Visualisation of contemporary public art

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Introduction

The current digital convergence has merged the processes concerning, on the one hand, the access to cultural heritage in terms of digital platforms, such as online museums, cultural websites, etc. (e.g., the Europeana web portal) and the distribution of media objects, with content producers and consumers who are given equal rights and cooperate to generate and share digital content[1]. In particular, in the field of cultural heritage, particular importance is given to the so-called re-mediation practices, with the contents of one medium re-focused onto another medium (such as, e.g., the reuse of movie contents in videogame design)[2]. In this paper, we deal with the digital visualization of the invisible parts of contemporary art; in particular, we focus on 3D graphic visualization for contemporary public art and its invisible issues. This topic has been addressed in many areas that concern the preservation and communication of cultural heritage.

A major issue of cultural heritage preservation concerns the application of 3D modelling to the digital documentation of Cultural Heritage, through the recording 3D (or 4D) multi-source and multi-resolution information, the management and conservation of 3D (4D) models, the visualization and presentation of the results for distribution through the Internet and online databases, the creation of digital inventories for many purposes, including education, research, conservation, entertainment, tourism[3]. The approach also includes dynamic reconstructions of sites and events concerning art and architecture for purposes of preservation of cultural heritage: an example concerning a XX century artwork has been the virtual reality reconstruction of the *Poème électronique*, realized by Le Corbusier (with Varèse and Xenakis) for the Philips Pavilion at the Brussels World Fair of 1958 (see Figure 1a), where the interdisciplinary philological research of both artistic and technical

[1] H. Jenkins, *Convergence Culture: Where Old and New Media Collide*, NYU Press, NY 2008.
[2] J. D. Bolter and R. Grusin, *Remediation: Understanding new media*, Mit Press, Cambridge MA 2000.
[3] Patias, P., *Cultural heritage documentation*, «Application of 3D Measurement from Images», Fryer, J., Mitchell, H., Chandler, J.(Eds.), Whittles, UK, 59, 2007, pp. 225–257.

(a) (b)[4]

Figure 1. (a) 3D reconstruction of the Philips Pavilion (VEP project); (b) visualization of a sculpture proposed for a public art installation in Sydney, and includes bricks from around the world.

claims has merged into a novel exhibition, a re-mediation based on the original contents[5].

In this paper, we address the visualization of contemporary public art. Public art has been a very dynamic area, contrasting with modernism tendency to host art in museums, involving both public and private subjects and originating a novel professional artist category[6]. Public art has the peculiarity of being planned and staged in some public place and space[7], usually open air or in publicly accessible buildings and it is accessible to all people. The computer graphic representation of contemporary public art is usually employed in the design phase (rather than the preservation), for the pre-visualization of projects (see Figure 1b): the major issues of the project are selected to point out features of the artwork, such as the size of the artwork, the materials employed, the appearance from a number of notable points of view, the conditions of access, etc. . Also, in the case of public art, it is of interest to represent the geographical position of the artwork, often together with other artworks (see Figure 2).

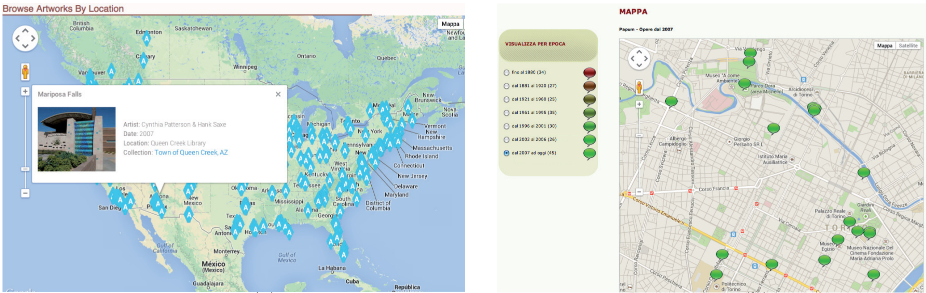
This paper illustrates how visualization of public art works in the context of project Invisibilia. Since the knowledge about the artworks is encoded in a computational ontology, the visualization provides a solution that takes as input the ontology of contemporary public art (reported in this journal issue by Damiano et al.) and provides as output the visualization of a number of "invisible" features, presented in graphical form.

