Geomatics and Virtual tourism

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AIIA13

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Horizons in agricultural, forestry and biosystems engineering

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Guest Editors
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PRESENTATION

The Board of Directors of the Italian Association of Agricultural Engineering, following the well-established tradition to organize every four years a Conference, has chosen Viterbo as venue for the tenth edition which will be held on September 8-12, 2013.

The closer and closer integration of scientific know how, that is demanded in the use of the environmental resources and it is driven by the new developing models, has addressed the agricultural engineering toward the bio-systems engineering, therefore expanding its former expertise-area by incorporating living systems related to both the agriculture and to natural systems. As a consequence, the interests of the Association now spam even over the application of engineering principles to processes governing territorial phenomena with the aim to study, to model, to manage and to set off biology systems toward an optimal agricultural development, crop production, the use of the soil and the environment.

Within such a context the conference, by accomplishing the actual and future needs of the world population, represents an important chance to bring together engineers and researchers to let meeting people working in different, although similar, environments.

In particular, the 2013-conference will focus on: new horizons in agricultural, forestry and bio-systems engineering and, to better homogenize discussions, presentations will be organized according to the listed below sessions:

1 Forest-wood chains
2 Hydrology and dynamics of water and sediments in agricultural and mountain basins: monitoring, modeling and risk analysis
3 Hydraulics and hydro-morphological processes for stream and river restoration and management
4 Information technology, automation and precision farming and forestry
5 Structures and technologies for livestock production: technical, energy and environmental aspects
6 Structures and technologies for protected crop production: technical, energy and environmental aspects
7 Post harvest, food and process structures and technologies
8 Power and machinery in agriculture and forestry
9 Analysis, modeling and planning of rural areas
10 Renewable energy, biomass and biological residues
11 Safety, health and ergonomics - SHWAnet international meeting
12 Sustainable planning and management of soil and water resources

Prof. Alessandro SANTINI
AIIA President

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Dear colleagues,

it is my pleasure to welcome you to the 10th AIIA Conference: "AIIA13 – Horizons in agricultural, forestry and biosystems engineering", and to welcome you to Viterbo.
For the first time the AIIA conference will be held in English. The purpose of this choice is to involve academics and researchers coming from other nations.
This conference will then be a unique opportunity for scientists, researchers, experts, students and people representing the business world to show, share and discuss the results of their researches. Another goal of this conference is the promotion of the cooperation and networking in the field of Biosystems Engineering, also trying to include the business world in it.
By doing that, we will be able to take on the new challenge of Horizon 2020, the new European Framework Programme. This programme attributes a capital and fundamental role to research and innovation, seen as important means to guarantee an intelligent, sustainable and comprehensive growth to Europe.

Horizon 2020 is articulated on 3 strategic objectives

1) Excellent science, intended to secure Europe's leadership in science worldwide.
2) Industrial Leadership , aimed at supporting research and innovation of European industry, with a strong focus on industrial technologies and investments for SMEs,
3) Societal challenges , aimed at tackling major global challenges in the following areas: health, demographic change and wellbeing, food security, sustainable agriculture, secure, clean and efficient energy, smart, green and integrated transport, climate action, resource efficiency and raw materials, inclusive, innovative and secure societies.

In all these fields Agricultural, Forestry and Biosystems Engineering in the coming years will have a major role.

I conclude by saying that AIIA13 is also an opportunity to know the Tuscia, a still intact territory, in which culture and respect for the land, innovation and tradition come together in a truly original model of sustainable development. I wish all the participants a pleasant stay in Viterbo and Italy.

In closing this brief greeting I want to thank:

- CEFAS, Special Agency of the Chamber of Commerce, for the logistic support to the Conference,
- the Tuscia University, which offered the beautiful and historic seat of the Conference
- the Ministry of Agriculture, the Lazio Region, the Provincial Administration and the Municipality of Viterbo, UNACOMA and CRA-Ing, for their support,
- CIGR and EURAGENG, for their sponsorship,
- FACMA and Enama, sponsors of the Conference.

