Visiting a Neighborhood of Medieval Silves Using Virtual Reality and Non-Player Characters

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Introduction

Traditional methods of visualizing ancient archeological sites, including drawings, models, and static representations, often fail to capture the essence of the spaces they represent. Although attentive research and three-dimensional reconstruction can recreate the architectural complexities and demonstrate the building materials and surrounding landscapes, these simulations can appear spare, somewhat empty, lacking the vibrant atmosphere of inhabited cities. Because of this feeling, a tendency has arisen to incorporate virtual characters into three-dimensional (3D) simulations, adding a layer of narrative involvement and ambience (Erickson et al. 2018). Whether they are historical personalities or fictional characters, these characters allow the simulated experience to be transformed, providing a more comprehensive understanding of past societies and improving the immersive representation of history.

The increased availability of virtual-reality technology has led to a transformative shift in the development of immersive and interactive virtual environments within the realm of reconstructing and simulating cultural heritage. Virtual reality (VR) emerges as a cutting-edge tool for museums and education, arguably helping to bridge the temporal gap between the past and the present.

This article explores the combination of VR technology with self-organized autonomous virtual characters to foster a profound sense of "being there," in the historical and cultural sites of the past. Using a case study of the simulation of Xilb (the medieval town of Silves in southern Portugal), we examine the transformative impact of VR coupled with non-player characters on users and their connection with cultural heritage. The challenges and limitations, including authenticity, representation, and ethical considerations, are analyzed. The article focuses specifically on a

narrow definition of VR, one that excludes realistic 360-degree experiences and focuses on the synthesis of 3D virtual environments.

The structure of the article includes a review of the literature on the intersection of VR, cultural heritage, and virtual humans, providing an up-to-date overview of this practice and research. The process of building the Xilb simulation is first described, followed later by a discussion of the experience of visiting participants who have tried out the simulation. The subsequent discussion critically examines the challenges and limitations in the field of cultural heritage, addressing ethical considerations, technological constraints, and the potential impact this technology may have on traditional methods of heritage interpretation.

Virtual Humans in Cultural Heritage

In contemporary historiographical practice, 3D technology is increasingly used to visualize ancient sites, offering various technical possibilities, such as static images, immersive videos, and VR experiences. However, these 3D representations often convey a misleading perception of "ghost towns" with empty streets and public places. To integrate dynamism and infuse life and vitality into these visualizations, virtual characters have gradually been introduced, providing a more accurate reflection of the historical sites (for instance, Salyers et al. 2017; Antunes et al. 2017; and Erickson et al. 2018).

The introduction of virtual human beings into digital landscapes aims to represent the everyday activities of ancient citizens, their social interactions, and their occupation of space. Virtual characters enhance the overall user experience and provide the visitor with valuable historical and architectural information, acting as guides, for instance. Vosinakis and Avradinis have identified different categories of virtual actors in historical simulations of this type, such as: (1) animated props, (2) virtual guides, (3) virtual crowds, and (4) intelligent agents, each of which contributes to the immersive and educational aspects of the simulations in which they appear (Vosinakis and Avradinis 2016).

Although virtual characters offer a rich and deep narrative, there are nevertheless challenges to their successful implementation including (1) some limitations in terms of individual expression, (2) relatively homogeneous behaviors as well as (3) behavior models that have to be developed specifically for each context, for each simulation. Significant efforts have been made to improve AI modelling techniques to increase individuality and spontaneity, contributing to more realistic and immersive simulations (for example, psychological parameters or crowd patches (Pelechano et

al. 2017)). The use of VR in the simulation of ancient sites and events, as exemplified by several projects (Barreau et al. 2015, Lithodomos 2021, VRScout 2023), offers users a fully 3D immersive experience, allowing them to engage meaningfully with representations of the past.

The Project Xilb

Based on an archeological survey in Silves, Portugal, which documented an excavated area with traces of urban presence from the twelfth century, we simulated a small neighborhood consisting of eleven houses and their respective support structures. The simulation project involved students from the University of Lisbon, with the aim of modeling these houses and the castle using data and documentation from the archeological survey provided by the Silves Museum.

The simulation work included the modeling and subsequent artistic texturization of 3D models, including doors and roofs, meticulously crafted to enhance realism. The houses and other architectural structures referenced in the archeological survey were placed on the virtual terrain. In the absence of period-specific information, the virtual city's terrain was modeled to reflect the morphology of the current city.

