

SYNCHRONIC REPRESENTATION OF SPACES AS A WAY TO UNDERSTANDING THEIR DIACHRONIC EVOLUTION

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Abstract

Starting from theoretical principles on the production of space and the role of perception, imagination, signification and their possible temporal overlap, the research addresses an innovative way of representing historical urban space. This, borrowing the sequentiality of the comic strip, intends to amplify its dynamics, transposing them beyond the pages and bringing them into a three-dimensional virtual environment for a synchronic narration of the transformations of the urban space over time.

Keywords: Synchronic narration; Urban space; Virtual environments.

1. INTRODUCTION

The act of dwelling is temporally linked to the present time. The experience, the representation and the narration of a place often go beyond the limit of the present time: the perceived reality is subjected to the constant modification of forms and spaces and the evolution of uses and activities carried out in them. These changes become part of our experience, often in a totally unconscious way. Drawing as narration and sequential art allow us to ring together different moments, distant in time but linked to the same site.

The representation of space in comic strip form reveals an unusual type of visualization of architecture and the city responding to specific needs of architec-

tural representation that find little space in coded technical drawing or in sketches. Architecture adopts new tricks and stratagems to broaden its audience.

Further interpretative openings arise when the linearity of the narration is abandoned in a “game” of rebounds between present, past and future; in this way the cause-effect condition of the changes is removed, giving the “reader” a greater freedom.

An emblematic example is *Here*, the graphic novel by Richard McGuire [1], in which space passes in a few pages from the background of events to the protagonist; the story, in its non-linear evolution, almost loses its importance, the reader is forced to jump between the pages, reread some or browse others quickly. The

non-story is a pretext for letting the reader experience space and its mutations.

The contribution presented aims to explore these mechanics by transposing them outside the pages of a comic and bringing them into a three-dimensional virtual environment, through the creation of a prototype of urban virtual tour. The paragraph 2 discusses the phenomenological aspects related to the spatio-temporal experience of architecture and city. This part represents the theoretical apparatus to fully understand the meanings of the proposal presented. The paragraph 3 introduces the potential of virtual environments for heritage communication, discussing the concepts of immersion and incorporation. Finally, the paragraph 4 presents the experimentation. The user is offered the opportunity to move in a reproduction of a real space, a historic district in the city of Cagliari (Italy), in its current configuration, within which he can interact with temporal windows and see, immersed in the present, the same place but in the past. The user can know the space in which he is immersed and its changes, going beyond the fixed point of view of a 2D cartoon.

2. PERCEIVE, DWELL AND PRODUCE THE URBAN SPACE

In *La production de l'espace* [2], Henri Lefebvre underlines the importance of understanding urban spaces related to their everyday use. For the author, the production of space is based on a triple dialectics between “conceived space”, abstract representations of space linked to the practices of visualisation and synthesis, and therefore to its design; “perceived space”, produced by practices and uses; “lived space”, linked to the intrinsic and common aspect of social life, through images and symbols deriving from the experiential background of the inhabitants. Understood as a central element of architectural construction, “the privileged interest in space marks a distance with respect to the objectivity of form and emphasizes instead its topological and experiential aspects” [3]. Read in this sense, architectural matter is therefore the means to interact and affect reality through its “poetic and poietic” power, creating tangible signs, but capable of affirming material (physical) and immaterial (of meaning) relationships. And it is this combination that Lefebvrian interpretation finds its connection in Heideggerian concept of dwelling, for which “the relationship between man and space is nothing other than dwelling thought in its essence” [4].

Jean Marc Besse, taking up the idea of inhabited space as living space, evokes existence as directly determined by the act of dwelling, inviting a sensitive reading of the world and promoting the aestheticisation of our relationship with it [5]. Nicola Emery, returning to architectural practice, affirms that in order to build, one must first of all know how to inhabit, and since we inhabit and gradually assimilate sensations, perceptions and messages, by inhabiting we are also inhabited [6]. Within the concept of inhabiting, there are therefore two complementary concepts of use and experience [7]. Architectural objects are perceived and used by their users through crossed meanings in terms of aesthetic reception, atmosphere, coexistence, social image. This combines with Jonathan Hill’s assertion that through use, which he recognises as a creative activity, each user finds a role in the creation of architecture, contributing to the shared rewriting of a text that is never finished, dialectical and in flux [8]. This way of understanding the relationship between space and use represents the theoretical core of Architecture and Disjunction [9]. Bernard Tschumi identifies the relationship between spaces and bodies as what determines the essence and existence of architecture; this because without bodies and perception, space does not exist. Architecture is extrinsic through the event, through the experience of it.

