Visualising historical knowledge using virtual reality technology

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Abstract
This paper discusses virtual reality reconstructions of historical sites. Seeing the past as a cultural construction makes the process of representation problematic. Two case studies illustrate aspects of the visualisation of virtual environments: how authenticity in computer reconstructions is reduced to their visuality, and how historically-based VR environments as copies honour their original. The paper asks for more implementation of life forms into architectural settings, and also examines the impact of user expectations on the VR experience.

Key words: authenticity, reconstruction, visualisation, virtual heritage, virtual reality

1. Introduction
The idea of a time machine has triggered people's imagination for many years, with different fantasies about how such a thing would look and work, and especially what experiences of ancient and future times it would give us. Virtual reality environments that present the past might be thought of as contemporary time machines. In this paper I will explore virtual reality representations of historical sites, thus restricting VR to certain computer graphical worlds in which the user can navigate and interact. To what extent can we experience the past in such a VR world? What must be considered when making a graphical representation of history? And what influences our experience of these reconstructions?

Examples will be taken from two case studies. Hellenic Cosmos cultural centre in Athens is owned by the Foundation of the Hellenic World (FHW), a private foundation that aims at preserving and disseminating Hellenic culture and history. The centre opened in 1998 and uses sophisticated new technology. The VR department contains a VR CAVE, where visitors can tour a computer graphical reconstruction of the ancient town of Miletus (see Figures 1, 4, 5 and 6), and a 'Magic screen', where one can learn about Byzantine costume, and both are stereoscopic 3D environments.

Nu.M.E. (Nuovo Museo Elettronico) claims to be the first museum of its kind and calls itself a "new electronic museum". It contains a VRML model that shows the architectural development of the city of Bologna, Italy, through the past 800 years (see Figure 2 and 3). The program runs on a powerful...
computer and is open to the public at the Information Office downtown. Visitors can navigate through the streets using the mouse, and by clicking on a timeline they can see how the city looked at different times in history. When you enter a different year, the scenery changes to what it was like at the time selected. Everything that is visualised in this four dimensional model is solely based upon historical documentation.

The case studies conducted by the author are mainly based on interviews with producers and visitors of these VR environments. They serve not as representatives for a general conclusion, but rather as examples of two different approaches to historical modelling.

2. Historical Knowledge

Graphical reconstructions are complex and involve many fields of study. Naturally, the first thing we need to know in order to make a representation is exactly what it is that we are trying to represent. A historic representation, in other words, requires thorough investigation of the conditions at the time. But how can we be sure about what has happened in the past?

According to heritage theorist David Lowenthal (1985 187), historical knowledge can be derived from three sources: memory, history and relics. Some of what we know we remember from our own experiences or from what people have shared of their memories. Other parts belong to the collective written history. And then there are old artefacts and buildings which remain as witnesses to the past. These three sources of knowledge fill in for each other, and listening at what they all have to say we get as close as possible to getting to know the past.

However, this knowledge is limited. Of all the things that have happened, we only remember a selection of events. Most artefacts break or disappear in time, and descriptions of past events cannot bring them back the way they were, simply because they are descriptions and not the events themselves. Furthermore, a story about an event will always be subjective, both for the storyteller and the listener, and it will be coloured by the experiences we have at the time. This goes for any type of representation, abstract or visual. Every time we make a new statement about an artefact or an event, we are making a new interpretation, and then something new is born, different from the original happening (Lowenthal 1985 214ff). In this sense we always change the past, therefore it is possible to conclude that the past doesn't really exist, at least not in the way we normally think it does. What we know about the past is for the most part based on interpretations, and cannot ultimately be proved. The past is a cultural construction.

3. Representation

Some of the knowledge derived passes on from one generation to the next. It can be mediated through various expressions representing the knowledge or message, such as speech, writing, pictures or actions. When making a representation we have the opportunity to tell the story the way we want it to be told, so how do we decide which parts to represent?

Let us compare a photograph of the centre of Bologna to the Nu.M.E. reconstruction...
tion of the same street (Figure 2). In the real Bologna you could not see the buildings from this angle because you would be standing in a street with heavy traffic. Nu.M.E. was built to present the architectural history, and the visitor has the opportunity to walk, or even fly, freely through the streets downtown watching only the buildings, not having to worry about being hit by a car or hearing the noise of the traffic. All signs, bins, cables and also all life is taken away to concentrate on the architecture. Since a representation of the past is restricted to showing parts of the total scene, it also helps us focus on the parts selected.

