Advanced Practices of Augmented Reality: the Open Air Museum Systems for the Valorisation and Dissemination of Cultural Heritage

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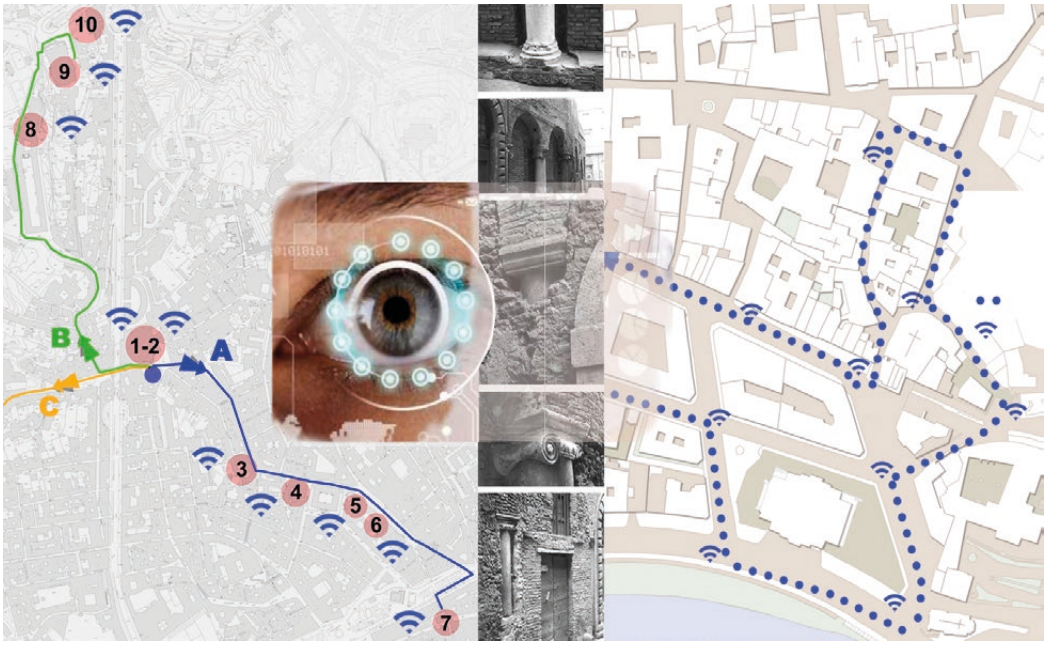
Abstract

This paper aims to explore the broad topic concerning the use of virtualization technologies in order to earn knowledge of the cultural heritage and it's dissemination. The activities aimed to develop the use of these advanced technologies, in the archaeological and architectural heritage promotion, are constantly evolving. This is the case for the museum fruition, that was confined to places of conservation and contemplation until a few years ago, but now exportable to whole urban sites (open air museums) thanks to the support of the virtuality that introduce to immersive learning paths. Very important resources in the cultural heritage valorisation process are the fruition improvement and the active involvement of the guest through the use of immersive paths, both pedestrian and vehicular.

Keywords
cultural heritage, representation, museum experience, advanced technologies, augmented reality.



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This paper is part of a broader research work, already anticipated in other scientific discussions dealing with the use of the reality's virtualization technologies applied to the enhancement of the cultural heritage; this technology represent a powerful tool to improve knowledge, learning and dissemination supports, but it only should be considered effective when its use is codified through rigorous approaches.
Strategies for knowledge disseminating through efficient and enjoyable communication approaches, include diversified levels of in–depth analysis (such as those offered by advanced technologies in the fields of surveying, post–processing and representation). These strategies take on an indispensable role as support of the scientific research methodologies in the archaeological and architectural heritage activities, sometimes overcoming the instrumental value and configuring themselves as an individually recognizable step of the research process.