Only apparently is the act of inhabiting explicit in the present time. In fact, this poietic condition is confronted with a wider dimension: a “time” that finds its most suitable meaning in the memory-present of the past-, in the direct vision – present of the present – and in the expectation – present of the future. It is therefore clear how the sense of place is intertwined with the sense of time; by establishing a relationship with it, and mainly with the past and urban memory, a dialectic is constructed so that it is both diachronic and synchronic, since the interpretation of temporalities is always connected to the understanding of the present and to future planning.

Architecture reinforces existential experience, by determining the act of perceiving, in a reality made up of events, memories, narratives, emotions, imaginations and feelings. In this sense architecture becomes “built mental space, therefore: that is, architecture as a place that expresses and embodies a spatial and life experience [10]. It is the same relationship that Pallasmaa identifies between mind (rationality) and body (sensoriality): mental space cannot materialise except in corporeal forms, through the senses [...] The matter of architecture – according to

the phenomenology of architecture that Pallasmaa advocates in the wake of Merleau-Ponty – is in this “lived” immersion in spatial experience” [11]. And in this, the poetic component that defines the subject's relationship with space is also manifested, imagined values are also reconnected and these soon become dominant values. The space grasped by the imagination cannot remain an indifferent space [...] through a dazzling image, the distant past resounds with echoes and it is not possible to grasp to what depth these echoes will reverberate and extend. In its novelty, in its activity, the poetic image possesses its own essence, its own dynamism, it depends on a direct ontology [12]. This research work is precisely directed towards this ontology. In fact, if urban space in its making, through multiple meanings, is subject to constant evolution, the possibility of producing representations of it, both afferent to the past and the fruit of invention, determines the genesis of the poetic image. The latter, becomes an invaluable engine of knowledge and a wide ideational horizon for the project. The theoretical contents anticipate the outcome of the phenomenological mechanisms that characterise the perception of architecture and city and the meanings of experimentation. Regarding the ways to strengthen these fields of knowledge, through which to induce these specific mental processes, the research identifies the hybridisation of the physical and digital spheres as an alternative and synthetic way to determine this condition.

3. VIRTUAL ENVIRONMENTS FOR HERITAGE COMMUNICATIONS

A virtual environment can be traversed, sometimes even in ways that are not possible in physical reality, and it is possible to interact with it; in brief, it allows, thanks to the freedom of movement in the virtual space, a personal and unique experience within it: this is what distinguishes the fruition of a virtual environment. The particular relationship that is generated between the person and the virtual environment is examined by different disciplinary fields, one of these, that was taken as a reference for the paper, is game studies, which gather contributions from a heterogeneous range of research fields.

It is necessary at this point to give a definition of virtual environment, and borrowing from game studies, it was decided to adopt a definition of Calleja: “virtual environments that are computer generated domains which create a perception of traversable space and afford the exertion of player agency. They

are populated by objects and often human or AI controlled entities with whom players can interact” [2]. The author mainly refers to digital games but identifies common elements between them and virtual environments: the user, the representational sign, the game and environment structure, and finally the material medium. This notion is particularly relevant for the purpose of the paper because it separates digital games, but also cross-media technology applications, from other virtual spaces, such as chats, social networks or websites.

The scientific literature has long questioned the relationship between the user and the virtual world, investigating the perception of bodily presence within a virtual space. Among all, the main concepts we want to highlight are those of immersion and presence, but reconstructing their history is beyond the scope of this paper [3–6]; therefore, it was decided to refer to some key concepts representing the different positions: Murray's notion of immersion [7] and Calleja's notion of incorporation [8].

Regarding the concept of immersion, Murray defines it as a dimension that does not belong to physical reality, in which one remains suspended as long as he or she actively and creatively participates in immersion through an “active creation of belief” [7].

The concept of incorporation goes a step further and tries to merge different positions: “[...] the absorption of a virtual environment into consciousness, yielding a sense of habitation [...]” [8]. Calleja, starting from the traditional meanings of the term, i.e. assimilation in the mind and embodiment, defines a notion that constitutes the meeting point between them. The author, like Murray, refers primarily to the virtual environments of digital games, but the position is valid and adaptable to any virtual environment that aims to create spatial engagement with users, so as to arouse a sense of inhabitation of space.