A special thanks to the Carivit Foundation of Viterbo, whose contribution has enabled the printing of the Conference Proceedings.

Danilo Monarca
AIIA 2013 CONVENER

Geomatics and virtual tourism

Valeria Minucciani,[1] Gabriele Garnero[2]

[1]DAD, Dipartimento di Architettura e Design, Politecnico di Torino, Torino, Italy;
[2]DIST, Dipartimento Interateneo di Scienze, Progetto e Politiche del Territorio, Università e Politecnico di Torino, Torino, Italy

Abstract

The most recent technological revolution, concerning web and "ICT", not only changed individual and collective behaviors, but also allowed experiences no possible before: a real time communication, regardless of the distances; an extended access to disjointed data and sources; the shift in different realities – missing or entirely imaginary. Nowadays, we can think about a new concept of museum, much more inclusive than "objects container": now the museum involves entire countries, entire ecosystems, entire regions. We can speak of "museum outside of the museum", to extend museum "storytelling" to a regional scale, beyond the walls of the traditional museum. On a regional scale experiments entirely convincing have not yet been carried out, but from this point of view cultural lands can be visited as great open air museums, to find objects, artworks or signs: the whole land is a "collection" to be preserved, to be presented and to be interpreted. Thus the visit allows to elicit outstanding objects, to read into landscapes with different filters. Both the physical and virtual visit seem to be a "tour" (Minucciani and Garnero, 2013). To create a virtual tourism prototypal station, we need several and unconventional geometrical data (shared geographic databases, DTMs, digital orthoimages and angle shots, modeling with spherical cameras, ...), thematic data (related to cultural content) and no conventional input units to move and to observe how and where the observer prefers. Authors report here their experience to carry out a prototypal station, able to relate geomatics references to cultural content and to offer a whole experience, involving users also from the sensory point of view.

That's nowadays a specific purpose of new technologies applied to cultural heritage.

Correspondence: Gabriele Garnero, DIST, Università e Politecnico di Torino
Via Leonardo da Vinci, 44, 10095 Grugliasco (TO), Italy.
Tel. +39.011.670.5518 - Fax: +39.011.670.5516.
E-mail: gabriele.garnero@unito.it

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ICT and virtual tours

The concept of virtual museum is by now established, multi-faceted and so widespread that it is now inflated: but a shared definition isn't given yet, and it indicates the possibility of access to the historical, artistic and cultural heritage through the network, sometimes replacing sometimes integrating the real experience of visit.

Then we have "virtual museums" that simply are "catalogs" on line, but we have also cases in which, with more or less interaction, we can perform via video real visits (selecting paths, objects, information). The static nature of these experiences is often the weakest point, despite considerable progress (Caraceni 2012; Minucciani, 2009a; Minucciani 2009b; Antinucci, 2007). In general, they interpret "virtual" as "simulation" (on the screen) of a real experience.

This "replacement" (which anyway provides immediate availability and accessibility everywhere - sometimes more than in the real situation) nevertheless pays a price, that's - above all - disorientation and barrier effect of the screen.

Even very recent projects (*e.g.* Google Maps service "Google Business Photos": after Spain, Denmark and Sweden it's now running available also for Italy - see the "Museo dell'Automobile" case, in Turin), providing an access to interiors thank several 360°pictures, don't completely overcome this hurdle. Fundamentally, they hat replicate indoor the Street View solution.

Likewise if we mean "virtual tourism" reductively as "access to information" related to a place, it seems to be aseptic and far, via video. We cannot define it as "tourism", but rather as "cultural or touristic information".

