2020 CiViTAS
Cleaner and better transport in cities

DESTINATIONS

D9.6 – Publications and papers in high qualified journals

List of scientific and research publications within DESTINATIONS

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Responsible Co-Author(s):	
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2020 CiViTAS
Cleaner and better transport in cities
DESTINATIONS

THE CIVITAS INITIATIVE
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Abstract

During the project's lifetime, important research findings coming from the demonstration of innovative mobility measures and new technologies tested by the CIVITAS DESTINATIONS sites were published and disseminated to the scientific community.

This deliverable encloses the complete list of the peer-reviewed papers published in qualified journals, the articles published in conference proceedings (International, European and national level) and of relevant books/book chapters, which overall demonstrate effort devoted to the research work and the collection of a relevant best practice deriving from the real-life experience tested at the six DESTINATIONS sites.

The CIVITAS DESTINATIONS publications are grouped in five thematic areas: Sustainability Impact Monitoring and Assessment; New technologies / ITS solutions enhancing Shared Mobility and Public Transport; Mobility management, Planning and Infrastructure for Shared Mobility and Public Transport; Gamification, Users' Behaviour and Mobility Patterns; COVID-19 Impacts on Mobility.

Till today, thousands of researchers, cities, mobility stakeholders and urban planners have gained access and inspiration from the analysis of the following research finding, project's outcomes, best practices, lessons learned and policy recommendations, deriving from the innovative measures demonstrated in the six CIVITAS DESTINATIONS cities.

Project Partners

Organisation	Abbreviation	Country
Horários do Funchal, Transportes Públicos, SA	HF	PT
Agência Regional da Energia e Ambiente da Região Autónoma da Madeira	AREAM	PT
Câmara Municipal do Funchal	CMF	PT
Secretaria Regional da Economia Turismo e Cultura	SRETC	PT
Agência Regional para o Desenvolvimento da Investigação, Tecnologia e Inovação	ARDITI	PT
Limassol Tourism Development and Promotion Company Ltd	LTC	CY
Municipality of Limassol	LIMA	CY
Stratagem Energy Ltd	STRATA	CY
Dimos Rethimnis	RETH	EL
The Research Committee of the Technical University of Crete	TUC	EL
Comune Di Rio	Rio	IT
Comune Di Portoferraio	PF	IT
MemEx S.R.L.	MEMEX	IT
Authority for Transport in Malta	TM	MT
Valletta Kunsilli Lokali – Valletta Local Council	VLC	MT
Universita ta' Malta	UoM	MT
Ministry of Tourism	MOT	MT

Guaguas Municipales Sociedad Anonima	Guaguas	ES
CINESI S.L consultoria de transport	CINESI	ES
Ayutamiento de Las Palmas de Gran Canaria	LPGC	ES
Ingeniería Electrónica Canaria S.L	INELCAN	ES
Sociedad Municipal de Aparcamientos de Las Palmas de Gran Canaria	SAGULPA	ES
Istituto di Studi per l'Integrazione dei Sistemi	ISINNOVA	IT
European Integrated Project	EIP	RO
Sustainable Services	GV21	ES
Vectos GmbH	VECTOS-G	DE
Conférence des Régions Périphériques Maritimes d'Europe	CPMR	BE

Document History

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19/42021	Maria Aryblia	Second Draft	Draft	SC
23/4/2021	Stavroula Tournaki, Theocharis Tsoutsos (TUC)	Peer Review	Draft	SC
28/4/2021	Maria Aryblia	Prefinal version, sent to PC	Draft	SC
29/4/2021	Maria Aryblia	Final version	Final	SC
30/4/2021	Joana Gaudêncio	Submission	Submitted	EC

Status: Draft, Final, Approved, and Submitted (to European Commission).

Dissemination Level: PC = Project Coordinator, SC=Site Coordinator, TC=Technical Coordinator, EM=Evaluation Manager, EC= European Commission.

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Executive Summary

The CIVITAS DESTINATIONS has developed a set of innovative packages to test and demonstrate smart mobility solutions in six European insular cities; Funchal, Madeira (Portugal), Las Palmas de Gran Canaria (Spain), Limassol (Cyprus), La Valetta (Malta), Elba (Italy) and Rethymno (Greece).

The cities experience significant seasonal flow of tourists on annual base, putting pressure in the transport systems and commuting services. A set of innovative solutions integrating sustainable tourism and mobility strategies to address the urban challenges have been implemented, to improve mobility patterns and the quality of life for both residents and visitors.

Thorough the project's life, the DESTINATIONS sites achieved to improve urban mobility, to reduce emissions and energy consumption, to motivate behavioural change to more sustainable transport modes and a car-free lifestyle, to improve cost-effectiveness of public transport and shared mobility services, and recorded a measurable impact on economic, environmental, society and energy sectors.

The methodologies developed, the innovative mobility solutions implemented and the measurable impacts were assessed, analysed and presented into the scientific community by the DESTINATIONS sites.

