

Multiuser interaction in an archaeological landscape: the Flaminia project

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1 Introduction. The Flaminia Project

The virtual reconstruction of the archaeological landscape is an holistic process of great complexity, that is made of relations and includes in a virtual ecosystem many kinds of data, according to a multidisciplinary approach. This system of relations, interactions and behaviours assumes cultural, psychological and perceptive relevance.

In this paper we'll present the project dedicated to the Roman "Via Flaminia", an important consular Roman road, built in 220 B.C. by Gaius Flaminius. In that period the road began in the center of Rome and continued toward north, along the Tiber valley, the Appennini mountains and then it descended toward the Adriatic sea along the Metauro valley until Fanum Fortunae (Fano); from here it continued toward Pesaro and finally reached Ariminum (Rimini) following the coast (Fig 1).

The project, started in 2005 and supported by Arcus Foundation, has the goal of exploiting and diffusing its knowledge and historical context, focusing mainly on five important archaeological areas, in the northern part of Rome: Ponte Milvio (the important bridge where the emperor Constantino defeated Massenzio in October 28th of 312 A.D.); Tor di Quinto and Grottarossa (where the road is partially conserved together with its funerary monuments); Villa of Livia (the superb roman villa of Augustus's wife) and finally Malborghetto (a Roman arch transformed today in a museum) (Messineo, 1991; Messineo, 1993).

The final result of the project is the creation of a Virtual Reality application that will be installed in the National Museum (Museo delle Terme di Diocleziano) in Rome. Here a room will be specifically dedicated to the virtual musealisation of the road "Via Flaminia", through a network of four PC and a main, wider, screen, a sort of virtual theater connected with each single PC.

The project¹ will be presented to the public in 2007.

The archaeological observed landscape of this Roman road is very different from other cases such as, for instance, the area around the *Via Appia*, in the southern part of Rome, where it is still possible to find a long, and almost intact, path of the Roman road with its surrounding funerary monuments. From a topographic

point of view, the *Flaminia* landscape is characterized by a deep enclosure in the actual urban context, which often has hidden or completely destroyed it. The result is that the Roman path and monuments are not conserved, except for few cases. Its territory is not a closed and continuous entity with a coherent spatial area and delimitation. Thus the problem of its reconstruction is strictly connected with the attempt to establish a linear path in the virtual visit and with the difficulties of imposing arbitrary choices in the case of "empty" or unknown areas, where visible or studied structures can't be clearly located.

For this reason the main problems in the virtual representation are the spatial contextualization of fragmented sites and the cultural and communicative contextualization of "Via Flaminia" as a whole entity.

To conciliate these two needs of contextualization, we are implementing two main levels of scale and storytelling:

- a macro scale level, referred to the holistic vision of the archaeological landscape,
- a micro scale level referred to the five relevant and defined sites along the Flaminia road (Malborghetto, Ponte Milvio, Tor di Quinto, Grottarossa, Villa of Livia).

2 The reconstruction of the archaeological landscape

The archaeological landscape has been reconstructed through different techniques and data sources, integrated in a coherent methodology of elaboration and communication. In specific we worked on the reconstruction of

- the actual observable landscape (fig.2a)
- an interpreted landscape (fig.2b)
- an hypothetical ancient landscape (fig.6)

In the first case we used available geospecific data (DTM, geospatial images, vector thematic layers) to build a 3D terrain base representing the actual landscape. The digital 3D representation of the terrain was obtained using mainly cartographic data (technical cartography such as Sara Nistri, scale 1:5000) and satellite images (Landsat

¹Still in progress at the time of this publication (Oct.2006).

30 mt resolution and Ikonos 1m resolution). Cartographic maps have been used for elevation data manual digitalization and integrated with a more detailed topographic survey with DGPS of some areas and, in

some cases, also with time of flight - laser scanner data used in topographic way (CyraX 2500).