When history is the issue there isn’t always enough information available about the object we want to reconstruct. How can we solve this problem? Can we make a model of what the object probably looked like, or should we skip representing it due to little information? The balance between fact and fiction is a dilemma for the designers. Being a representation of the evolution of Bologna’s town centre, the historians in the Nu.M.E. team were concerned that the model was as historically accurate as possible. Even though there is an enormous amount of documentation about the town, for some of the buildings they lacked the information needed to provide an accurate reconstruction. The team found a solution to this problem by using a plain brown wall where they lacked information about the surface or the structure of the building (Figure 3). This way the visitor can see that they knew there was a house here, but not exactly what it looked like. These ‘black holes’ in the model make it historically very correct, but they do not make the experience very realistic.

Normally the point of making a historical reconstruction is to show or give an impression of the past. What was life like in the past? Many visitors did not feel that they got an answer to this question after having experienced the computer reconstructions. The details can be very impressive, but it takes more than a good scenery to show how it really was. As most...
visitors don’t know the details of ancient architectural styles, they are more concerned with the human part of city life—which is something they can relate to. Perfectly designed columns (as in Figure 5) do not tell us about the everyday life of people in a particular time or place. Even though the architecture is presented in a lively way, the contrast to living creatures became very clear in the part of the reconstructed Miletus where one can dive into the sea in the bay nearby. Here fish and dolphins are swimming by, and if you wish you can even get a close look at the inside of a turtle’s shell. The designers felt that they had a liberty under water to reconstruct it the way they wanted. Unlike the city, where historical accuracy was the guideline to the visualisation process, the under water environment was created with a good deal of imagination. The heavily documented parts of the town were impressive in their details, but in the end gave a sterile impression. After all, the buildings were made by and for their inhabitants. What is a town without people (Figure 4)? What is a stadium without athletes? Does a ghost town give a more realistic impression than its ruins? It is a paradox that the part of the virtual environment that was based on less information (the under water scene) was the one that the visitors liked the best and the one in which they felt the most presence.

4. Visual experience

However, the design is important in getting the message across. In graphical VR worlds the visuality of the representation is particularly focused. More than anything the virtual world offers a visual experience. What we see defines our experience. How does this affect our representation of the abstract concept of history?

Perception theories are important for designers in order to make the virtual environment a smooth and natural place to be. For a long time the dominant idea of perception was as follows: first one perceives the object, then one gives meaning to the object based on previous experience and recognition (Davey 1999 12). This view corresponds well with the western scientific and philosophical convention that thought and perception are two separate activities. Today, theorists are moving away from this view, and show a tendency towards the idea that these are not two separate operations, but
one: perception and the adding of meaning to
the object take place at the same time, thus
giving the individual an active role in percep-
tion, rather than just passively receiving impres-
sions from the surroundings. Within philoso-
phy, hermeneutic aesthetics has been foremost
in promoting this view (Davey
1999)².

If people are actively taking part in perception, then
many cultural factors have an
impact on how we perceive
objects. Scientific studies from
the 1960s show that picture
recognition may not be as
intuitive or natural as one may
think (Johansen 1999 61–97).

Western cultural scientists took
photographs and simple
drawings of people, animals
and objects to traditional tribal
communities in Africa and
South America where the use
of pictorial representations was
not so widespread. Many of
the subjects had difficulty
recognising what they saw as
representations of real objects,
the images were rather seen in
terms of their flat surface.

Looking at images, whether
they are two or three dimen-
sional, requires experience in
the required way of seeing.

What does this tell us
about our own western way of seeing? Three
dimensionality and perspective is a common
way of representation in western culture. For a
long time perspective has been used in many
areas of our culture, such as the practices
surrounding the use of scientific instruments,
the drawing of maps, designing for the theatre,
etc. Starting from the premise of a long ac-
quaintance with perspective as a way of seeing,
the development of tools for 3D generation is a
natural step for us to take in western visual
culture. Even though three dimensionality is
often described as the most advanced and
persuasive way of reflecting a reality, it is
important to keep in mind that perspectival 3D
reconstructions are merely a form of represent-
ning a phenomena, and no more
‘true’ than other types of
representation.