More specifically, through the project the following publications were delivered:

- **5 scientific articles in qualified peer-review journals; 2** authored by the Technical University of Crete - Renewable and Sustainable Energy Systems Lab, **2** authored by University of Malta and **1** from ARDITI.
- **15 articles in conference proceedings** of International, European and National conferences, **10** authored by ARDITI, **1** by Horários do Funchal and **4** by the Technical University of Crete - Renewable and Sustainable Energy Systems Lab.
- **1 booklet** authored by MeMex and **1 book chapter** authored by the Technical University of Crete - Renewable and Sustainable Energy Systems Lab.
- **1 Master of Science Thesis** authored by the Technical University of Crete - Renewable and Sustainable Energy Systems Lab.
- **1 open access book** authored by several CIVITAS DESTINATIONS partners and submitted after approval to a high qualified editor, Springer for open access publication. The book is dedicated to DESTINATIONS core results, findings, lessons learned and innovative features (currently under publishing process).

This document presents the DESTINATIONS researches grouped under following thematic:

1. **Sustainability Impact Monitoring and Assessment** (5 *publications)*
2. **New technologies / ITS solutions enhancing Shared Mobility and Public Transport** *(3 publications)*
3. **Mobility management, Planning and Infrastructure for Shared Mobility and Public Transport** *(4 publications)*
4. **Gamification, Users' Behaviour and Mobility Patterns** *(8 publications)*

COVID-19 Impacts on Mobility *(2 publications)*

1 Sustainability Impact Monitoring and Assessment

Sustainable mobility solutions and impact assessment in touristic areas in CIVITAS DESTINATIONS project. The case of Rethymno

Authors: S. Tournaki, E. Farmaki, T. Tsoutsos – Renewable and Sustainable Energy Systems Lab, Technical University of Crete.

Publication info: ASHRAE 2nd International Conference for Energy in Transport, Athens, 2017 - Conference Proceedings

Available at:
https://www.researchgate.net/publication/324504304_Sustainable_mobility_solutions_and_impact_assessment_in_touristic_areas_in_CIVITAS_DESTINATIONS_project_The_case_of_Rethymno

Abstract

Car dependency along with the intensive use of conventional fuels have resulted in high environmental pollution and increased energy consumption. Current EU policy is setting emission mitigation and energy efficiency as priority pillars in national, regional and European environmental policies, leading the path towards sustainability in the transport sector. The European CIVITAS initiative aims to address the rising challenges in the transport sector and CIVITAS DESTINATIONS, launched in 2016, is the first project to take into account the impact of high tourism flow on mobility infrastructure. Six European island tourist destinations (Rethymno, Limassol, Valletta, Funchal, Las Palmas and Elba) will demonstrate innovative mobility solutions, combining state of the art technology, soft measures, local policies and behavioural changing techniques. Rethymno is the first Greek city to participate in a CIVITAS project, following the existing strong vision of the Municipality towards sustainability.

Within DESTINATIONS, Rethymno will implement a total of 14 measures in order improve the overall urban mobility and address the impact of seasonality in transport demand during the touristic period, in terms of heavy congestion, poor air quality, noise pollution and high energy consumption. The demonstration actions foreseen in Rethymno cover a wide range of thematic areas related to sustainable transportation: car-independent lifestyle, electric vehicles and clean fuels, transport telematics, urban freight logistics, collective passenger transport, tourist mobility services, demand management strategies, safety and security. The existing Sustainable Urban Mobility Plan (SUMP) will be upgraded and specific measures will be developed in conjunction with SUMP, following a holistic approach.

The integrated implementation of the mobility measures aims to maximize the environmental benefits and create a sustainable, safe and energy efficient mobility system. The evaluation of the measures' effectiveness is strongly incorporated into the core of DESTINATIONS, as a key element to facilitate replication and upscaling of identified best practices.

The assessment framework consists of a set of monitoring indicators to evaluate the transportation, environmental, economic and social aspects of each measure in the DESTINATIONS sites.

Building on previous CIVITAS experience, the Technical University of Crete (TUC) undertook the refinement of the assessment framework in terms of environment, energy and economy, including indicators for emissions, noise, pollutant levels, energy efficiency, costs and revenues. Data collection and impacts calculation tools provide a comprehensive overview of the environmental assessment. Rethymno foresees outcomes regarding the total reduction of GHG emissions and the total energy savings.

Keywords: sustainable mobility, impact assessment, mobility solutions

Green energy for the city of Rethymno. The H2020 CIVITAS DESTINATIONS project

Authors: T. Tsoutsos, S. Tournaki, V. Mathioudakis, E. Farmaki - Renewable and Sustainable Energy Systems Lab, Technical University of Crete

Publication: 2nd International Conference on Environmental Science and Energy Engineering (ICESEE 2017), ISBN: 978-1-60595-417-2, ISSN: 2475-8833, 2017 - Conference Proceedings

Available at:
https://www.researchgate.net/publication/324504416_Green_energy_for_the_city_of_Rethymno_The_H2020_CIVITAS_DESTINATIONS_project

Abstract

CIVITAS DESTINATIONS builds an integrated approach to address mobility and tourism challenges and implements a set of reinforcing innovative solutions towards nearly zero energy demand, aiming to reduce emissions and energy consumption and to improve urban attractiveness and accessibility in six (6) European sites. Amongst them the city of Rethymno, an island tourist destination in Greece with a strong vision towards sustainability and a Covenant of Mayors' member since 2011. DESTINATIONS cities adopted measures to achieve a more sustainable mobility system, like electric vehicles in public transport and shared mobility modes. Sustainable Urban Mobility Plans (SUMPs) are under development taking into account not only the traditional transportation indicators, but giving priority to citizen involvement, environment, economic development, energy, social cohesion, safety and land use.

