smArt: Open and Interactive Indoor Cultural Data

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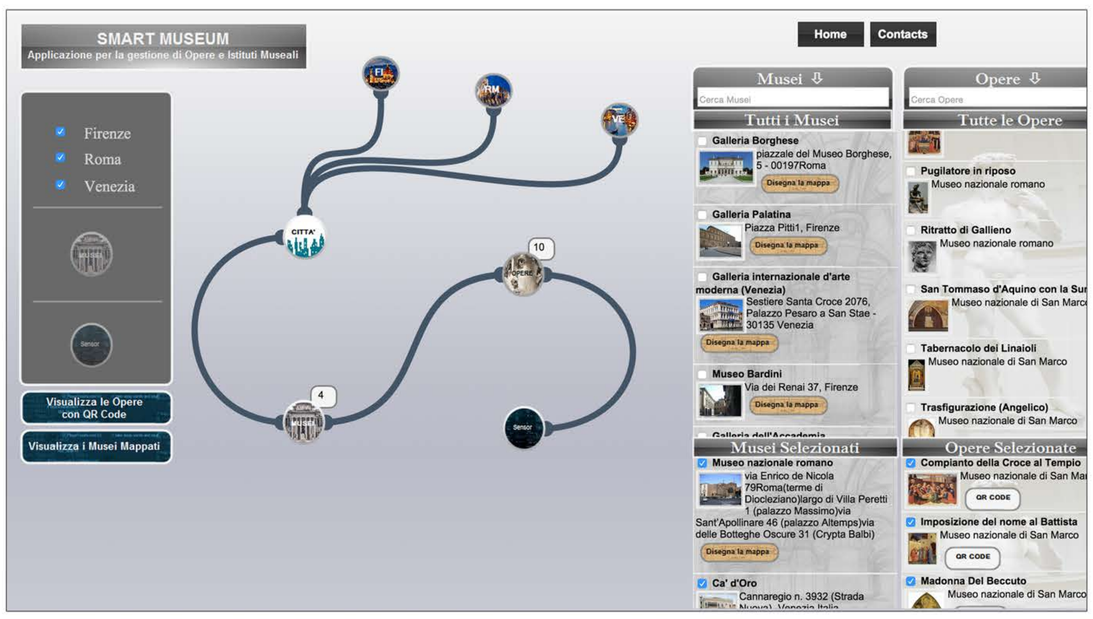
The System

smArt is a low-cost framework to quickly set up indoor exhibits in museums featuring a smart navigation system. The framework is **web-based** and allows the design on a digital map of a **sensorized museum environment** and the dynamic and assisted definition of the multimedia materials and sensors associated to the artworks.

Indoor localisation and routing is provided through a **mobile app** taking advantage of active and passive sensors advertisements and user interactions. In this way we overcome the Global Positioning System (GPS) unavailability issue in indoor environments.



The **system** is mainly composed by **two modules**:

1) a web-based application for the **semi-automatic ingestion and management of Open Linked Data** regarding the cities of Venice, Rome and Florence in Italy;

2) a **mobile Android application** which exploits the data generated by the web app and reacts to the expected signals in the real environment.

Configuring the environment: the Web Application

The Web Application provides a graphical user interface for building data and components mashups **in order to configure a sensorized environment.** Users are enabled to 'pipe' several interface components and then set up rules for how content should be modified.

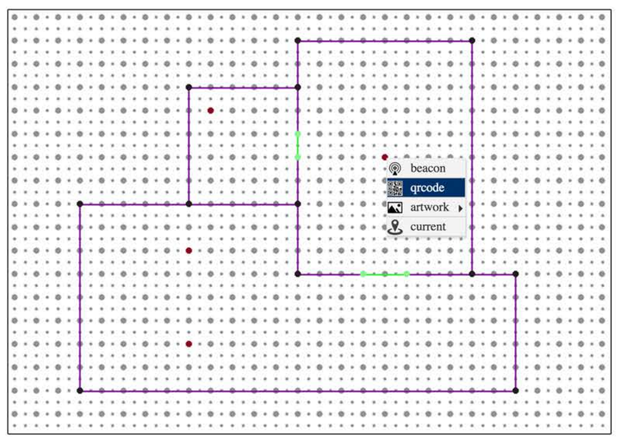
There are **three main components**:
1) **City Component**: it allows to choose cities from which to select public multimedia data;
2) **Museum Component**: it is used to collect, aggregate and enrich data about museums and artworks from DBPedia through Open Linked Data;
3) **Sensor Component:** it can be applied to artwork collections in order to automatically associate physical sensors (i.e. QRCode and Beacons).

