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THE ADVANTAGES OF DIGITAL PUBLISHING OF ARCHAEOLOGICAL RESEARCH FOR THE GENERAL PUBLIC: CASE STUDY ART PROJECT *VIRTUAL VINČA*

Abstract: In the information age in which computers have caused a revolution in the way of structuring information, its availability and use, the primacy of the printing press – the technology that was at the center of Western culture and communication over the past five centuries – is being challenged. As the use of computers, information and communication technologies in the creation of digital reconstructions of the past is redefining the possibilities of archeology in the 21st century we often justify the transition (our choice of new media) by specifying its benefits or advantages. In doing so we often disregard the disadvantages which are not only a result of media performance but in fact greatly depend on our use of it.

This paper presents a unique approach to digital publishing of archaeological research through a case study of project *Virtual Vinča*. The project combines archaeological research and methodology with artistic representation of archaeology and artistic use of digital media. The project is in the form of a web site that contains virtual 3D models of figurines discovered at the site Vinča during the 1998-2009 excavations. This form of publication allowed the reconstruction of the figurines, their comprehensive analysis as well as the publication of virtual panoramas of the archaeological site and interactive texts that are accompanied by interactive illustrations and animations. Technical challenges (choice of appropriate software) and methodological aspects are analyzed to show how an artistic representation of archaeological data and flexible and imaginative use of available technologies can offer an alternative that uses the advantages and resolves the disadvantages of digital publishing of archaeological research.

Keywords: Vinča - Belo Brdo, web site, interactive multimedia, virtual artifact, 3DSOM, virtual panoramas, PTGui, Pano2VR, artifact reconstruction, illustration, animation, design.

1. Introduction

Today, results of most academic work and research are still published in the form of journal article, treatise book or thesis form. However, in this information age in which computers have caused a revolution in the way of structuring information, its availability and use, the primacy of the printing press – the technology that was at the center of Western culture and communication over the past five centuries – is being challenged. Academic publishing is undergoing major changes, as it makes the transition from the print to the digital format and currently, an important trend is the open access via the Internet.

The term *digital publishing* represents the development of new forms of production, distribution, and user interaction in regard to computer-based production of text and other interactive media. Many publications that are using the advantages of distribution via the Internet are known as online publications or web publications when in the form of a website.

The ongoing transition from analogue to digital requires analysis and brings us to the question of why such a transition is taking place. In other words, what are the advantages of digital publishing of academic research? In most studies the following are mentioned as the key advantages:

Accessibility and searchability. This is one of the most often mentioned advantages, that digital documents can be available to everyone who needs them instantly, regardless of

the users' physical locations worldwide. It is argued that the easier to find research, the fewer duplicated experiments there will be, resulting in less time wasted.

Affordability. Digital publishing is affordable since it saves on print and binding costs of traditional publishing. This allows for a greater amount of data to be published.

Speed. The speed at which research can be put on the Web as soon as it is ready, without having to wait maybe months for a space in a journal issue.

Added value: links and interactive multimedia. Links are the mainstay of the hypertext format. Cross-references to external projects and importing of data from external projects are possible and a large amount of supporting data can be linked. A great advantage is that all media in the digital form can be combined into what is known as interactive multimedia: text, audio, illustration, animation, photography, video and virtual reality.

Flexibility or Updating. Digital publications can quickly evolve because changes can be made at any time and more data can be added easily. This allows publication of results of ongoing research.

Reader's preference. According to recent research a great percentage of the public is interested in accessing publications via the Internet.

Digital publishing is also **eco-friendly.**

When justifying our choice of new media we often mention that these advantages are further bolster the transition from analogue to digital publishing. In doing so we often disregard the disadvantages which are not only a result of media performance but in fact greatly depend on our use of it. The use of technology can be (and in many cases is) such that the advantages in fact turn into disadvantages:

Inaccessibility. The availability and ease in which any author can publish now makes it more difficult to get noticed. This amount of online publishing also raises the problem of information overload.

Expensive solutions. The cost is significantly less to both publish and distribute data but this is a hotly debated point, since there are claims that extra costs are caused by new features. Many projects indeed invest in the newest technology or focus on development of new software.

Slow publishing. Some software requires a very long process to create results, so the advantage of speed is not always used.

Limited use of media. Although there are many combinations of media possible, many publications are actually just recreate a print journal in exact format.

Instability. Frequent changes in URL-s make citation, indexing and annotation very problematic.

Not user friendly. Most projects are not user friendly and do not focus on the public demands and trends.

In addition to these, there are many more disadvantages due to the technological problems such as lack of standardization, poor archiving of data, constant development of new software and hardware leads to the problem of outdating of online publication.

