PULSE: Participatory Urban Living for Sustainable Environments

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Big Data for Precision Medicine Symposium

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PULSE
Participatory Urban Living for Sustainable Environments

Project aim

Transform public health from a **reactive** to a **PREDICTIVE** system using Big Data and IT tools and technologies.

Shift public health from a surveillance-based system to an *inclusive* and *collaborative* system via citizen engagement/citizen science.

Minimize environmental and behavioral risk of chronic disease incidence and prevalence via an integrated system of sensors, app and data analytics.

Why is this critical?

Air Pollution Deaths Cost the Global Economy US$225 Billion ...

In 2013, the aggregate cost of premature deaths was more than US$5 trillion worldwide. In East and South Asia, welfare losses related to air pollution were the equivalent of about 7,5 percent of GDP…

— The World Bank 2016

Our Urban Health Disadvantage

- Cities are burdened by high levels of non-communicable diseases. The increasing incidence, earlier onset, and aging populations in cities, create a multiplier effect.

- Type 2 Diabetes (T2D) has been called the 'plague of the 21st century'. T2D has also been described as the 'hidden enemy' as symptoms of the disease may not be apparent for some time.

- Factors driving the increased incidence of T2D include urbanization, sedentary lifestyle and obesity.

The final goal is to build **extensible models and technologies** to **predict**, **mitigate and manage public health problems**, and promote population health, in «Smart» cities, **embracing integrated IT infrastructures and solutions**, and **citizen services**, including health.

Leverage **participatory health**

Air pollution and Asthma
Physical inactivity and Type 2 Diabetes.
Well-being in communities.