Components are managed and organised on the interface using a **drag-and-drop paradigm**.
When dragged on other components icons can make appear contextual menus in order to apply modifiers.
The Museum Component provides contextual panels to search museums, select and associate sensors to artworks.

Drawing the museum / exhibits map

For each museum the user can:
1) interactively **draw the map** of the environment to be sensorized;
2) decide the **location of the artworks**;
3) define the **access point** to the museum halls and finally
4) mark out all the trajectories that visitors can use to reach the artworks.

All this infos are then used by the mobile application to provide localisation and routing systems to museum visitors. .



The web app has been developed in **HTML5** for the client and uses PHP and MySQL on the server for metadata storing. Storing and communication with the semantic knowledge-base is performed through **RDF** and **Sparql Queries** to a **self-hosted DBPedia endpoint**.

The Mobile App

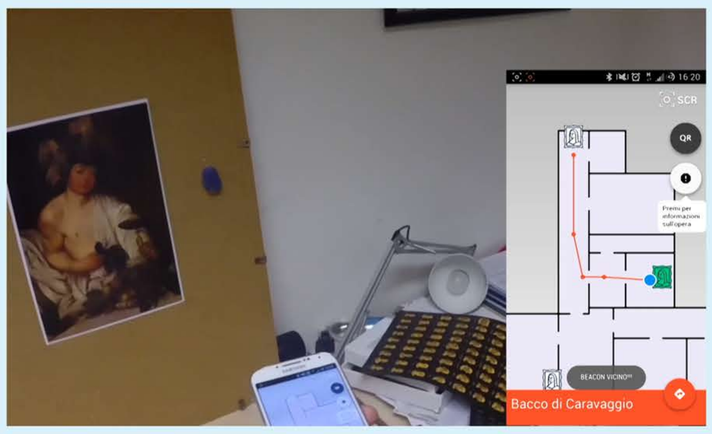
smArt mobile application allows the visitor to localise himself in the indoor museum, where GPS is not available, and provides a routing system to guide the user to artworks of interest on the basis of the data generated by the web application.

As regard to **sensors** smArt exploits **bluetooth beacons** which are cheap and well supported and require a low level of interaction. Each artwork can be also automatically or manually associated to **QR codes**.

Exhibits configurations, museum data as well as the map and all the multimedia material concerning the artworks generated by the web app are stored in a **sqlite file** and ready to be used by the mobile app.

When a user approaches an exhibit he is notified on the mobile app of the possibility to switch to an i**ndoor map visualisation**. The map is rendered in realtime on the device using canvas and vector shapes.

Once the user has localised himself or the app has identified his location, the user can select any artwork on the map in order to be suggested with the **shortest path** to it. **User location** is acquired when the app receives the unique identifying information broadcasted by **a beacon via bluetooth** or when the user scans a **QR code** associated with an artwork or provided as a localisation hotspot in the museum.



Spots have been defined by the web app user on the map and can be sensorized artworks, door spot or localisation spots. The shortest path to an artwork is computed by the indoor engine using the **Dijkstra's algorithm**. The engine provides also a completely automatic system to calculate the shortest path which uses automatic 2D polygon convex partitioning of the museum map: the **Hertel-Mehlhorn algorithm** is exploited Then the center of mass of each partition is treated as a path spot to be used in the graph by the Dijkstra's algorithm.

See the demo video of the smArt system on VIMEO