The loss of the viewer's corporeality creates alienation and separation, thus we need a kind of "*alter ego*" to fill this gap. So, if we attribute to the term "virtual" its scientific meaning, *i.e.* simulation of reality (and consequently simulation of experience), new scenarios open (Vince, 2004): not only the computer version of a real place, but also a place that does not exist - or that no longer exists…

Some experiments have enhanced museums by "virtual guides", *i.e.* synthetic characters that can interact with visitors in a more or less advanced way (Minucciani, 2009a). In other cases, they attempted to give back a "physical", bodily dimension to the virtual tour: in Italy one of the pilot cases goes back to 1994, and it concerned the virtual reconstruction of Nefertari tomb (Antinucci, 2007) ("Nefertari: Luce d'Egitto", temporary exhibition in Rome, Palazzo Rispoli, 1994).

But in this field there have been many other experiments, (in particular, see V-MusT.net NoE experiments during 2012-2013 period (www.v-must.net), more or less immersive, someone scientifically rigorous, someone similar to videogame *tout court*, someone very poor

from the cultural point of view (Minucciani, 2009a; Minucciani, 2009b). They're studying solutions - using geo-caching, geolocation in interior (still a bit problematic) – that offer really educative "games" involving the entire web community: in this regard it should be noted that the Web 2.0 advent has given further impetus to virtual experiences, enriching the cultural impact with socialization and sharing (See Tate Gallery case (www.tate.org.uk/britain/exhibitions/howweare/) or Brooklyn Museum of NY (*Click! A crowed-curated exhibition*: www.brooklynmuseum.org/exhibitions/click/)), (Proctor, 2010).

Furthermore, the new concept of museum (Poulot, 2005), much more inclusive than simple "objects container", enclosed by walls and clearly divided between "inside" and "outside. Now the museum could involve entire countries, entire ecosystems, entire regions. We can speak of "museum outside of the museum" (Minucciani, 2005), that extends museum "storytelling" to a regional scale, beyond the walls of the traditional institution. On a regional scale experiments entirely convincing have not yet been carried out, but from this point of view the cultural lands can be visited as great open air museums, with transversal or theme paths, to find objects, artworks or signs: the whole land is a "collection" to be preserved, to be presented and to be interpreted. Thus the visit allows to elicit outstanding objects, to read into landscapes with different filters. Both the physical and virtual visit seem to be a "tour".

In fact, the new concept of "virtual tourism" is very similar to "virtual museum", but it's more inclusive (Wang, 2011a; Gerosa, 2011; Gärtner at al., 2010; Gretzel *et al.*, 2010; Minucciani, 2009a; Minucciani, 2009b; Hyun *et al.*, 2009; Cheong, 1995; Williams e Hobson, 1995).

Its own meaning is still not universally shared, anyway it originates from the advent of new technologies in the tourism industry: not only regarding new channels of information and purchase, but also the "virtual tours", exploring synthetic worlds (sometimes encroaching on videogame) or the real world. Nowadays the attention is focusing on the second one. Often the "virtual tourism" is defined as "stationary tourism", but they're trying to overcome this feature also because territory perception and his understanding are more complex than a remote visit to museum.

Actually, we could define "virtual tourism" two different cases: a virtual trip in a virtual site (that's a model, mirroring the real world or not) and a real trip (that's powered by another reality – the augmented one). Of course, there is a lot of intermediate options, and we have to take account of specific purposes and different goals (commercial, cultural, entertaining…). But we would like to focus on solutions that don't resort to models and virtual worlds, but instead aim to face to real environment.

About database construction, in addition to traditional, cartographic bases are now achievable different information sources (orthoimagery, digital models produced by photogrammetric correlation to LiDAR takes ...).

Current technology is mature to support specifically these applications with products as UAV shootings (made with extremely manageable and low cost aircrafts, operating with a high degree of automation to realize updated shooting at sustainable costs); reliefs by single "session" (with equipped aircrafts and high-performance vehicles, to acquire information components – photographic - and metric components - LiDAR); use of spherical cameras, able to acquire "views" to be freely visited by user (Figure 1).

Real sites, virtual tourism

Focusing on tourism in real sites, they're attempting to expand the perception and knowledge modes, also thank to open databases more and more extensive.

We can acquire information in increasingly articulated ways, in order to rejoin virtual world and real experience.