Taking into account the elements described above, and thanks to the evolution of technical tools, virtual environments are widely used by a broad spectrum of industries, both for educational and training purposes as well as for communication; there are numerous examples of the use of these tools, tailored to the final purpose, the type of users, the age, or the level of education [9–11]. Virtual environments, meaning computer-generated traversable spaces inhabited by users, have become highly relevant for the promotion of intangible accessibility, and their use is also extensively documented for cultural heritage, a key test bench for cross-reality technologies [12]. The promotion and communication of cultural heritage, both



Figure 1.
Via Università in the Castello district, Cagliari, Italy (Photos by the authors)

tangible and intangible, inevitably involves the application of these technologies, which also include virtual tours and serious games site-specific, and have proved that their use is now indispensable [13, 14].

4. METHODOLOGY

4.1. Characteristics of the case study

Since the purpose of the proposed prototype is to offer immersiveness in a virtual environment that represents in a recognizable way the contemporaneity of the chosen place, and to take advantage in this environment of windows that open in other epochs, it is essential to first identify the space that we want to simulate. The ideal place must present two fundamental characteristics: there must be historical photographic material that represents it in different historical periods and it must be detectable in its current condition.

The detectability of the current state is essential so that the space can be read, interpreted and represented in a critical way, in order to identify the minimum characters that allow a virtualization referable to reality.

Regarding the availability of historical visual material, wanting to allow a synchronic reading of situations or “states” distant in time, the greater the variety of new temporal points of view offered, the greater the fascination and interest that can be triggered in the user. The variety can be expressed in terms of single views captured in multiple eras, as well as multiple views in multiple eras of the same subject.

Following this logic, the public spaces that have been experienced the most by the population, becoming

the protagonists of the events themselves, are the ideal places to apply the proposed methodology. These places are rich in phenomenological, situational and experiential changes, which often led to transformations of space and its configurations, both because of the changes and in function of them, to facilitate or counteract them.

Such spaces are rich in stories, whose narration leads to represent them in time; to represent the place means to talk about it and the narration of its events. The wealth of historical material is therefore the natural consequence of the wealth of vitality of the places. Once the optimal characteristics and the space to be represented has been identified, the next step is the collection of historical and current materials.

Regarding historical materials, nowadays an increasing number of public and private archives are physically and virtually opening their doors to the public, making available an enormous amount of visual material; more and more often, private initiatives of collection and sharing of materials, often according to specific themes, are added to these. All these materials offer voluntarily, or involuntarily, a window from which to observe glimpses of places now transformed or unrecognizable.

In contrast, actual space is directly legible and interpretable, and therefore representable. Our everyday life is characterized by an increasing number of tools, which are increasingly accessible, that allow us to capture the space that surrounds us. All we need is a smartphone to take photographs, videos or in some cases even three-dimensional captures; to these we can add tools such as photogrammetry, laser scans or simple two- or three-dimensional restitution of images.

4.2. Via Università in Castello District, Cagliari (Italy)

An ideal case with the characteristics described is via Università, in the historic district of Castello in Cagliari (Italy) (Fig. 1); it has been the scene of architectural, urban planning, but also political and social transformations. Transformations recounted by numerous archival and cartographic sources, which are fundamental to the proposed work.

The district of Castello was founded as a Pisan city in 1217 on one of the hills of the present-day city of Cagliari and its urban layout is almost unchanged since then [26].

From 1720, with the process of modernisation by the Duchy of Savoy, Via Università was at the centre of construction events culminating in its re-functionalization as a cultural centre and the construction of a complex housing the University and the Tridentine Seminary [27]. The complex, with its perceptive and scenic effects, provides a new key to interpreting the area, also thanks to the subsequent construction of the Reggio Theatre.

Only in the 19th century we had a radical urban change. Following the example of the Paris town plan, ramparts were demolished all over Europe and unhealthy medieval quarters were eliminated. The State became a promoter of social policies and found expression in Academies and technical schools. It was in that season of change that Gaetano Cima played a leading role. In particular, plans were developed for the expansion of the city and, at the same time, plans were approved for the modification of the streets of Castello, such as the widening of Via dei Genovesi by 5 metres, the building of new palaces or the project for the new theatre based on drawings by Cominotti and reworked by Cima himself.