Citizens

Public health organization

Wearable monitor

Citizens

Air quality & pollution monitors

Monitoring & analytics dashboards

Public health organization

Wearable monitor

Wearable APIs

PulsAir app

Back-end services

Central Personal Data Store

Citizens

Air quality & pollution monitors

Air Quality APIs

Monitoring & analytics dashboards

Public health organization

Wearable monitor

Wearable APIs

Test Bed managers

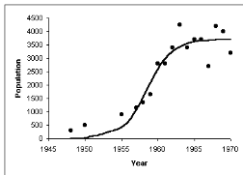
PulsAir app

Back-end services

Central Personal Data Store

Citizens

Pulse models



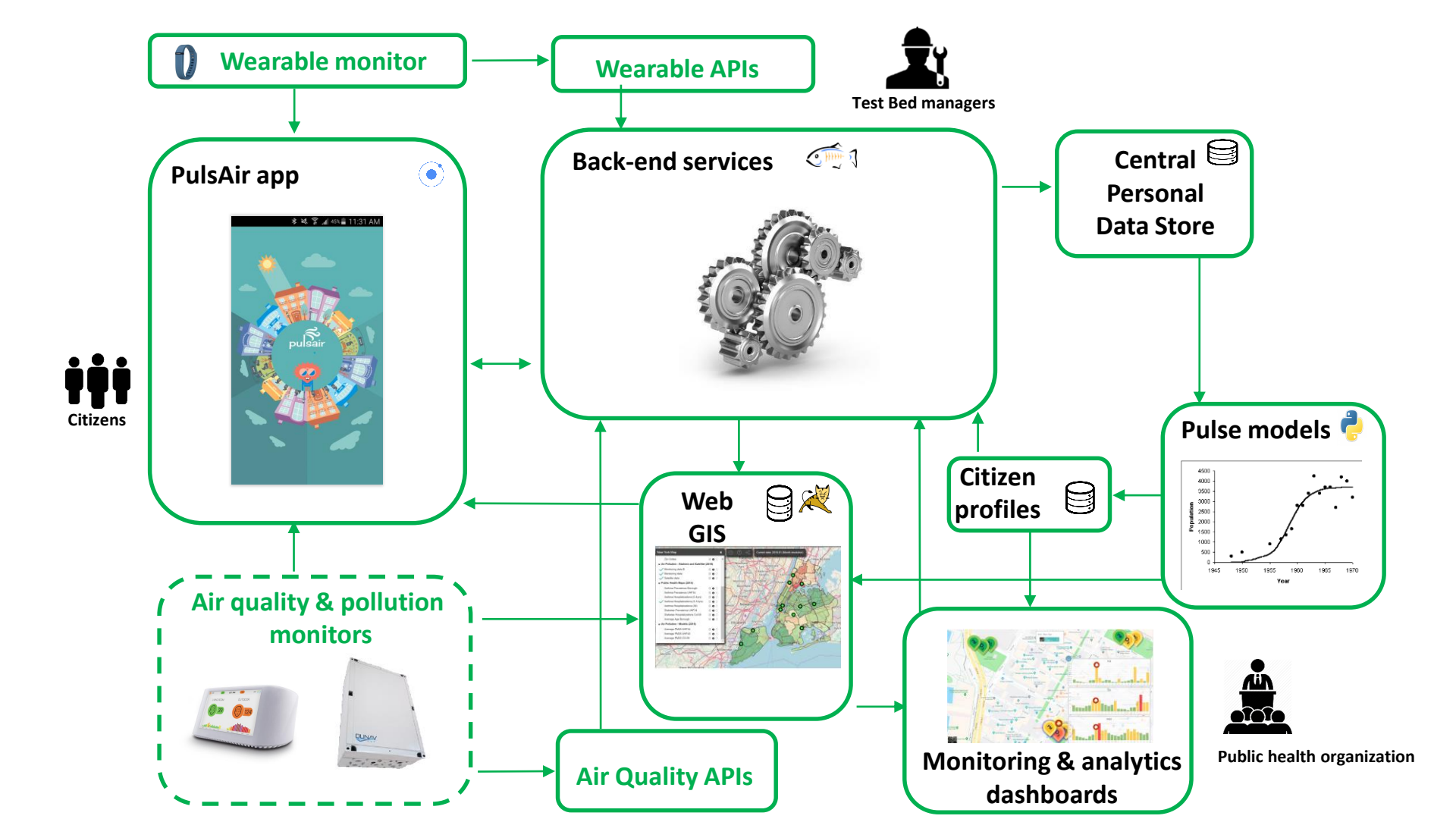
Citizen profiles

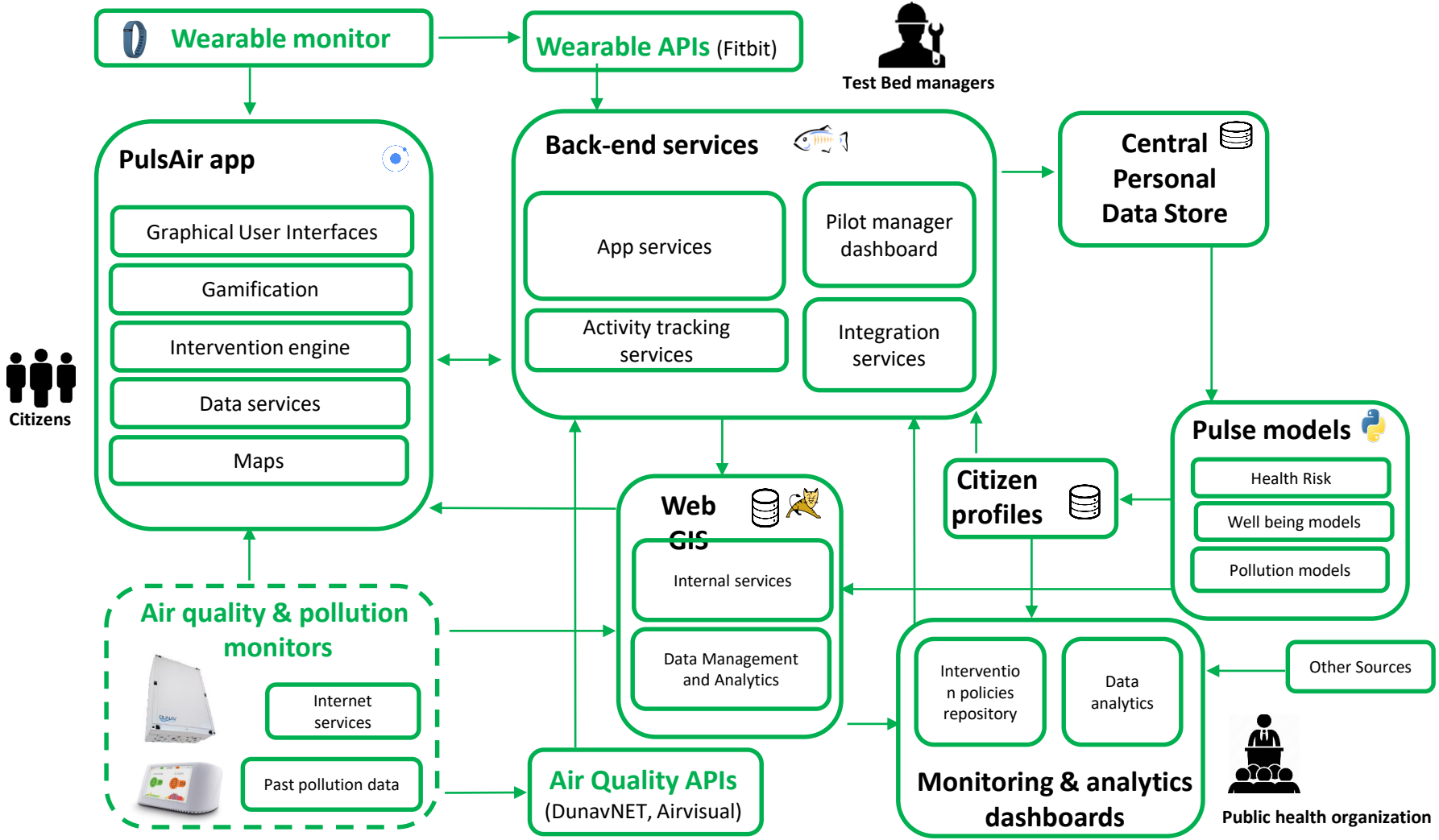
Air quality & pollution monitors

Air Quality APIs

Monitoring & analytics dashboards

Public health organization


Wearable monitor
Wearable APIs
Test Bed managers
PulsAir app
Back-end services
Central Personal Data Store
Citizens
Pulse models
Web GIS
Citizen profiles
Air quality & pollution monitors
Air Quality APIs
Monitoring & analytics dashboards
Public health organization


