1

Walk and bike? In *Manila*?

Walking and cycling are hostile experiences in the city.

Poor walking and cycling infrastructure means even trips a 15-minute walk or bicycle ride away are taken via motor vehicles.

2

LGUs need street-level insights.

Assessments of walkability and bikeability are city-wide. *Policies are not.*

3

We need *street-specific, human-scale information* for targeted and effective mobility interventions.

To fix our streets, we need to understand them.

INTRODUCING

Padyak

Walkability and Bikeability Index Modeling for Sustainable Mobility Planning

Team Hippothesis
Eltagonde, Germar, Yunque | *Ateneo de Manila University*

?

PADYAK models street and area-wide walkability and bikeability.

1

SIMULATE
LGU transport interventions

2

EVALUATE
walker and cyclist comfort

Features

EVALUATE

Walker and Cyclist Comfort

Discrete walkability and bikeability scores, considering street-level infrastructure, traffic speed and volume.

SIMULATE

Features

EVALUATE

Walker and Cyclist Comfort

What distance will people trade for comfort? Route and area discomfort vs. distance curves.

SIMULATE

Features

SIMULATE
LGU Transport Interventions

What if a route was safer? more convenient? Model impacts on bikeability and walkability indices.

EVALUATE

Features

SIMULATE
LGU Transport Interventions

What if security was more important? Attractiveness? Changing the weight of walkability and bikeability components.

EVALUATE

Methodology

1

DATA COLLECTION

- Data Cleaning on OpenStreetMap (OSM), merging with other datasets
- Data Generation (from street images)

2

INDEX DEVELOPMENT

- Discomfort Estimation
- Clustering and Clustering Analysis
- Walkability and Bikeability Curves

3

WEB APPLICATION DEVELOPMENT

- Interactive Map of Walkability
- LGU Dashboard
- Analysis of discomfort-vs-distance curves
- Route-finding (based on sensitivity to discomfort)
- Discomfort Recomputation (based on user-specified weights)

Marie Danielle V. Guillen, PhD

Associate Professor, UP Asian Institute of Tourism, Board Member; Transportation Science Society of the Philippines; and Core/Founding Member, WITL

Marie Danielle V. Guillen, PhD., is a currently an independent consultant and published academic with expertise on policy and planning (regional and urban planning) sciences specifically transport, tourism, participatory planning including social safeguards and climate change. She is strong advocate of inclusive mobility.

Image and description are sourced from Planetary Health Philippines.

0

Before pursuing the project, we consulted a mobility expert on Padyak's methodology.

Data Collection and Cleaning

OpenStreetMap (OSM) data

- Obtained from Geofabrik
- Street network data for the target city (Mandaluyong) with geospatial and physical descriptors
  - e.g., type of street/cycleway, sidewalks, parking, etc.

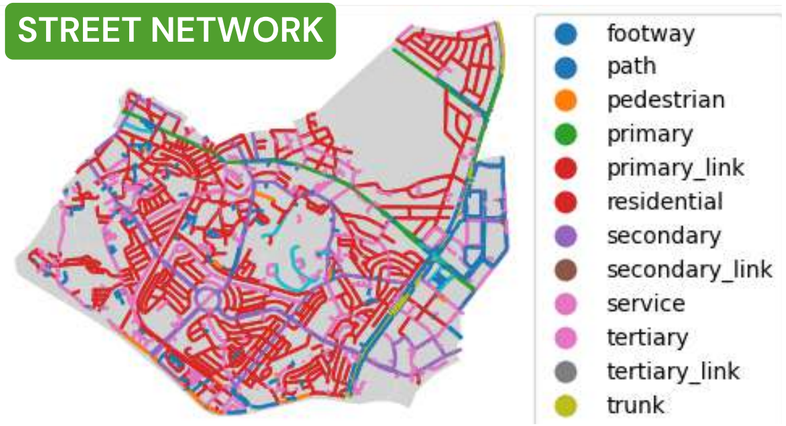
EDSA Road Traffic Accident data (Luz and Blanco, 2019)

- Accidents with exact location
- Used for estimating relative accident risk for different segments of EDSA

Data Generation from Street-level Images

- Mapillary API, 2024
- Image segmentation
- Places365, SegFormer
- Road quality and object detection

STREET NETWORK



COMPLETE BIKE LANE DATA

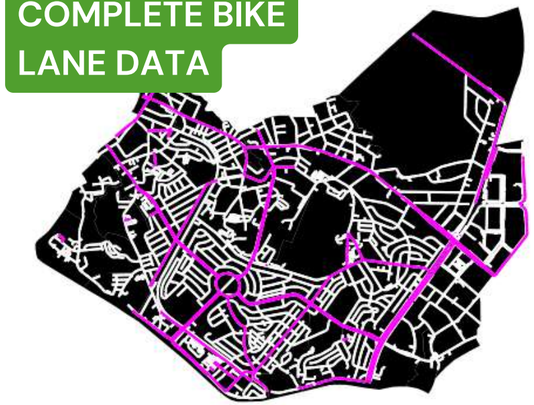
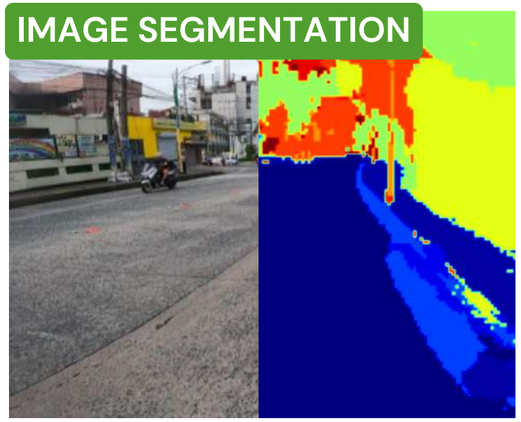