Subsequently, to provide a context for the surrounding urban fabric, we filled the empty spaces in the landscape with bright white blocks, thereby occupying the remaining space around the castle (Figure 1). These landscaping embellishments emerge in parallel, distinct from the historically accurate representation of the houses, but allowing their placement in context and framing them within what the city would have been like at that time. A landscape art layer was then enhanced, adding vegetation, dirt in the streets, and other details.

Once the static architectural layer had been consolidated, a second, animated layer was added. At this stage, virtual characters were introduced to bring dynamism and animate the simulated environment. A first category was simply pre-animated characters with pre-determined gestures, in what can be called *animated props*: Characters performing one or more actions continuously, in repetition. It was therefore possible to create situations that illustrate everyday functions and situations, such as the baker kneading bread, workers in the gardens, or someone unloading a cart (Figure 2). To this animation layer we also added domestic animals, also in repetitive actions, such as donkeys, horses, or chickens.

Figure 1. A simulation from Project Xilb, a reconstructed cityscape

Blocks of house-props fill the otherwise empty landscape (fore-ground and right). These contrast with the faithfully reconstructed houses of the excavated area, such as the one on the left of the image (more detailed in Figure 2), with a roof and textured walls.

Figure 2. A simulation of activity from Project Xilb

Characters sitting by the fire animated with small and repetitive gestures.

In addition to this first type of character, which we can describe as having passive agency, because they operate "blind" to their environment and other entities, there is a second type, active in the sense that they integrate the environment and other elements into their own behavior. These are animated with finite state machines (Von Neumann 1966), defining sequences of states/action-animation. In this group, we also include birds that are animated in a combination of state machines and flocking behavior (Reynolds 1987) that considers the other members of the bird class.

A second type of active agency characters are the human inhabitants of this virtual neighborhood, who have the ability to move around autonomously, roaming the streets of the simulation. They are intelligent agents, being able to act and exhibit spontaneous behavior, such as stopping to talk to a companion. These NPCs, *non-player characters*, as they are known in the video game environment, were built based on an artificial intelligence model for simulating self-organizing groups of virtual humans (Figure 1). These autonomous characters (NPCs) demonstrate spontaneous and heterogeneous behaviors and have a visual representation that correlates with the scale of a human of average height when immersed, allowing the visiting user of Xilb VR to have a body-to-body perception.

These characters have enriched the experience by adding a certain degree of realism and variability, somehow creating an imitation of the human presence in the neighborhood and allowing a glimpse of what the day-to-day environment would be like in the represented site. Their actions, interactions, and the social dynamics displayed inform the visitor's experience and promote a sense of presence in the virtual environment.

The Propedeutics of Experience

This Xilb VR experience was presented in the main tower of Silves Castle, offering a panoramic view of the contemporary city and the simulated old quarter. The presentation took place in one of the towers, from where one can see the former archeological site. Although a block of modern buildings is currently located there, excavating their foundations had revealed the neighborhood being simulated. This space was shown to visitors before they tried out the virtual experience with the XTC Vive VR headset.

This experience of the medieval quarter of Silves, Portugal, offered an idiosyncratic exploration of the historical space. By immersing visitors in a doubly absent space – the destroyed historic site, experienced through the virtual realm – the VR headset served as a gateway, bridging the gap between present physical reality and a crafted virtual representation.

As Magritte (*The Treachery of Images,* 1929) and Kosuth (*One and Three Chairs,* 1965) so aptly explained, representation builds on the indexicality of images and words that refer to abstract properties of physical objects. The concept of "door" encompasses properties that are not entirely evident in the virtual door we encounter in Xilb. The visual door has an allegorical quality.

When we put on the VR headset, we enter a propedeutic moment in which we prepare to assimilate the rules of another space of agency/experience (*spatium* in the Deleuzian sense). We embrace a way of being in which we prepare to inhabit a space with its own rules, potentially different from those of the surrounding space. The door of the building in front of us in Xilb does not have carbonic matter, so it lacks a physical existence comparable to what we see in the world we inhabit. In that sense, it could be an illusion like a shadow or a rainbow. It lacks cohesion or unity beyond its own appearance. It is fetishistic.

