GPS Trajectory Analysis for Health Quality Insights

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Koios Care

Empowering care with clinically meaningful insights from everyday devices, unobtrusively.

Big Blue
DATA ACADEMY

Little things about ourselves

Marios Gravias
Data Scientist/Analyst
Mathematics

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Data Scientist/Analyst
Mechanical Engineering

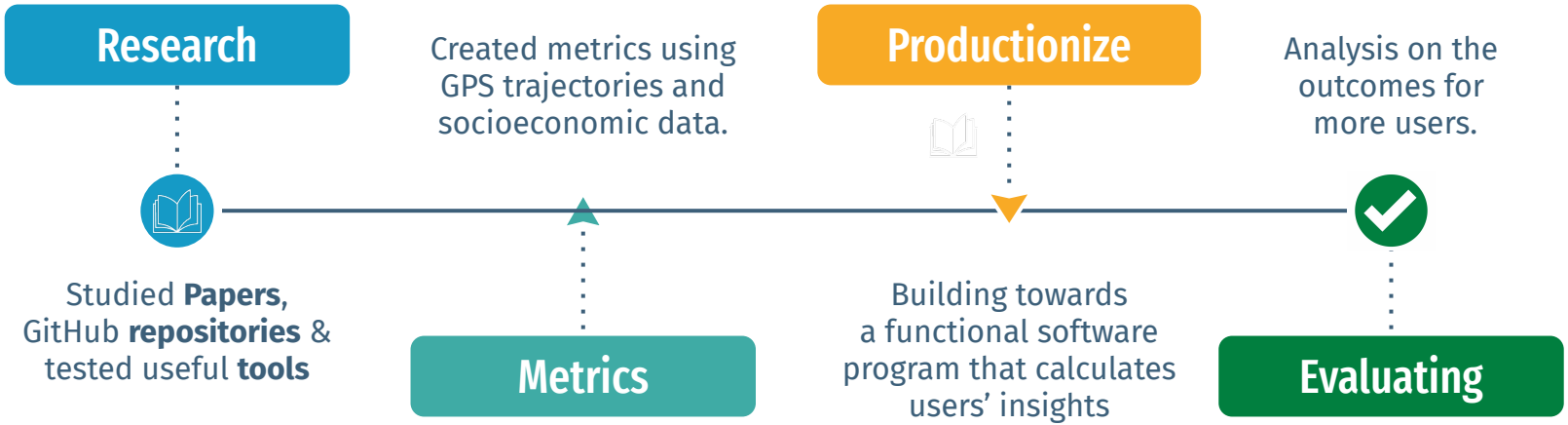
Scope

Enabling combined measures of **Lifespace** and **Environment** to approximate **Quality of Life**.

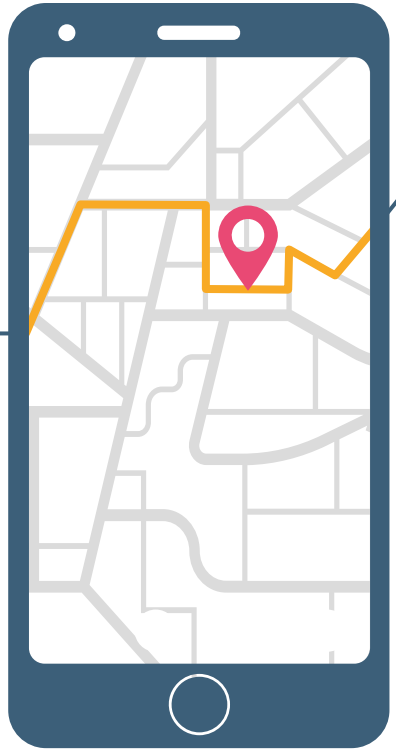
Objectives

- Within Subject metrics modelling movement, social life and behavioral patterns across time.
- Fusion of external knowledge (e.g. socioeconomic) to model environmental factors of micro-macro scale.

Product development process



Data Transformation



GPS data

Extracting locational data approximately **every minute** when in motion.