Faced with these problems we come to the conclusion that the transition to digital publishing should be approached with more care. In this paper we demonstrate a case study that offers a unique approach to digital publishing of archaeological research that uses the advantages of the medium while attempting to resolve the mentioned disadvantages.

2. Case Study: Art Project *Virtual Vinča*[1]

The conditions for Collaboration. The project was a result of the collaboration of artist Dr. Natalija Stojanović and archaeologist Dr. Nenad Tasić, the head of the research at the archaeological site Vinča – Belo brdo.[2]

The aim of the collaboration. The site of Vinča – Belo brdo is the place where the remains of the largest prehistoric settlement in Serbia and one of the most important Neolithic sites in Europe were discovered. One of the reasons that this site became world famous is the numerous Neolithic figurines of exquisite beauty that were found here.

At the beginning of the collaboration Dr. Nenad Tasić suggested that in the interest of the Vinča project we should focus on creating a web site which would contain 3D models of figurines unearthed during the last series of excavations from 1998 – 2009 as well as the most famous ones found during earlier excavations.

3. 3D Models (Virtual Artifacts) of the Figurines

Certainly, there were earlier attempts on the Vinča project to digitize the figurative art but each 3D scanning technology, has advantages, limitations and of course, cost. The scanner that had been used was a so-called noncontact-active scanner that transmits a laser beam to detect reflections and examine the surface of the figurine. Working with this type of scanner proved to be complicated, slow and did not allow simultaneous scanning of texture. Only half a dozen figurines were scanned. Since there was no need for a large amount of data about the figurines to be taken for the presentation of adequate models that could be quickly and interactively seen on the Internet, the problem was approached in a different way, using software that creates high quality 3D models from images of real objects.

Work methodology in software 3DSOM. To create a 3D model, it was necessary to build a specially modeled base in front of a contrasting background. The bottom part of this base was the calibration surface with a stand to raise the artifacts and reduce the possibility of cast shadows appearing on the calibration surface. The background and base were lit from left and right and a digital camera was mounted on a tripod in front of the setting.

The software required about 20 photos for each figurine. Figurine and base were rotated while photographs were taken with a fixed camera giving a total of 15 images from different angles. Flash was not used in order to prevent occurrence of shadows and reflections. Five additional photographs were taken from a higher position and one photo of the top and foot of the figurine.

These photographs were imported into the software and then masking allowed the software to get the information about the exact position of the object within the image. The next stage was the creating of the polygonal model or wireframe composed of a net of triangles. The surface geometry was optimized (the number of triangles reduced) to help alleviate edge geometry and reduce the size of the file so that the models could be viewed faster. After this the texture maps were created using the wireframe and each original photograph to determine how to paint each model segment. Of course, during all phases some subsequent altering was necessary for the software did make mistakes in geometry and texture but this was done easily and quickly.

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[1] Doctoral art project *Virtual Vinča, website with 3D models of figurines from Vinča and virtual panoramas of the archaeological site,* University of Art in Belgrade, 2012.
[2] N. Stojanović has been assigned to the Vinča project thanks to the fellowship of the Ministry of Education, Science and Technological Development of the Republic of Serbia.

For all textures, it was necessary to do color correction since the photos were done using a warm light. This was done in Photoshop using the Match Color command, comparing the texture maps with earlier made photographs of figurines. All of the models were exported and automatically displayed in 3DSOM Flash Viewer. This viewer allowed the changing of conditions in which the models were viewed like background and control bar for zooming, rotating and translating. The automatically generated HTML document was imported into Dreamweaver software and placed in the appropriate ActiveX framework.

The collection comprises of 82 3D virtual artifacts, figurines found during the latest excavations and another 9 models of the most famous figurines discovered at the site. Most of the figurines were anthropomorphic with a few zoomorphic and a couple of amulets (Figure 1). Simultaneously with the photographing, the inventory numbers and basic data such as dimensions and year of excavation were documented for later addition to the project.

For each figurine as an artifact of historical or cultural significance knowledge and information in the form of short texts containing the description of form as well as the interpretation of origin, function, use, ownership and history was prepared.

Figure 1. Collection of 91 3D models of Vinča figurines (shown in size relation to one another).

Advantages of the approach. Unlike the previous solutions, this approach to virtual artifacts was simpler, faster and cheaper and allowed simultaneous capture of the texture. The approach allowed the capture of the entire collection of artifacts and not only a few selected. The models had a satisfactory quality with significant number of details. Also, the virtual artifacts were not 2D representations or renders of 3D models as in analogue publication but interactively viewable from all angles (the software allowed manipulation such as zooming and rotation).