Seeing is complex, and
there is a difference between
merely seeing something and
really having a close look at it.
A lot of what we know about
the world we know uncon-
siously, and a VR world must
be designed to satisfy both
unconscious and conscious
describes how perception
studies show that we usually
turn towards movement,
strong colours or other
markers, and the designer
needs to be aware of these
behaviours to make a natural
and (therefore) outstanding
VR experience. There are
various ways of doing this.
One can add animations that
catch the attention, make the
graphics less attractive in the
periphery of the model, or one
can add sounds to particular
places within the environment.

The designer needs to make the unimportant
details natural or very simple so that we focus on
the parts we are supposed to and get the most
out of the possibilities within the virtual world
(Fencott 1999 310ff).

Entering Miletus in the CAVE, you have
a 180° view of the virtual environment which in
itself provides a unique feeling of immersion.
You are not yourself represented by a graphical
avatar, since you are wearing stereoscopic 3D

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glasses (as opposed to a head mounted display) and can directly see your own body within the virtual city. You are there, and you can see yourself being there. The illusion is so convincing that you find yourself accepting the surroundings nearly as if they were physical reality.

Every individual has their own experience of the VR world. The individuality of these worlds are often pointed out as the most positive and unique feature of VR applications. Even though the interactive world gives the visitor freedom to go where she wants when she wants to, the environment must be planned in such a way that the visitor wants to go where she will experience the things that the world is meant to show. A well-designed virtual environment will lead the visitor through the highlights letting her think she found them herself. In this way the experience isn’t necessarily so individual after all.

Then, what if two persons have totally different experiences of the same representations? Did the designer make a mistake? Hermeneutic aesthetics claims that the subject matter is open, an essence which can always be further developed and changed, and thus can never be fully interpreted. An artwork (or a virtual environment) is not a monologue, but a dialogue between the artist, the artwork and the spectator, and in this regeneration new forms of the subject matter continually appear (Davey 1999 21). The individual is not passive in the aesthetic experience because new interpretations and experiences are created. Thus it is not only the historical happening that is being subject to continuous interpretation, but also its representation.

5. Authenticity

Using good tools one can make incredible things. Hypermedia designer Nickolas Gouraros in Athens had this experience when his team was going to make a 3D representation for a CD-ROM production, and wanted to use a photograph of a museum object as a reference point.

We had a hammer... I remember we couldn’t get the original photograph. I was very disappointed, because the museum wouldn’t give it to us, and we really wanted to have it. So I was in my office, saying “Oh dear, what am I going to do... we really need to have this object”. So I was discussing that with our graphist there. After three or four hours he said “I got the photograph, I got hold of it through the internet”. He showed me the hammer, and I said “Fantastic”. I said, “It’s brilliant, I can have that, and I will persuade them that we have to pay for this photograph”. Then he said, “I made it. It’s not real”.

A traditional problem in the field of representation is the question of authenticity. An authentic copy should be as close to the original as possible. Is authenticity also a relevant issue for computer representations? For a physical reconstruction of a column, we need to make it the same size, use the same materials, maybe even the same tools, and then we need the craftsmen who can use them, etc. When we are making it on the computer the problems are different. It needs to look like the old column,
but not feel like it; it must have the same proportions, but not the same size. Your tool is your software, and textures and colours are carefully selected to make the right impression. In these reconstructions, authenticity is restricted to the visuality of the model. But the notion of time and history as a cultural construct that could be totally different if we just thought differently about it, makes it difficult to persist with the idea of an accurate reconstruction of the past. Still this is what we want and expect from a historical reconstruction. If the past was not necessarily like the reconstruction, then what is the point of experiencing the latter?

Computer graphic images aren't always meant to represent reality. Sometimes they are made not to. Spectators of such images can still enjoy seeing them and appreciate the images because they can admire and imagine the technology, wondering how the images were made. Still, correct representation has been, and still is, the guideline for presenters of historical material for reasons mentioned earlier. When it comes to the expression of the image, accepting that it should be as correct as possible, the details are also important in making it believable. The real world is a messy place, things are scattered around, there is dust and dirt in the streets and on windows, and the weather isn't always sunny. These factors are rarely considered in graphical virtual worlds, also adding to the sterile impression as a result. If one wants to create a feeling of presence, such details must also be included.

