



# **A Smart Tourism Approach to Prevent Overcrowding and Improve Destinations Sustainability (PREVENT CROWDING PROJECT)**

**Fernando Brito e Abreu**

Associate Professor

ISTAR-SSE Integrated Researcher

Prevent Crowding Project Leader

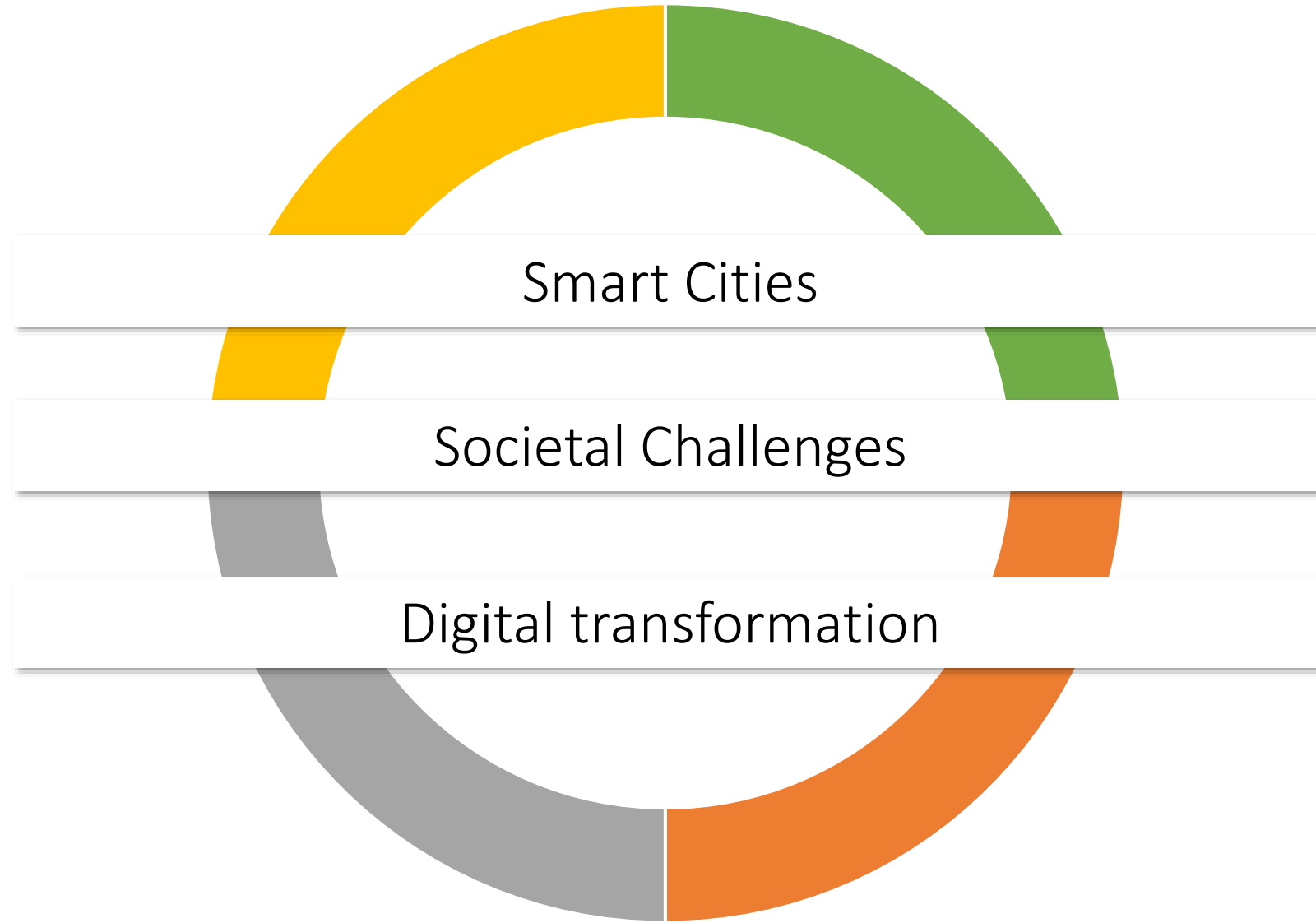
## **VISION**

Become a reference multidisciplinary research unit in the application of computing approaches and digital services to identified problems of individuals, organizations and society.