4. Reconstructions

Further on, we decided to add reconstruction to the publication. The advantages of reconstructions are that they present the artifacts in a state when they were used, in contrast to the state in which they were found and they fill the gaps of the conceptual puzzle. Among the figurines in this collection were a few that were hardly damaged and didn't require reconstruction, and some that were only fragments that were impossible to connect to some original form. A great number of figurines however were suitable for reconstruction.

Figure 2. Possible reconstructions of the original appearance of figurines
(here they are not displayed in the correct size relation to one other).

Each reconstruction of the possible original appearance began with a detailed discussion between artist and scientist. The basic principles of reconstruction were followed such as rules of typology, analogy with similar forms, as well as artistic sense of form, balance and insight into the style and taste of the era. Also existing conventions such as light angle, positioning of artifacts, shading and indications were respected.

There was practically no limit when it came to combination of media that could have been used. However, while new technologies solve many problems they can lead us to forget simple solutions that have long and reliable histories. Many archaeologists argue that the digital approaches should not be introduced as an alternative, but should complement traditional ones. With this in mind the basis for the reconstructions were analogue pencil drawing, shaded and scanned and collaged with corresponding photographs of figurines and their 3D model texture maps (Figure 2).

Advantages of the approach. In a traditional (analog) publication an archaeologist or museologist is limited when ordering reconstructions, since their price determines the number and quality. Here, these restrictions were not imposed and a large amount of reconstructed objects thus created for the general public a better impression of the material culture of the studied community. Of course, it was possible to place these so that they could be viewed simultaneously with the 3D models that were created.

It is also interesting to mention an unexpected advantage in this process. During the reconstruction the artistic interpretation helped in recognizing that it was possible to position some of the figurines in a completely different way, so that for example one fragment considered previously to have been a leg of a figurine was with analysis of perforations reversed and reconstructed as a head.

5. VR Panoramas of the Archaeological Site

Today, there are many methods for creating virtual reality. This term refers to the computer simulated environment that simulates physical presence in a particular place in the real world, and the presence of imaginary worlds. The method used here was one of the most widely used systems, a simple technique to create virtual tours, so called VR panorama VR panoramic photographs. The technology gives viewers an experience of being in the middle of a space which can be explored by simply moving the cursor around. Their viewing does not require special hardware and they can be seen using a web browser. VR is especially important visualization technique for presenting archaeological discoveries, since it is not always easy to imagine scenes from a distant past.

Work methodology with software for creating VR panoramas - PTGui and Pano2VR. The methods used for creating VR panoramas consisted of generating panoramic images which were then projected onto an imaginary inner cylindrical surface. The decision to create so called cylindrical panoramas influenced the way the photographs have been taken. Having selected the four key points at the archaeological site, digital camera was placed on a tripod and with horizontal rotation of the camera 15 partially overlapping photographs were taken from each point.

The obtained sequence was imported into the software (PTGui) for automatic merging of images into a single panoramic photo.

The process of making panoramic images leaves enough space for experimenting, so that in addition to photographs, it is possible to import painted or sketched images which maintain the impression of three-dimensional space. These panoramic photographs were used as reference for the development of analogue illustrations, panoramic drawings that were

scanned, digitally colored and then used as a basis for VR panoramas (Figure 3). Pano2VR software was used to enable the interactive viewing of these images. This software tools also allowed the adding of hot spots (activation points) which allowed the connection of several VR panoramas to one another, as well as a connection to other multimedia information.