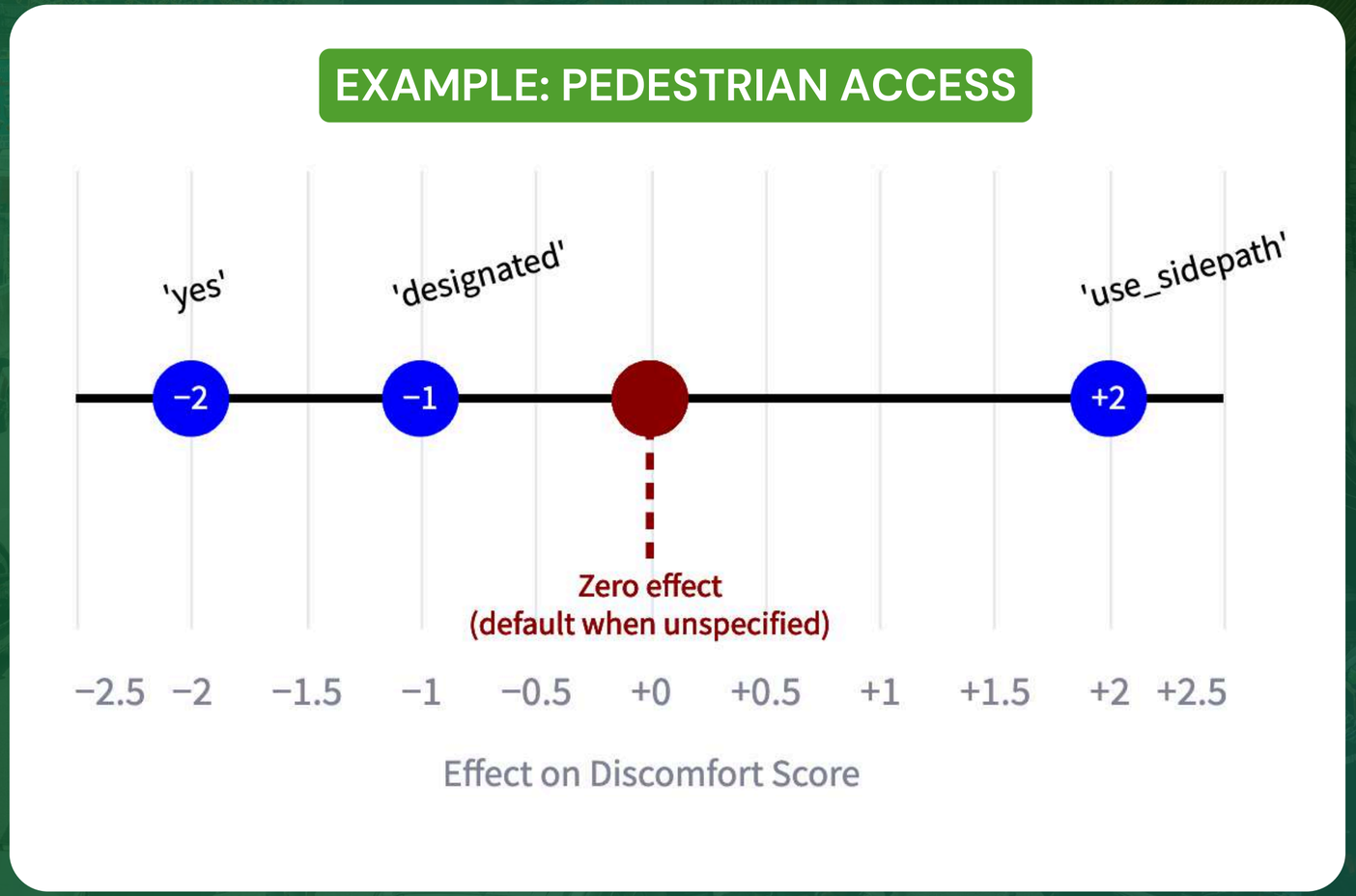
IMAGE SEGMENTATION



Discomfort Estimation

Cleaned OSM data to identify:

- Level of pedestrian/cyclist **access** to each street.
- Presence of **sidewalks, crossings, car parking, and bike lanes** (and the class of each bike lane)
- Other physical characteristics affecting **sense of security, traffic safety, convenience, attractiveness of route (greenery), accident risk**

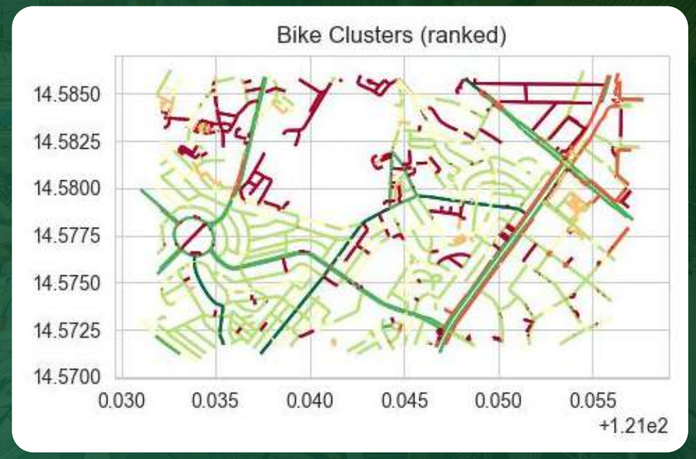


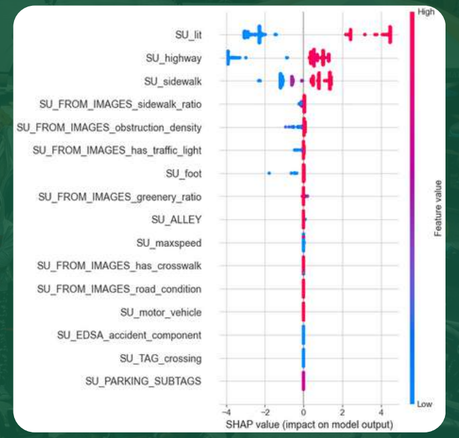
Clustering and Ranking of Streets

We apply clustering to group clusters based on features.

- K-Means with scaled data (0-1) vs unscaled.
- Rank the bikeability and walkability clusters based on Arellana et. al 2020 and Boongaling et. al 2022 respectively.
- XGBoost for determining weights (Gain score).
- SHAP explainer for interpretation.