# Internal call for action ...



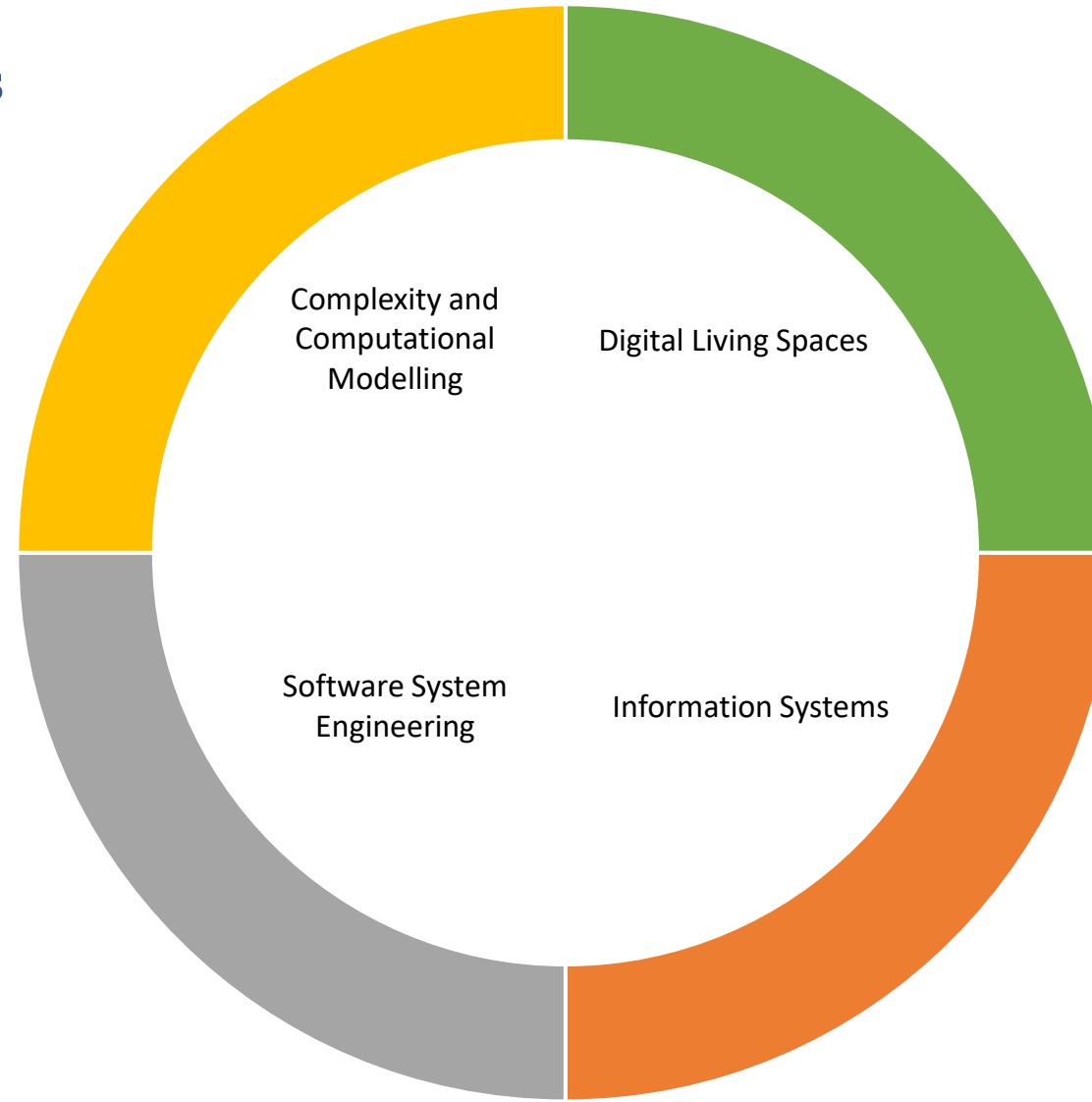
# Core lines



**UN  
Sustainable  
Development Goals  
2030**

**Societal  
Challenges H2020**

**Horizon  
Europe  
2021-2027**



Open Science

Global Challenges and  
Industrial  
Competitiveness

Open Innovation

→ Create more impact  
through mission-  
orientation and  
citizens' involvement