Textual clues to indicate the position of hot spots were removed so that the users could feel free to explore the virtual space and find a hidden content. Only cursor states specifically designed in the shape of footsteps or a magnifying glass point to the existence of hot spots in certain places. In the end, optimization - a compromise between the size of files and quality of image was made. The VR panoramas were exported as SWF files which made their distribution easy.
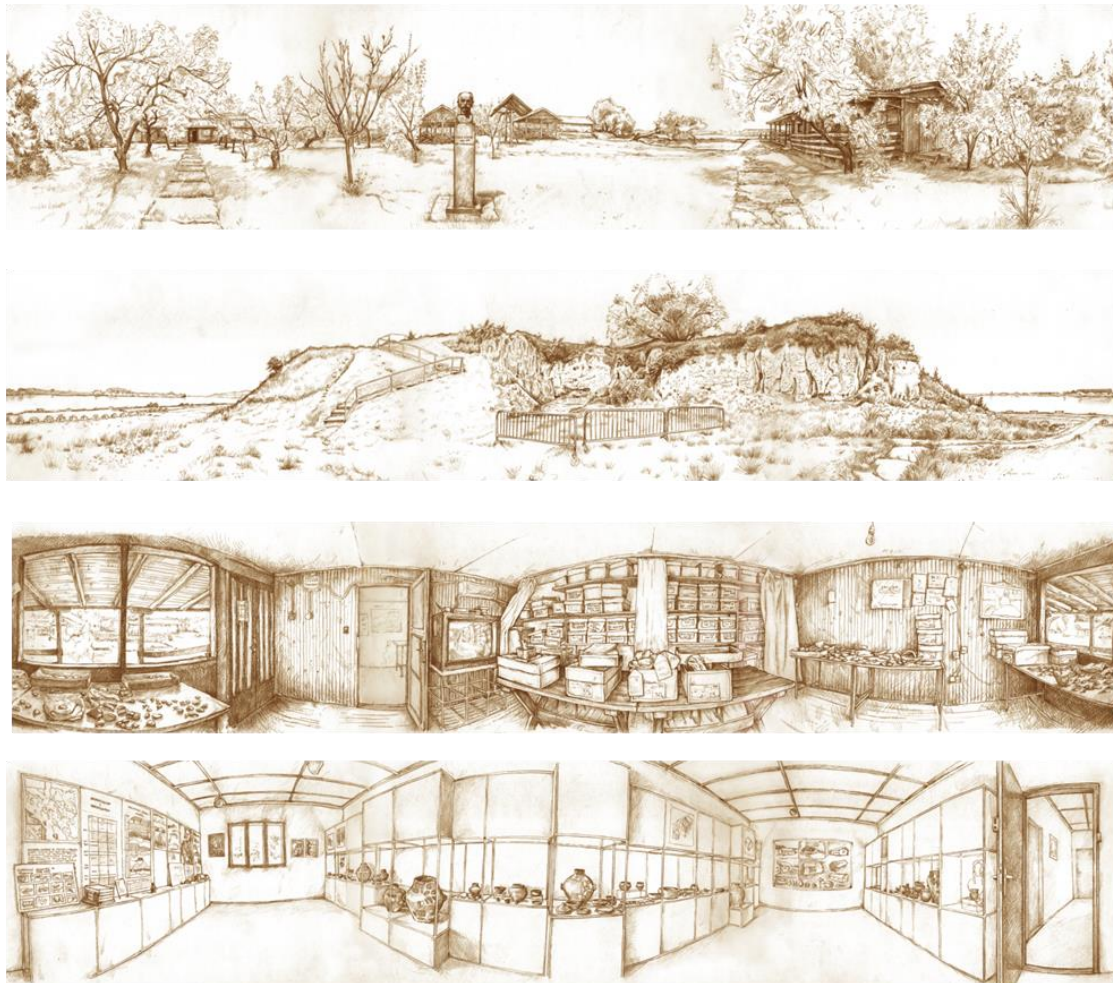

Figure 3. Panoramic illustrations of the site used as basis for VR panoramas.

Advantages of the approach. VR Panoramas unlike VR photographs allow viewers the interactive viewing of space, and the public has a sense of being at the location. Also, these panoramas have an additional advantage of being interfaces that can engage the viewer to search for and access additional information.

6. Additional Multimedia Content

VR panoramas serve as a platform for accessing a variety of texts and multimedia content about the sites history, various research, data about the life in the Neolithic community. Each of the original texts is accompanied by numerous interactive illustrations that offer additional information (Figure 4).

The website contains links to existing web pages about Vinča as well as a link to the electronic edition of the book *Vinča - prehistoric metropolis, surveys from 1908-2008* which contains significant texts related to the site research as well as the catalog of the findings from 1908 to 2008.

ODEĆA, FRIZURE, NAKIT

* Ogrlica od morskog puža (Dentalium)

Iako je veliki deo rukotvorina drevnih vinčanaca nestao tokom sedam hiljada godina koliko su proveli u zemlji, o nekima od njih možemo dobiti posredne informacije. Primera radi, na dnu keramičkih posuda ponekad se vide otisci asura i tkanina koje su nam do sada pokazale da postoji nekoliko vrsta tkanja i načina pletenja asura. Na osnovu proučavanja otisaka platna ustanovljeno je da postoji nekoliko karakterističnih prepleta koji se koriste i u naše vreme.
Sudeći po predstavama nošnje na figurinama, i

muškarci i žene su verovatno bili obučeni u neku vrstu haljine sa V izrezom ušivene na stranama. Postoje i predstave suknji i pregača koje su se vezivale

Sudeći po figurinama, i muškarci i žene su bili obučeni u neku vrstu haljine sa V izrezom ušivene na stranama.