Track Intel library

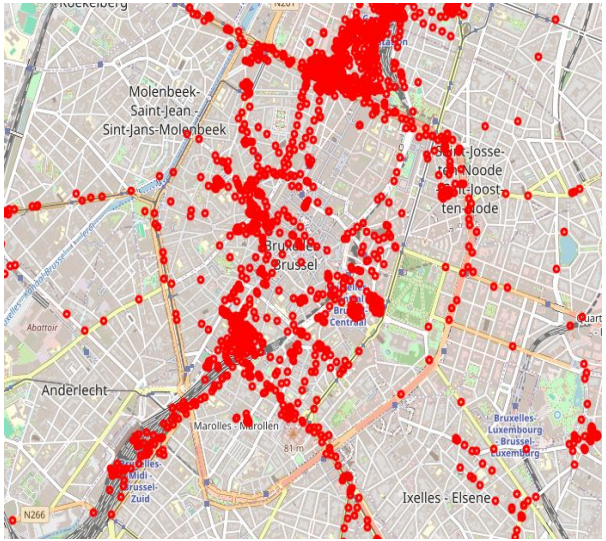
Generation of **Stay Points** and **routes** from longitudinal data.

What is a Staypoint?

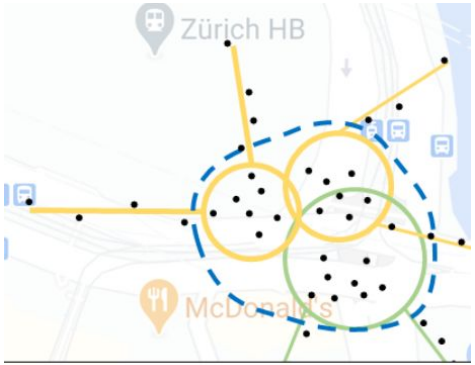
A place where the person spent a **significant** amount of **time** in a **small area**.

Trackintel Library

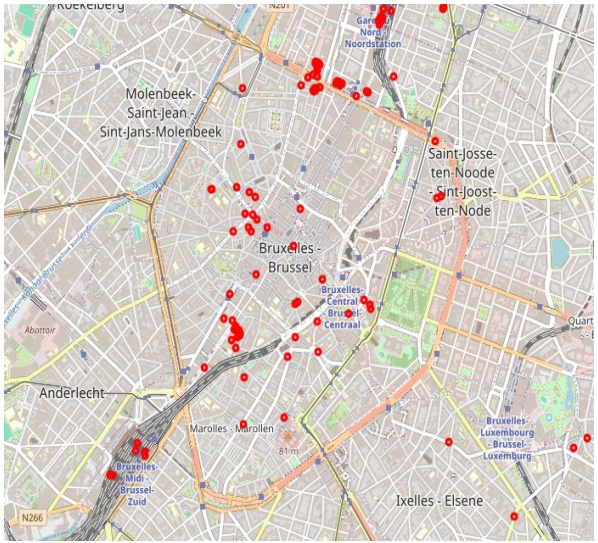
GPS data



Method:
DBSCAN Clustering



Staypoints



Home location

Data exploration

Working on all user's coordinates data

Home - Duration

Homes are matched to the corresponding Duration in the area

Sleeping Hours

From 22:00 to 05:00 a person is mostly expected to be at home

Handling Errors

Functional even if the person stays away from home for 2 nights.

Dynamic Home Features

Change of House

Moving to a **new home** in the same City.

Vacations

Identifying a **3-day trip** to the UK.

Duration

Tracking the first and last date of the **“event”**.

Weighting Results

Based on **main residency** the number and duration of trips.