Integrated researchers 7  
 Associated Researchers 6  
 PhD students 4



MARIA DO ROSÁRIO  
FERNANDES



MANUEL ALBERTO MARTINS  
FERNANDES

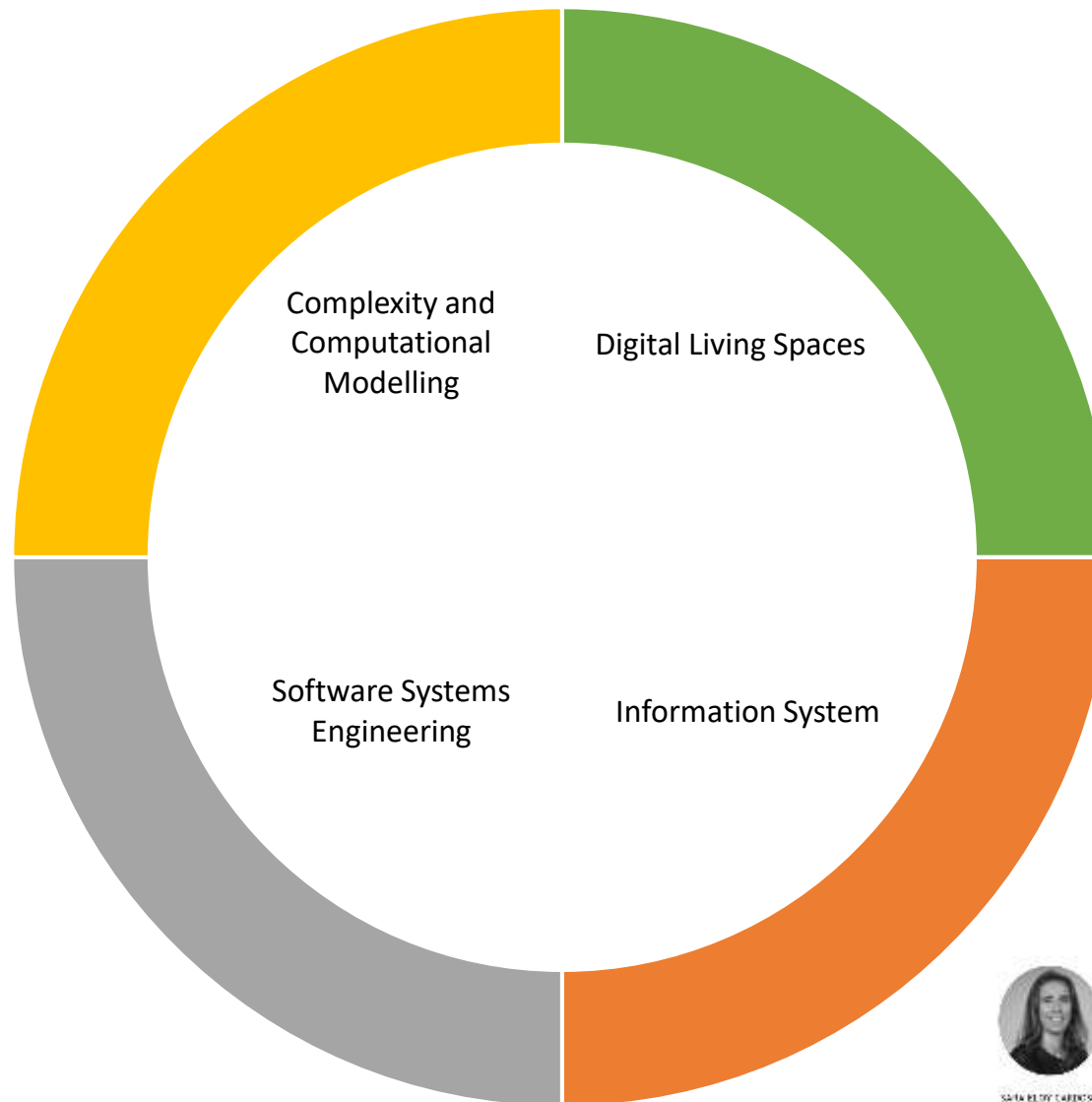
Integrated researchers 8  
 Associated Researchers 11  
 PhD students 6



CARLOS JOSÉ CORREIA DA SILVA



VÍTOR MANUEL BASTO  
FERNANDES



Integrated researchers 11  
 Associated Researchers 7  
 PhD students 17



JOSÉ MIGUEL DE OLIVEIRA  
MONTES



JOSÉ RICARDO PONTES  
FERNANDES

Integrated researchers 9  
 Associated Researchers 14  
 PhD students 14



SÉRGIO MIGUEL CARNEIRO  
MONTES



MARIANA ALMEIDA SANTOS  
ALMEIDA DA COSTA



SÓNIA BEIRÃO  
RODRIGUES

Integrated researchers 35  
 Associated Researchers 38  
 PhD students 41





## INTERNATIONAL TOURIST ARRIVALS 2015

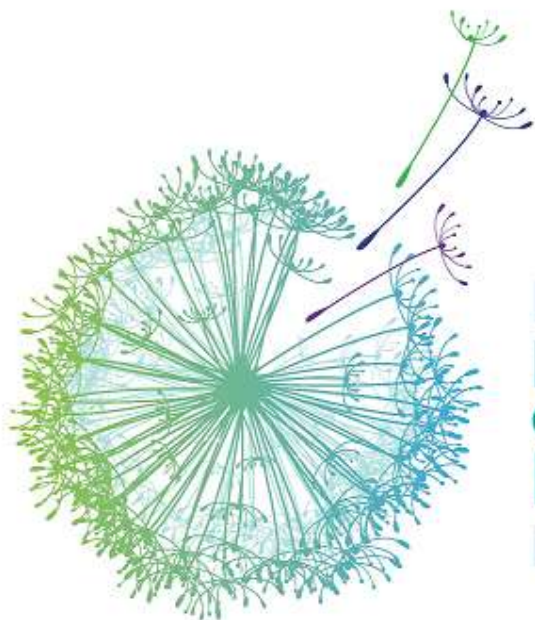
Share (%)