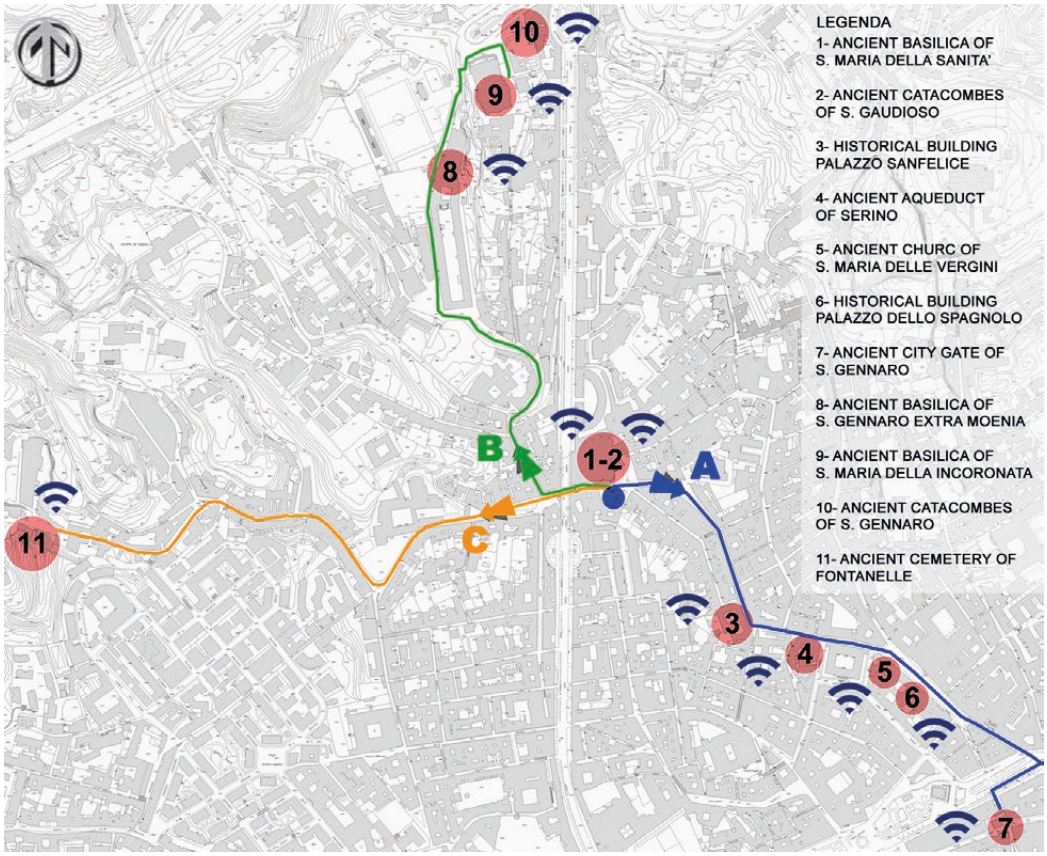

Fig. 1. Open air museum: experiment of immersive AR path, Naples Rione Sanità

The gradual development of the digital virtuality, which began in the 70's of the last century [1], has had a large spread that was proportional to the constant migration of the IOT technologies towards easer platforms, widely usable and accessible to most people. This defines a widespread acceptance of a new transmission code of informations or a new system of symbols, typical of the virtual environment; already considered by the researcher M. Forte in 2004 – with some residual doubts – is the exponential development of widespread applications to be integrated into exhibition tour for museums, widely usable by all the people and not the prerogative only of a specialist users [Forte 2004].
The full diffusion of the digital and simulation technologies, now achieved, obliges us to share this new informations transmission code, that is based on various cybernetic interactions [2] and is alternative to the natural one that is based on known spatial and perceptive rules; already at the beginning of this millennium, some researches took into consideration this possibility, resulting from the diffusion of virtual reality and its dynamics of information exchange, from which it would emerge "un nuovo codice percettivo dello spazio e del tempo in cui la prospettiva, insieme alle operazioni mentali di temporalizzazi-

one e spazializzazione che essa presupponeva, viene definitivamente messa in discussione e, divenuta un'alternativa tra le altre, si de–oggettivizza" [Pecchinenda 2003, p. 49].
By circumscribing the argument in the interests of this study, we can be maintain that the main purpose of a digital processing is to increase the perception capacity (of the object itself as a cultural asset) and it's resulting semantic charged. In other words, the digital transposition of a cultural asset introduces a complex process whose effects include a extensive review of the asset itself for its reinterpretation and dissemination in a virtual way. We can assumed that the studying, analysing and processing activities applied to the cultural asset itself for the purpose of its transposition into a digital way, can bring out a features (and their interpretations) alternatives to those obtainable from the approach not aimed at simulation activities in a virtual environment. In this way, a rigorous approach to the cultural heritage produce multiple variables of knowlodge: "L'epistemologia del virtuale suggerisce alcune riflessioni circa lo scambio e la geometria di informazioni fra reale e virtuale, fra soggetto e oggetto della fruizione culturale nell'ottica di una nuova musealizzazione virtuale di dati ed informazioni culturali" [Forte 2004, p. 429].
By spreading this considerations, it is clear that the need to code a rigorous syntax not only of the digital models (which are the basis of augmented virtual reality) rather of the entire procedure of developing and managment in the virtual environment, still finds ample space in the scientific debate.
To date be lack a univocal code, a procedural guidelines to refer to develop these specific activities. This situation represents an anomaly not only of epistemological value but also normative one, that we must be considered as any approach to the cultural heritage is, to date, regulated both in terms of methodological aspects and in terms of the definition of the outputs.