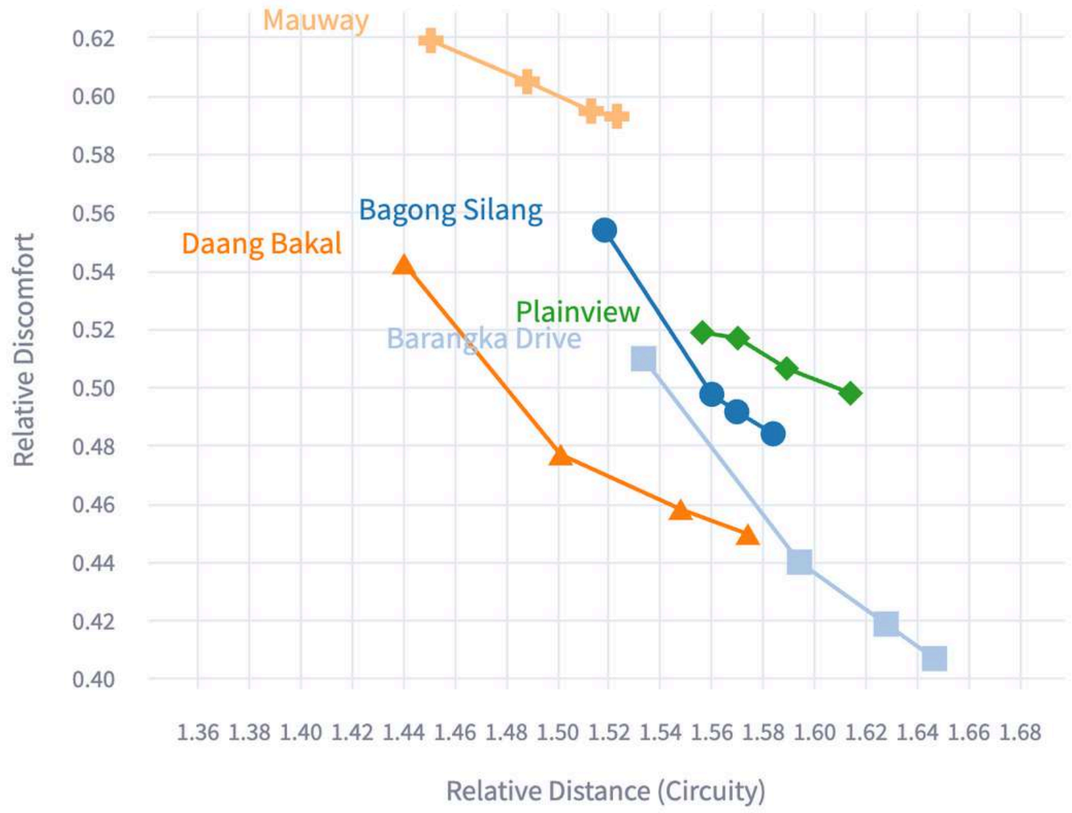
CLUSTER COMPARISON





Discomfort-vs-Distance Curve

EXAMPLE: CURVES FOR 5 BARANGAYS



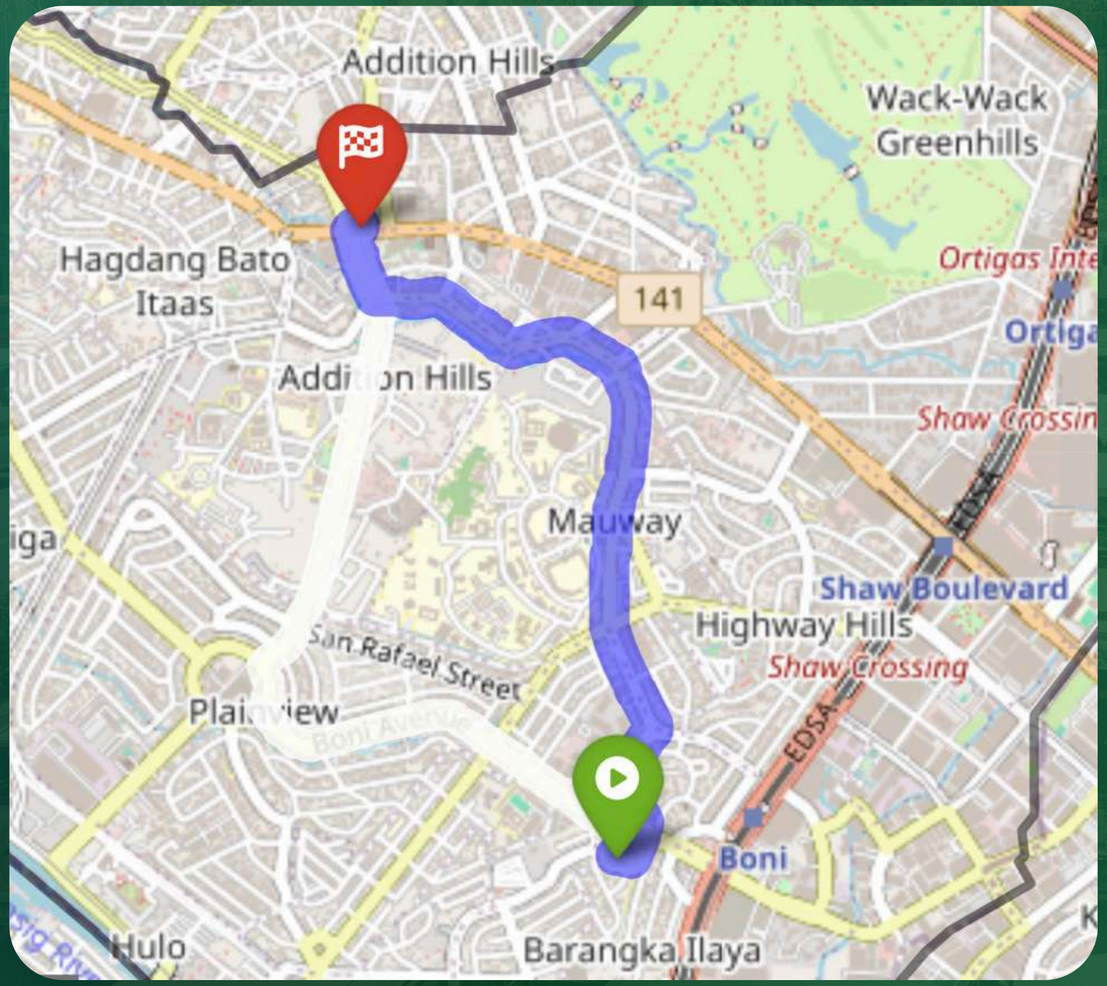
GOAL

Compare areas (barangays or cities) in a way that is *interpretable* and *inclusive to different types of commuters.*

- Pedestrians and cyclists have different levels of **sensitivity to discomfort** while commuting.