**WORLD: 1,186 MILLION**

©World Tourism Organization (UNWTO) 2016





## 2017 INTERNATIONAL YEAR OF SUSTAINABLE TOURISM FOR DEVELOPMENT

## The 2030 Agenda for Sustainable Development



### IY2017 Key Areas

Inclusive and sustainable economic growth

Social inclusiveness, employment and poverty reduction

Resource efficiency, environmental protection and climate change

Cultural values, diversity and heritage

Mutual understanding, peace and security

UNWTO - a Specialized Agency of the United Nations





# Tourism Carrying Capacity

*"Maximum number of people that may visit a tourist destination at the same time, without causing destruction of the physical, economic, socio-cultural environment and an unacceptable decrease in the quality of visitors' satisfaction"*





# Urban waste, sanitation and environmental pollution problems



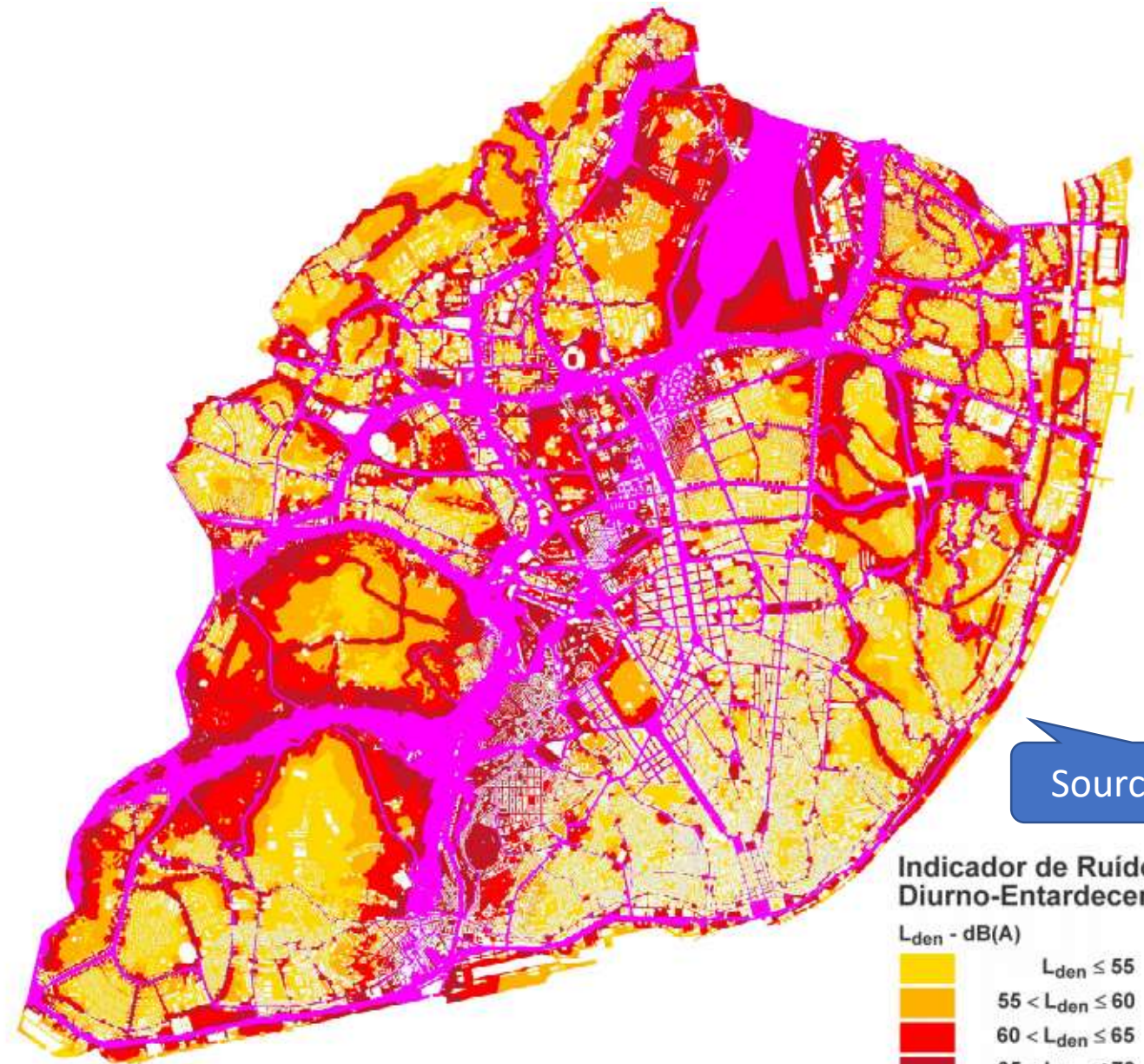


# Localized urban noise pollution

Two unexpected main actors ...