Fig.1. The Roman *via Flaminia*

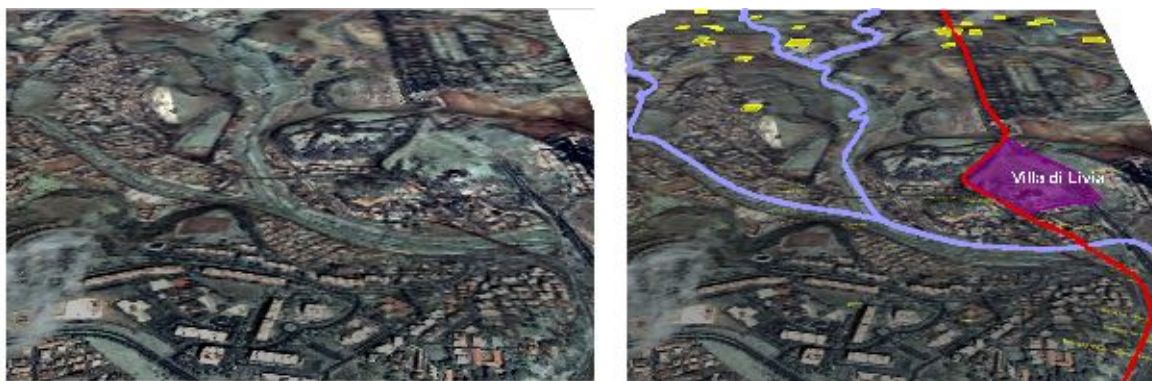


Fig.2. The observed and interpreted landscape reconstructed

In the second case, thematic layers were overlaid on the 3d terrain in order to help the interpretation process and to allow a transparent transition to the hypothetical reconstruction of the ancient landscape: for this reason vector layers (points, polygons, lines) were taken from archaeological maps and excavation plans and processed to obtain: archaeological areas, Roman villas, Roman aqueducts, hypothetical ancient hydrography, Roman roads, etc. (fig.2 right).

In many cases the observable landscape is put in relation with interpretative and reconstructive hypothesis of structures and contexts, as they could be in ancient times. This approach is supported by the top down methodology: the critical study of the collapsed areas and decorative fragments, bibliographic references,

typological comparisons with similar and contemporary roman buildings².

In the last case, different sources have been analyzed (Latin sources, historical, archaeological, geomorphological data, lithology, natural vegetation, etc.) and used in integration, to try to reconstruct an hypothetical ancient landscape (Traina 1983, Braconi 2004, Funicello Parotto 2001, Volpe Arnoldus Huyzendveld, 2004). Specifically, we defined a series of classes, starting from known data, that were processed in the GIS to obtain new classes that helps in the definition of:

² For a detailed description of these aspects see L. Vico, A. Moro and V. Vassallo's paper in this volume: *The importance of the relief and sources to interpret and communicate the cultural heritage.*

- Cultivated areas
- Non cultivated areas
- Inhabited zones (Villas and other buildings)
- Roman Digital Elevation Model
- Roman hydrography
- Roman roads
- Monumental (funerary) areas
- Roman vegetation

A first test was done on the area of the villa of Livia (Fig.6).

Architectonic surveys were carried on, processed and then integrated in the terrain, choosing the different techniques (scanner laser, photomodelling, photogrammetry, computer vision, total laser station and so on) in accordance with the kind of structures and information we needed³.

In order to share available geospecific data with the team and all the partners and co-operate in the construction of the VR application, a first Internet web site has been built, based on a VR webGIS open source platform (www.vhlab.itabc.cnr.it/flaminia). A Mozilla and Explorer plug-in was developed in order to allow a complete interaction with 3d reconstructions, 3d models, vegetation and thematic layers⁴.(fig.8).

The main aim of the virtual reality application is the creation of a digital virtual ecosystem to integrate geographical, topographical, perceptive, historical interpretative, narrative and symbolic data.

In our approach the spatial three-dimensional reconstruction of an archaeological site is only a first, basic step where it is necessary to organize, link and develop all cultural contents.

Only in these conditions we can communicate the "sense of place" and obtained an impressive cultural result.

The virtual environment should be alive, a space that we can experience, interpret, change, transform and establish relations according to our interests and interpretative approach.

Another important issue for us is "transparency": 3D models, reconstruction of the actual and ancient landscape have to declare the methodology and the sources they come from, so to allow the discussion, the critical awareness of the public and therefore their cultural impact.

