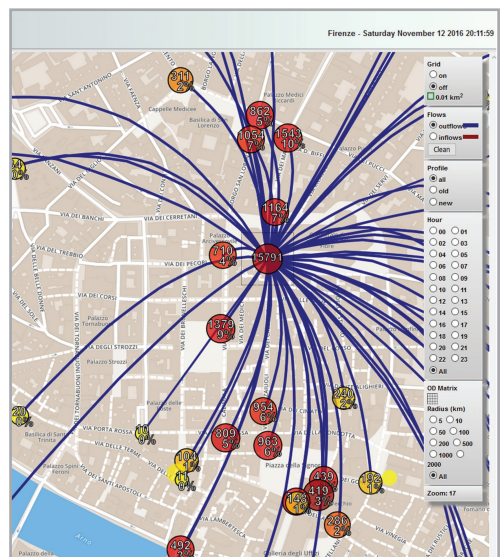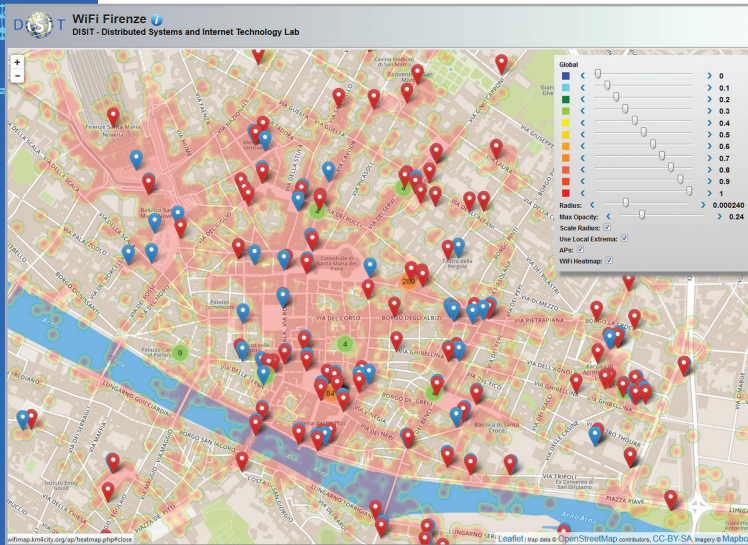# SNAP4CITY

People Flow Analysis

Monitoring, understanding and predicting city user behaviour (hottest places, trajectories, flows, etc.) is one the major topic in the context of Smart City management. People flow analysis provides valuable information about city conditions; very useful, not only for monitoring and controlling the environmental conditions, but also to optimize the delivering of city services (security, clean, transport,..). The people flow analysis can be performed by using Wi-Fi data, Cellular data and/or Mobile App Data, or specific PAX Counters. In the example reported in these pages the data are referring to Wi-Fi Access Points, AP in Florence. Snap4City has also other technologies to reach similar result.

In this case, Wi-Fi Access Points, AP, are used as sensors to capture and understand city user behaviour with a significant precision rate (concretized with the computing of heat-maps, origin destination matrices, trajectories and predicting user density). Figure reports the heatmap derived from the city users' movements in the city by using the App with overlapped the position of the 1500 AP of the Wi-Fi network. To better understand the movements in the city, it is mandatory to perform flow analysis to effectively evaluate user's behaviour. Since in the downtown the APs are also overlapped this issue has to be taken into account. The raw data are processed by a set of Data Analytics algorithms, to compute:

- Permanence time of tourists in the city, balance of citizens and tourists,
- Preferred trajectories and locations,
- OD matrices for each time slow, inboud and outbounds
- Amount of new and returning visitors: Regency and Frequency analysis.