Today, therefore, Via Università is home to some interesting architectures, bearing witness to the changes that have taken place over time, from the Torre dell'Elefante and the San Giuseppe Calasanzio complex to the Balice architectural complex, the ends of the street, via the University of Cagliari complex and the Teatro Regio.

4.3. Representation techniques

In this first part of development, it was decided to opt for a three-dimensional modelling of a limited portion of space, maintaining a relatively low level of detail, preferring a focus on a characterization more architectural than realistic. The context is therefore modelled through simple volumes on which the dec-

orative elements essential for the recognition of architectural objects are applied. This first approach aims to create the “container” of the early features of the tour, to be implemented in the future with elements to increase the sensory immersiveness of the user.

One of the early features are temporal windows in which the user sees a simulation of the same point of observation, obtained from historical images; it is therefore necessary to identify for each image / window in an approximate way the point of view and visual direction represented, in order to obtain a correct positioning and orientation of the temporal windows.

In this phase of the experimentation, it has been decided to simulate the three-dimensionality of the historical environment, to be visualized through the windows, simulating a parallax effect in the images. This effect is obtained by identifying a reduced number of focal planes according to which an image segmentation takes place; the portions of space between two focal planes are saved as single images.

4.4. Implementation in software

For the realization of the prototype, it has been decided to use the Unity game engine, for its versatility and simplicity of use. The developed models are directly importable in the development environment preserving the scale and the textures, eventually modifiable later if the necessity should arise; in phase of importation the colliders are generated, indispensable in order to simulate the physical interaction between user and surrounding space. The explorability of the model is instead guaranteed from a system of movement applied to the video camera, that simulates the movement of the user and its visual field; the granted movements are those standards for a simulation like that one proposed: movement of the four base directions, rotation on itself and of the visual through the movement of the mouse and jump.

The temporal windows are represented from empty rectangular elements whose content is visualized once that the customer interacts with them through a simple click of the mouse; the content is the rendering of a second camera that frames the historical image to visualize. The visualization mechanism foresees the creation of a couple of windows, one in the actual context and one placed in another fictitious space of the environment; the second camera whose position in relation to the window is calculated, through the opportune scripts, in reference to the



Figure 2. Window-camera positions for temporal windows (a), an image from the prototype (b), an example of image segmentation for parallax effect (c)

position of the user with respect to the first window (Fig. 2a) to the second window. This allows to simulate the view through the window and to visualize the historical image opportunely segmented and positioned in front of the second window (Fig. 2b); to guarantee the parallax effect, the image segmentations are arranged along a direction normal to the plane of the relative window (Fig. 2c).

5. CONCLUSIONS

The contribution aims to study the possibilities offered by the use of a virtual setting to narrate urban space. In particular, the recognisable representation of a physical space offers an immersive experience enriched by a synchronic narration of the events that have taken place in the represented space; this is thanks to the use of the mechanics of time windows that allow the discovery of past spatial configurations within the space in its current state. The experimentation presented here proposes a workflow that allows the relatively simple creation of small prototypes in which the user can freely explore the space and discover its diachronic evolutions through interaction with open windows in the past. However, this approach presents difficulties related to the modelling of large urban spaces, the level of detail of which must be carefully calibrated to ensure the recognisability of places without falling into the problem of over-modelling. In addition, in order for time windows to fulfil their task effectively, it is essential to faithfully trace back to the original point of capture of historical images, which is often not an easy task.

Future developments will certainly concern a greater implementation of elements to increase the sensory immersiveness of the user, such as the inclusion of ambient sounds or dynamic lighting of places in accordance with real-life environmental characteristics.

In conclusion, the kind of exploration proposed helps not only to increase the knowledge one has of the urban space, but also to raise awareness of the space itself and the mechanics that define its changes over time.

AUTHORSHIP CONTRIBUTIONS

Raffaele Argiolas elaborated all figures.

Although the study was jointly performed by the authors, most of the paragraph 1 was written by Vincenzo Bagnolo; most of the paragraph 2 was written by Andrea Manca; most of the paragraph 3 was written by Sara Cuccu; most of the paragraph 4 was written by Raffaele Argiolas; the Conclusions were jointly written by all authors.

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