In that frame, the Technical University of Crete (TUC) developed an environmental assessment framework to be applied in all DESTINATIONS cities to evaluate each of the measures' effectiveness in terms of environment, energy and economy. Common strategic goals and predefined performance indicators amongst all 6 destinations allow a consistent and comparable analysis at the project level. The environmental benefits of the sustainable mobility measures are evaluated by monitoring indicators for emissions and CO_2, CO, NOx, PM and Volatile Organic Compounds levels; also for noise levels, energy use for urban transport, fuel mix. TUC will analyze them using industry approved formulas and existing experience, also from previous CIVITAS projects. The environmental assessment will include Life Cycle Assessment in certain cases like the conversion of Used Cooking Oil to biodiesel.

Keywords: Urban mobility, Sustainable mobility, SUMP, Environmental assessment

Impact Assessment of Sustainable Mobility in Touristic Cities of Europe: The CIVITAS DESTINATIONS Approach on Energy, Environment and Economy

Authors: S. Tournaki, E. Farmaki, T. Tsoutsos - Renewable and Sustainable Energy Systems Lab, Technical University of Crete

Publication info: The Role of Exergy in Energy and the Environment, Editors: Sandro Nižetić, Agis Papadopoulos, Springer, 2018 - Book Chapter, Peer-Reviewed

DOI: https://doi.org/10.1007/978-3-319-89845-2

Abstract

The International Energy Agency estimates that 28% of global primary energy consumption and around 25% of CO2 emissions can be attributed exclusively to the transport sector. Meanwhile, the European transport sector contributes to nearly one-third of the CO2 emissions, and despite the economic downturn, the ongoing vehicle technology and the promotion of clean fuels, transport is the only major sector with an increased rate of emissions over the last decade. Road transport accounts for approximately 73% of the total transport greenhouse gas (GHG) emissions in the EU and nearly two-thirds of road transport emissions originate from light-duty vehicles, while the remaining one-third originates from heavy-duty vehicles. Besides the extensive GHG emissions and impact on climate change, transport is also responsible for the e Bus Stops as Interactive Touchpoints missions of noxious air pollutants which are proven to have serious implications for human health. Thousands of deaths annually can be attributed to road transport-related air pollution, almost equivalent to the deaths from road accidents, highlighting further the need for action.

According to the European Commission [6], the EU needs to reduce the GHG emissions by 40% below 1990 levels by 2030 and by 80–95% by 2050. Transport will contribute to the goals by reducing its GHG emissions below 1990 levels by 60% by 2050. In order to achieve these goals, the European Commission has set as a priority pillar the reduction of energy consumption in the transportation sector, which is set in national/regional and European environmental policies and is reflected in the Paris Agreement on climate change commitments. Cities hold a key part in achieving these goals since they attract the biggest part of the population and drive economic growth, but they can also drive the change towards sustainability. Many metropolitan or fast-growing cities are focusing on more green spaces, better environmental quality, innovative energy-efficient technologies, clean transportation and increased quality of life. While embracing the vision towards sustainable urban development, urban planners and public authorities realise the key role of the transportation sector and acknowledge the potential for significant social, environmental and economic benefits towards sustainability.

The CIVITAS DESTINATIONS is one of the CIVITAS demonstration projects funded by the European Commission within the framework of the Horizon 2020 programme. It is the first one to take into account the connection of mobility and tourism, aiming to provide mutually reinforcing innovative mobility solutions for residents and tourists and to improve the urban environment at six demonstration areas. It will now provide a refined assessment framework in order to evaluate the impacts of the mobility measures in touristic island cities.

The scope of this study is to present an environmental assessment framework, which is developed to evaluate the impacts of proposed measures at city, region and project level. More specifically, it outlines the case of the Rethymno, one of the project demonstration areas which will adopt a set of innovative mobility solutions. Rethymno's case is used to demonstrate the environmental assessment framework by indicating the suitable evaluation indicators according to the specific measures under implementation, in terms of energy and sustainability.

Keywords: sustainable mobility, environmental impact assessment, energy in transport, sustainable tourism

Environmental evaluation of mobility measures in EU islands. Lessons from the H2020 CIVITAS DESTINATIONS project

Authors: E. Farmaki, M. Aryblia., G. Piteris, S. Tournaki, T. Tsoutsos* - Renewable and Sustainable Energy Systems Lab, Technical University of Crete

Publication info: Clean Energy in EU islands, Athens, 2019 - Conference Proceedings

Available at:
https://www.researchgate.net/publication/335339421_Environmental_evaluation_of_mobility_measures_in_EU_islands_Lessons_from_the_H2020_CIVITAS_DESTINATIONS_project