However, this door is a real object, as David Chalmers explains so well in *Reality +*. These ghosts, these illusions, also have a material existence as a representation made of bits embedded in integrated circuits. There are no doors, no inhabitants of Xilb, but rather digital objects that exist within the computer in the form of data structures that allow us to visualize characters, doors, and walls (Chalmers 2022). We are in osmosis, as José Bártolo tells us, quoting Roy Ascott (Bártolo 2004). There are no biological exchanges, but there is a displacement of data within the computer's internal structure. It is in osmosis that the hardware system, the software system, and the user conspire to update an immanent plane. In this plane, the visualized door is a closed door that blocks the visitor's access, preventing the visitor from entering the house in front of them. Solid. It reveals causal powers over the virtual behavior of the visitor. A perceptual illusion is compensated by perceptual reinterpretation.

It is relevant to emphasize David Chalmers's idea of there being a virtual existence that does not oppose physical existence. The building at the end of the Xilb's street does not physically exist 10 meters away but is virtually at that distance from us. It is not fiction; it is not an illusion. They are coupled representation systems, with a material and voltaic existence. And at their highest level of representation, they operate in linguistic signs shared with humans. What we see are indeed doors. Virtual doors. Beyond appearances, they retain some of the existential properties of doors. They are something more than ghosts, something more than illusions. However, this representation raises some questions – on the one hand, about the uncritical acceptance and potential misuse of such

experiences, which can be perceived by the lay visitor as magical, and, on the other hand, about the nature of perception and how it relates to our understanding of the experience.

It is through and with our bodies that we become aware of the world. As Merleau-Ponty tells us, "It is through my body that I understand the other, just as it is through my body that I perceive 'things'" (Merleau-Ponty 2022, 253). Upon entering the Xilb environment, visitors engaged in a sequence of actions, from scrutinizing their surroundings to confirming their bodily presence in the virtual space. They immerse themselves in the virtual world and see it from a first-person perspective.

Immersing into the world, we replicate the behavioral model that employs the bodily lexicon of a two-year-old child (Bártolo 2004, 308), looking around, up and down, feeling the ground, taking a step, exploring, using a simplified and limited semantics. Through repetition and difference, we come to understand the world. Simulacrum is the system "in which different relates to different by means of its difference itself" (Deleuze cited in Bártolo 2004, 311). As we repeat gestures, we also notice the differences: The senses of the visitor are hijacked, mainly, the gaze, of course. With the headset, visitors become blind to the physical surroundings. However, they perceive the surroundings of Xilb's street that virtually surrounds them–the walls of houses, the dirt on the ground, and the water puddles. And then, there is the movement of this virtual body that can take steps in physical space, adjusting the corresponding position and orientation in virtual space. Simultaneously, he/she can move through teleportation when activating the trigger in the handle, allowing the visitor to move to the desired location after firing a beam to the destination point a few meters ahead, making the virtual body advance on Xilb's street while keeping the physical body stationary. Finally, the exploration is done in the virtual environment using the haptic device that allows us to virtually grasp an object. This handle produces a vibration when encountering a "grabbable" object, such as a ceramic jar that the visitor picks up from the ground. The visitor's hand has a dual sensation when "grabbing" the jar – the visitor feels the vibration corresponding to the object and sense the hand in the act of touching and pressing the trigger. Visitors now feel the trigger of the device they manipulate, not the surface of the object they virtually grasp. It is a filtered and virtually altered yet amplified bodily experience.

An Embodied Experience

> This virtual action of things on our body and of our
> body on things is properly our perception.
>
> (Bergson 2011, 272)

Although filtered from the feedback mechanisms in interactions with the world, these interactions with virtual objects, virtually incorporated, contribute to the experience of that same world. Our own body, as a lived and experienced entity, is intimately involved in our perception of space. Our body provides a point of reference, a vantage point from which we navigate and make sense of the spatial environment.

Bergson's philosophy tells us that the perception of space establishes itself in a relationship of reading and pre-action, a relationship that considers tactility. In other words, space is initially apprehended through an interplay of memory and motor coordination with our surroundings, establishing a field of possibilities from our own body (Bergson 1939).