[4] <http://www.totld.com.au/portfolio/public-art-3d-visualisation/>.

[5] Vincenzo Lombardo, Andrea Valle, John Fitch, Kees Tazelaar, Stefan Weinzierl, Wojciech Borczyk, *A Virtual-Reality Reconstruction of Poème Électronique Based on Philological Research*, «Computer Music Journal», Summer 2009, 33, 2: 24–47.

[6] T. Finkelpearl, *Dialogues in Public Art*, The MIT Press, Cambridge MA 2001.

[7] P. B. Bach (Ed.), *New Land Marks: Public Art, Community, and the Meaning of Place*, Grayson Publishing, 2000.



(a) (b)

Figure 2. (a) The visualization of the ”public art archive” at world level[8]; (b) the visualization of the ”public art archive” of the city of Turin[9].

Augmenting the ontology of public art Invisibilia

Extending (Damiano et al., this issue)[10], we have encoded Contemporary Public Art into the Invisibilia ontology, referring to the tripartite frbr model (Work, Expression, Manifestation) with the following interpretation, which will be then addressed in the visualization. In Figure 3, there is a sketch of the ontology: the upper part of the sketch (with respect to the class “Artwork”) is a reference to the core ontology; the lower part is the augmentation that accounts for the visualization issues.

Each artwork is associated with a corresponding visual scene that is composed of several items and is visually represented by a model (a 3d model, in particular). Each model has geographic coordinates (usually imported from the Geoportal of the city, in the case of Public Art), size parameters, and an IRI (Internationalized Resource Identifier). The iri is a reference to some address for the actual (3d) model, typically a Collada file[11]. An item of the visual scene for an artwork can also be a Model or a Shape, that is a polygon (composed of vertices at some coordinates) to be extruded from the Geoportal of the city. A shape can have parameters that define the visual aspect of the item: for example, the densities of streetlights as well as of trees of an area can be set to some value (“low” or “high”, respectively, in the figure) and set or interpreted procedurally. A shape can be some abstract

[8] <http://www.publicartarchive.org>.

[9] <http://www.comune.torino.it/papum/user.php?context=opere&submitAction=mappa>

[10] Cf. Antonio Lieto, Rossana Damiano, Vanessa Michielon, *Conceptual Models for Intangible Art*, *infra*.

[11] Collada (visit collada.org) is an xml-based schema for the portability of 3d assets between applications, enabling several 3d authoring and content processing tools to be combined into a single production pipeline.

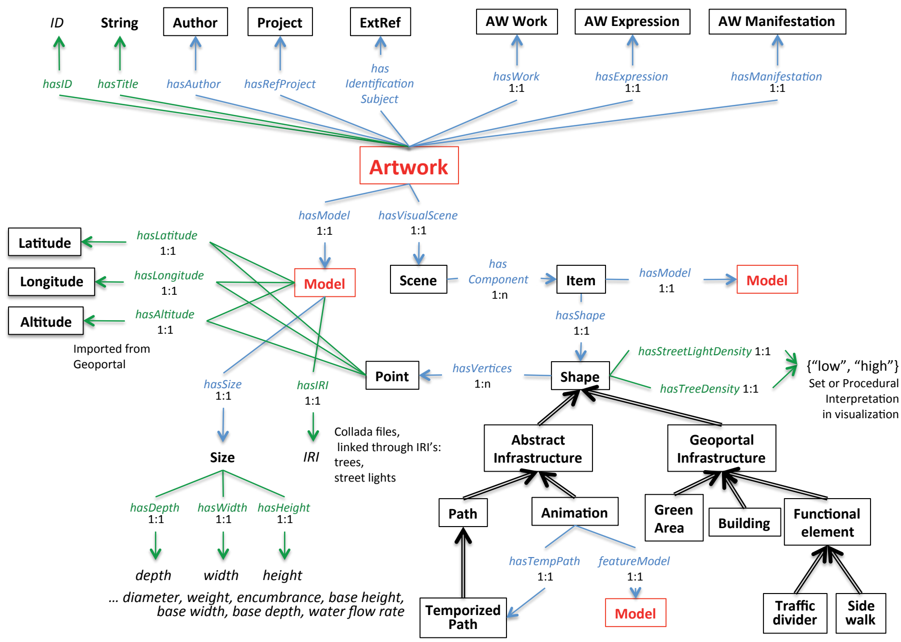
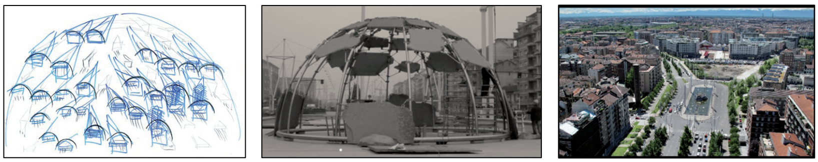