Fig. 2. Open air museum: augmented contents (Palazzo Sanfelice, Rione Sanità).

The analysis procedures and surveying systems are, for example, rigorously codified, the methodologies of approach to study, research and planning recognized and internationally shared, the typologies and number of the outputs to be produced are well regulated. Even the use of digital in the AEC scope, is harnessed within a regulatory system that encodes and regulates the processing phases [3]: the processing of technical and designing data into the BIM process, are governed by regulatory and unifying rules issued both by the EU and by the nationally jurisdiction [4]. It seems to slipping away a shared regulation, for the approach and implementation method, especially in the direction of the archaeological and architectural heritage, specific for the virtually tools.
To better clarify the concept, we should be remember that the virtualization of works art or cultural assets in the museum buildings is a well–established practice that finds excellent examples; there are many important museum organizations that have elected the virtuality as the ordinary modus for the public offer of their heritage. The most usual use, in this case, is the virtual reality (VR). On the other hand, the possibility of converting entire areas or urban districts of historical and archaeological interest where to develop immersive paths of perception through digital reality, makes use of augmented reality (AR) [5].
Semantic issue: the activity already described is not free by some aspects that still need to be explored. For example, we can considered, in the case of the 'museum translation' of entire sites through the instruments of the augmented reality, that the semantic weight bring out of this experience have a greater concreteness than a similar one lived in a completely virtual environment. This because the digital transposition of scientific contents (so–called augmented contents) finds a direct and one–to–one correspondence with the real context, developing with it continuous interactions and exchanges of information that are not expected due to the

multiple variables introduced by the guest himself. Instead, the many museum organizations that offer visiting through virtual reality, translating the visitor into a concluded virtual environment with a programmed digital dynamics (both for the object, for the work art or for the archaeological site) offer digital experience that, in proposing a completely virtual environment, impose precise conditions so reducing the uncontrolled variables.
The virtual environments: we can speak about "territorial systems of cultural heritage" understood as areas with specific features. In the open–air museumization experiments, the important possibilities offered trought the simulation technologies, in terms of reality understanding with the support of the virtually reproducing, appear today as a overcome frontiers through the transposition of the visitor from an external dimension to a participatory one. This opportunity must be understood not only as the ability to interact with the digital model and as a conferment of an active role to the viewer but, rather, as the induction of a concrete participatory perception in a digital reality. We talk about a digital perceptual system in which the observer not only follows preordained paths (mental, visual, exploratory or perceptive) but in which he can freely exercise arbitrary choices, placing himself in an active one–to–one relationship with the virtual environment: "In RV tutte le informazioni sono interconnesse in uno spazio 3D; una ontologia della connettività implica una causalità mutuale: attore ed ambiente si modificano reciprocamente creando nuova informazione" [Forte 2004, p. 430].
The user of immersive knowledge paths, supporting by augmented reality, can follow preordained patterns but also can activate alternative behaviours, creating new conditions during the experience of exploration: in any case, the cybernetic relationships that are triggered during this experience are multiple and unpredictable, precisely because they include a participatory–active role of the visitor within the fruition and learning environment: "l'animale umano, grazie al fatto che interpone uno schermo semiotico fra la mente e l'ambiente esterno, può […] guidare dall'interno la percezione, liberandosi dall'influsso diretto dell'ambiente esterno" [Cimatti 2000, p. 246].
In this time the so–called open air museum use [6], that is enjoyed outside of the architectural envelopes and supported by new perceptive tools based on integrated digital systems, becomes a concrete opportunity in the purpose of cultural heritage dissemination and deepening.
Thanks to the support of GPS systems it is possible to develop dynamic paths of perception of the archaeological and architectural heritage, integrated by augmented reality applications; this change allow immersive experiences of knowledge, reconstruction and stratigraphic reading not only of monuments but of entire historical sites. This approach, implemented trought an active involvement of the visitor during the immersive augmented reality paths, can be enjoyed for pedestrian both vehicular itineraries, representing a very relevant resource in terms of opportunities to valorisation the cultural heritage. Very interesting for the research purposes are also the replicable experiments about homogeneous territorial areas, with replicable characteristics, such as the Jewish ghettos within the main historical cities. Two researches are underway, one in Rome in the Jewish Ghetto area and the other in Naples in the Sanità district.
The first sample develop an experiment with the pedestrian path. In this mode, the technological support must include specific viewers for the augmented reality. These devices are nothing more than glasses equipped with high–definition transparent lenses that allow the wearer to benefit from augmented reality applications through a holographic interface with which to interact through gaze, hand gestures or voice. In order to function correctly and guarantee the recognition of the augmented contents, it is necessary to associate spatial references (target) to the context, in order to obtain a system that guarantees the correct overlap between physical environment and digital reality.
The second sample experiments a vehicular path, enjoyed from inside the vehicles such as a taxi, bus, city sightseeing or other. The guests on board will install an application on their smartphone that will allow them to enjoy the augmented contents. The application will activate the geo–referencing system for the tracking of the visitor's position along the path, while a Bluetooth device will allow activation of the digital contents when the user arrives near the site or point of interest.

