Mid-Term Conference

HERIT-DATA:
Innovative solutions to better manage tourism flows impact on cultural and natural heritage sites through technologies and bigdata

Herit-Data Tourist flow management platform. Snap4City.

Paolo Nesi, Gianni Pantaleo
UNIFI, DISIT Lab, Snap4City
9th June 2021

https://www.disit.org/
https://www.Snap4City.org/
Project Aims Recall

• Herit-Data is involving six pilot sites
  • Dubrovnik (Croatia),
  • Pont du Gard (Occitanie Region, France),
  • Ancient Olympia (Western Greece Region, Greece),
  • Florence (Tuscany Region, Italy),
  • Valencia (Valencia Region, Spain) and
  • Mostar (Bosnia Herzegovina).

• To COLLECT GENERATE INTEGRATE ANALYZE data of different nature
  • somehow connected to the Tourism views, that may
    - be correlated to touristic events/services  -or-  give an idea of the related business / evolution
    • Thus: predictions, flows, anomalies, impact assessment, etc.

• To identify innovative solutions for better tourism flow management.
  • exploits new technologies and Big Open Data for reducing the impacts of tourism on cultural and natural heritage sites.
Data Driven Decision Support

• Decision Support system
• Assessment / Strategies
• Data Rendering, visual analytics
• Data Processing
• Data aggregation, Storage, indexing
• Data Ingestion
How the Platform Works
Interesting (Herit-)Data Sources

• People Counts/Flows:
  • PAX Counters, TV Cameras, Mobile Apps, Wi-Fi, Telco Operators
  • Origin Destination counting from passports, registering on hotels

• Vehicles Flows: (cars, busses, trains, aircrafts, ferry, ...)
  • Spires Sensors, TV Cameras, Mobile Apps, OnBoardUnit (on cars/buses), tickets, ...

• Sharing Services:
  • Bike, e-bike, car, scooter, billing/accounting, etc.

• Parking Areas close to:
  • Railway stations, touristic attractions, historical point, natural areas, vista points, hospitals, markets, etc.

• Contextual Information: over roads and streets
  • Environment: weather conditions/forecast, pollutant, satellite data, etc.
  • Events: natural, entertainment, touristic, lockdown (also, color of the region), manifestation/protest, etc.

• Social Media Comments, facts, appreciations:
  • Twitter, etc.

• Key Performance Indicators, KPI, coming from:
  • Operators: tickets, arrivals/departures, expenditure, investments
  • Other: stock exchange, ....
Ingestion, aggregation → exploitation

- **Snap4City** efficient tools for
  - Bidirectional data channels
  - Any format, any channel, any data, any broker, any protocol, ...
- **Km4City** Knowledge base
  Ontology reasoning on geo, space, time, relationships

- Expert System semantic queries accessible via:
  - **Smart City API** for Apps and third party
  - **MicroServices** data driven develop via visual language Node-RED
Solutions: reliable, secure and fast to realize

- Via Snap4City tools
  - Dashboard Wizard
  - Dashboard Builder
  - Data Analytic...
  - Visual Analytic...

- Smart Solutions results to be
  - Real time data drive
  - Secure end-to-end
  - GDPR compliant
  - Reliable, interoperable
  - Auditable, marketable
Data Analytics on Snap4City platform

Swagger

Ontology Schema

LOG.disit.org

Knowledge Base, Km4City

Big Data Store Facility

Smart City API from Knowledge Base and other tools

Creating MicroServices

Saving / Sharing reusing

Using them into IOT Applications

Resource Manager

Nodes

TensorFlow

R Studio

Python

NVIDIA CUDA

Big Data Store Facility
Resulting (Herit-)Data

• **How the city is used:** Trajectories into the city, Flows, Origin Destination Matrices, hot places, critical conditions....
Resulting (Herit-)Data

• relations among data via AI: identification of *predictors*, identification of early warning detectors, typical time trends, anomaly detection, relevance, etc.

![Graphs and diagrams showing data analysis examples](image-url)
Twitter Vigilance of DISIT lab

https://rttvhd.snap4city.org/

HERIT-DATA Mid-Term Conference, 9th June 2021
## Twitter Vigilance RT of Herit-Data: Some Numbers