Abstract

The negative impacts of the current transport modes on the environment, energy, health, and economy have led to policies promoting clean, safe and efficient mobility. Under this scope, the Horizon 2020 CIVITAS DESTINATIONS project, funded by the European Commission, integrates the tourist mobility needs and the fluctuation impacts on the design of mobility solutions in order to enforce the accessibility, attractiveness, efficiency and sustainability of transport services and infrastructure for both residents and tourists in six island cities: Rethymno (Crete-Greece), Limassol (Cyprus), Valletta (Malta), Funchal (Madeira-Portugal), Las Palmas de Gran Canaria (Spain) and Elba (Italy). DESTINATIONS cities adopted measures to achieve a more sustainable mobility system, like Sustainable Urban Mobility Plans (SUMPs), electric vehicles in public transport and shared mobility modes. The environmental impacts of all the measures are evaluated, per measure and per site, within the Environmental Assessment Framework (EAF) developed in accordance to previous CIVITAS guidance and adapted to address the specific objectives of the project. Indicators for emissions, pollutant levels and Used Cooking Oil collection were incorporated in a refined EAF. Rethymno, the first Greek CIVITAS city, demonstrates 14 mobility measures to improve overall urban accessibility and to address the heavy impacts of tourist flow in the transport system and the environment. This paper analyses the methodology followed by the Technical University of Crete and presents the first findings from field measurements regarding traffic data, weather conditions (temperature, humidity, wind speed), pollutant levels (CO, NO2, Particulate Matter), CO2 values and noise level with the installation of environmental sensors on 5 meteorological stations, along with portable equipment for additional on-site measurements in 9 different locations.

Keywords: Clean islands; sustainable mobility; environmental impact assessment, clean transport

Assessment of sustainable urban mobility measures in the Mediterranean, integrating stakeholders' viewpoint through multi-criteria decision making

Authors: Farmaki E. Renewable and Sustainable Energy Systems Lab, Technical University of Crete

Publication info: School of Environmental Engineering, Technical University of Crete, 2019 - Master of Science Thesis

DOI: https://doi.org/10.26233/heallink.tuc.80393

Abstract

Due to the identified environmental and health impacts of the current transport habits, a shift towards sustainable mobility is adopted by the European Commission and national and local authorities, that are actively establishing new policies. Numerous studies are exploring potential mobility solutions, taking into account the specific characteristics and needs of urban areas. Aiming to address the complexity of prioritising the various mobility measures, this study performs an assessment of 11 sustainable urban mobility measures according to 10 criteria for European medium-sized touristic cities, through multi-criteria decision making, and more specifically, by using the PROMETHEE method. The study is also linked to the Horizon 2020 CIVITAS DESTINATIONS project, aiming to gap the link between tourism and mobility in 6 touristic insular areas with various mobility measures. The study integrates the viewpoint of 6 European (EU) and 7 Greek (GR) stakeholder groups, identifying their interests and comparing their ranking on the selection of appropriate mobility policies. Moreover, tourism aspects are incorporated in the examined actions, the evaluation criteria selected and the stakeholders' groups involved. The CIVITAS DESTINATIONS network was actively involved during the formation of stakeholders' groups at European level. Most EU and GR stakeholder groups presented very similar rankings, although Academic institutions and Mobility experts presented the most differences at EU and GR level. "Mobility management and travel plans" was ranked as the most suitable policy, for all EU and GR stakeholder groups, and was identified as a very stable option by a sensitivity analysis performed. In terms of interests, most EU and GR stakeholders give priority to the wellbeing of local communities and the quality of life, while tourism sector's priorities were set on environmental criteria, acknowledging the links between tourism and transport-related pollution. Overall, the study provides an assessment approach for decision-makers that manage mobility challenges in tourist destinations and suggests the incorporation of stakeholders' view as a vital element for sustainable mobility planning.

Keywords: sustainable urban mobility, mobility measures, multicriteria, decision making

2 New technologies44rf / ITS solutions enhancing Shared Mobility and Public Transport

ViTFlow: A platform to visualize tourists flows in a rich interactive map-based interface

Authors: D. Redin, D. Vilela, N. Nunes, M. Ribeiro – ARDITI

Publication info: Sustainable Internet and ICT for Sustainability (SustainIT), 2017 - Conference Proceedings

DOI: 10.23919/SustainIT.2017.8379814

Abstract

In this paper, we describe ViTFlow, a platform to visualize tourists flows, integrating different data sources into a rich interactive map-based visualization. The data are collected using low-cost routers, enabling wi-fi passive tracking, and sensors, detecting environmental conditions, spread over the Madeira Islands. Different types of data can be visualized in the map-based interface, including spatio-temporal mobility data (i.e., movements between places and common paths taken by tourists), airplane and cruise ship traffic, weather information, and official events. We designed the interface with the aim of providing citizens and tourists with a public display to facilitate a dialog between the different communities, exploiting synergies to promote the sustainability of the archipelago.

Keywords: spatio-temporal data, mobility, tourism, map-based interface, sustainability

Enhancing sustainable mobility awareness by exploiting multi-sourced data: The case study of the Madeira islands

Authors: C. Prandi, N. Nunes, M. Ribeiro, V. Nisi – ARDITI

Publication info: Sustainable Internet and ICT for Sustainability (SustainIT), 2017 - Conference Proceedings

DOI: 10.23919/SustainIT.2017.8379799

Abstract

In this paper we present a low-cost infrastructure to collect a variety of location-based multi-sourced data with the aim of providing personalized services and raising awareness for sustainable mobility solutions. The gathered data can be used to provide: (i) citizens and tourists with personalized location-based services to increase sustainability awareness; (ii) local authorities and tourism boards with a tool to identify and prevent mobility issues; and (iii) transport companies with an instrument to support urban mobility planning decisions.

To collect data, we exploited a low-cost Wi-Fi passive tracking system and we augmented this infrastructure using sensors for detecting environmental conditions. To achieve this, we provided 60 points of interest and 20 buses with our solution, to spread out the sensors over the entire Madeira Island. Using the gathered data, we developed different scenarios to prove that in a world where sensing data is becoming inexpensive, there are opportunities to use our approach to deliver data back to the citizens, empowering local communities, with the goal of promoting sustainable mobility and tourism.