Wearable monitor
Wearable APIs (Fitbit)
Test Bed managers
PulsAir app
Graphical User Interfaces
Gamification
Intervention engine
Data services
Maps
Back-end services
App services
Pilot manager dashboard
Activity tracking services
Integration services
Central Personal Data Store
Citizens
Pulse models
Health Risk
Well being models
Pollution models
Citizen profiles
Web GIS
Internal services
Data Management and Analytics
Air quality & pollution monitors
Internet services
Past pollution data
Air Quality APIs (DunavNET, Airvisual)
Interventio n policies repository
Data analytics
Monitoring & analytics dashboards
Other Sources
Public health organization

Tools for Citizens Pulsair App:

- Foster citizen responsibility and awareness on air quality
- Show the impact of the pollution on the health status to the citizens
- Promote habits to improve wellbeing and air quality.
- Contribute to the creation of an urban health and wellbeing dataset and enable the creation of a observatory to assess city wellbeing and resilience

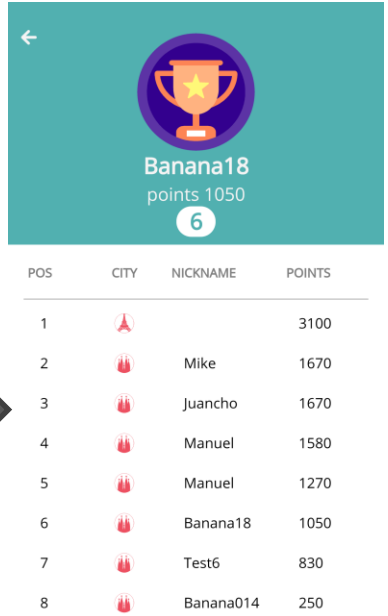
Pulsair: game dynamics

LEVEL 1
dirty and grey city + ill avatar

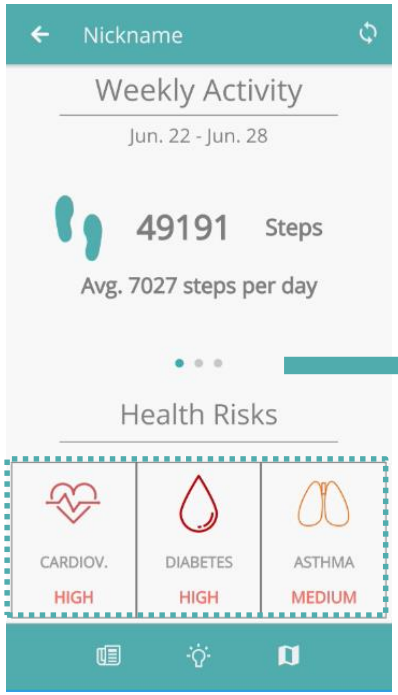
LEVEL 5
green city + healthy avatar

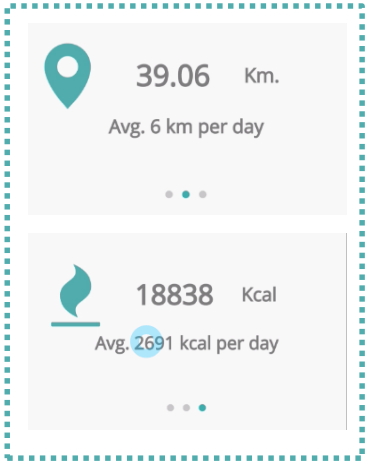
Definition of game dynamics,
Characterization
Gamified Features:

1. Levels of the game
2. Points
3. Rewards
4. Leaderboard



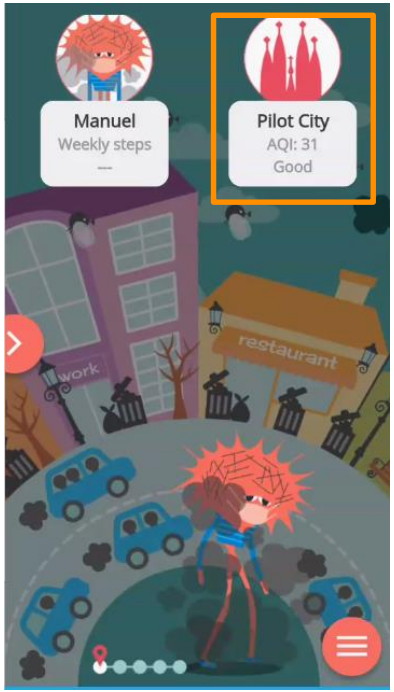
Health functionalities

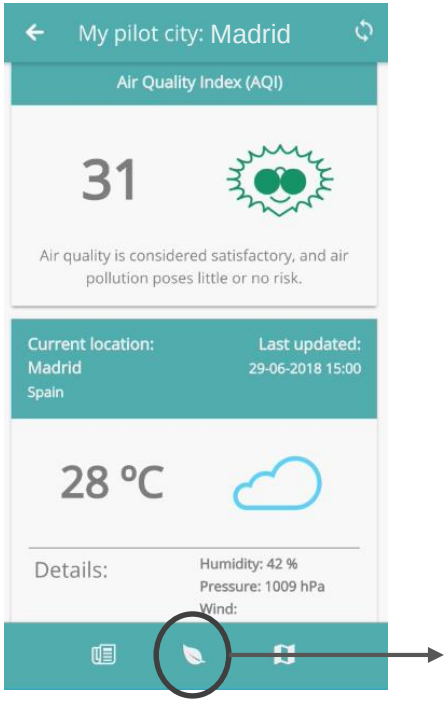


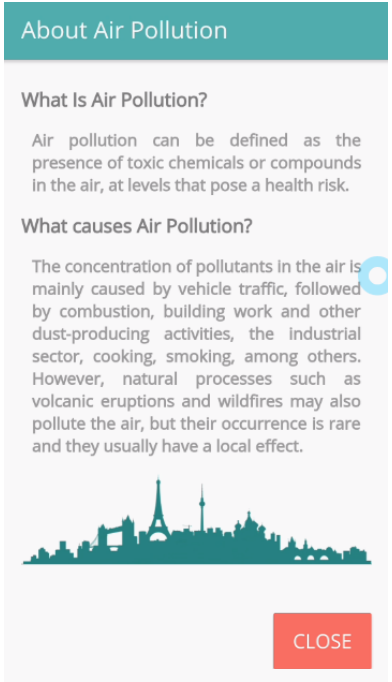


Feedbacks & recommendations

City functionalities







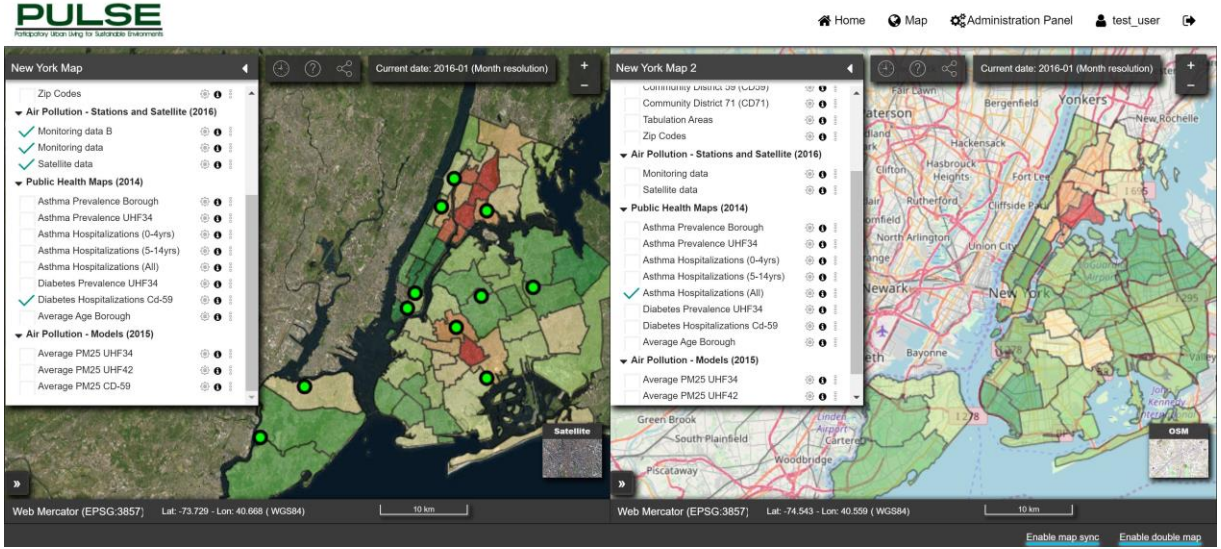
Proposed contents:

- Definition and causes of air pollution
- Most relevant Air Pollutants
- How to reduce Air Pollution
- Tips to exercises and recude exposure to air pollution

Contents have been extracted from:

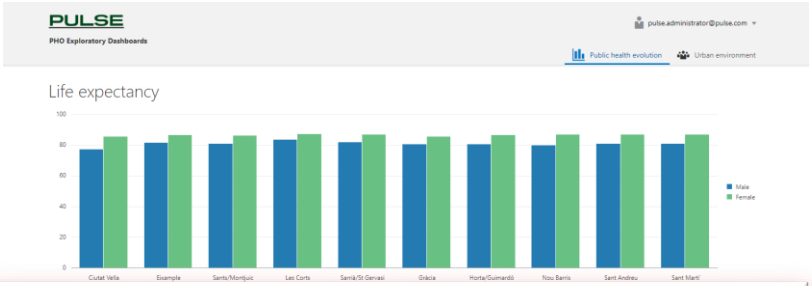
- Environmental Pollution Center
- European Lung Foundation
- Environmental Protection agency

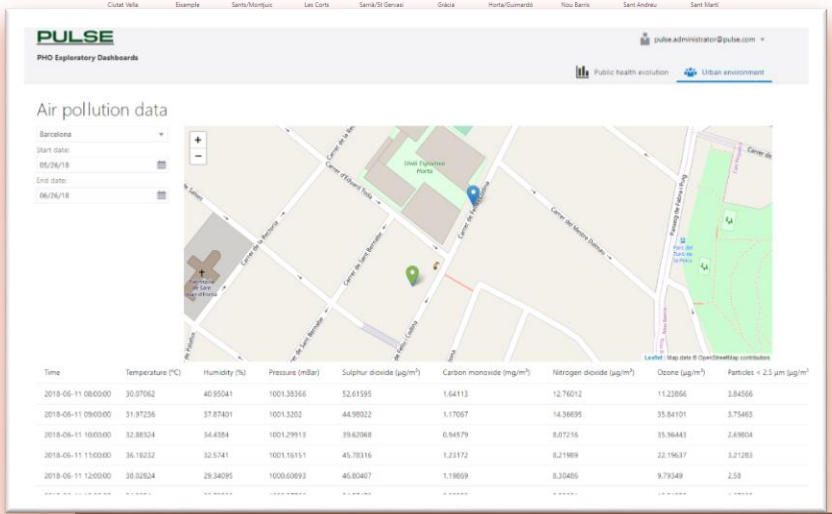
WebGIS: advanced visual analytics



- Spatial enablement through geolocated population-based data about health, environment and well-being;
- Multiple overlapping visualization layers;
- Timelines and dual windows;
- Advanced analytics.

PHO Dashboards





- Interactive exploratory analytics – timeline evolutions and correlations with past and statistic indicator datasets
- Support of interventions based on public health data and well-being models.
- Assessment of urban spaces, mobility patterns, micro-climate and environmental conditions, public spaces usage, community behavior

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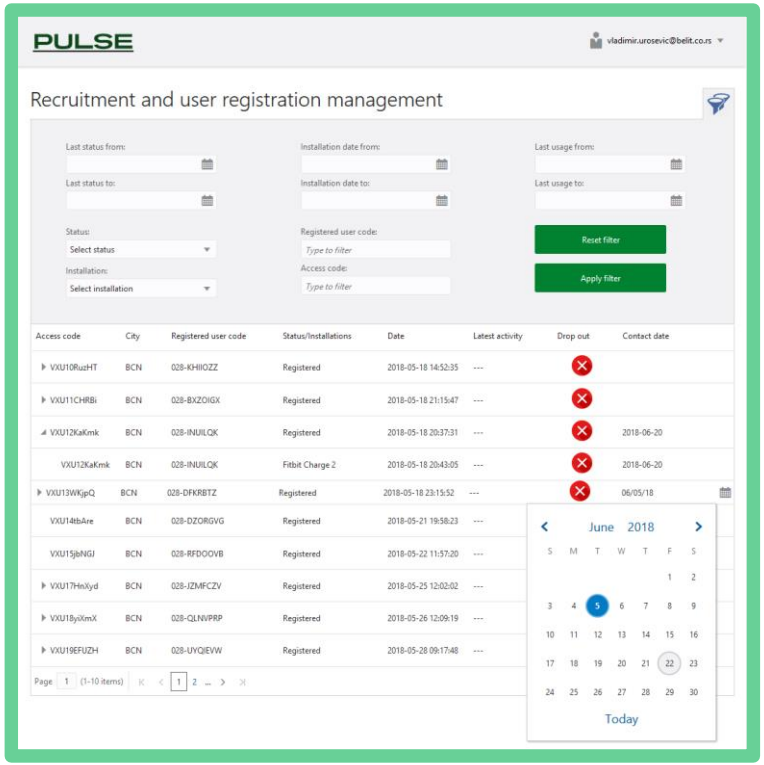
Piloting Management Dashboard

- Managing user recruitment, drop out and delete procedure
- Monitoring installations and usage of user apps (PulsAir) and connected IoT devices (wearables and air quality monitors)
- Quality check of gathered data