For a long time the Authors are interested in this field (Minucciani, 2012; Vaudetti *et al.*, 2012; Minucciani, 2009a; Minucciani, 2005). They believe that communication of cultural heritage has yet to fully benefit from the new technologies chances, not only in Italy (where the matter is particularly urgent and strategic, although their country isn't an emerging model about ICT exploitation for Cultural Heritage). In addition, they trust in a cultural and social mission of virtual tourism: it shouldn't not only enhance already known and possible functions (increasing the commerce and information occasions), but it should also broaden avails to situations and categories of people who have so far been excluded, in different ways.

They are convinced that the time savings should not sacrifice the awareness of real parameters (distances, differences) and that the so-called edutainment shouldn't be a simple compromise between different needs, but rather a richer opportunity. Thus their interest is addressed to technologies able to tie virtual visit and *real site*. Furthermore, they want to pay more attention to "visitor's body", *i.e.* his physical involvement, in virtual experiences.

Many projects facing this issue are already been carried out: from simple "virtual books or tables" to particular experiments as *PointAt*, (These solutions are interactive installations, the first one to consult documents, while *PointAt* allows to learn more about a digital version of an artwork, just pointing the finger on details - that's a very instinctive gesture (Museo del Palazzo Medici Riccardi, Firenze, 2003)), *Museum Wearable*, (This small, lightweight computer, in a carrying backpack, was connected to a body motion sensor and to augmented reality glasses and headphones, in order to support and enhance the museum visit (temporary exhibition "Robots and Beyond", MIT Museum, Boston 2000)), *Cave*, (An enterely virtual, immersive environment you can visit thank stereoscopic glasses and special "mouses" (*e.g.* Kivotos system, Foundation of Hellenic World, Athens 1999)), haptic interfaces, holograms and so on. In these cases, anyway, virtual real-

Figure 1. Multiple access to information.

ity integrates real environment – through 3D models and simulations.

The Authors have just developed a project aiming to explore the opposite situation, integrating the virtual environment by *real elements*.

About this issue, an interesting project has already been carried out: the virtual "Trans Siberian Railway". Thanks to a simple video camera system, it offers the real sights from the train window along the 9000 km travel. The website also features images of small cities crossed, as well as tourist information, related to Google Maps (http://www.google.ru/intl/ru/landing/transsib/en.html. The project was originated from a collaboration between Google Maps and Russian Railways). However, they miss an element that Authors consider crucial: the real interaction with physical movement of the user. Although friendly and shared, a map is an abstraction and cuts immersive effect. All information access should be strictly related with a real sight, and originated from it: interaction interface is crucial.

Thus, as the objective is to merge physical and virtual reality, involving the body motion, the challenge is interesting because they want to present the real views, without 3D models. Another issue becomes crucial: the increase of data sharing, *e.g.* data related to systems as primarily Google Earth, Google Maps and Street View - now in common use. They already can provide, completely free, real images of the sites on global scale. Their content are by now integrated tools, namely repository of territorial data that we can integrate and share.

Recently, another opportunity has been jointed: integration of local and remote databases of images, and implementation in GIS systems (Ferrante and Garnero, 2013, Pirotti *et al.,* 2011).

Virtual Earth and Google Earth use a cartographic representation system not yet implemented – in Italy – in other applications (http://www.google.ru/intl/ru/landing/transsib/en.html. The project was originated from a collaboration between Google Maps and Russian Railways). Particularly interesting for our purpose are the geo-referenced images of Google Street View, implemented within Google Maps and Google Earth that provides panoramic views of 360° horizontally and 290° vertically along the streets (at a minimum distance of 10-20 meters apart). It was introduced in May 2007, and it runs in Italy since October 2008: Street View allows users to view portions of cities around the world at ground level, by placing on the map a little orange man.