Based on Reggiani et al. (2021)

How curves are computed



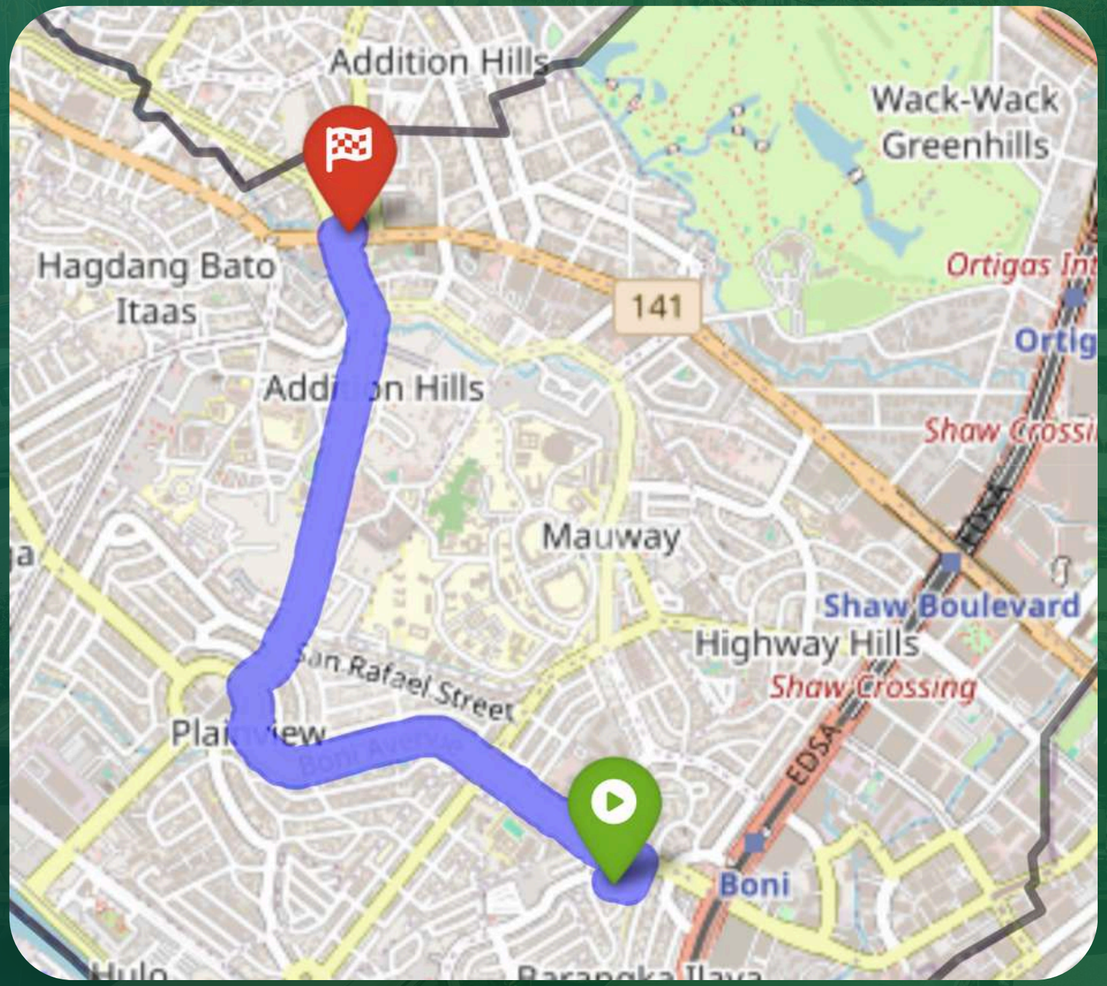
EXAMPLE

From Boni Ave (near Pioneer St) to a commercial area on Shaw.

Types of cyclists:

- **Low sensitivity to discomfort:** Prefers to take the shortest path.

How curves are computed

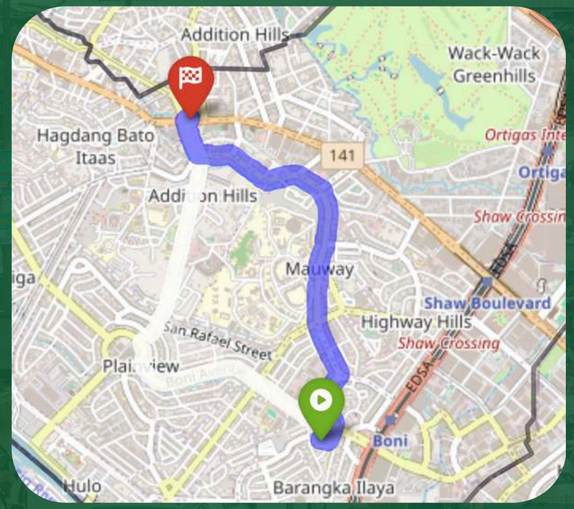


EXAMPLE

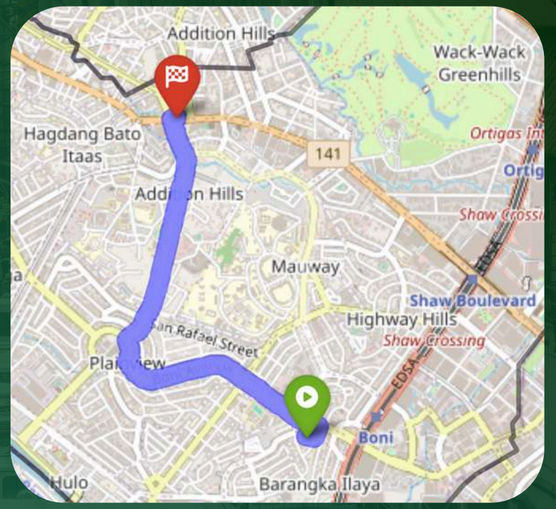
From Boni Ave (near Pioneer St) to a commercial area on Shaw.

Types of cyclists:

- **Higher sensitivity to discomfort:** Takes a detour on a more bike-friendly route, to reduce discomfort.