Lisbon pavements and rolling suitcases do not match well 😞



Source: CML

Indicador de Ruído  
Diurno-Entardecer-Nocturno

$L_{den}$  - dB(A)





# Authenticity threats



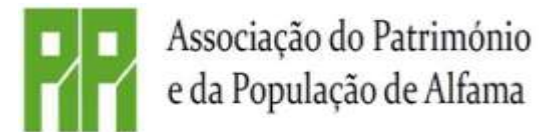






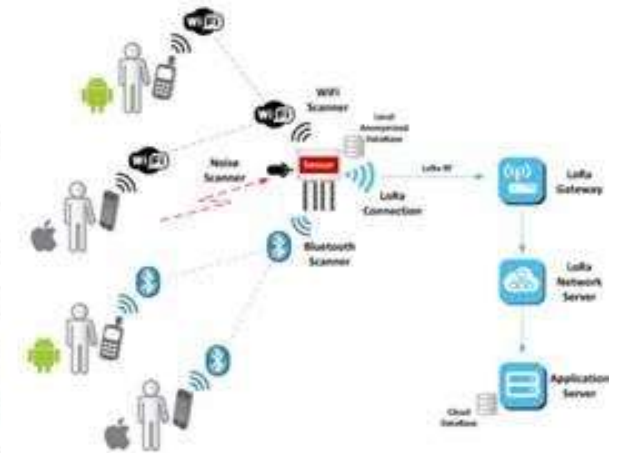
## *Prevent Crowding:*

Analysis, Monitoring and Management of Crowding  
in Real Time in Lisbon Historical Neighborhoods



# PREVENT CROWDING

This project proposes a mitigating solution for the tourism crowding phenomenon of Lisbon historical districts. Real-time crowding detection nodes will be installed in the critical zones. Each node, using SDR (Software Defined Radio) technology, captures information on the radio activity of individual mobile devices (3G/4G, WiFi and Bluetooth) carried by people on that zone. Those data streams are preprocessed in each node and then sent to a cloud server using a LoRaWAN network. In that server, those data are combined with other data derived from GIS-based forecasting of the beds offering (e.g. local accommodation and hotels), the crowding perception of tourists, and the carrying capacity of the natural environment and heritage sites. Results processed in the cloud server are then presented in a mobile app to tourists and tourism professionals (e.g., guides, tourist transportation drivers, etc.), representing the levels of congestion by means of heat maps, as well as a recommendation system for less congested alternative routes that maximize the passage by points of interest of the local communities, having as criteria their authenticity and sustainability.



## Partners



## Researchers



## Expected funding

Funding through programme: Linha Sustentabilidade / Programa Valorizar / Turismo de Portugal



