S.LI.DES
Smart strategies for sustainable tourism in LIvely cultural DEStinations

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Dynamic mobility maps

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Responsible Partner:	**INSTITUTE FOR TOURISM**
Partners involved:	**LP – University of Cà Foscari (IT)** **PP1 - CISET (IT)** **PP2 - Ecipa (IT)** **PP3 - SIPRO Ferrara (IT)** **PP4 - City of Bari (IT)** **PP5 - City of Venice (IT)** **PP6 –CAST-University of Bologna (IT)** **PP7 – Institute for Tourism** **PP8- Craft College- Institution for adult education Subsidiary Rijeka** **PP9- Development Agency of the City of Dubrovnik-Dura** **PP10-Sibenik Tourist board**

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1. Dynamic Mobility Maps

Using distributed sensors, the experimental campaigns provide real time information on the pedestrian flows or the presences at some specific points in the considered area. This information is integrated in the visitor's mobility models that also consider the statistical data on the past tourist flows collected by the project and the location of the main attraction points for the tourist flows. The models simulate the pedestrian dynamics at individual level considering the crowding effects through a fundamental diagram velocity-density (see D-3.2.4 for more details on the models). In Figure 1 we show a layout of the graphical model interface for the historical centre of Ferrara, where the red dots are the position of the simulated individuals on the road network (see the simulation report for the other cities).

Figure 1: Layout of the graphical interface of the mobility model: each dot is a virtual individual moving in the Ferrara historical centre.

The mobility models have been prepared to integrate the collected by the distributed sensors data both as daily mobility data to perform:

1) a nowcasting of the flows over the whole road network i.e., the extension of the daily measures of the sensors to the whole road network computing the mobility flows and the presences for each road in a dynamic way (each hour or less);
2) a forecasting of the mobility flows: i.e., a short-term forecast of the mobility flows and presences for the whole road network using the real time data collected at the present time and the average behaviour of the mobility flows during the previous days.

In both cases that model provided the pedestrian flows that transit across each road in given time interval (i.e., the hourly average mobility flows) during a day. To visualize this information, we have introduced the dynamic mobility maps that associate a colour scale and a thickness to each road proportional to the simulated passing flows and give a georeferenced information to the dashboard to visualize the road network. Higher is the mobility flow provided by the mobility models, darker is the colour and thicker is the line. An example of daily mobility flow map is reported in Figure 2 for the Ferrara historical centre (other examples are reported in the model simulations report D-3.5).

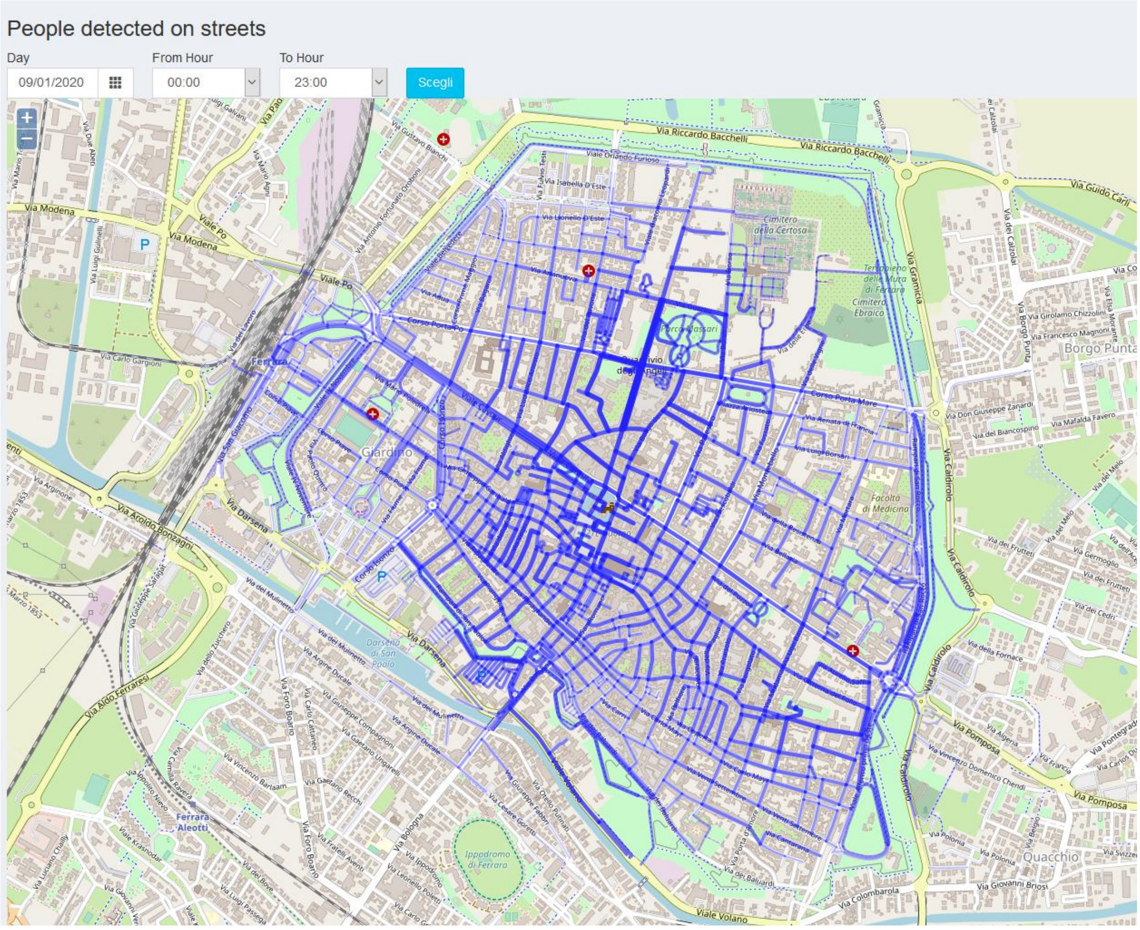

Figure 2: Example of dynamic mobility map using the nowcasting visitor’s mobility model in Ferrara. The thickness and the shade of each road is related to the magnitude of daily pedestrian flow simulated by the mobility model.

The dynamics mobility maps can be constructed for short successive time intervals allowing a dynamical representation of the mobility flows during the day. Using the simulation results, we have also built a heatmap of the presences in the considered area: the colour scale from green to red highlighted the areas with a greater influx of people during the chosen day (or time interval). In the

Figure 3 we show an example of daily heatmap for the Ferrara historical centre (other examples are available in the model simulations report D-3.5).

Figure 3: Heatmap of the daily presences simulated by the visitors mobility model in the Ferrara historical centre

The people distribution is mainly concentrated in the city areas nearby the main attraction points. Also, in this case, it is possible to provide a sequence of heatmaps for successive time intervals to give the daily presence evolution in the considered area.

The forecasting models are based on possibility of recording real time data from the distributed sensors using in the experimental campaigns and consider the future evolution of the mobility flows according to the current observations. The model is able to modify the parameters that define the mobility demand of the different individual categories to take into account of the data that are measured in a given moment by the sensors and provides a forecast of the mobility flows for the next hours using the same procedure of the nowcasting models. The forecasting models have been prepared for all the cities and they produce a dynamic mobility map of the future state. The following figure show an example of forecasting for the mobility flows in Ferrara during a day of September from 10 am to 2 pm.

The forecast models may also simulate possible new future scenarios that consider the implementation of governance policies for future mobility.

The model codes will be available from the public repository Github:
https://github.com/physycom