
Retrieving Reviews: \$17 / 1k Requests

Prompts:

- For the optimal performance of the AI model, prompt engineering was done to guide detailed analysis.
- Moreover, models were trained as the analysis continue; thus it is able to make much more detailed analysis as the input capacity increases.

In conclusion, it costs about \$9 in average per BIA.

Potential Use Cases

MMS Dashboard – Case Study

- By integrating the methodology of walkability analysis to the MMS Case Study, it can provide more user-centric / pedestrian-centric information for mitigating daily experience.
- Further, it also enables for a more efficient allocation of resources, deviating from what the conventional Walk Score implies.
- More in-depth comparative analysis between various main streets / cities can be made for urban planning
- This methodology also provides a new measure to take into account when building a “Complete Community”

High Applicability

These two programs has high applicability and a wide range of usage since we can flexibly change the source of informations (APIs) according to our specific needs.

Construction Mitigation – Ontario Line

- Google Maps API allows us to retrieve real-time pedestrian feedbacks about the overview of a place.
- With the help of AI, we can easily tailor-made the program to focus on constructions and the inconveniences it causes

Others

- Tourism – Guided Tour: Tourism companies can design walking tours based on areas with high walkability scores and positive sentiment analysis.
- Environmental Sustainability – Green Space Planning: Identifying areas that need more trees and green spaces to improve walkability and environmental health.
- Real Estate – Property Valuation: professionals can use walkability scores to assess the value of properties, as higher walkability often correlates with higher property values.

Thank you!



Canadian
Urban
Institute

Institut
Urbain du
Canada