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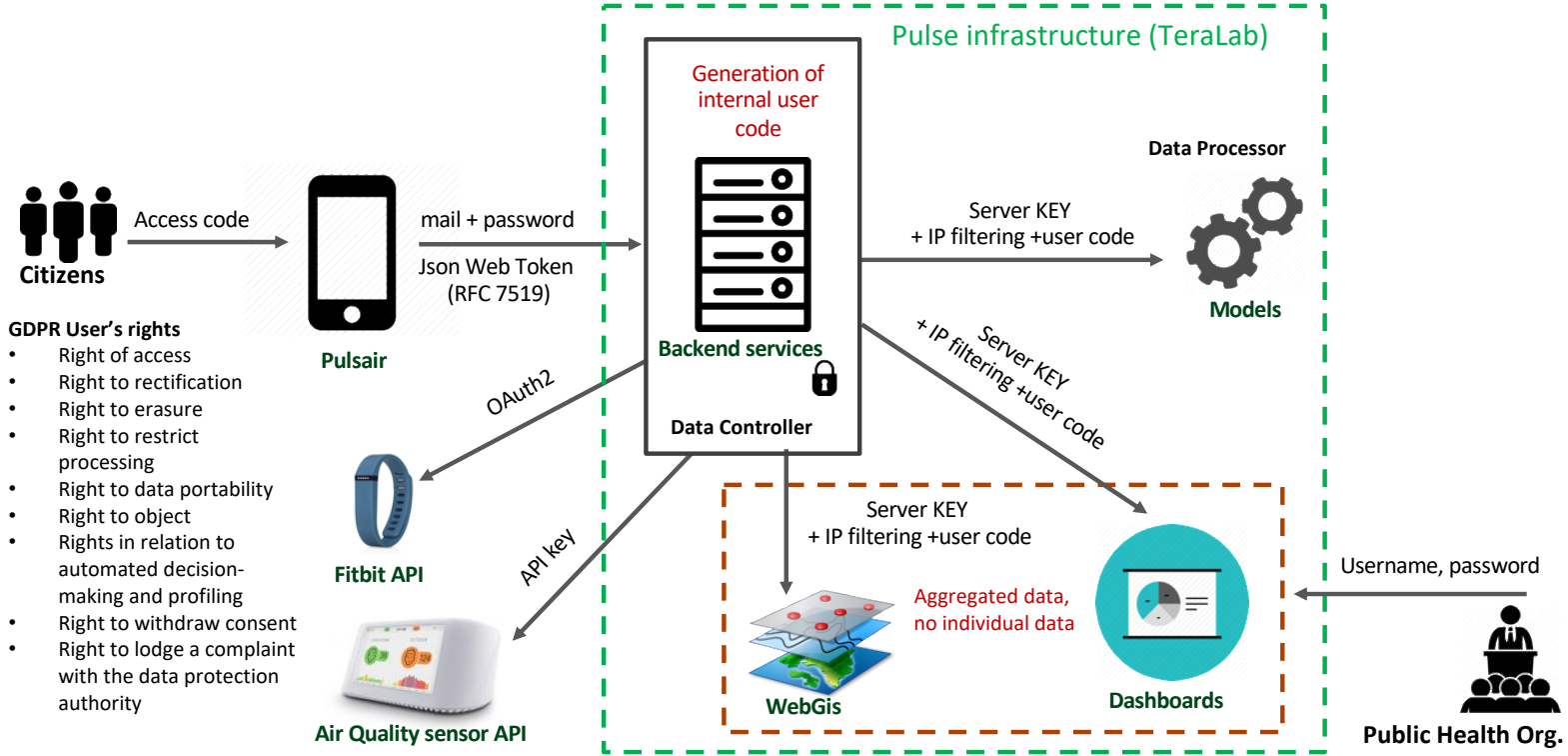
Security and citizen privacy



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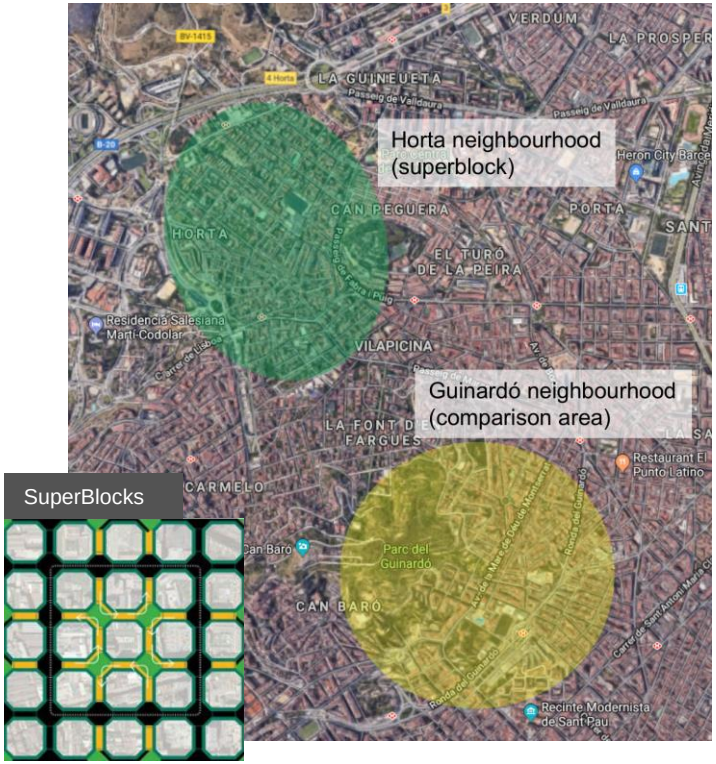
Barcelona