3 The use of virtual reality inside museums. A multi-user system to communicate the Ancient "Via Flaminia"

The museum application is based on an innovative methodological approaches in the field of digital virtual heritage:

- the storytelling
- the multi-user domain.

The storytelling is referred to an interactive system based on narrative techniques and metaphor, virtual characters, avatars, speaking objects and sometimes game dynamics and rules. The aim of storytelling is to make the space "alive".

The multi-user domain allows many users to interact at the same time in the virtual environment, recognizing each other and developing shared purposes and joined actions, as it is described below.

In its traditional off-line applications, virtual reality creates quite exclusive relationship between the user and the rules that regulate the exploration. Fruition, interaction, comprehension of the dynamics and behaviours are individual experiences.

Inside a museum or an exhibition, the multiplication of the installations that allows more people to interact at the same time but without relations and contacts among them, is only a partial and not decisive solution.

Museum should encourage a collective and shared communication of cultural contents. For this reason they are generally more interested in communicative formats, that involve a large public at the same time (for instance movies and in very rare cases virtual theaters), but where the conditions of fruition don't stimulate creativity, even if perception can be very impressive.

This project is an attempt to match this kind of needs with the personalization of the cognitive process pushed by virtual reality systems: free exploration of virtual environment in real time, possibility for users to relate themselves with cultural contents in a creative and interactive way, following their preferences, interests and organizing their own "mental map".

Virtual reality systems, virtual storytelling and multi-user domain, combined in an integrated methodological approach, can offer very efficacious and innovative solutions to generate a strong educational impact and involve the public in a collective fruitions of cultural contents.

In the fruition of the Flaminia project inside the museum's room, the focus of the communication system is a large screen positioned in the middle of the wall, in front of the public; it is the attractors of virtual events, addressed to collective fruition. Four users interact at the same time, everyone with one PC, and share the same virtual scene (Malborghetto or Grottarossa or Villa of Livia, and so on). They visualize the virtual environment not only on their monitors, but also on the large screen on which a virtual show is developed in real time according

³ For a detailed and technical description about this subjects see M. di Ioia, F. Galeazzi and N. dell'Unto in this volume: *The Flaminia project: relief and post processing data techniques*

⁴ See for a detailed explanation of the web application Calori et alii, *Sharing interpretation: the challenge of Open Source web approach*, in this volume.

to their actions and behaviours. So they are the creators and the directors of this performance and, at the same time, they are users, observers, together with all the public present in the room (Fig 3).



Fig 3: 3D simulation of the installation for VR system inside the museum's room.(3D model by dell'Unto)

The multi-user domain will not adopt the traditional channels of communication (such as chats or similar, that are not very suitable to museum contexts), but it will be developed in accordance with the following rules:

- share the same monographic level,
- allow the avatars to meet each other;
- transformation of the virtual environment by discoveries and actions of each user.
- Visualization of avatars actions and cultural contents (objects, characters, structures, storytelling, movies, metadata and so on) discovered in the main screen, that will become an “attractor”.

All these elements will create a virtual show for the users and all the people present in the room. The audio contents will be unique and common for players and public, in Dolby surround 5.1.

4 Sharing the same monographic level

The first condition to make the multi-user system effective is the sharing of the same virtual environment. For this reason the users aren't completely free to choose the monographic level to explore, but they will be invited to enter in the scene active at their arrival. The succession of the monographic levels is fixed, settled in advance on the base of the narrative impact, so to stimulate curiosity and interest to continue the virtual exploration until the discovery of all contents in all scenes is accomplished.

Every monographic level has a timeout, according to the complexity of cultural contents, storytelling and metadata that the level contains.

5 Modification of the virtual environment

When a user finds out objects, movies, characters and meta-data, he determines a transformation in the virtual world. On his monitor, and on the large screen, each user visualizes the transformations generated by himself and by the others.

In the “Villa of Livia”, for instance, the exploration begins from the actual, observed landscape (Fig 4, 5, 6). The avatars can enter in the actual villa from four different accesses; they meet characters and objects belonging to the present time and help them to discover and visualize contents connected with the interpretation of the rooms: their structure, their chronological phase, their history and functions and their relations in the context of the ancient villa, some news about the people that lived there in the past.