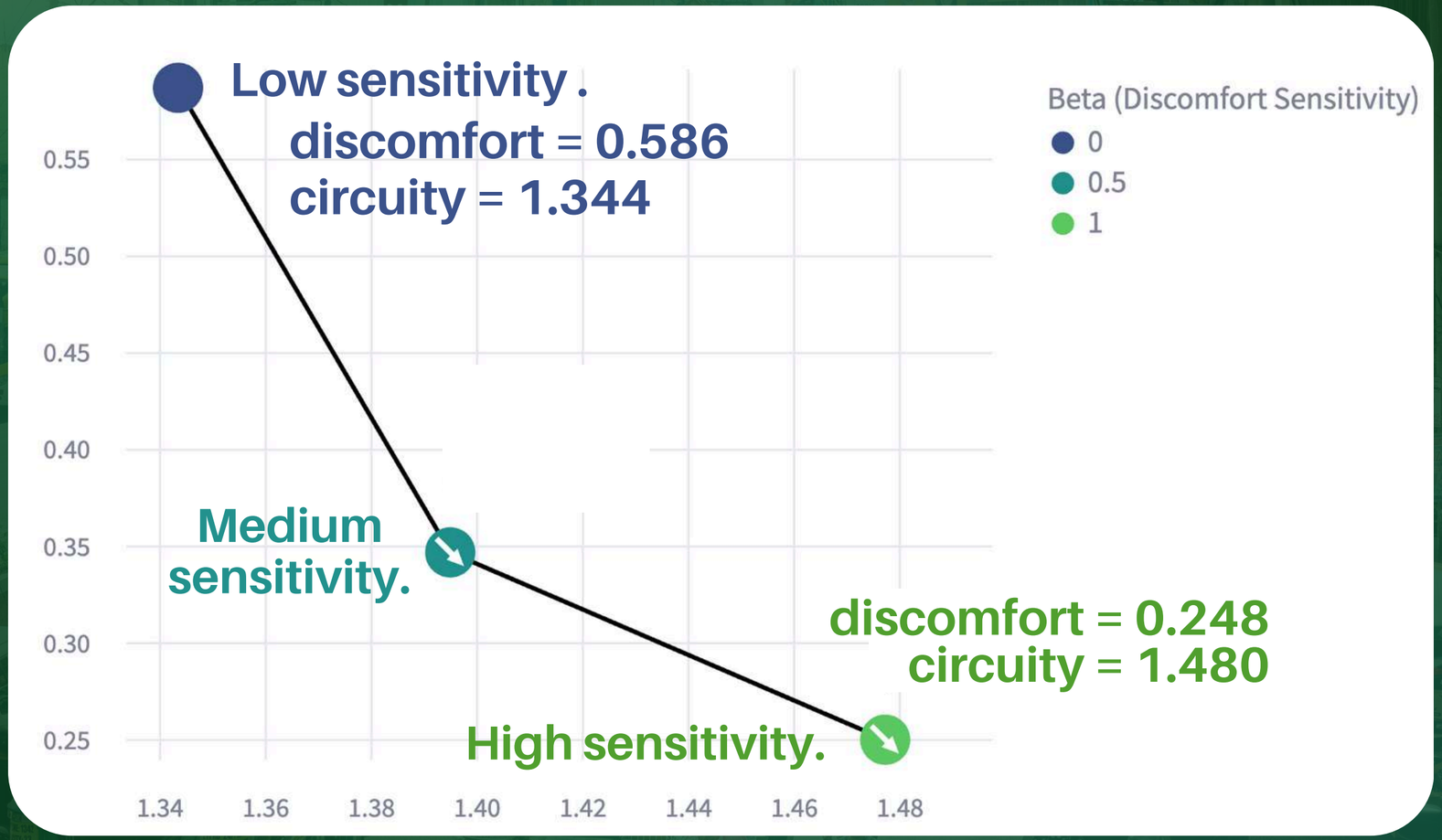
Low sensitivity（shortest route）



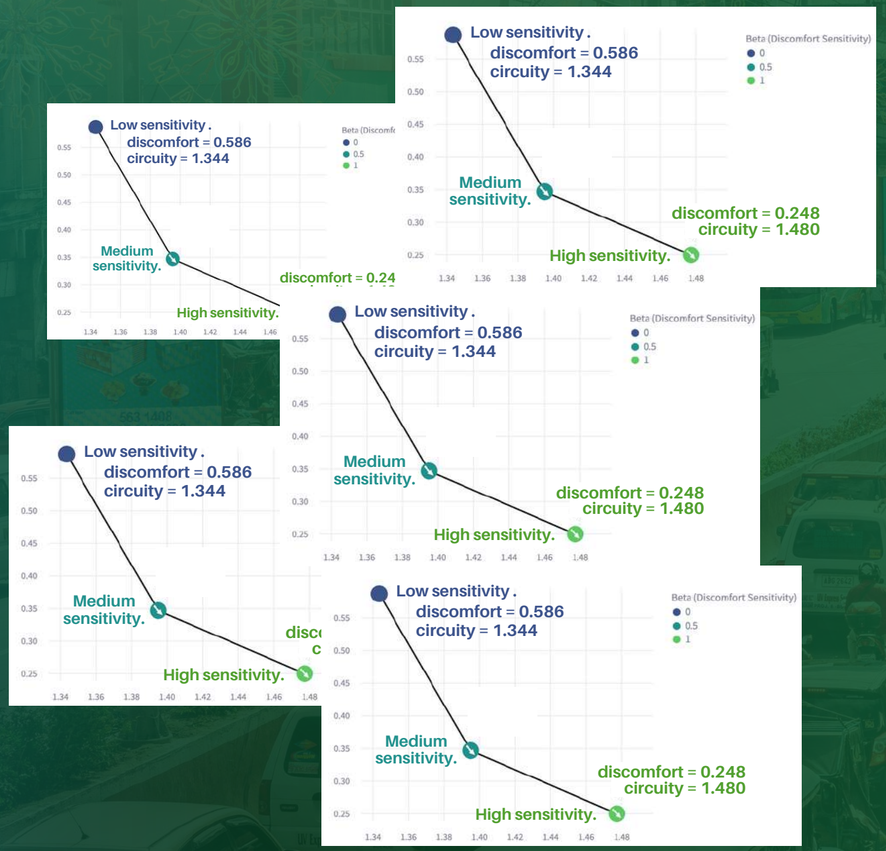
High sensitivity（detour）

	Low sensitivity（shortest route）		High sensitivity（detour）
Relative Distance/ “Circuity”:	1.344	vs.	1.480
Relative Discomfort:	0.586		0.248