Keywords: sustainable mobility; sustainable tourism; smart mobility, sensory data, passive wi-fi tracking, multi-sourced data

Comparison of Vehicle Detection Techniques applied to IP Camera Video Feeds for use in Intelligent Transport Systems

Authors: M. Bugeja, A. Dingli, M. Attard, D. Seychell - University of Malta

Publication info: Transportation Research Procedia, Volume 45, pages 971 – 978, ISSN 2352 – 1465, 2020, Paper in Peer-Review Scientific Journal

DOI: https://doi.org/10.1016/j.trpro.2020.02.069

Abstract

Vehicle detection is an important area in Transport and Artificial Intelligence. Through vehicle detection techniques, vehicles can be located across different images. Some of these models are robust enough to identify parts of vehicles in images where the vehicle might be partially occluded. Recent advances in detection methods gave rise to a range of different techniques that can be used for recognition and detection of vehicles. Although each technique has its merits, it is not always the case that the adopted model works well for scenarios involving IP Cameras. The motivation for this study is to compare several state-of-the-art techniques, including deep learning models and computer vision approaches.

A set of experiments are developed in order to test these models on a number of low-quality IP camera footages set in the transport domain in order to measure detection and recognition accuracy. The final evaluation compares detection accuracy using mean average precision, the semantics of the recognised vehicle as well as recognition robustness when applied to a dataset that contains images with different light conditions. The study also looks at persistence in recognition across frames in video data and a detailed description of the dataset used to train the evaluated models.

Finally, the paper also goes through some scenarios that applies the results obtained in this study to ITS systems that use IP camera feeds.

Keywords: Intelligent Transport Systems, Computer Vision, Artificial Intelligence, Vehicle Detection

3 Mobility management, Planning and Infrastructure for Shared Mobility and Public Transport

Beanstalk - Wi-Fi Tracking System for Analysing Tourism Dynamic

Authors: N. Nunes, M. Ribeiro, C. Prandi, V. Nisi - ARDITI

Publication info: EICS '17: ACM SIGCHI Symposium on Engineering Interactive Computing Systems, 2017 - Conference Proceedings

DOI: http://dx.doi.org/10.1145/3102113.3102142

Abstract

This paper presents Beanstalk, an interactive platform to assist communities in easily running systematic analysis of mobility patterns of tourists at their destinations, contributing in new ways in visualizing spatio-temporal mobility data for forecasting, tracking trends, detecting patterns and noticing anomalies. The approach takes advantage of a combination of passive Wi-Fi tracking and ground truth data provided by tourism authorities.

By analyzing a large dataset for a medium sized European island, we provide evidence of the accuracy and effectiveness of this low-cost method in inferring topological characteristics of tourist behavior and relevant typologies of trip itineraries. This helps decision makers in the touristic sector to plan and manage actions geared towards improving the sustainability and competitiveness of their touristic regions. In particular, we argue that in a world where sensing data is becoming inexpensive, there is an opportunity to use this approach to deliver data back to local communities which are empowered to act and leverage this information.

Keywords: Spatio-temporal data; Community-analytics; Human-Data Interaction; Activity Tracking

Shared Use Mobility Agency in Elba island: from the concept to the IT Platform

Authors: Ambrosino G. – MeMex (Elba)

Publication info: Shared Use Mobility Agency in Elba island: from the concept to the IT Platform, CIVITAS DESTINATIONS Booklet, 2018 - Booklet

Available at:

https://civitas.eu/sites/default/files/shared-use-mobility-agency_booklet.pdf

Introduction and content

The concept of Shared Use Mobility Agency (SUMA) is presented, as implemented in Elba island, (Regione Toscana-Italy), within CIVITAS DESTINATIONS project underlying the specifications of the platform and the mobile application. SUMA aims to integrate smart mobility services under the concept of MaaS in order to answer to the mobility needs of residents and tourists acting on the demand and providing coordinate collective and ride-sharing transport services.

The booklet consists of the following chapters:

Integrated Urban Mobility approach: Current Challenges and trends in Europe; The concept of Shared Use Mobility Agency (SUMA).

DESTINATIONS project in Elba: The Elba Island context; Needs and design principles; SUMA requirements.

Elba Shared Use Mobility Agency - SUMA Functions overview; ITS Technology, system and service requirements; Procurement of services; Operational aspects; Next actions and timeplan.

Canvas Business Model First Elements – Challenges/Problem; Users' segments; Unique Value Propositions (UVP); Solutions and advantages; Unfair Advantage; Revenues; Promotion Channels; Key Metrics; Cost details.

Keywords: Shared Mobility Agency, MaaS, sustainable mobility solutions

Passive Wi-Fi Monitoring in Public Transport: A case study in the Madeira Island

Authors: M. Ribeiro, B. Galvão, C. Prandi, N. Nunes - ARDITI

Publication: TRA2020, the 8th Transport Research Arena: Rethinking transport towards clean and inclusive mobility**,** 2020 - Conference Proceedings

DOI: arXiv:2006.16083

Abstract

Transportation has become of evermore importance in the last years, affecting people's satisfaction and significantly impacting their quality of life. In this paper we present a low-cost infrastructure to collect passive Wi-Fi probes with the aim of monitoring, optimizing and personalizing public transport, towards a more sustainable mobility. We developed an embedded system deployed in 19 public transportation vehicles using passive Wi-Fi data.