When the users find out the main cultural contents about that room or group of rooms, the award they receive is the reconstruction of that rooms as they could be in ancient time. We'll consider in particular two more relevant phases: 1st century B.C., referred to Augusto's and his wife Livia's period, and the 1st century A.D. The partial reconstructions will refer to the phases that are more relevant in the actual perception of the villa, in order to allow a clearer interpretation and comprehension of the structures we can see today. But at the end of the exploration, the whole reconstruction of the villa, during Livia's time will be available, to allow a coherent and homogeneous representation of the typology of the roman villa in that chronological phase. We'll distinguish, through graphic solutions and multimedia explanations, the level of reliability of the reconstructions proposed.

Reconstructions offer new interactive contexts and contents; inside them Roman characters will appear while performing their daily activities and they will dialog with the users' avatars.

Also the exploration of Malborghetto begins from the observed archaeological landscape (Fig 7).



Fig. 4 - 5: nowadays 3D representation of Villa of Livia with avatars exploring it (elaborated by laser scanner data)



Fig 6: Hypothetical 3D representation of Villa of Livia's hill during Roman times, processed with Visual Nature software.



Fig 7: 3D model of Malborghetto as it can be seen today (obtained with Photomodelling techniques).

Discovering cultural contents, the 3D context will change as it was in medieval time, and furthermore during Roman times, when it was a triumph arc built to celebrate the victory of Constantine over Massenzio.

The final purpose, for users, is to go back to the night before Ponte Milvio's battle, and find out Constantine's military camp in the field of Malborghetto, near Flaminia street, where the arch did not exist yet..

From here, a little later, the events will move to Ponte Milvio, so the battle will be described as if it would happen in real time; it will be represented through virtual storytelling and iconographic resources. We have chosen this event as the most representative of the "identity" of this bridge, from historical point of view, of the collective "sense of place" and the narrative potentiality.

In conclusion the avatars have the following possible behaviours:

- discover characters and interact with them;
- visualize movies, animations, activate audio contents;

- visualize areas through highlighting or colors in order to put in evidence specific themes, relations among structures, interpretative layers, affordances (chronological, typological, functional correspondences for instance);
- transform the environment following an ideal a time line;
- perform actions and 3D behaviours, interact directly with functional objects, manipulate tools to improve the sense of "embodiment" of the users in the 3D space.

Not all contents are narrative. Some of them are visual, as we said just before, put in evidence by highlighting and they are referred to particular relations of meanings (affordances).

In the upper part of the window, in each homogeneous group of rooms, there will be a symbolic Cybermap, with some "branches" or icons corresponding to the various affordances Space, Time, Use, Typology, Similarity, Reliance of reconstruction, Methodology of acquisition and modeling (fig 8).

The user can visualize the information activating the icons or branches of this symbolic interface.

In this way the informations referred to the archaeological structures and also those relative to the "transparency" of the elaboration processes, will be available and clear for the public, so to allow and improve the critical awareness of users and their capacity of interpretation.

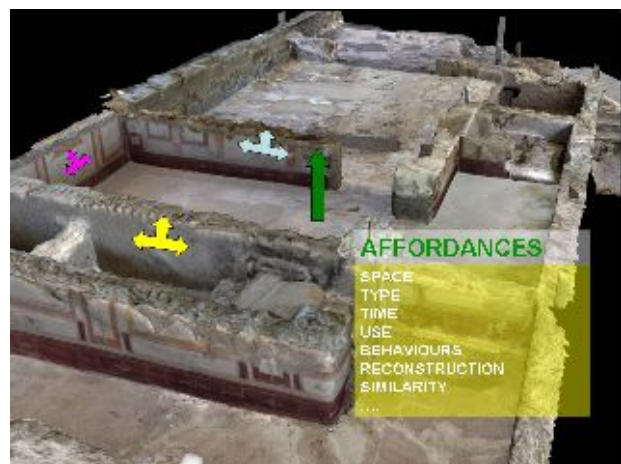


Fig 8: Flaminia project (CNR-ITABC): Roman Villa of Livia, Rome, where every objects, rooms and so on have relations of contents, such as Space, Time, Use, Type, Similarity. The user can interact with the model also de-constructing it, activating its affordances. Here is a schematic representation, not yet the final symbolic interface of the Cybermap.