Example Output I of a User

		LifeSpace Metrics				
Home	Duration	Walking time (h)	Time away from home (h)	Avg Distance from home (km)	Area (km^2)	Perimeter (km)
Athens	2 months	1.5	9	2.2	6	22
Paris	1 week	6	13.5	8	52	32
Berlin	6 months	3	5	3.5	4	8

Example Output II of a user

		Socioeconomic & Environmental features				
Home	Duration	Country's Quality of life index	Green area percentage	Type of Home Area	Retail & Shopping	Other Types of Places Visited
Athens	2 months	116	5%	Urban	0.4	…
Paris	1 week	123	12%	Urban	3.4	…
Berlin	6 months	158	31%	Suburban	0.2	…

Categorising types from Google Places API

Retail & Shopping

Sports

Transportation & Travel

Professional & Public Services

Entertainment & Food

Health & Wellness

Country's Quality of Life Index

Reverse Geocoding API

Identifying country
based on home location

+

Numbeo Platform

Web-Scraping data
for every country

Extract Quality of Life factors per country

- Healthcare Index
- Pollution Index
- Climate Index
- etc.

Home Area Classification

- **Maps Static** [Google API]
  - Acquire **satellite images** of Home area
  - Automated adjustments based on latitude

- **OpenCV** [Machine Vision]
  - Extract percentage of **Green**, representing environmental features

- **CLIP** [NLP and Deep Learning for Image-Text Pairing]
  - Probabilistic classification of Area‘s Category
  - **Urban, Suburban, Rural**