Data were analyzed on a per-vehicle and per-stop basis and compared against ground truth data (ticketing), while also using a method of estimating passenger exits, detecting peak loads on vehicles, and origin destination habits. As such, we argue that this data enables route optimization and provides local authorities and tourism boards with a tool to monitor and optimize the management of routes and transportation, identify and prevent accessibility issues, with the aim of improving the services offered to citizens and tourists, towards a more sustainable mobility.

Keywords: passive Wi-Fi; sensory data; sustainable mobility

Shaping Mobility Value Chain in Madeira - The challenges of tourist mobility

Authors: C. Mantero, J. Gaudêncio – Horários do Funchal

Publication info: TRA2020, the 8th Transport Research Arena: Rethinking transport towards clean and inclusive mobility, 2020 - Conference Proceedings

DOI: 10.13140/RG.2.2.10836.83845

Abstract

On highly touristic destinations as Madeira, it is of paramount importance to have in-depth knowledge of the mobility pattern of tourists. This information is relevant to define the mobility management strategy at Regional level, but also essential to map the Tourism Value Chain. It also allows to address the touristic needs, to adapt the mobility offer and to grant a sustainable development. Although, the tourism sector is unknown in what regards tourists' mobility patterns. A baseline scenario was built to support mobility operators towards mobility solutions tailored to non-residents, through surveys about mobility and tourism applied at the main gateways. The results from the surveys shown the many opportunities for improvements. In line with the findings and with the support of several EU projects, Horários do Funchal over the years has been capable of tackling the severe decrease of public transport users, through systematic commercial strategies and innovative solutions.

Keywords: TRA2020, Transport Research Arena

4 Gamification, Users' Behaviour and Mobility Patterns

The Madeira Touch: Encouraging Visual-Spatial Exploration using a Tactile Interactive Display

Authors: C. Prandi, C. Chiodo, R. Villaflor, N. Autzen, J. Schoning - ARDITI

Publication info: CHItaly '17: 12th Biannual Conference on Italian SIGCHI Chapter, 2017 - Conference Proceedings

Available at:

https://www.researchgate.net/publication/319632054_The_Madeira_Touch_Encouraging_Visual-Spatial_Exploration_using_a_Tactile_Interactive_Display

Abstract

The current information marketplace for tourists is dominated by for-profit purveyors of information. Potential visitors must rely on experts-for-hire or search engine results in order to learn about a desired destination.

In this paper, we introduce The Madeira Touch, a multimodal display installation rooted in the unique characteristics of Madeira, which allows users to explore the island by selecting a type of scenery and showing the user-generated photos of that type of scenery in a map-based interface. To make this pervasive display more engaging, we designed an exploratory tactile-input mode of interaction: users will be able to touch a physical object, representing a type of scenery (a rock for mountains, a seashell for the sea, etc.), which will then bring up suitable photos of that type of scenery overlaid on a map of the island. The display will help users to form their mental image of the island and to plan trips that best suit their interests.

Keywords: Pervasive display, tactile interaction, multimodal interaction, user-generated content, digital signage

Bus Stops as Interactive Touchpoints: Improving Engagement and Use of Public Transport

Authors: C. Prandi, V. Nisi, N. Nunes – ARDITI

Publication info: CHItaly '17: 12th Biannual Conference on Italian SIGCHI Chapter, 2017 - Conference Proceedings

DOI: https://doi.org/10.1145/3125571.3125593

Abstract

Bus stops are key touchpoints to improve the quality and engagement of citizens with public transports. Despite their ubiquity in modern urban landscapes, they are seldom considered a key design/technology element in improving the public transport experience.

This paper describes a design case study where different teams attempted to improve bus stops using interactive technologies. The resulting concept prototypes were designed to provide citizens and tourists with (i) safe, attractive and accessible public spaces, (ii) attractive, accessible and efficient public transport; and, (iii) smart traveller information tools and services for sustainable mobility.

Our case was set in Madeira, a medium sized European island, where tourism widely contribute to the local economy and buses represent the only available public mean of transport. We present the research insights and the design concepts leading to improve engagement and use of public transport.

Keywords: Sustainable urban transport, sustainable mobility, smart bus, stop, public transport, design and prototyping

Fighting exclusion: a multimedia mobile app with zombies and maps as a medium for civic engagement and design

Authors: C. Prandi, M. Roccetti, P. Salomoni, V. Nisi, N. J. Nunes - ARDITI

Publication info: Multimedia Tools and Applications, Volume 76, No. 4, 2017 - Conference Proceedings

DOI: 10.1007/s11042-016-3780-9

Abstract

This paper presents a study on urban data crowdsourcing driven by Geo-Zombie, a multimedia mobile application we designed and developed to engage pedestrians in taking note of urban architectural impediments and facilities by documenting them through pictures and multimedia data. Geo-Zombie aims at transforming the civic activity of contributing into a virtual gamified experience where players attempt to escape from horrific situations in which zombies are ready to cannibalize unsuspecting walkers.