Relative Discomfort

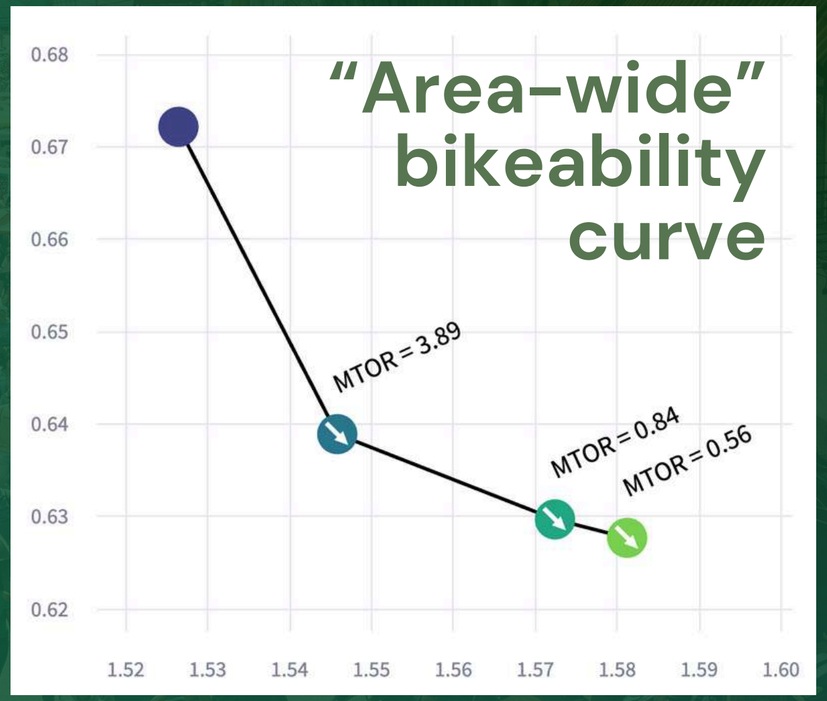


Relative Distance or “Circuity”

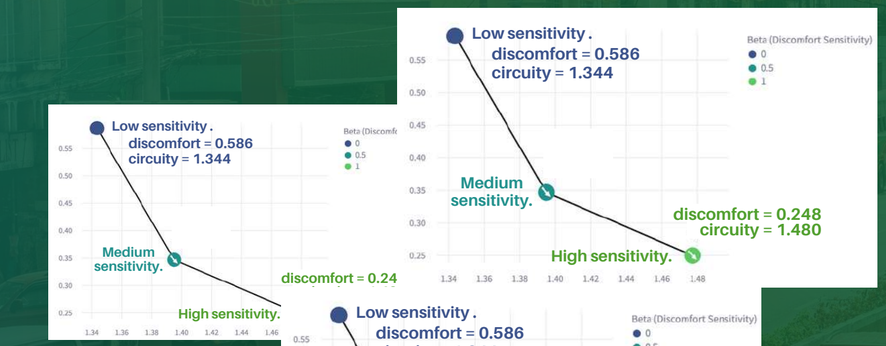


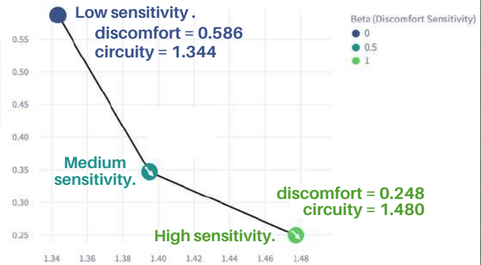
Curves for different origins and destinations

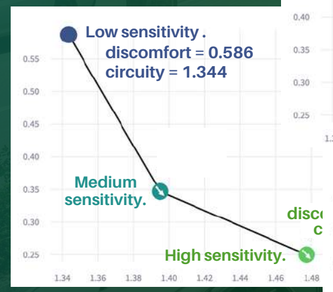
Expected Value* for all origins and destinations in an area

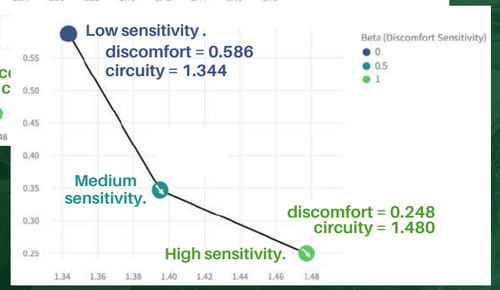


EXAMPLE: CURVE FOR 1 BARANGAY (BRGKA. ILAYA)





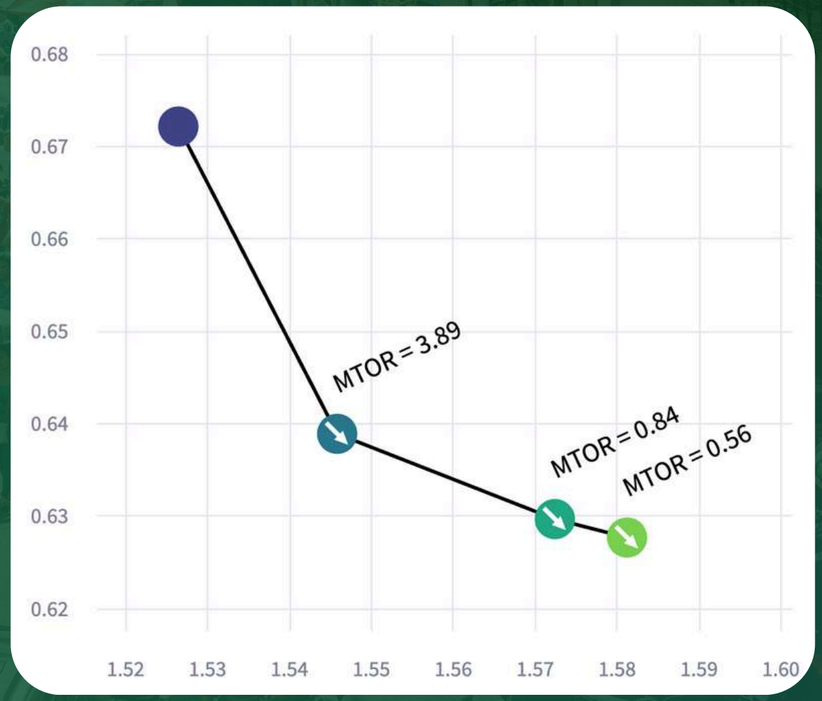




*Based on estimation of *demand* for cycling or walking.