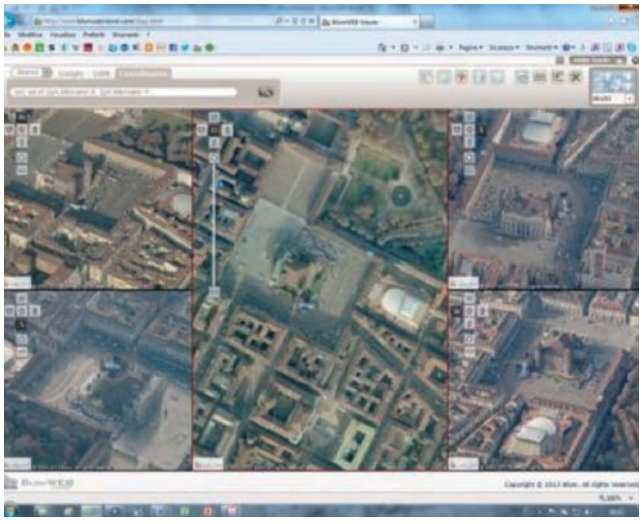

Figure 2. Nadir sight and 4 angle shots of Turin – area of "piazza Castello".

Google Street View uses special cameras (the Dodeca 2360, with 11 goals and produced by the Canadian company Immersive Media) located on the roof of cars or equipped bikes. The service is now extended to main roads and urban streets of large and small centers, across all Italian regions (The updated coverage is available online at http://www.google.com/help/maps/streetview/learn/where-is-street-view.html).

The images quality is satisfying, although they may perceive the "junctions" among consecutive shots.

Furthermore, there are other databases of images that can integrate "real" views (*i.e.* at eye level), to offer to users a complete description of sites. First, the digital orthoimages (high definition) and angle shots (able to acquire buildings facades). The industrial solutions (*Pictometry* ®, *Midas* ® of *Track'air*, *iOne* ® *Visual Intelligence*,...) use systems of cameras, connected to each other and assembled on a single support (Pictometry and Midas systems have 5 cameras: 4 are installed with an inclination of 40-45 ° from the vertical and according to the four directions of view perpendicular to each other (forward, backward, left and right); the fifth camera takes from the zenith. Thus different frames share the same take instant).

In fact, in order to know and document the buildings appearance without performing measurements, less expensive systems are available: *e.g.* drones (UAV, Unmanned Aerial Vehicle) with photographic equipment. The APR (Aircraft Pilot in Remote) will be able to perform low altitude shots everywhere.

Finally, is now possible to create *3D City Models*, namely consultation environments where the buildings are geometrically modeled and then "dressed" with their facades. 3D City Models are one of geomatic products available for a long time, but only the recent improvements in the autocorrelation techniques may allow automatic generation processes, therefore openings to more generalized use.

All of these activities are nowadays made possible by the generalized availability of digital terrain models (DTM). They're got thank to photogrammetric autocorrelation techniques, cartographic data and - as it often happens by now - specific LiDAR shootings (Pelagatti *et al.*, year not specified; INSPIRE, 2007).

Digital Terrain Models (DTM) are a resource in environment and land related applications. They can be employed in several way in order to deepen the comprehension of an area investigated by extracting morphometric parameters or to perform complex analyzes on the DTM alone or by combining it with other data sources with modeling purposes (Godone and Garnero, 2013; Pirotti *et al.*, 2012; Chiabrando *et al.,*. 2011) (Figure 2).

A further contribution comes from the increasing standardization of cartographic production, advocated by the INSPIRE Directive and recently inserted in the current Italian regulations (Garnero *et al.,* 2013; Ferrante and Garnero, 2013, INSPIRE, 2007).

State-of-the-art: the case study of Turin

Other, different databases can be related: information about history, architecture, cultural heritage. An interesting case study is *MuseoTorino*.