Associação do Património e da População de Alfama



# Related work

## Alternative routing to mitigate tourism crowding

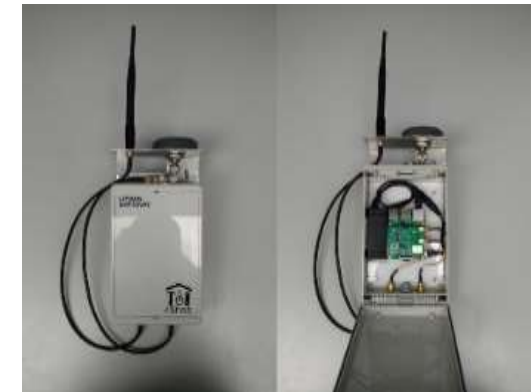
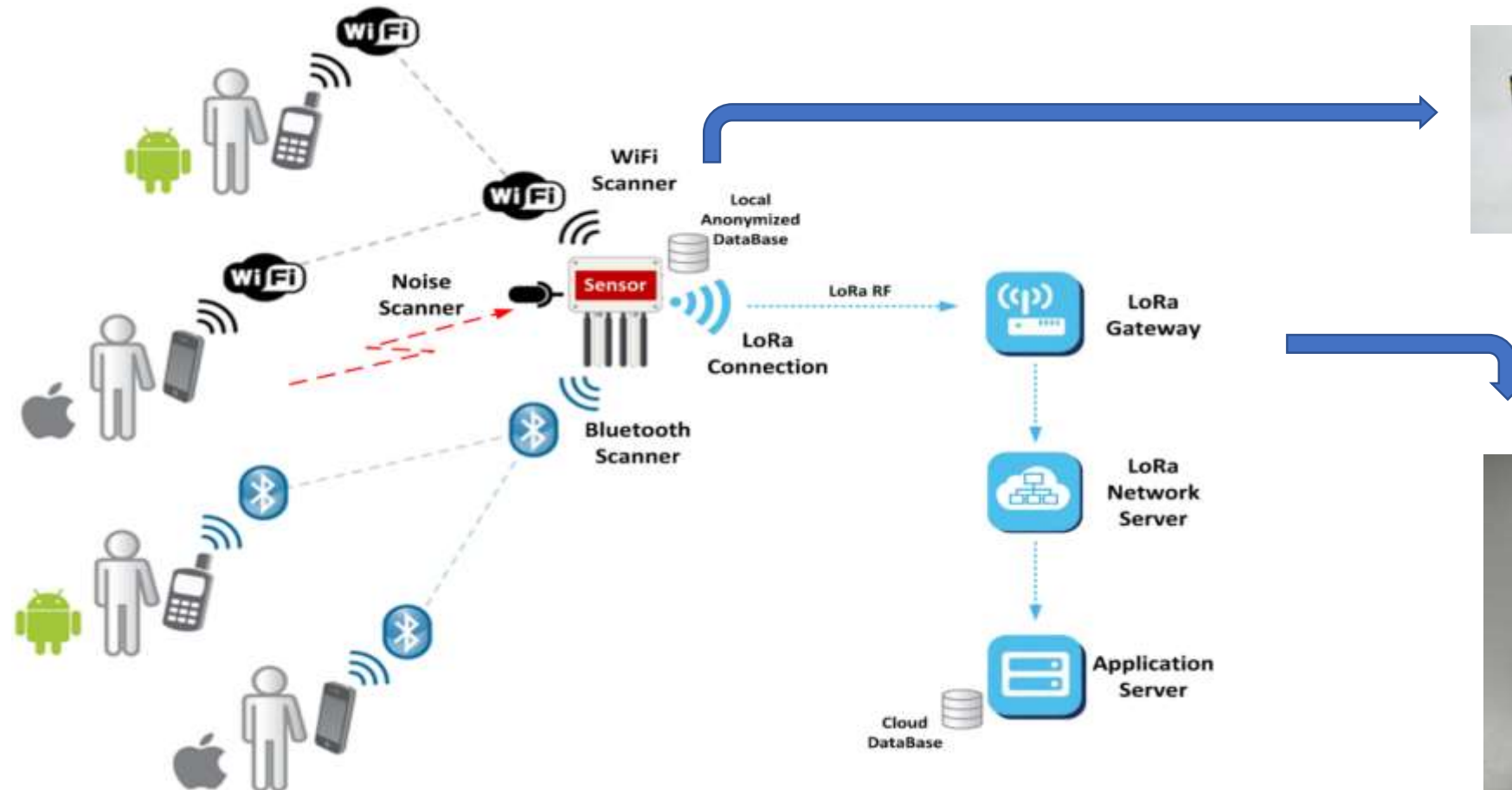
- The important Islamic city of **Kairouan in Tunisia** has introduced a well-marked itinerary through the historic sections of the old town, complemented by a single access ticket for all of the monuments. This encourages the majority of visitors to take the main route and avoid disrupting the privacy and lifestyles of the residents elsewhere in the old centre. In addition the mosque is closed to non-Muslims during the afternoons.
- The **Alhambra in Granada** has introduced strict limitations on the numbers of visitors permitted within the main historic palaces at any one time. Visitors are offered a range of itineraries that introduce the majority of the site, but control numbers within the sensitive areas.
- The historic town of **Hoi An in central Vietnam**, has developed a special program to spread tourism activity into adjoining areas of the town, reducing the traditional focus on the waterfront market areas. This has reduced the tourism and commercial congestion on the waterfront, and provided income and investment opportunities for a larger number of property owners and operators in the town.