Research shows that scientists prefer simple models for their use, while other people want the representation to be as close to the quality of a photograph as possible (Masuch 1999). Detailed and realistic graphics are crucial for making a believable experience. The problem with photorealism is that people tend to think of such images as the truth about the past, and not just a version or what it could have been like. Simpler graphics and less detail remind us that this image is in fact artificial, and does not seek to prove an event or scene. Sometimes wireframes, photographs or drawings can mediate the message better than a 3D representation. A 3D model and its content should underline the message, and the designer needs to consider which type of representation will serve the purpose best in each case. There is also the possibility of making several models, each referring to different theories about the origins or developments of a place. The representations can be lively, but when visitors are told that this is a probable or possible explanation, the complexities of history are drawn into focus. Then the visitor is invited to draw conclusions and actively take part in the exploration of how the events might have happened in the past.

A representation is based on a selection, and therefore it reduces the original setting. The model cannot include the whole original experience. Considering that one cannot make an exact copy of the original, one must extract certain characteristics in order to make a representation. Does this imply that the copy is of less value than the original? It is not a new thought that representations can give us experiences we would not have otherwise. Cultural expressions like paintings, sculptures, literature
Walter Benjamin (1975 41f) points out the advantages of the original artefact. He claims that experiencing an original instead of just reading or hearing about it is special, and the aura of the original, of which the visual impression is part, cannot be substituted. There are other qualities of an artefact that add to our total impression of it, like its smell and how it feels when we touch it. Still, with the quality of the computer graphic representations that are possible today, the visual impression need no longer be a substantial advantage of the original object over the copy. Considering the opportunity to create accurate copies with no deterioration in quality, it really doesn't matter whether you have the original image or a copy.

As VR technology offers a new opportunity for the transmission of previous culture, it also affects contemporary culture. Benjamin claimed that the technological means of reproduction puts an end to the special position given to originals. Baudrillard (1983) goes further, saying that originals can no longer be found, and that everything in our time is a reproduced copy without any reference to an original. Although this view has been subject to much discussion, historical VR worlds are just that, they are copies of a lost original past. But these copies imply that the original environments still keep their high status as originals. It is because of their content that these environments are special. The representation of any town would not be as extraordinary as specific non-existent environments (Figure 5). Thus it is the status of the lost original that gives the historical VR worlds their value.

Making representations of towns and scenery is one thing, but what about less concrete things like feelings and atmosphere? Hermeneutic aesthetics is consistent in arguing that it is the subject matter which makes the work an art work. The image should not be thought of as just the visualisation of an object, but should also make people understand larger connections. Intimacy, vivacity, and graciousness are not objects, but as phenomenological realities they are capable of radically changing our lives. They are in all senses real, but not easy to visualise directly. The artist and the 3D designer still keep in mind that there is something they want to mediate through their presentation. For the FHW, the aim is to give the visitor a sense of the Hellenic spirit. It was not a coincidence that they chose VR technology to achieve this goal:

VR technology is known to be a very good tool for realising the unrealisable, or for visualising abstract concepts or ideas, things that cannot be otherwise visualised easily, for showing things that may be expensive or costly to do in real life, or not able to do, or for visualising things that don't exist anymore. History, concepts, culture and heritage are very conceptual ideas, they're very difficult to present and visualise, and we think that virtual reality technology is a perfect tool to explore in that direction.

(Maria Roussou, leader of the VR department at the Hellenic Cosmos cultural centre, Athens)

6. Expectations

Expanded knowledge about the past should be part of the result of a visit to a virtual historic world. A VR environment offers this knowledge through the combination of the visual and the abstract. The sense of the atmosphere, the feeling of proportions, colours, etc. is a part of the knowledge that you can't easily express verbally, but might be inspiring and help us understand the conditions at the time. One of the Nu.M.E. visitors said she found it easier to look at the electronic model and remember what she saw than when she read a book. Seeing the development of her city also inspired her to find out more about the history from other sources.