T2D/Active mobility and Asthma/Air quality

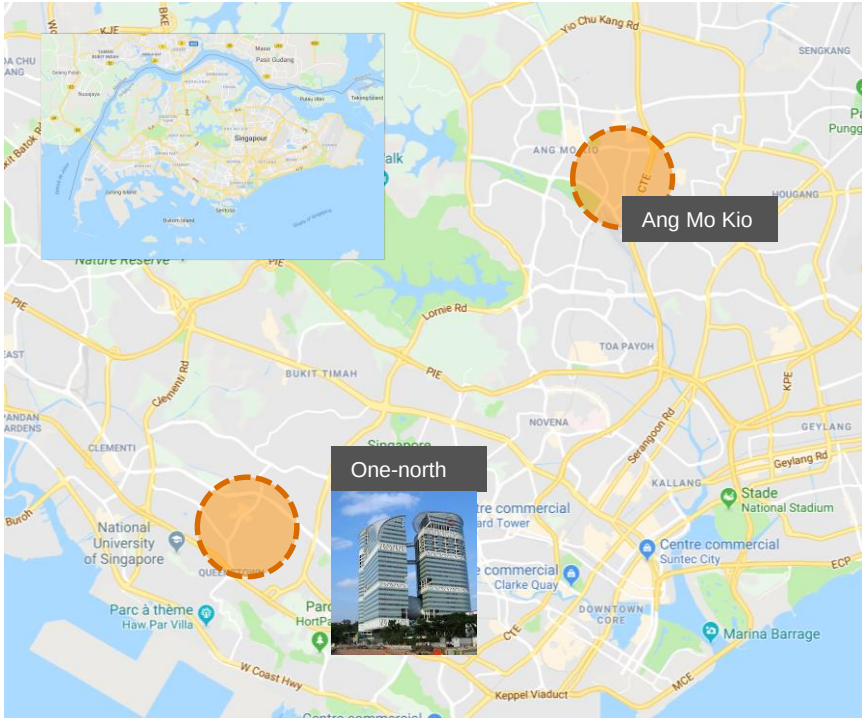
Target groups:

- Horta neighborhood (3,1 km2 with 27,730 inhabitants, area with special needs for urban planning – 3,5% children attendance for primary care on asthma and 8,5% for T2 diabetes) 4,2% for asthma and 7,7% for T2D in Catalonia.

Status:

- Superblocks assessments: more than 500 surveys with ads on PULSE (Pulsair and Access code).
- Target 150 deployed users (including 20 patients distributed for both asthma and T2D).
- DunavNET sensors across SuperBlocks.

Singapore



T2D/Active mobility

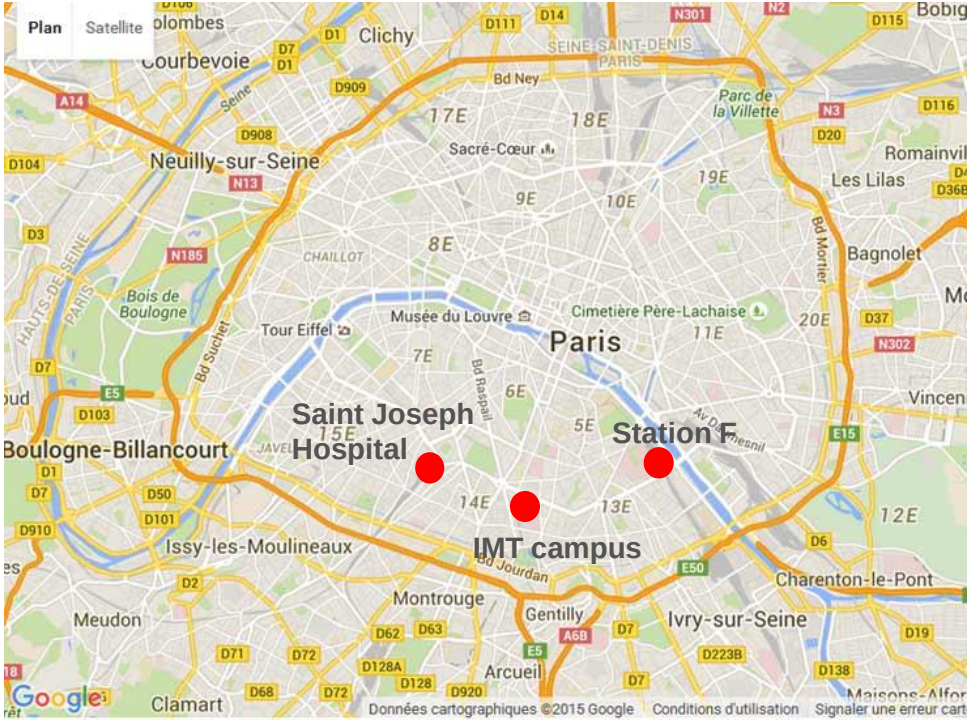
Target Groups:

- Physical condition (active).
- Diabetes: 8.6% of the population in Singapore (12 per cent of the population suffer from pre-diabetes. One-third of which will become diabetic, another one-third will remain pre-diabetic).