Figure 3. A sketch of the augmented ontology: in particular, while the upper part refers to the core ontological concepts, the lower part concerns the visualization issues.

infrastructure or a Geoportal infrastructure: one of the abstract infrastructures is a path (realized, e.g., by a spline) along which things happen; for example, an animation occurs along a temporized path (which is a form of path) and features a model that moves along the path; the Geoportal infrastructures are elements that can be extracted from some Geoportal of the city, such as green areas, buildings, functional elements (such as, e.g., sidewalks and traffic dividers).
This sketch of the augmented ontology, in order to exemplify some generic classes (such as, e.g., the two subclasses of "Functional element" being "TrafficDivider and Sidewalk"), has taken into account one specific example, the artwork "Fontana" (Fountain) by artist Mario Merz (see Figure 4c). The Fountain of Mario Merz is a public artwork in Turin, released in 2002, that has the shape of an igloo with the surface consisting of a puzzle of plates of slate, emerging from a rectangular water tab, with water jets. The fountain is located in a traffic divider of a road widening and is surrounded by green areas, sidewalks and buildings. Of particular importance for the visualization of Merz's fountain is the access to the public that is possible through cars that follow paths around the fountain.
A final word concerns the visual information included in the ontology: on the one hand, geographic coordinates are needed to locate the artworks and the items that

compose the visual scene in the interface, on the other, the 3D models and shapes (extruded polygons) provide the objects that have to be positioned according to the geographical information. Geographic coordinates are related to some map that represents the background against which 3D models and item shapes are positioned for the presentation to the user. In the next section, we present the visualization system.



(a) (b) (c)

Figure 4. Merz's igloo fountain in Turin: three paradigmatic images for (a) Work, (b) Expression, (c) Manifestation, respectively.

Overview of the visualization system

The visualization module is embedded in a system that encompasses three main modules (cf. Damiano et al. this issue, and Damiano et al. 2014[12]):

· the Ontology Server (implemented in the Stanbol framework[13]) maintains the ontology – where the artworks are described – and provides the reasoning services; also, it provides the SPARQL endpoint for querying the ontology;
· a Web Service, written in Java, implements the API that client side applications exploit to query the Ontology Server. Depending on the project, the RDF triples extracted from the ontology are serialized as Json or XML data;
· the Visualization module supports the interaction with the user through 2D/3D navigation (or, else, standard hypertext including maps, timelines, etc.), as standalone application or embedded in a browser.

The visualization module relies on three elements (Figure 5): 1) the visual data, that is the 3D models associated with items and artworks in the visual scene, the maps downloaded from some repository and employed through the Leaflet libraries, and the Geojson data extracted from the Geoportal of the city and augmented with information on geometry and other attributes; 2) the ontology server, based on the Stanbol framework, makes available all the information, including the visual issues (including the 3D models), through the ontology query API's; 3) the visual renderer,

[12] Rossana Damiano, Antonio Lieto and Vincenzo Lombardo, *Ontology-based visualisation of cultural heritage metadata*, in *IEEE Proceedings of CISIS 2014, 8th International Conference on Complex, Intelligent, and Software Intensive Systems*, July 2-4, 2014, Birmingham, UK.
[13] Stanbol is a framework for semantic content management (<https://stanbol.apache.org>).

that were developed in two versions, one, open-source, based on three.js library (which requires a json data file), the other, proprietary, based on GoogleEarth (which requires a kmz file and does not need the maps). The user interface dynamically arranges a set of visual elements which embed the items, staging and setting them based on their properties, as represented in the ontology server, and offers the users a number of controls, as defined by the visualization framework.