"How likely is it that someone needs to travel to/from each place?"

Expected Value* for all origins and destinations in an area



Demand Estimation

OpenStreetMap (OSM) data

- Point of Interest (POI) data: amenities, buildings, land use
- Intersection density (higher implies more demand)

Population density data

- Obtained from Data for Good at Meta (2022)

Intersection density

Land use mix

Population density

Estimated Demand

These components are based on USA EPA (2021) and Frank et al. (2009).

Demand Estimation

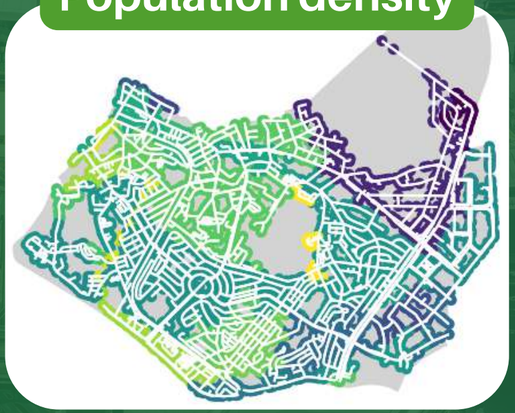
Purpose: **To ensure the relevance of our metrics.**

Certain routes in the city should matter less to our metrics because fewer people actually need to use them.

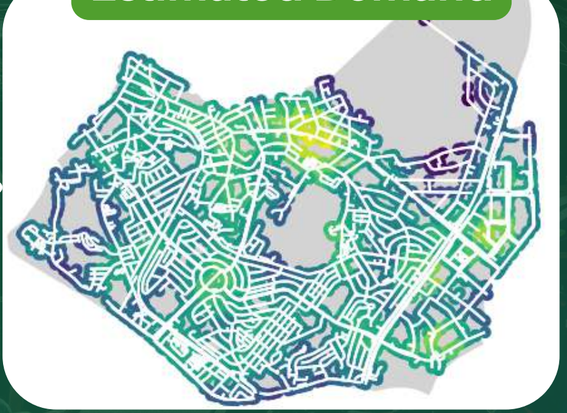
Intersection density

Land use mix

Population density

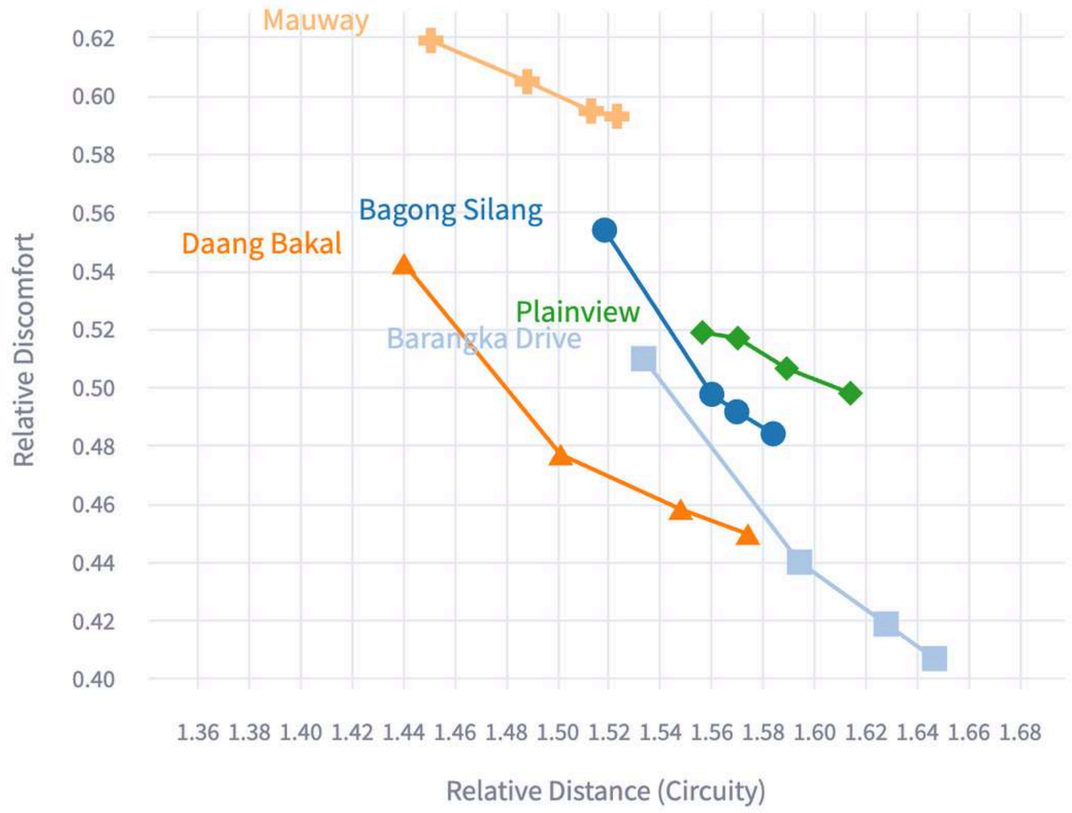


Estimated Demand



Comparing curves for different areas

EXAMPLE: CURVES FOR 5 BARANGAYS



- Closer to the **bottom left** is ideal.
- Near the bottom:
  - **Lower overall discomfort**
- Near the left:
  - **Lower overall circuity (shorter routes)**

This plot is easy to interpret: Daang Bakal (orange) and Barangka Drive (light blue) are more cyclist-friendly for within-barangay trips.

Web Application Development

Find Routes based on Discomfort Sensitivity

Mode of Active Transport

Cycling Walking

Select origin and destination using:

Node ID: Input ID of a location.

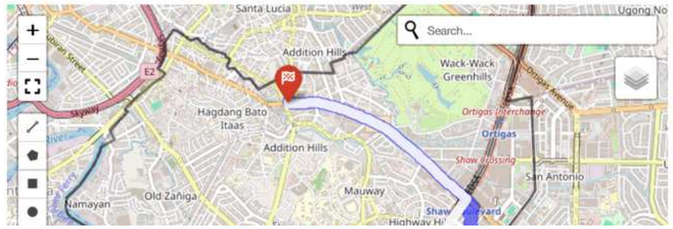
Map: Click to select points.