Status:

- One-North (new scientific R&D district, test bed area).
  - 100 participants.
- Ang Mo Kio (residential area, 100% HDB).
  - 50 participants.

Paris



Asthma / Air quality

Target Groups:

- Physical condition (active).

Status:

- Pollution levels have been high throughout the year and could be affecting the area's 1,1 million residents.
- IMT Campus (100 participants)
- Saint Joseph Hospital (Include 20 patients from Saint Joseph hospital).
- Station F (50 participants).

Birmingham

T2D/Active mobility and Asthma/Air quality

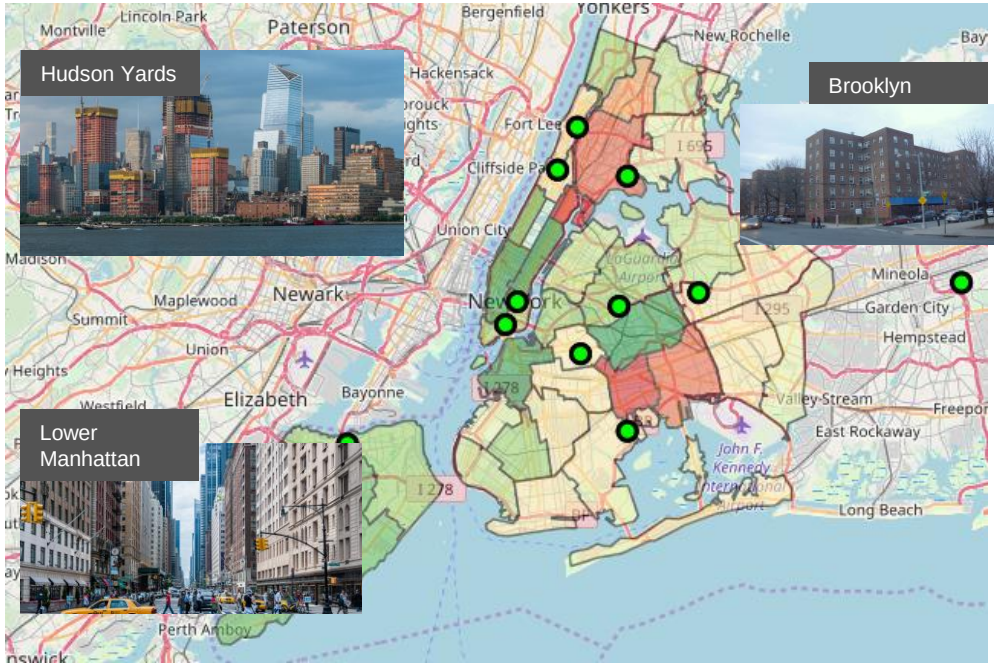
Target groups:

- Inner city wards (Sparkbrook, Bordesley Green and Small Heath) 20% most deprived areas.
- BME population > 40% (62% Asian including 42% Pakistani, 10% Black).
- Lower socioeconomic groups.
- High prevalence of T2D – target for screening programmes.
- Air quality around school areas and community and Faith centres.

Status:

- 35 signed-up.
- 150 across the 3 locations.

New York



Asthma / Air quality

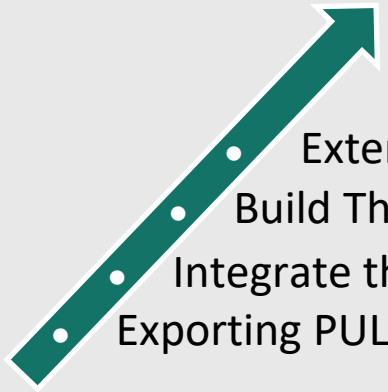
Target groups:

- Red Hook, Brooklyn (Low-income neighborhood with 70% residents living in public housing and 26% residents diagnosed with asthma).
- Hudson Yards (Under-construction “city-within-a-city” of 28 million square feet in Manhattan).
- Lower Manhattan (Mixed-use low-income neighborhood).

Status:

- Target 150 deployed users.
- Access to network of air quality sensors through CUSP – NYU.

What's next



Extend recruitment and starting City challenge

Build The City Observatory

Integrate the Pulse models

Exporting PULSE to other cities (Taiwan, Pavia)

Consortium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degli Studi
di Padova


DIGITAL
BIRMINGHAM


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DELL'INFORMAZIONE


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