<table>
<thead>
<tr>
<th>Channel Name</th>
<th>Total Number of Collected TW+RTW</th>
<th>Number of Collected Tweets</th>
<th>Number of Collected Retweets</th>
<th>Twitter Volume Processing Time Range</th>
<th>NLP &amp; Sentiment Analysis Processing Time Range</th>
<th>NLP &amp; Sentiment Analysis Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>104.6 Millions</td>
<td>37.9 Millions</td>
<td>66.7 Millions</td>
<td>From 30-01-2020 to current datetime</td>
<td>From 01-02-2020 to current datetime</td>
<td>English</td>
</tr>
<tr>
<td>France</td>
<td>31.7 Millions</td>
<td>8.2 Millions</td>
<td>23.5 Millions</td>
<td>From 30-01-2020 to current datetime</td>
<td>From 01-02-2020 to current datetime</td>
<td>Italian, English, testing French</td>
</tr>
<tr>
<td>Greece</td>
<td>11.0 Millions</td>
<td>3.6 Millions</td>
<td>7.3 Millions</td>
<td>From 30-01-2020 to current datetime</td>
<td>From 01-02-2020 to current datetime</td>
<td>English, ..</td>
</tr>
<tr>
<td>Italy</td>
<td>1.8 Millions</td>
<td>652 Thousands</td>
<td>1 Millions</td>
<td>From 30-01-2020 to current datetime</td>
<td>From 01-02-2020 to current datetime</td>
<td>Italian, English</td>
</tr>
<tr>
<td>Croatia</td>
<td>24.1 Thousands</td>
<td>10.3 Thousands</td>
<td>13.8 Thousands</td>
<td>From 30-01-2020 to current datetime</td>
<td>From 01-02-2020 to current datetime</td>
<td>English</td>
</tr>
</tbody>
</table>
Twitter Vigilance: the last 12 months
Herit-Data Twitter Vigilance Summary

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=Mjc3NQ==
Herit-Data Platform Main Dashboard

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzExNQ==
Dubrovnik

- Tourism Domain
  - Counting People
  - TV Cameras and Wi-Fi
  - Social Media

- Dashboards
  - Monitoring and real time control
  - People flow
  - Twitter Vigilance

- Historical and Real Time data

- Services Exploited on:
  - Dashboard

- Since 2020
People Counting in/out old City
Dubrovnik: people on old town 2020 vs 2021

Trends of Counting
TV Positions

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA4Nw==
Dubrovnik IoT App
For 6 cameras / For downtown

https://flows.nodered.org/search?term=snap4city
Florence Impact of COVID-19

- Multiple Domains Data
  - Traffic, environment, People, parking, stock options, Twitter, etc.
- Decision Makers Multiple Locations
  - NO2 long term predictions
  - Twitter analysis
- Historical and Real Time data
- Services Exploited on:
  - Dashboards
  - Social media,
  - Sentiment Analysis
- Since 2019, 2020
On Florence

• **Points of Interest** (static)
• **Real Time data**
  • Wi-Fi access points (location) and data for Pax counting
    • real time data stream about paxcounting
    • Traffic, parking, pollutant, etc.
• **Actions:**
  • Dashboards and view on Mobile App: **FeelFlorence**
• **Data Analysis**
  • Traffic Flow real time data: active
  • Parking real time data: active
  • Environmental aspects
  • Other KPI (still to come), some are accessible
  • Twitter Vigilance data collection and monitoring: active
Feel Florence Mobile App vs Herit-Data Dashboards

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzAwNA==

Herit - Data Project

Tourism is a major engine of economic growth but at the same time has a great impact on the conservation of cultural and natural heritage. Hence it requires a more careful and advanced management, especially in terms of flows, and is irrevocably linked to the big and open data available. The HERIT DATA project follows these trends, aiming at a better analysis and management of anthropic activities and impacts on cultural heritages, by means of ICT technologies and data.
Economy and Tourism KPI: true reference values

• **GDP**: gross development product (PIL italian)

• **Value of the stock exchanges** shares of the Florence Airport

• **Traffic**
  • truck/highways has been demonstrated to be correlated with **stock exchanges**
  • Vehicles on roads, and parking: are more an Economy factor rather than on Tourism index in Florence

• **Number of people**: arriving by train, tourist Busses, Airport, registered at museums, passing on major open attractions, etc.
  • Number of people by cars: only 10% are due to tourists in Florence
NO2 long-term prediction

Deep Learning Approach

mean progressive NO₂ of 2019

mean progressive NO₂ of 2020

Table 4. Assessment of the predictive models with respect to the actual values of the 2019.
Italy: Protests flare in Florence over restrictions

Florence mayor condemns violence and vandalism in historic centre in "surreal, terrible and painful night" for Tuscan city

Protests clashed with police in central Florence last night during an unauthorized protest over tighter restrictions amid surging coronavirus cases.
TV: From Herit-Data Florence Keys