Launched during the celebrations for the 150th Anniversary of Italian Unification, it's the new on line museum of Turin and it aims to collect, preserve and communicate information about cultural, historical and artistic heritage of the city, and more. The website (www.museotorino.it) is conceived and structured as a museum, where you can find information on places, people, events, itineraries (thank a browsable map of the contemporary city). Each item has a brief label and a file containing notes and information. The most inter-

esting feature is the use of the latest platforms and technologies based on the Web 3.0 (semantic web) and Linked Open Data philosophy. Museum staff has been working on the website creation and data collection since 2009, and they have produced so far more than 15.300 files on places, events, themes and characters. Each file has been stored in a new generation database, a GraphDB providing excellent performances in data management.

This database is "museum catalogue", which can be consulted online, open to free searches. You can also move across the contemporary city, through a Google Maps application, and travel through time by visiting the permanent historical exhibition on the history of the city. MuseoTorino aims to involve the largest possible number of people, by sharing their knowledge and memories, suggesting ideas and projects. Icom Italia has awarded to MuseoTorino the prize Information Communication Technology (in occasion of *Premio Icom Italia - Musei dell'anno 2011*).

Thus, if the physical environment can be re-composed, instead of modeled, and if data and information can be collected and related, the visitor will be able to perform a "tour" without traveling. But his experience will be really "immersive" only if his motion and his perception of physical environment can be preserved.

So he will have several tools to move, literally, and to observe how and where he prefer (as if he were walking, for instance, but also turning his eyes or his head), namely natural ways with which he normally explores the world.

Suitable I/O peripherals will ensure the correspondence between the physical motion of visitors and views (and a crucial requirement will be the level of immersion of output).

Furthermore, transposition of user' real motion along a trajectory, identified on Google Maps, will be put in relation in real-time with street view images. Several markers on these will allow to access (even through queries in natural language) not only to tourist information but also to cultural ones, detailed and specific, that will catch from different databases. Travel will be featured by shots specially made, in order to access also to particular interiors.

A prototypal station

Starting from aforesaid notes, the Authors believe users can really appreciate und understand the land features, with distances, relations, proportions and morphologies (*i.e.* the territories as "systems"). Among the requirements of a "real" tour, there is the free motion in places and the "guides'" support. The new functions and services of augmented reality, in addition to unstoppable spread of smartphones (which nevertheless don't break the barrier effect of display), still require a cultural, strategic reflection.

The project therefore intends to explore a tour simulation with three basic features:

it offers to the "tourist" a *real* and *immersive vision* of what he would see across the places he's visiting, without turning to city models or synthetic worlds;

it brings together the virtual displacement on sites with a *physical motion really made* by the "tourist";

it uses *shared databases*.

The final prototype (replicable for different contexts - in urban environment and in extra-urban context - and for different situations of use) will allow to visit remote sites, without turning to traditional station in front of a monitor, but recovering movement and free choice of timing and sequences.

The virtual tourist would thus have the opportunity to visit any place, stopping when and how he wants.

The experience will provide most of the functions available for real tourism, improving them: among these, virtual tourists will be able can make stops, get into some interiors and benefit of observation points that are not possible in physical reality, but easily achievable in virtual way (elevations of points of view, spherical shooting etc..).

At last, there are different uses of databases: cloud systems availability and adequate, technological infrastructure allow creation of data bases adaptable to different needs, for scholars, conservation institutions, or simple curious and tourists.

Just the "virtual tourism" is the most attractive form to consult and use such information, because the observer-visitor, according to our project, can access specialized information in intuitive way, thank to navigation tools as described, maybe with virtual assistants and so on.

Of course, such information bases could be available also to users physically visiting real places, thank to positioning instruments (GNSS, gyroscope, compass, ...) already provided on smartphones and tablets . Real tourists will able to access to same information body than virtual one, and to navigate by using the information architectures as geometric and thematic index, data retriving, metadating repertoire ….

Furthermore, at even larger scale, they will enter into the building / museum: dedicated systems will recreate a reference system (radio apparatus as GNSS systems emulators, objects identifications through QRcode, and so on) to enable real user to automatically synchronize, from its location, to available data bases.

Interaction should be as natural as possible, using also natural language and virtual assistants.