# Activity of mobile devices (3G,4G, WiFi, Bluetooth)





# General architecture of proposed solution



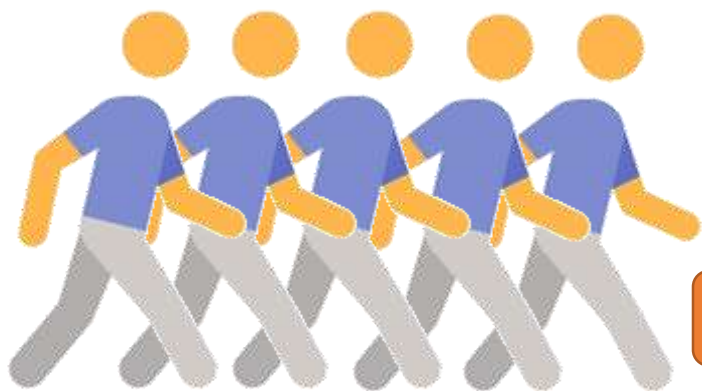




GIS + Points of Interest

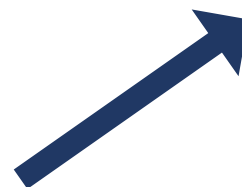


Graph Algorithms



Crowding detection data

MSc thesis



MSc thesis

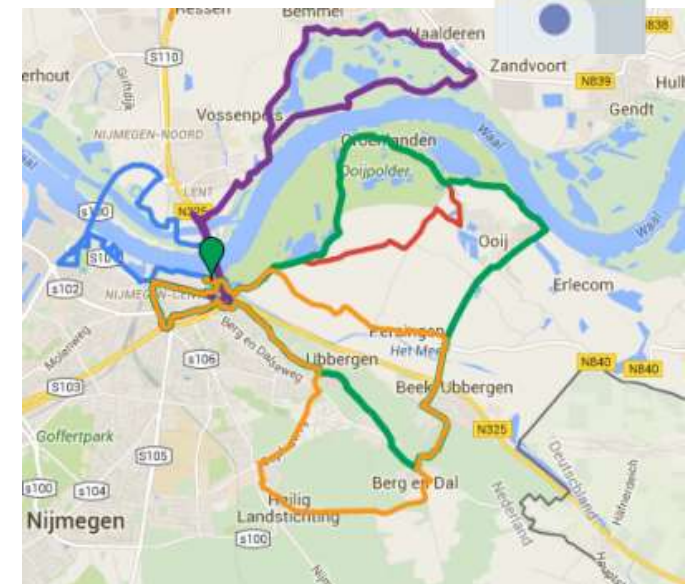


Sustainable walking routes recommendations

MSc thesis



MSc thesis



*"SDR-based Crowding Detection"*  
Rúben Silva MSc thesis

*"Modeling, Deploying and Testing  
Microservices Architectures"*  
Duarte Almeida MSc thesis

*"Optimizing User Engagement, Experience  
and Retention in Mobile Apps for Walking  
Routes Recommendation"*  
João Virtudes MSc thesis



kubernetes



*"Cloud-Based Analytics for Tourism  
Sustainability: the Case of Lisbon Over Crowding"*  
Rita Peixoto MSc thesis

