PULSE: Participatory Urban Living for Sustainable Environments

Manuel Ottaviano
Universidad Politécnica de Madrid

Big Data for Precision Medicine Symposium
11th July 2018, Athens

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No GA727816.
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.
Wearable monitor

Air quality & pollution monitors

Monitoring & analytics dashboards

Public health organization

Citizens
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**

**Definition of game dynamics, Characterization**

**Gamified Features:**
1. Levels of the game
2. Points
3. Rewards
4. Leaderboard

**LEVEL 1**
dirty and grey city + ill avatar

**LEVEL 5**
green city + healthy avatar

**Gamified Features:***

<table>
<thead>
<tr>
<th>POS</th>
<th>CITY</th>
<th>NICKNAME</th>
<th>POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>🍌</td>
<td>Mike</td>
<td>3100</td>
</tr>
<tr>
<td>2</td>
<td>🍌</td>
<td>Juancho</td>
<td>1670</td>
</tr>
<tr>
<td>3</td>
<td>🍌</td>
<td>Manuel</td>
<td>1670</td>
</tr>
<tr>
<td>4</td>
<td>🍌</td>
<td>Manuel</td>
<td>1580</td>
</tr>
<tr>
<td>5</td>
<td>🍌</td>
<td>Manuel</td>
<td>1270</td>
</tr>
<tr>
<td>6</td>
<td>🍌</td>
<td>Banana18</td>
<td>1050</td>
</tr>
<tr>
<td>7</td>
<td>🍌</td>
<td>Test6</td>
<td>830</td>
</tr>
<tr>
<td>8</td>
<td>🍌</td>
<td>Banana014</td>
<td>250</td>
</tr>
</tbody>
</table>
Health functionalities

Weekly Activity
Jun. 22 - Jun. 28

49191 Steps
Avg. 7027 steps per day

39.06 Km.
Avg. 6 km per day

18838 Kcal
Avg. 2691 kcal per day

Feedbacks & recommendations

Unfortunately your risk of Asthma is high! We will help you keep a healthy lifestyle to lower it!
Proposed contents:
- Definition and causes of air pollution
- Most relevant Air Pollutants
- How to reduce Air Pollution
- Tips to exercises and reduce 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
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
Security and citizen privacy

GDPR User’s rights
- Right of access
- Right to rectification
- Right to erasure
- Right to restrict processing
- Right to data portability
- Right to object
- Rights in relation to automated decision-making and profiling
- Right to withdraw consent
- Right to lodge a complaint with the data protection authority

Username, password

OAuth2

API key

mail + password

Json Web Token (RFC 7519)

Server KEY + IP filtering + user code

Server KEY + IP filtering + user code

Server KEY + IP filtering + user code

Aggregated data, no individual data

Dashboards

WebGis

Air Quality sensor API

Fitbit API

Pulsair

Backend services

Data Controller

Generation of internal user code

Pulse infrastructure (TeraLab)

Data Processor

Models

Citizens

Access code

Access code

11th July 2018. Big Data for Precision Medicine Symposium, Athens
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.
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).
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)
Contacts

Web Site  http://www.project-pulse.eu

https://twitter.com/PulseProjectEU1

https://www.linkedin.com/company/pulse-project/

https://www.facebook.com/PULSEprojectEU1/

Manuel Ottaviano
mottaviano@lst.tfo.upm.es
www.lst.tfo.upm.es
Skype: manui_