The project encompasses several disciplinary cores: museography (that's exhibition strategy and communication of cultural heritage, complemented by historical and technical disciplines); geomatics and image processing (connection between the visitor's motion, the geo and cartographic reference and related databases); virtuality (and web 2.0.), ontologies (and web 3.0); tourism sociology and marketing (implementation of investigation/verification techniques, and their transposition to the virtual tourism) (Figure 3).

Conclusions

The matter the Authors wish point out, in conclusion, relates to the use of technologies and databases now widely available.

Figure 3. Immersive and interactive virtual reality, at LAQ (High Quality Laboratory) "Auditorium", Politecnico di Torino.

In fact, in addition to the scientific and experimental contents in itself, from their use can arise important effects for people.

Indeed it concerns not only economic and commercial business (even if the creation of new jobs and new employment sectors is undoubtedly important). Let's rather consider the social importance of a tourism solution that does not exclude whole, weak segments of population, due to income, age or disability.

In addition to effects of social inclusion (which is a main goal of European Strategy for 2020) should also be underlined the opportunity for a greater access to culture, that's a primary factor of human development and progress.

The territorial information systems leave "technical" fields and gain application contexts related to large public. For this reason, transversal use is crucial: we don't need "new knowledge bases", but to integrate them and provide *interpretations* (ontologies; network systems; systems person-based; systems on geographic key; various access systems, mutually integrated …).

Also "closeness" is, in the most recent project, a crucial key to access information. In this field, due to great amount of interrelated information, and to worldwide spread, the Wikipedia project "Nearby" has really an excellent chance (http://blog.wikimedia.org/2013/05/29/wikipedia-nearby-beta/) (Figure 4).

The information of the largest free encyclopedia in the world will be connected with their geographical reference, so tourists or professional operators will able to browse starting from their real location and then accessing related information. "Nearby" application is already active.

But a true, "intelligent access" has to provide to you information you need, or tailored for you: nowadays, thank to information available *e.g.* on social networks, particular interests of any visitor can be saved and considered. Not only "where you are" is important, but also "who and how you are", because in the information sea you should find what you are really interested to know. Of course, this goal requires a great work on ontologies that have to cross with "social" data, very heterogeneous: each user has the right to receive "his ownr" information output.

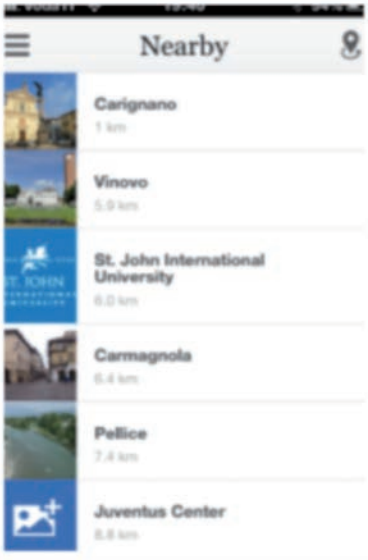

Figure 4. The Nearby feature on iPhone device.

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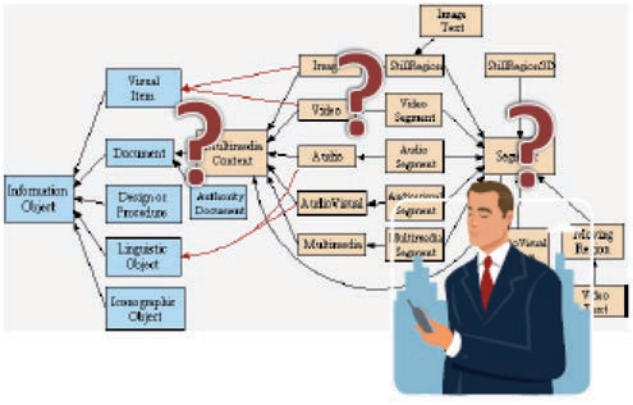

Figure 5. Ontologic interrogation of geographic and thematic DB.

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