The visualization framework consists of: the visual components, the control interface, communication protocol. The visual components are the elements whose appearance depends upon the narrative metaphor, which drives the visual experience (e.g., the "city map" for Invisibilia). The visual components include:

- an environment, that provides the narrative context of the visualization, where the visual objects (i.e., the narrative elements) are located and experience their behaviour;
- a set of visual objects, possibly with behaviours triggered by the user interaction;
- a scene layout, i.e., where objects are located in the environment.

The control interface consists of the mapping between the items and the visual elements, actually the mapping of the item properties onto the visual features of the icons (colour, size, shape, etc.), of their relations into spatial relations and the interaction design specifications, which are inspired by the notion of guidance (vs. exploration), in order to facilitate the user access to the environment and the meaning conveyed through it. Finally, the communication protocol between the visualization component and the ontology server queries the ontology and feeds

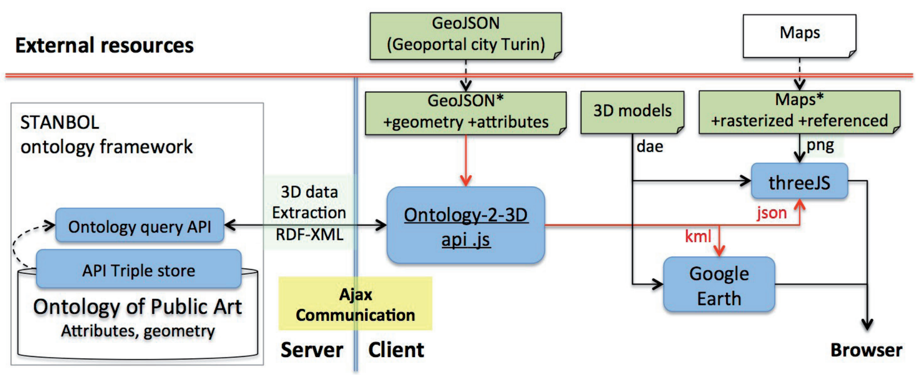


Figure 5. The architecture of the visualization module.

the results into the visualization. In the next section, we describe the design issues concerning the visual object design and the scene layout.

Design of visual objects and layout

The design of the visual objects and of the scene layout for the Public Art "invisibilia", which are the result of the visualization module, is a delicate phase. The Public Artworks arrive with a marked visual stance, which makes a visualization of intangible knowledge more challenging. We can sum up the following premises about the visualization:

- it cannot be a replacement for the original artwork, though exhibited in virtual terms;
- it has to balance between the goals of the visualization and peculiarities of the artwork;
- it must adhere to the model (of the features) of the artwork;
- the authorial intervention should be limited to the "invisible".

The visual components that represent the feature values are derived from the existing documentation and are augmented with iconic elements appropriately designed by the visualization artist. These elements must be in overt contrast with the original elements, though creating an environment that can visually host the original elements; so, the idea is to acquire the artwork components and to integrate them in a single visual framework. Given the considerations above, we provide three visualization levels:

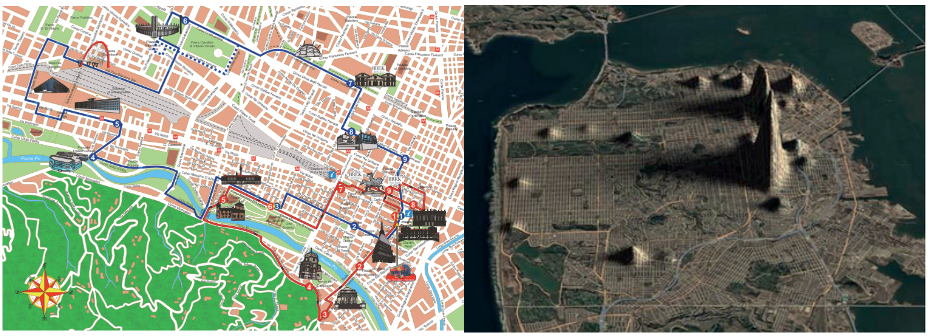
- a synoptic view on a number of artworks that are connected through a number of features;
- the exploration of an individual artwork;
- the materials connected to the work-expression-manifestation tripartition, organized as a repository.

The synoptic view provides a top-view cartographic representation on a city map of the public artworks, with their relative positions; the public artworks are represented by visual items that propose the shape of the artwork; these items can be original (if they exist in the documentation) or introduced ex-novo.

The inspiration for this solution originates in the tourist city maps, that combine topological and topographical elements (see Figure 6a): in our case, we decided to employ geodata from the Geographical web portal of the Municipality of Turin. To these we applied a graphical transformation, without any alteration[14] on the geometry, in order to recall sightseeing touristic maps, which have a longstanding tradition in cartography and are effective in guiding tourists in picking the preferred sites in a city. Also, we augment such a visualization with a 3D perspective, augmented with data visualization techniques (see, e.g., Figure 6b), in order to be coherent with the subsequent level and to make other invisible elements perceivable from the same map.

[14] <http://www.comune.torino.it/geoportale/>.

For Invisibilia top level view (see Figure 7, top), we insert topographic elements, such as the rivers (in blue), the major access as well as inner roads (in yellow and white), and the major reference buildings (in light grey), to provide orientation cues, and topological elements, one per public artwork with a light blue glow to provide a sense of presence against a dark background. In Figure 7, bottom, we see the implementation in Google Earth of the same scene; another implementation has been carried out in three.js library with maps from public repository imported through the Leaflet.js library (actually, in the current implementation, personalized maps are rasterized to cover a plan with an exact match of the references, given the relocation from the central point through a simple javascript function).



(a)[15] (b)[16]

Figure 6. Inspiration for the top level view: (a) Sightseeing maps cartography; (b) Data visualization superimposed to 3D city map.

We can go from the synoptic, top level view to the individual artwork view by clicking on the visual object that represents some artwork. The individual artwork view is a perspective view that is reached through a 3D-simulated camera motion: this view remains in the graphic style described above (monument in glow with a detail of the map), with superimposed active icons for accessing the visualization of the ontology features, namely work, expression, manifestation. In Figure 8, we can see the visualization conceived for Merz's Fountain (8 top) and implemented in three.js library (8 middle): the artwork is surrounded by roads, green areas, and tall buildings, and the latter elements are stylized icons, that repeat themselves over the several artworks (cf. 8 bottom).
The object representing the artwork objects are 3D models with photographic textu-

[15] <http://www.torino.city-sightseeing.it/eng/percorsi1.htm>.
[16] <http://gulzar05.blogspot.it/2011/02/crime-data-visualization.html>.