In our experience, we encounter objects that occupy specific spatial positions and relationships. There is a practical foundation in perception based on existential praxis. We perceive distances, shapes, and spatial arrangements, with these aspects being essential elements of our spatial experience. The understanding of space considers the perceived entities, those we can reach physically. Space is thus established as a physical, bodily relationship. It is a synthesis of stimuli, memory, and motor coordination. A close dimension refers to the immediate spatial field directly given by perception, while a distant dimension involves the extension of space beyond our immediate perceptual field, which we can project and anticipate through our intentional acts. The visitor relates to space and brings things into presence, becoming aware of what is at the reach of his/her hand, what is at the level of the retina, and there is also an invitation to discover what lies beyond the visible, beyond the corner at the end of the street.

> There is a proprioception that, as one immerses oneself in the virtual environment, becomes a hyper-real perception, to the extent that one feels the body, in which there is a correspondence, located in the body, between cause/effect operations... thus having no consistency, neither material nor temporal. (Bártolo 2004, 317.)

We gradually fine-tune the fit between the environment and the different forms of agency, the actions and reactions motivated by the environment

and by ourselves, immersing ourselves in a space that is simultaneously the osmosis between the designed space and a psychologically constructed interior space, in which the simulacrum can function without being questioned. Simulation is only possible and effective with a smooth and efficient functioning of the material and operational order. This is the only way to achieve an "illusion of non-mediation," in what Lombard defines as presence (Lombard and Ditton 1997). This is how a cognitive map, associated with interactions and feedback, gradually develops, shaping visitors' understanding of the spatial layout and architecture of Xilb's virtual site. By associative leapfrogging and because the body is there or has the perception of being in the street of Xilb, an embodied knowledge of the historical space is also shaped as mechanisms of memory integrate these experiences.

What Comes Out of the Xilb VR Experience

The inclusion of autonomous virtual human entities, or non-player characters, in the Xilb environment increases the degree of immersion and the feeling of presence, promoting a greater sense of incorporation. A reading of Merleau-Ponty tells us that, from the phenomenological point of view, we feel their presence in relation to our own existence, creating a sense of shared space and mutual understanding that goes beyond mere visual observation. "There is confirmation of the other by me and of me by the other" (Merleau-Ponty 2022, 253). For example, when we see the character walking up the street of Xilb, toward us, we don't just see his movements as isolated acts, we perceive his movements in relation to our own body's potential for movement. This creates a sense of shared space and bodily understanding, where the observer's body schema influences how that person interprets the intentions of others.

These virtual entities inhabit the digital world, representing the ancient inhabitants of the site, but above all, they may bring interactive and narrative dimensions, combining historical records, archeological manifestations, and cultural contexts to create a more immersive and educational experience. Elaborating the behavior of the NPCs to align them with the social norms, codes of conduct, and cultural and historical contexts of the period represented can provide visitors with a deeper understanding of the beliefs, values, and customs of the time. Interaction with these virtual characters deepens the visitor's connection to the historical context represented, providing a more engaging and captivating educational experience than that possible through traditional resources.

As we mentioned earlier, the experiment was first presented to visitors in the Castle of Silves. These visitors were interviewed immediately after Xilb's emersion. Subsequently, students from the master's course in computer engineering at the Faculty of Sciences in University of Lisbon were also interviewed. From the analysis of the surveys, some ideas become clear, which we share here in a summarized form, and which may serve as clues for future developments. In particular, visitors were able to immerse themselves in the reconstructed environment, gaining a more comprehensive understanding of the neighborhood. Their feedback suggests that Xilb VR was able to effectively communicate urbanism and architecture in a spatial context and can be said to offer educational value. Unlike traditional visualizations, it allowed users to perceive the size, scale, and spatial relationships of the historic site by virtually walking the streets. The immersive nature of the VR environment, with autonomous characters that mimic human behavior, lent realism and credibility to the experience.

A significant outcome of this experiment will then be to emphasize the transformative impact of visualizing historical sites in VR inhabited by characters of the time. The concepts of presence and immersion offer a new perspective for understanding the urbanism and architecture of ancient sites, giving them a relatable human scale. This immersive Xilb VR experience gives users a deep psychological sense of being present in Xilb's historic environment, enriching their understanding of the space and its meaning. However, the deliberate use of an esthetic that was not photo-realistic raised some questions about the balance between informative content and realism. Some participants thought that an increase in the degree of detail, especially in the design of the characters, might improve the overall experience. It will certainly be a challenge to maintain a high level of plausibility in appearance and behavior while at the same time addressing concerns about credibility.