In some sense, walkers that kill zombies deeply reconnect with the concept of imminent danger which can be fought resorting to appropriate civic actions. To challenge our initial hypotheses, we conducted a design process, starting with a concept generation where three different concepts were discussed which gave rise to five different multimedia mobile apps including the one with zombies. Then, focus group, experience prototyping, application design and implementation, and finally field trials were exploited to refine the design and to select the best apps out of the five that better responded to the need of involving common people in collecting urban accessibility data.

It is worth noting that the experiences of use with 50 avid walkers have demonstrated that a multimedia mobile app with maps and zombies can be a concrete step towards a social inclusion strategy while inviting new reflections and discussions on the issue of urban data crowdsourcing.

Keywords: Urban accessibility, Crowd sourcing, Social inclusion, Gamification, Multimedia mobile app

On Exploring a Pervasive Infrastructure to Foster Citizens Participation and Sustainable Development

Authors: C. Prandi , V. Nisi , N. Nunes – ARDITI

Publication info: 32nd International BCS Human Computer Interaction Conference (HCI), 2018 - Conference Proceedings

Available at:

https://www.scienceopen.com/hosteddocument?doi=10.14236/ewic/HCI2018.223

Abstract

This paper presents an experimental study where we engaged citizens in a user-driven innovation process to design smart services, exploiting data collected by a low-cost pervasive sensing infrastructure, called Beanstalk. Such as infrastructure has been developed with the final goal to deliver data back to local communities which are empowered to act and leverage the collected hyperlocal information. In doing that, we organized different user-driven innovation sessions aimed to capture communities' ideas and desires, with the intent to develop human centred and transparent intelligent urban environments. The preliminary results show the interest of citizens in being informed about the phenomena revealed by the gathered data and in acting toward a sustainable development, through the creation of smart services.

Keywords: Citizens participation, user-driven innovation, sensing, pervasive infrastructure, smart urban environment

When Gamification Meets Sustainability: A Pervasive Approach to Foster Sustainable Mobility in Madeira

Authors: B. Cardoso, M. Ribeiro, C. Prandi, N. Nunes – ARDITI

Publication info: SMAS '19 - 1st ACM Workshop on Emerging Smart Technologies and Infrastructures for Smart Mobility and Sustainability, Los Cabos, Mexico, 2019 - Conference Proceedings

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Abstract

In this paper, an approach to increase the use of public transportation by tourists, exploiting pervasive technologies and a smart objects infrastructure, is presented. The idea behind our platform is to take advantage of gamification and smart technologies (such as iBeacons technologies and smartphones) to engage users and persuade them to use (more) sustainable means of transport.

The Beacons, in fact, acts as a provider of authentic contents related to the story of Madeira, assisting and locating the user in his/her adventure. We carried out a case study on the Madeira island, a well-known touristic destination where several bus lines allow tourists to reach the different sight-seeing places.

Moreover, a preliminary usability test and a SUS questionnaire were performed to assess the usability and facility of use of the application.

Keywords: Gamification, sustainability, mobility, smart objects

Gamification and engagement of tourists and residents in public transportation exploiting location-based technologies

Authors: B. Cardoso, M. Ribeiro, C. Prandi, N. Nunes - ARDITI

Publication info: TRA2020, the 8th Transport Research Arena: Rethinking transport towards clean and inclusive mobility, 2020 - Conference Proceedings

DOI: arXiv:2006.16077

Abstract

Cities are becoming very congested. There is a need to reduce the number of private cars on the roads, by maximising the potential for local public transport. With the increasing awareness of transport that is sustainable in the sense of environmental impact, but also climate and social, there is the need to create engagement into public transportation. Gamification, which is the use of game elements in non-game contexts, has proven to deliver very positive results, by turning regular activities into engaging ones, which are fun to perform. We have designed a mobile application, that interacts with short-range wireless communication technologies, inviting people to use public transport. To evaluate the solution, we have created a questionnaire based on the System Usability Scale, but also using usability testing with specific tasks.

Keywords: Gamification, Short-range wireless communication technologies, public transport, sustainability

A visual immersive participatory platform to foster dialogue between locals and tourists

Authors: J. Candido, V. Nisi, C. Prandi, N. Nunes - ARDITI

Publication info: 2020 IEEE 17th Annual Consumer Communications & Networking Conference (CCNC) - Conference Proceedings

DOI: 10.1109/CCNC46108.2020.9045124

Abstract

The paper presents a participatory platform designed and implemented with the aim of fostering dialogue between locals and tourists. The platform exploits the crowd-sourcing paradigm to collect the voice of the locals in order to provide tourists with authentic experiences. The system was designed as an immersive visual storytelling experience, to let the user discover the locals' story in an interactive rich environment. The insights that emerged during a preliminary evaluation with users point out that the system is able to deepen the relationship between locals and tourists while interacting with the platform.

Keywords: Participatory platforms, crowdsourcing, storytelling, tourism

Attitudes and perceptions towards shared mobility services: Repeated cross-sectional results from a survey among the Maltese population

Authors: S. Maas, Maria A. – University of Malta

Publication info: Transportation Research Procedia, Volume 45, pages 955 – 962, ISSN 2352 – 1465, 2020 - Paper in Peer-Review Scientific Journal DOI: https://doi.org/10.1016/j.trpro.2020.02.071

Abstract

Shared mobility services, such as (e-)bicycle and car sharing, are a recent introduction in Malta. Following the roll out of these services, the transport regulator (Transport Malta) implemented an information and awareness campaign to promote the use of shared mobility services, and to educate the general public about cycling safety and how to safely share the road.