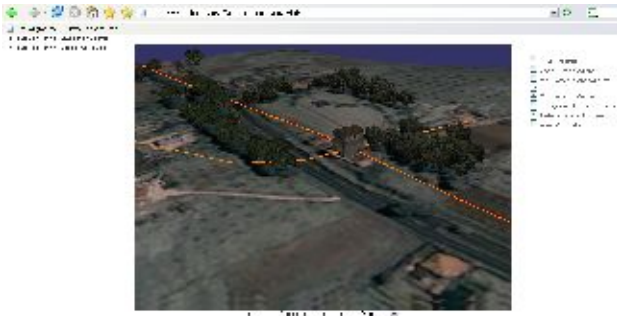


Fig. 9: Navigation on Malborghetto (Costantine Roman arch) in the web site (www.vhlab.itabc.cnr.it)

6 Visualization, interaction interfaces and collective fruition of contents

All the actions performed by the avatars and all the cultural contents converge on the main screen, focus of the virtual experience. They are visible through a continuous switch of virtual cameras.

All these events create a sort of movie in real time, destined to both players and public.

Each "player" can follow the development of contents from two perspectives: his single point of view (in his PC he moves with first person camera) and the collective point of view (with third person cameras, dolly cameras, free cameras and so on).

This condition allows less expert users to observe the others players' behaviours and understand the results of their actions. In this way they become able to learn cultural contents and interaction rules and they can defeat the frustration caused by their initial inability.

When users explore the environment without finding out anything, global views and views showing each avatar alternate on the large screen,

When a user discovers a contents, on the large screen, the camera gets near his avatar and near the discovered object (a movie, a character, a reconstruction and so on). In that moment all the local PC will stop and all the users, together with the public, will look, on the large screen, at the event activated by that avatar.

As we said before, the audio comment is common for all the people and it will be spatialized in 3D.

This solution solves the problem of the distribution and management of sound in the room. All other possible solutions (headphones, glass-domes and so on) present some disadvantages from both the economical and spectacular points of view.

When the collective event on the large screen finishes, each user can continue his exploration from the point where he stopped before.

But all the local applications, on each PC, will have loaded the transformations determined by the author of the last discovery. Each user will not be able to discover the contents already discovered by the others but he saw them on the large screen.

In order to make the exploration and the interaction direct, easy and intuitive, no 2D menu are used to access

cultural contents or visualization tools. The activation of all the informations inside the 3D space is determined by proximity, contact or crossover of interactive objects.

Navigation and interaction are controlled exclusively by the joystick

The Museum application is realized with Virtools DEV 4.0 and the Multiuser Server-pack.

7 Conclusions

We think that this new (for museums) methodology can offer many advantages.

First of all it can speed up the time of fruition, because the exploration and the interaction are collective: everything discovered by one user is available and useful for all the public. This is very important also in consideration of the large amount of available information in a quite limited time.

Secondly it enforces a conception of virtual reality that is particularly efficacious inside museum's context.

The innovation consists also in the integration of many media and metaphors of fruition: virtual reality (creativity and personalization of choices and interaction), game-rules (discovery and award dynamics), storytelling and cinema (real time movies performed by all users' interaction on the large screen), enhancement of 3D perception (stereoscopic vision).

Although we know that this field (3d real time environments with multi-user interaction) is at its starting point, we believe that it will be more and more uptaken in the future and it will need more epistemological and psychological researches, involving also neurosciences. In particular we need to study and overcome some problems related to the concentration-attention level, in a communicative and didactic approach, in comparison with the number of behaviours, interactions and windows available. The aim is to create better VR applications where personal analysis capabilities are not lost in the rapid exploration of simple "surfaces", of collection of meaningless objects, of simulations without sources and originals (Turkle, 1995, 2-13).

In the next future we intend to experiment this kind of multi-user VR application also for web application, working on open VR 3d communities in the development of concepts such as sense of place and shared working environments for cultural heritage.

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