In this way, the Xilb VR experience, while providing a meaningful and memorable journey for many users, may eventually lean more toward caricature than realistic representation. The tension between immersive storytelling and maintaining a credible representation underlines the complexity of historical simulations in VR. Issues such as the balance between the "uncanny valley" and frustration with the lack of realism of the characters, as well as the balance between informative elements and aesthetic choices, stand out for their potential for improvement.

The survey of Xilb VR visitors also revealed opportunities for improvement in creating a more realistic environment. Techniques such as high-quality graphics, greater user agency and the existence of more

diverse populations could improve the sense of verisimilitude and presence. More possibilities for user interaction with characters and objects, along with special attention to system performance and visual quality, could also contribute to a more immersive, engaging, and empowering experience.

Xilb VR provokes critical reflections on the relationship between the past and the present, the role of technological mediation in representing cultural heritage, and the potential for misuse or misinterpretation of virtual simulations. In some ways, by highlighting issues of representation, it questions the absolute historical truth. It challenges the notion of a complete and objective representation of the past, emphasizing that VR is an interpretative medium. The discussion extends to the poetics and creation of meanings inherent in historical simulations, acknowledging their discursive nature and the impact of social and ideological contexts.

On this plane, there is a clear risk that choices and omissions in the reconstruction process may reflect the biases of the creators, necessitating a careful analysis of competing theories and an accurate and thoughtful representation of cultural nuances. This means responding to the challenges that historical reconstructions require, including, on the one hand, multidisciplinary collaboration among experts from various fields of knowledge with diverse technological skills, and, on the other hand, transparency in decision making. Poorly constructed simulations, based on erroneous, careless, or intentionally altered data, may be perceived as true replicas of the bygone era, potentially conveying false "history." They then run the risk of becoming potential producers of hyper-realities, contributing to what has been termed the post-truth regime, where reality no longer relies on properly structured and substantiated information but instead is distorted or hallucinated.

In a time when these simulations are expected to be easier to construct thanks to AI-based generative tools, issuing this warning becomes imperative. Providing users with contextual information and the academic sources used to build artifacts ensures a more authentic representation and guards against misunderstandings.

Final Notes

In conclusion, the VR simulation of the Silves neighborhood discussed in this article raises some important considerations about the balance between immersive narrative and historical accuracy in this type of simulation. We have seen how VR is both a technical and psychological medium that operates in a fluid articulation between different systems – voltaic, machin-

ic, logical-symbolic, symbolic, transductive (the interfaces), and organic matter. These factors make it a quasi-ecosystem in flux. As technology continues to evolve, solving the challenges presented here will contribute to more enriching and authentic representations of historical and cultural contexts.

The Xilb VR experience provides a new and immersive approach to communicating and disseminating historical sites. The use of VR allows users to better understand the urban and architectural aspects of the old sites, with the integration of virtual humans fostering an added sense of presence. Discussions with a deeper philosophical basis related to embodiment, perception and the nature of reality can offer us useful new insights into the impact that the presence of NPCs in virtual environments has on the visitor's sense of presence and engagement – of one's own body and the body of the other, perception, interaction, human existence, and the world.

On the one hand, this type of historical VR with population simulation allows us to obtain information about rural and urban areas and the daily lives of their inhabitants, offering a more vivid and contextualized view of the past and revealing fundamental aspects of the existence of its inhabitants. Yet on the other hand, it is a technology that also allows us to speculate and simulate hypothetical scenarios to test hypotheses and help interpret architectural and urban features, contributing to the formulation of occupation and use theories. Further, it also allows virtual access to archeological sites that might otherwise be difficult to access for a variety of reasons.

However, we should take a vigilant and responsible approach to developing 3D-VR experiences that simulate historical cultural heritage sites, so as to avoid perpetuating stereotypes or spreading inaccurate information and cultural appropriations. Because these "time travel" experiences are instruments of high educational value, enriching learning through observation and experimentation, it is crucial that these simulations give absolute priority to accuracy and authenticity. The guarantee that the historical representation is reliable and informative extends to the representation of architectural elements and building materials, as well as the accurate representation of clothing, objects in use, and even facial expressions and distinctive social behaviors, both on an individual and collective level, of the virtual characters.

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