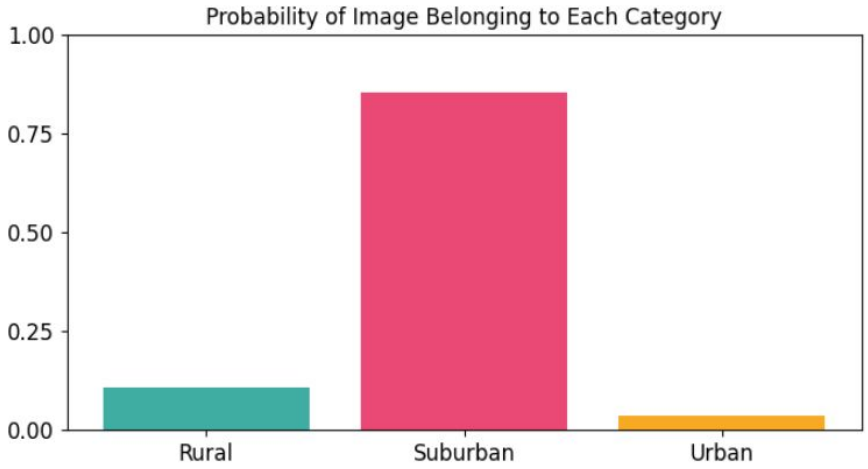
OpenAI

CLIP & OpenCV

500x500m^2 Satellite Image of the User's Home 1

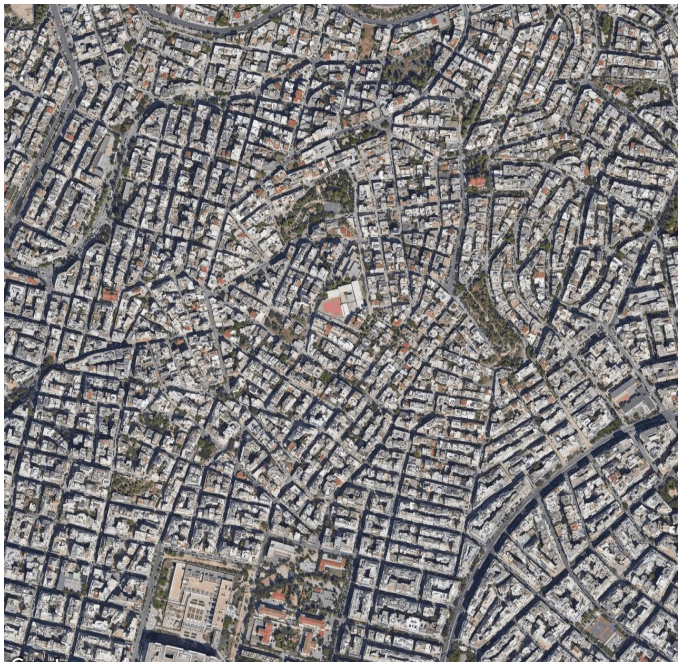
Green Area Percentage

28%



OpenAI

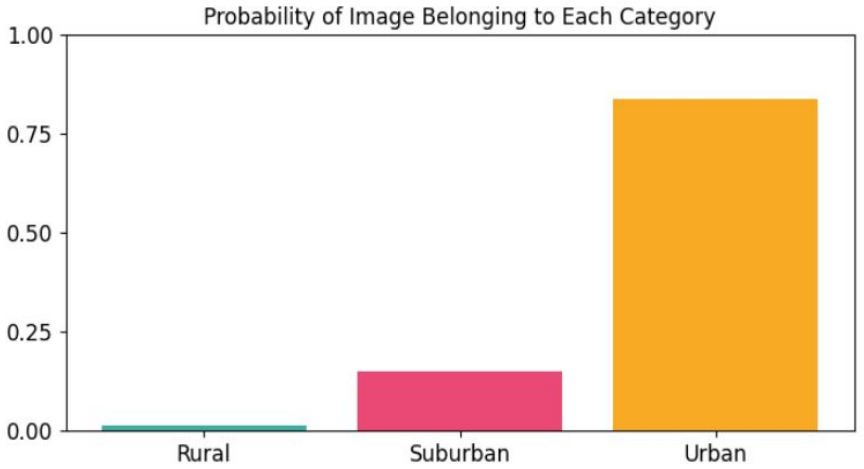
CLIP & OpenCV



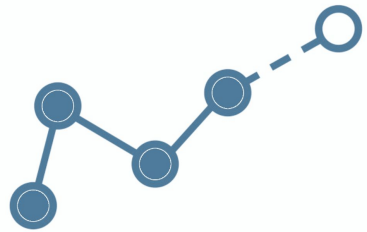
500x500m^2 Satellite Image of the User's Home 2

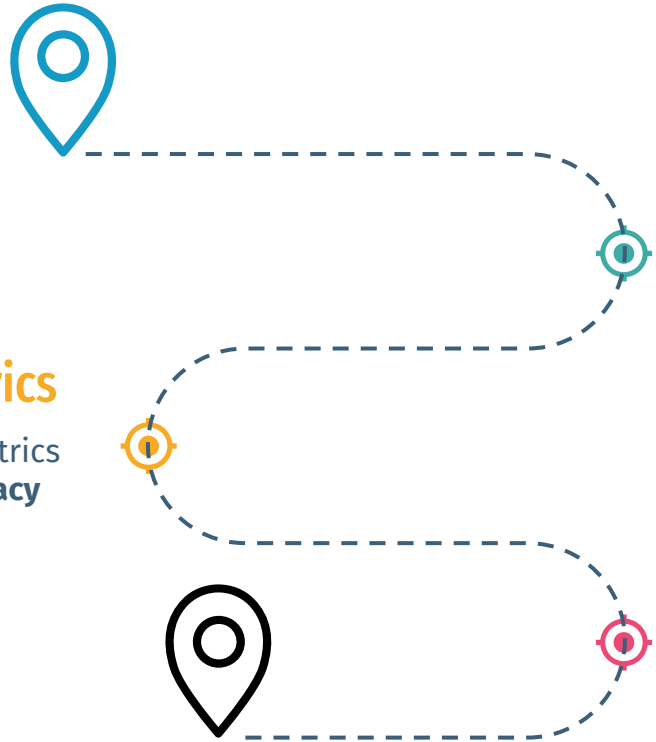
Green Area Percentage

1.5%



Moving Forward





Up-to-date data

Update existing metrics using additional **recent** datasets

Precise Metrics

More **localized** region metrics to improve feature **accuracy**

Expand insights

Include **alternative types of metrics** to extract bonus insights

We are glad to set the foundations of Koios Care’s goals!

We look forward to following any further developments.

References

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