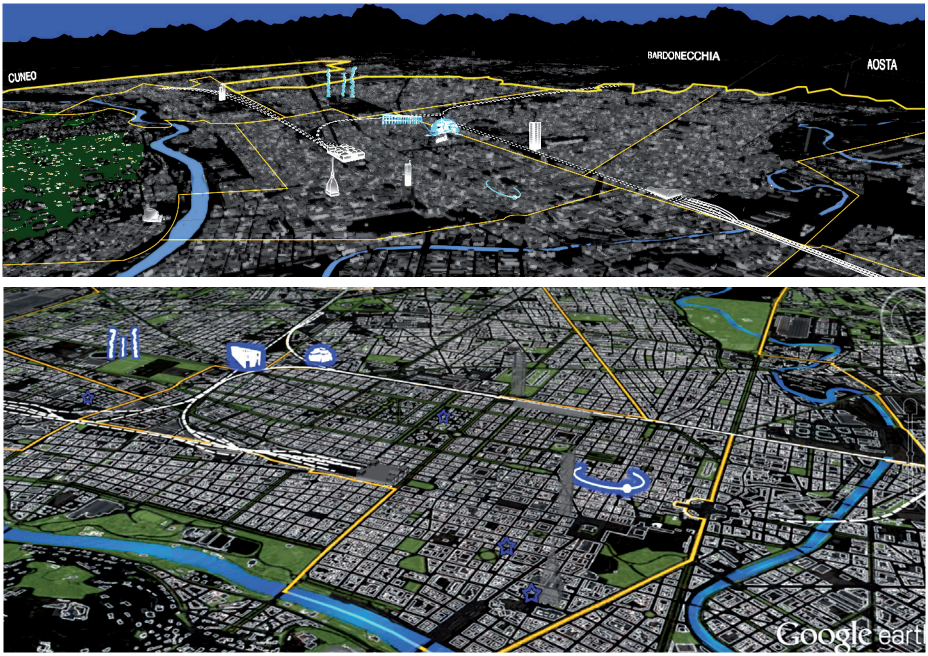


Figure 7. Invisibilia top level view.
Top: design in Blender; Bottom: implementation in Google Earth.

ring, obtained by means of automatic photogrammetric techniques. The input data are sets of digital images, acquired through a compact digital camera, which have been processed through the software Photoscan[17] (see Figure 9). This approach, which can be carried out by a non 3D professional, such as the architects that work in the city hall office for Public Art, makes it sustainable from the operational point of view; the visual appearance makes the object different from the iconic solutions for the other elements.

From the artwork level, we can access the details of the documentation, related to concept, that illustrate the ideas of the artist, the production stages, that illustrate the various phases of the realization of the artwork, and the access plan, that, combined with the positioning provided by the top view and artwork level view, provides visitors with an idea of how to access the artwork (by foot, by car, etc.).

As far as concerns the tripartition into work, expression, and manifestation, the visualization module of project Invisibilia provides a repository of files, accessible through Merz's fountain for the description of an artwork.

- Work: the artistic concept (the values the artwork conveys, expressed in

[17] <http://www.agisoft.com>.