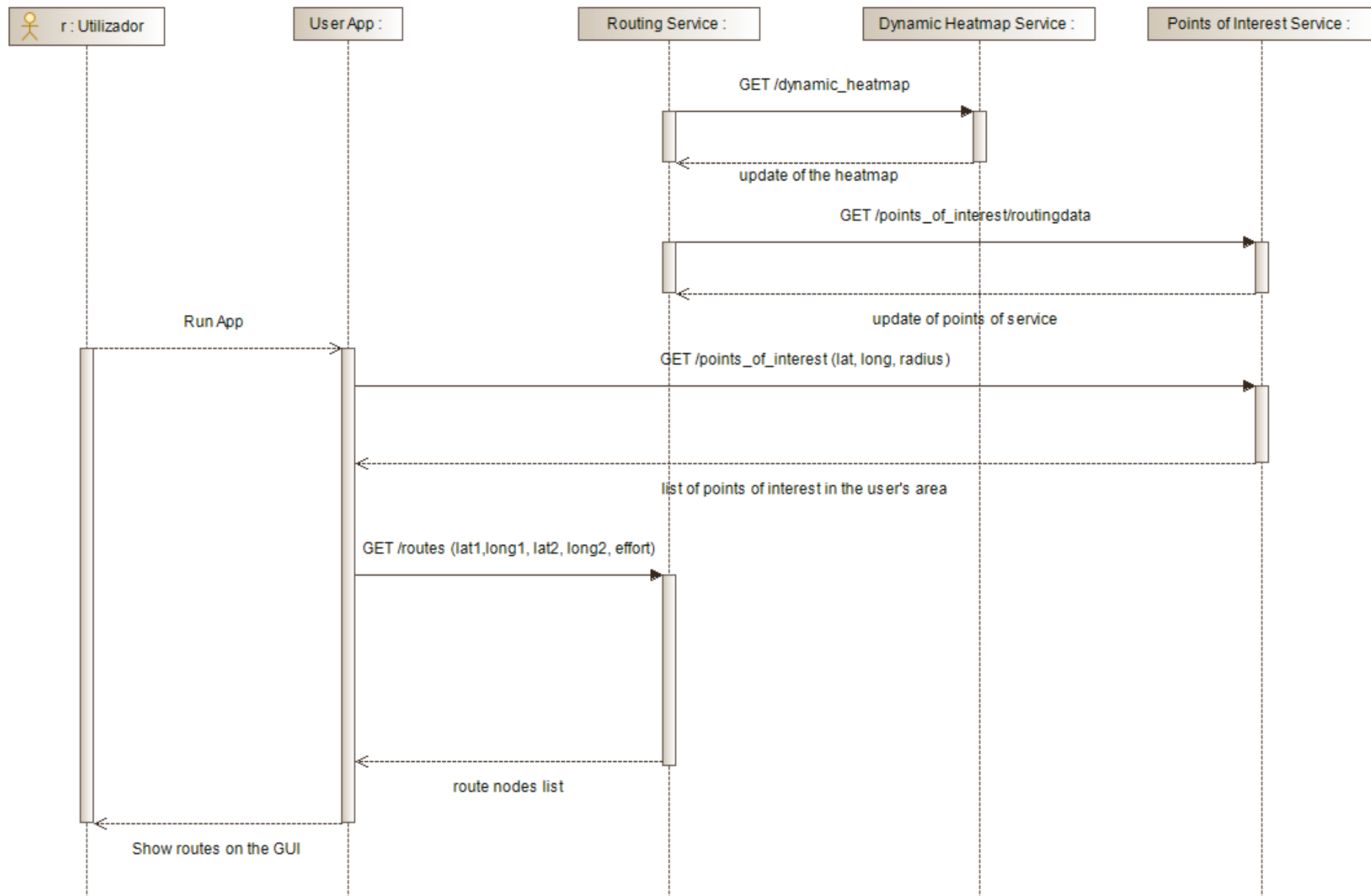


OpenStreetMap

Graphhopper



APP USER  
RETENTION





TURISMO DE  
PORTUGAL



*"Big-data Dynamic Visualization Techniques  
Applied to Nation-Wide Longitudinal  
Studies in the Tourism Industry"*

Post-doc



INSTITUTO NACIONAL DE ESTATÍSTICA  
STATISTICS PORTUGAL



Aeroportos  
de Portugal



*"Simulation of Pedestrian Dynamics in Historical  
Districts for Over-Crowding Mitigation"*

Phd thesis

Multiscale Modeling of  
Pedestrian Dynamics

Emiliano Cristiani • Benedetto Piccoli • Andrea Tosin

MS&A

Modeling, Simulation & Applications



Springer



**NOITE EUROPEIA**  
**de INVESTIGADORES**  
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**QUERES SER VOLUNTÁRIO NA NOITE MAIS CIENTÍFICA DO ANO?**

**Inscreve-te em:**  
**noitedosinvestigadores.org**

# Technology

**Scientista**  
**Scientist**

**28 de Setembro**  
**18h00 – 00h00**

Museu Nacional de História Natural e da Ciência  
Jardim do Príncipe Real

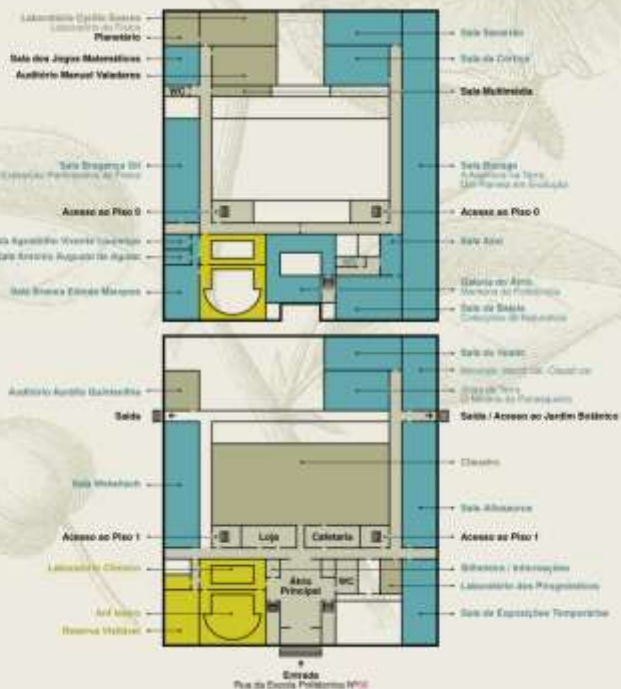
Sustentável  
Sustenable



## EDIFÍCIO PRINCIPAL

### Piso 1

### Piso 0



Exposições  
Laboratório  
Químico

**INICIATIVA**

**NOITE EUROPEIA  
E INVESTIGADORES**



## ORGANIZAÇÃO



Este projeto da União Europeia dos Investigadores é financiado pela Comissão Europeia no âmbito das Ações Marie Skłodowska-Curie.

/07/2019

# ENCONTRO CIÊNCIA'19

23





## **PREVENT CROWDING PROJECT**

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