In order to make the synchronism between the approach of the visitor and the delivery of multimedia contents reliable, the interaction system is entrusted to particular transmitters (beacon) which, positioned near the points of interest, send information managed by the application pre–installed on the guest's devices.

Conclusion

The studies in order to codifying and to controlling the potential of the reality simulation applications about the archaeological and architectural heritage, are constantly evolving, which confirming the important opportunity linked to the new frontiers of approach in this specific scope. Although in a simulated way, these processes have their main objective in the description of the cultural heritage within its site of origin; in addition to the strong contribution carrying out from the technologies, we must remember that the effectiveness of these systems is based on a methodologically correct approaches in the phases of investigation, analysis, surveying and processing, which are typical of the representation sciences. About the identification of precise guidelines, useful to implement the correct use of these technologies in order not to 'succumb' to the digital and virtuality potential but, vice versa, to direct their contents in the correct direction of a scientific approach, we must to consider the possibility of defining new syntactic codes within the mechanisms of perception and representation, as recently observed by Alberto Olivetti [7]: "Dovremmo riflettere su quanto sia cambiata la dimensione della percezione e la consapevolezza diffusa del passato, del presente e del futuro. Alludo alla dilagante rapidissima estensione dei mezzi virtuali di tipo informatico che hanno profondamente inciso su quel rapporto di spazio e tempo che forma l'endiadi entro la quale passato–presente–futuro agiscono poiché il tempo, in una dimensione virtuale, annulla le categorie di spazio e tempo quali erano state elaborate solo fino a ieri".

Notes

[1] The first virtual reality system is the one created in 1968 by Sutherland and Sproull, cfr. Biocca, F., Delaney, B. (1995). Immersive Virtual Reality Technology, in: *Communication in the Age of Virtual Reality*, Hillsdale: Lawrence Erlbaum Associates.

[2] Cfr. https://www.treccani.it/enciclopedia/cibernetica, definition by Treccani online: Cybernetics, a discipline that focus the unitary study of processes concerning 'communication and control in animals and machines'. It can also be defined as the general study of highly organized complex systems, regardless of their nature.

[3] The acronym AEC (Architecture Engineering Construction) identifies the building sector supported by IT approaches. The reference literature is very large and finds important interests in the area of the representation.

[4] In Italy: the law about BIM is the D.M. 560/17; the regulation about BIM is the UNI 11337–7.

[5] A brief definition of augmented reality by Treccani online cfr. https://www.treccani.it/encyclopedia/ augmented–reality: virtual reality technology (AR) through which a digital contents are added to the real environment. In opposed to the concept of virtual reality (VR) which develops fully virtual environments.

[6] The reference is to conversion of full historical sites in open–air museums. On the subject cfr. Cennamo, G. (2018).

[7] Cfr. Olivetti, A., Stati Generali della Memoria, Università Telematica Internazionale UNINETTUNO, Roma, 2020.

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