This paper presents the results of a repeated cross-sectional survey with a sample representative of the Maltese population, to understand the awareness and acceptance of these shared mobility services, and analyse the impact of the information and awareness campaign through a comparison of 'before' and 'after' results. The 'before' results show that the majority of respondents are not aware of bicycle sharing or car sharing. While the second wave of the survey showed an increase in awareness about shared mobility services, wave 3 did not show a continuation of this trend, and evidence for a strong impact of the information and awareness campaign is limited. Respondents consider reduction in traffic and pollution, as well as getting exercise as the main reasons for considering bicycle sharing. For car sharing, respondents view convenience and time savings, as well as financial savings, as the main considerations.

Improved road safety and more specifically, segregated and safe infrastructure, investment in cycling skills, and education to promote cycling safety are the main factors identified that have the potential to encourage respondents to consider starting to use bicycle sharing. The exposure to and understanding of the information and awareness campaign is evaluated through additional questions in the second and third wave of the survey, during and directly following the most intensive part of the campaign. The paper ends with a discussion of the results and recommendations for action in support of further promotion of shared mobility services.

Keywords: shared mobility, bicycle sharing, car sharing, attitudes, cross-sectional survey; Malta

5 COVID-19 Impacts on Mobility

Transportation in the Mediterranean during the COVID-19 pandemic era

Authors: D. Tarasi, T. Daras, S. Tournaki, T. Tsoutsos – Renewable and Sustainable Energy Systems Lab of the Technical University of Crete

Publication info: Global Transitions, Vol 3, 2021, Page 55-71, ISSN 2589-7918 - Paper in Peer-Review Scientific Journal

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Abstract

The recent pandemic has considerably changed urban transportation while highlighting the weaknesses of the current transport modes. The crisis provided a unique opportunity to redesign the urban mobility plans in a more sustainable and resilient way.

This study captured the impact of the COVID-19 outbreak and the subsequent restrictive measures on citizens' commuting habits and travel mode choice in two Cretan cities with academic communities and intense seasonality of tourism, in two phases (four periods) before, during, and after the quarantine. The sample consisted of 308 (1st phase) and 193 (2nd phase) citizens, 60% and 30% permanent residents of Chania and Rethymno, respectively. During the weeks before the pandemic, 4/10 participants opted for travelling by car daily, either as a driver or as a passenger; almost the same ratio chose walking; 1/10 used public transport (bus). During the first week of the quarantine, one-quarter had decreased car usage and opted for sustainable transport modes (walking, cycling, public transport). The population who chose walking 1–2 times weekly almost doubled. Nevertheless, most factors were found to affect men and women differently; personal safety and road safety are significantly more important for women; ecological footprint is a less essential parameter for men's travel mode choice. Private vehicle use still holds a considerable role in urban transportation, and noteworthy is due to the sharp decline in public transit in January–February and April and the meager percentage of public transport ridership (1%).

The analysis and modelling could be useful in the future design of more sustainable and resilient mobility strategies

Keywords: Sustainable mobility, COVID-19, Daily commuting, Public transport

The impact of COVID-19 pandemic in Mediterranean urban air pollution and mobility

Authors: N. Sifakis, M. Aryblia, T. Daras, S. Tournaki, T. Tsoutsos* - Renewable and Sustainable Energy Systems Lab of the Technical University of Crete

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Abstract

The pandemic has created opportunities which researchers, developers and planners should analyze, capitalize and adapt. How much COVID-19 restrictions affected air quality in Mediterranean tourism destinations? Was there a rebound effect during post-lockdown period? Which was the behavioral change concerning the urban mobility? Noteworthy changes in the air pollutants' mean concentration on the ground-level have been experienced. The air quality was measured on the ground-level and reviewed concerning CO_2, CO, NOx, and CH_4 under various climate conditions. 5-min air quality and traffic load data were processed from different city spots in a Mediterranean tourism destination.

The study examined the impact of State strategies on tackling the COVID-19 spread on both traffic load and air quality employing statistical methods. The obtained results show the lockdown period's impact on improving air quality. Although there was a minor decrease, the mean CO_2 levels were not significantly affected during the lockdown period. The mean NOx levels during the lockdown period were decreased by 32% compared to the same period in 2019; there is also a 10% decrease in the mean levels of NOx compared to the period before the lockdown. This study related four primary air pollutants (CO_2, CO, NOx, and CH_4), the total number of vehicles, and the total number of tourists. A rebound effect proved during the post lockdown period.

The results and the methodology of this research work are replicable as confirmed by other studies for different cities.

Keywords: Urban mobility, air pollution, GHGs, monitoring

6 Conclusions

Forging on sustainable mobility and tourism innovation, DESTINATIONS research publications cover significant thematic topics such as impacts assessment of sustainable mobility solutions, innovative measures for the improvement of Public Transport, shared mobility services, urban planning and infrastructure, change of mindset and finally the mobility response to COVID19 pandemic. Furthermore, relevant research outputs cover also solutions related to Intelligent Transport Systems – ITS, emerging technologies and technological advancements related to transportations.

Thousands of researchers, policy-makers, urban planners and mobility experts had already the opportunity to access the DESTINATIONS scientific work and benefit by the project's research findings, innovative measures and tested methodologies, and new smart technological solution.