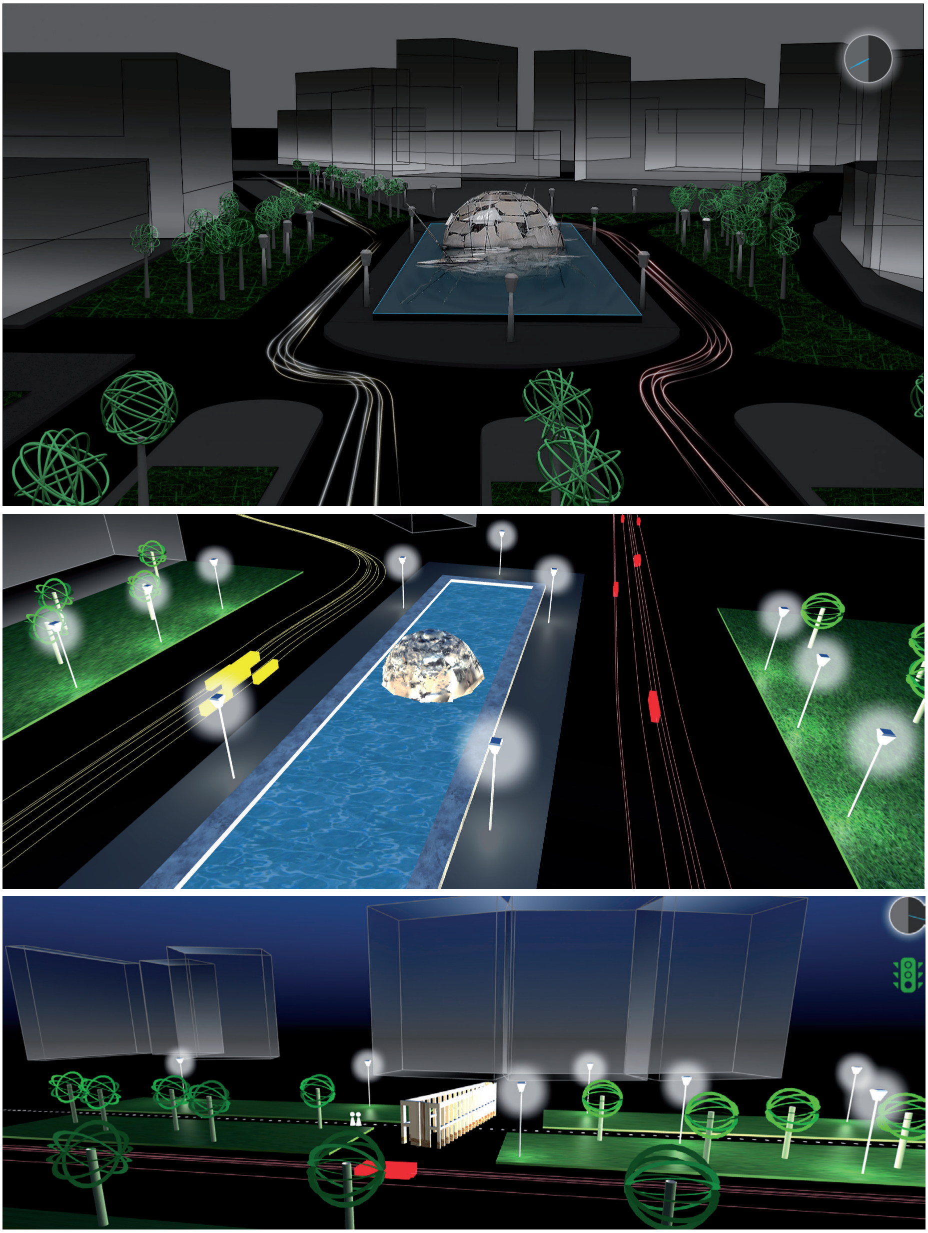


Figure 8. Invisibilia artwork level view. Top: design of Merz's Fountain in Blender; Middle: implementation of Merz's Fountain in three.js library; Bottom: implementation of Kirkeby's "Opera per Torino" in three.js library.

terms of abstractions, sketches, related documents, including video interviews with the artists);

- Expression: the production process (how the realization of the artwork unrolls over time, what materials are employed, the dynamics of the artwork);
- Manifestation: placement of the artworks in the physical site, with a characterization of the surroundings, audience access to the artwork, realization of the artwork.

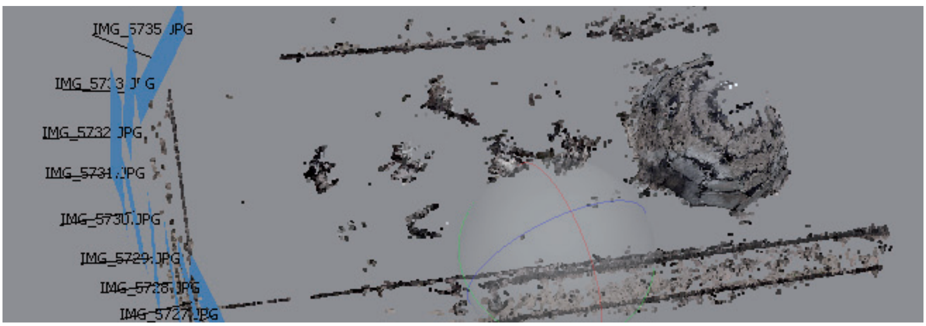


Figure 9: Composition of Merz's Fountain scans in Photoscan.

Conclusion

In this paper, we have described the visualization module of the Invisibilia project. Being related to Public Art in particular, the visualization process has taken into account the placement of the artwork the typology of the surroundings (park, buildings, and the type of buildings, green areas, etc.), what are the methods and the ways for accessing and experiencing the artwork, sketches and video material about the conception and the realization of the concrete artwork. Public art also requires the exposition of the relationship of the artwork with respect to other public artworks in the same city. We decided to take into account both the features of an individual artwork as well as the relationship with other artworks in the city.

Acknowledgement

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