A visitor of Miletus in the CAVE admitted he didn't like it very much. However, there was nothing wrong with the VR experience, "I would have come back if they had a
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If history and architecture is not of interest, this experience will not be exciting, unless one comes for the sake of experiencing the technology. A survey at N u.M.E. shows that technology itself was as common a motivation factor for visitors as the historical dimension.

Phrases like ‘three dimensional’ and ‘virtual reality’ also influence the experience. Both N u.M.E. and the C A V E at Hellenic Cosmos are presented as ‘virtual reality’, which creates certain expectations in the visitor, whether or not she has experienced these things before.

The headlines promise a lot. Finally the time machine is here, so we can find out what life was like before. But what if your boring everyday life was just as boring a thousand years ago? Nothing happened. People got up in the morning, had breakfast and went to work. Then they came home and went to bed at night. There’s nothing extraordinary about that. Perhaps there are no large differences across the centuries. When it comes to it, people may be the same both then and now. It might be useful to reach this insight. But is this what we want from a VR experience?

Some of the visitors were not very impressed with Miletus in the C A V E. They didn’t find it exciting enough and complained, “there weren’t things coming quickly towards you so you had to jump, you were just standing in a room and didn’t get to sit in chairs that moved or anything”.

These expressions first gave the impression that they wanted to be more active and use their bodies, but this was not their point. The same visitors said they would probably prefer to see a 2D film, even though they wouldn’t be able to control it actively themselves. “You can be carried away by a film, too”, they said. It was the prospect of having the ultimate experience that was the most attractive feature of VR for these visitors. They wanted an experience where they would forget about time and place, and leave the room feeling privileged.

It appears that they confused the historical tour with a fun ride in an amusement park.

The C A V E at Hellenic Cosmos is the first to present historical knowledge in this kind of immersive environment. Even so, these visitors were convinced they had experienced similar 3D environments before, without being able to point out exactly where or when. The rush to criticise it came from the expectation based on what they thought were (better) previous experiences, whereas they couldn’t possibly have had this type of experience before. It is tempting to trace this misinformation back to the rhetorics of the media, which tends to describe...
future computer possibilities as if they were already natural parts of our everyday lives. The implementation of computer graphics in films also makes highly realistic impressions on the screen, and sets the standards for other technology-based visual experiences.

Is it so important, then, that the colours, or the texture, or the sizes of the reconstructions are exactly like the original building? Could we open for a little tolerance for the sake of experience?

Archaeologists that knew the Athenian amphoras - they knew what they looked like. If you make a 3D object that looks like the shape of the amphora, but it's not actually the same, probably it will be a brilliant amphora. In a 3D environment, it will look fantastic, it will look very real, but they say it will be wrong. So, probably you have a fantastic texture, you have brilliant colours, you have the right representations of the amphora, but you have the wrong shape. Everything will be fantastic. But they say it would be wrong. (Nickolas Gouraros)

It should be real, if it pretends to be real. This is about the integrity of the producers. But it is also part of the experience. Promises of a travel to fantasyland do not give us the same expectations as travel to a concrete place.

7. Conclusions

This time machine might be less fictive since it is about the past and not the future. VR is particularly useful for visualising things that do not exist anymore and that would otherwise be lost to us but, as we have seen, we are not bringing back the past itself in these reconstructions. As a result of the interpretations and representation processes a new history is born.

The designer needs to be aware of the impact of such representations. Abstract ideas made visual are powerful in the sense that they present interpretations in very persuasive ways. There is also the challenge of implementing everyday life within these representations.

Finally, there is a conflict of expectation in historical VR worlds. On one hand visitors want their experience there to be as realistic as possible, what they see should be real and true, and they want to be swept away into a different time and get a feeling that they have been there. But at the same time they do not (yet) mistake the graphical world for the real one. In a world where flying from one house to the other is as natural as walking the distance step by step, the conditions are different and we don't get confused. In other words, we know the historical VR world is fake, but we would like to believe in its reality.

Notes

1 Cave Automatic Virtual Environment, a 3 x 3 x 3 m. room where the floor and the walls are projection screens showing images which change according to the navigation with a remote control. For further information, see http://www.evl.uic.edu/EVL/VR/systems.shtml.

2 The work of Gadamer has been especially influential on hermeneutic aesthetics.

References


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