Search related to channel Italy

Zoom: 1H, 3H, 6H, 12H, 1D, 1W, 1M, all

From Oct 20, 2020 To Nov 1, 2020

Sunday, Oct 25, 2020, 17:00

#climatechange #airbnb #4thIndustrialRevolution #gentrification #carbonfootprint #SustainableDevelopmentGoals

{Image of a chart with Twitter Vigilance logo}
**Random Forest Model**

As predictive model of lockdown period

Results exploiting the **confirmed** keys:

- Accuracy = 0.90
- Kappa index = 0.81
Origin Destination Matrix based on Mobile App data
Mostar, Bosnia Herzegovina

- Tourism Domain
  - KPIs
  - People flows
  - POI
- Dashboards
  - Monitoring KPI
  - POI, flows
- Historical and updated data
- Services Exploited on:
  - Dashboard
- Since 2020
Mostar Arrivals

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyNQ==
# Mostar Locations: Time Trends


## Mostar locations (HeritData)

### Annex 1: Attractions - Mostar

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Last update</th>
<th>Last 4 hours</th>
<th>Last 24 hours</th>
<th>Last 7 days</th>
<th>Last 30 days</th>
<th>Last 6 months</th>
<th>Last 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture-related Tourist Attractions</td>
<td>NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existence of Intelligent Info Sessions</td>
<td>NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latitude</td>
<td>43.14354</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longitude</td>
<td>17.68794</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimizer_number of visitors in the same time</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recomended duration of the visit in minutes</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorting_Attraction_working_hours</td>
<td>Announced visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban Zone</td>
<td>YES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Map of Mostar locations](https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzExMQ==)

---

*Project co-financed by the European Regional Development Fund*
Pont du Gard

- Tourism Domain
  - KPIs
  - People Counting
  - Social Media
- Dashboards
  - Monitoring KPI
  - Twitter Vigilance
- Historical and updated data
- Services Exploited on:
  - Dashboard
- Since 2020
Twitter Vigilance: Sentiment Analysis

Twitter Vigilance Herit-Data Dashboard

Last crawling: 2020-11-13 16:21:11

Channel active from 2020-01-30 to 2020-11-13 16:00:00

Data processed from 2020-02-01 00:00:00 to 2020-11-13 15:45:00

Sentiment trends in channel France
Valencia, FSMLR

- Tourism Domain
  - Counting People
  - Environmental data
  - Social Media

- Dashboards
  - Monitoring and real-time control
  - People flow
  - Twitter Vigilance

- Historical and Real Time data

- Services Exploited on:
  - Dashboard

- Since 2020
FSMLR: Twitter Vigilance & Dashboard

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzA4Ng==
West Greece

- Tourism Domain
  - KPIs
  - People Flows
  - OD matrices/flows
  - Social Media
- Dashboards
  - Monitoring KPI
  - Twitter Vigilance
- Historical and updated data
- Services Exploited on:
  - Dashboard
- Since 2020
Twitter Vigilance “Greece” Channel

- Tweets and Retweets volume trend, Natural Language Processing and Sentiment Analysis

West Greece: Visits vs Expenditure

Last Year Visits from major countries

Last Year Visits from major countries

Time Trend of Visits in Thousands

Values cost-expenditure last year
West Greece: Arrivals & Beds
West Greece: Domestic Movements

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEzMw==
West Greece: Cruise Ports Flows

https://www.snap4city.org/dashboardSmartCity/view/index.php?iddasboard=MzEyOQ==

No subtitle
Conclusions

A relevant number of data sets

- different kinds/nature: POI, KPI, devices, social media, events, etc.,
  - representing people flow, economy, tourism flows, etc.
- Plus contextual data as: traffic, environment, maps

They have been taken from the six pilots with their geographic areas:

- Dubrovnik (Croatia), Pont du Gard (Occitanie Region, France), Ancient Olympia (Western Greece Region, Greece), Florence (Tuscany Region, Italy), Valencia (Valencia Region, Spain) and Mostar (Bosnia Herzegovina).

The data have been ingested, analysed and integrated on the basis of the geostructure and relationships among them.

We have performed data analysis as:

- statistic analysis, machine learning predictions, ...
- Natural Language Processing (NLP) and Sentiment Analysis on millions of Tweets

A relevant number of visual analytics and dashboards has been produced

- to monitor and provide hints on the situations

In the next months we are going to increase the data sets and to identify solutions for better tourism flow management, in the view of the restart of the activities.
Contacts:

**DISIT Lab**  
*(University of Florence, Italy)*

*Paolo Nesi*  
paolo.nesi@unifi.it

*Gianni Pantaleo*  
gianni.pantaleo@unifi.it

https://www.snap4city.org/  
https://www.disit.org/

THANK YOU FOR YOUR ATTENTION!