From the analysis of the OD matrices and/or OD Spider Flows it is evident that different parts of the city are differently used by different city users. AP presents different kind of trends in the usage of the Wi-Fi along the 24 hours and in the different days of the week. For example, we may have some areas by which the people typically arrive (station) in the morning and leave in the afternoon while they are less accessed at lunch time. For example, some APs could have a huge workload only during mornings or evenings (when people go/back to/from work), others only on late evenings (when people go out for entertainment), others only of festive days etc.
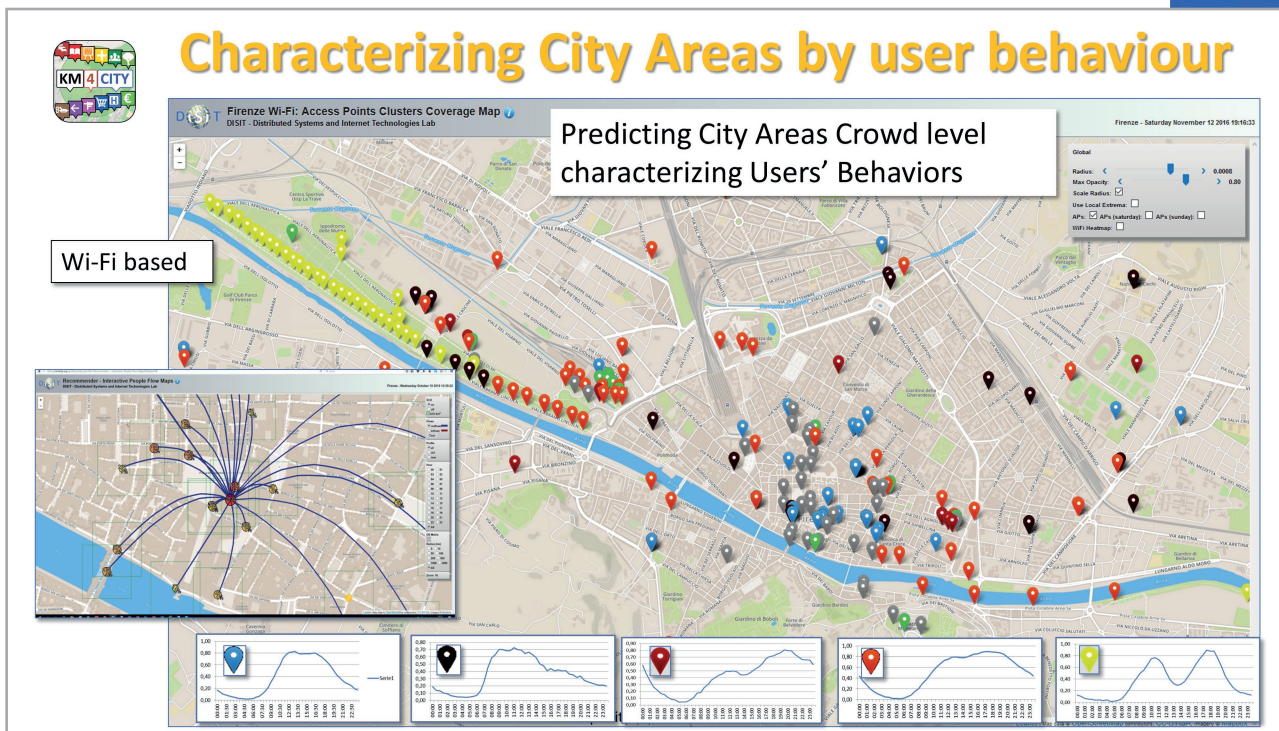
According to the data collected from the Wi-Fi network, the averaged trend along the 24 hours of the day, for each AP, for each day of the week has been computed. Since the main interest is to find the similar patterns for each AP a Scale Factor and the normalized averaged pattern has been computed. This resulted in 345 APs, on 7 days, 24 hours per day. In the figure, at pin with the same colour correspond the same user behaviour of the area. It can be noticed that there are areas very active in the morning and afternoon respecting a break for lunch. Moreover, some clusters provide an evident activity in the afternoon with respect to the

Characterizing City Areas by user behaviour

Wi-Fi based

Predicting City Areas Crowd level characterizing Users' Behaviors

morning or vice versa, but with different proportions. A few of them present significant activity also after dinner and in the first hours of the night. So that, it is evident where the city is active during the night.

On the basis of the clustering and historical values, for each AP the predictions on the number of people attending the different area of the city are computed, and thus probable movements and thus needs. The approach is used for anomaly detection and early warning when the actual data differ from the predicted of relevant amount.
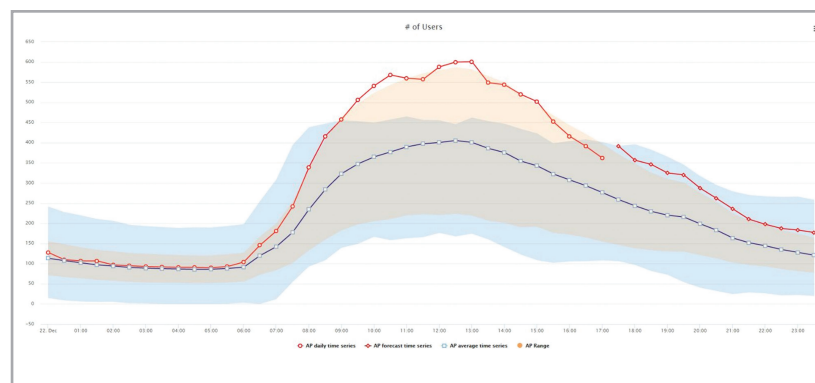
The briefly presented solution has been developed by DISIT lab for Florence city with join effort of the city for the W-Fi network instrumentation and of DISIT lab for the algorithms, tools and dashboards. The solution has been integrated into the suite of Snap4City Data Analytic and External Services.

Extended version accessible from: https://www.snap4city.org/540
Contact: https://www.snap4city.org
Partners: Firenze Città.