You can search for nodes using their ID, by **typing into the boxes below.**

Choose Origin: Node 2139543216

Choose Destination: Node 5644815363

Show Routes



PADYAK: Walkability and Bikeability Index Modeling for Sustainable Mobility Planning

Loading data...

STREET INFRASTRUCTURE ATTRIBUTES

Select street features to display on hover

Choose an option

Update Street Features

COMPONENT VISUALIZATION

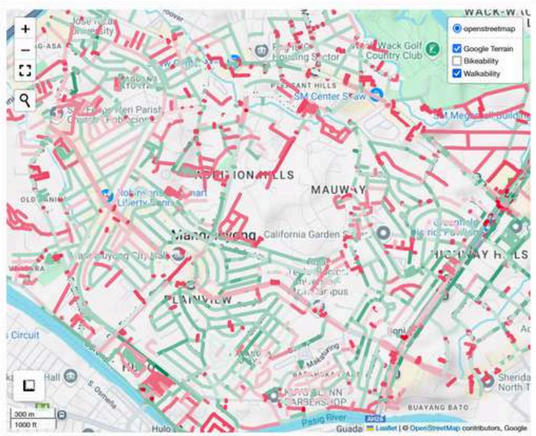
Select dataset

Bikeability Walkability

Select components to display as colored layers

Choose an option

Update Map Layers



Bikeability and Walkability Curves

Analysis

Bikeability

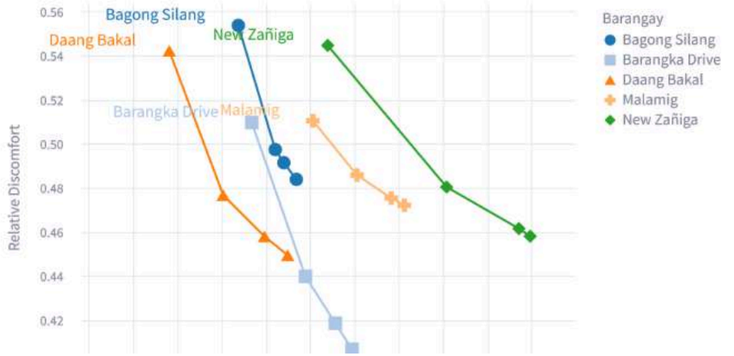
Walkability

City-wide Barangay-wide

Choose what you want to do:

Use Preset: Best 5 Barangays by Lowest Relative Discomfort

Comparison of Barangay Bikeability Curves



Streamlit

Streamlit is an open-source Python framework for data apps.

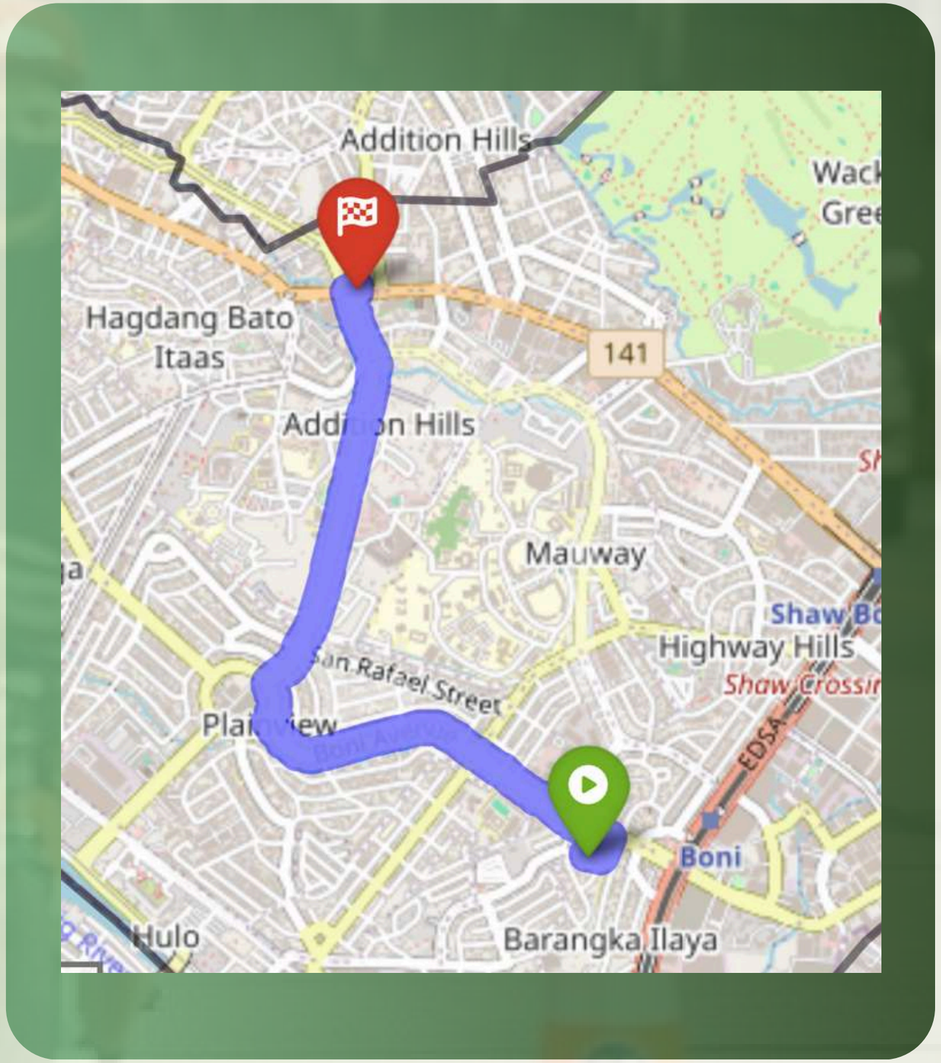
Let’s see PADYAK in action.

padyak-pjdsc.streamlit.app

SCAN THE QR CODE TO TRY PADYAK

Case: Pioneer St. to Shaw Blvd.

padyak-pjdsc.streamlit.app



Next Steps and Future Potential

1

Instead of clustering, a survey of streets

To determine an initial sample of walkability and bikeability scores

2

Padyak for commuters

Crowdsource info on walkability/ bikeability components, Route planning facilities

3

Further Analysis

Implementation of Padyak to other cities can allow city-level comparisons.

Mobile App Conceptualization


Let’s move forward,
one **Padyak** at a time.

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