oko pojasa. I jedne i druge su najverovatnije bile ukrašene različitom vrstom tkanja i bojom. Ukrasi

na pregačama na figurinama su unikatni i ne ponavljaju se više puta. Najomiljenija boja u vinčanskoj kulturi je bila crvena boja koja se dobijala iz gvozdene rude i cinabarita.
Obuća je bila slična čizmama – komadi kože obavijani su oko nogu i pričvršćivani nekom vrstom pertli od kože ili kanapa.
Otkriće nekoliko grumenčića okera sa perforacijom izuzetno malih dimenzija zbunilo je arheologe. Oker je naime zemljani pigment gvožđe oksid (Fe_2O_3)

1 | 2

Figure 4. Screenshot of page *Clothing, hairstyles, jewelry* with interactive text and illustrations.

Two texts are accompanied by animations. One of the animations shows the position of the site on a map as well as the area of the Vinča culture and look of the settlement. Given that the main content of the website is the 3D virtual artifact collection, it seemed relevant to describe the assumed process of making the figurines. The second animation as well as showing this process shows the exterior, interior or the Vinča home, scenes that hint that the inhabitants were farmers and ranchers, and engaged in fishing.

Stylistically resolved like the illustrations and panoramas, the animations were done using rotoscoping technique. Hairstyle for the character and costume and set design were based on earlier illustrations or reconstructions and attention was paid to the proportions of the elements and the type of artifacts used at the time.

Advantages of the approach. The classical media of text and image is now interactive and linked giving it a new dimension of information. The advantages of the animations created are that as places for combining various elements into a single unit to show key aspects of the Neolithic life this was also done in an interesting and dynamic way.

7. Interface and Web Design

Current website design trends were selected by the artist from personal aspirations:
1.   Illustrated websites
2.   Monochromatic websites
3.   Retro and newspaper design websites

Associations were then made with the project:

1. The first point was the excavation diaries or journals of Dr. Miloje M. Vasić, first researcher of Vinča. They contained drawings of artifacts that were similar to the illustrative style of the artist.

2. The second point was numerous sepia toned photographs taken during the first excavation that were associated with similar colors used by the artist in digital illustration.

3. The integral facsimile release of the first issue of the magazine *Starinar* from 1884. Miloje Vasić was the editor of this magazine for a while and this edition was a starting point for the design of a retro looking, newspaper inspired website.

All these points now encouraged the creation of a website that looked more like a personal, illustrated, retro, monochromatic, newspaper design inspired website.

8. The Website

Website Virtual Vinča has been available to the public since February 2012 at www.virtualvinca.com and www.virtuelnavinca.com. It is linked to the Facebook page Archeaological site Vinca - Belo Brdo as well as Wikipedia article on Vinča. A YouTube video exists showing a walkthrough of the website and the animations[3]. Both of these videos are presented on the web portal Past Horizons Archaeology TV where have to date gotten 21,000 views[4].

The first page of the website is the SPLASH PAGE (Figure 5) that gives the choice of language or script and relevant information about the browser and software required to view the content. After this the HOME PAGE (Figure 6) is accessed.

Figure 5. Screenshot of splash page of website *Virtual Vinča*

According to the latest statistics most users have a monitor with standard aspect ratio of 1024x768 pixels. The main content of the website is located in within this most common format. The composition of individual pages follows the classic design with a header that contains the navigation bar below which are the main content and the footer of the page.

The logo of the website is a unique typographical solution that imitates the title of *Starinar*. Consistent with the concept, style and color the many icons and buttons and scroll

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[3] http://www.youtube.com/watch?v=H8W91GIjuQY
[4] http://www.pasthorizons.tv/virtual-vinca/

bar used for the website were custom made. Most were inspired by conventional icons while the website has a unique favicon (short for favorite icon) made from the initial letters of the logo.

The background of the website is inspired by *Starinar*, filled with objects that symbolize Vinča (magnifying glass, figurine and fragments), Miloje Vasić (glasses, pocket watch and notebook) and some objects used during work (camera, mouse and keyboard).

Figure 6. Screenshot of home page of website *Virtual Vinča*

As for the structure of the website, all the content mentioned is arranged on pages that are linked to one another in a hierarchical structure, from general to specific. The navigation bar present here and on all subsequent pages contains the following titles:

1. HOME PAGE – informs users about the content and goals of the website
2. FIGURINES – leads to general articles and graphic representations of types of figurines which in turn lead to each specific figurine texts and model as well as reconstruction.
3. PANORAMAS – open a page with a map that allows access to VR panoramas which are platforms for accessing various texts and multimedia. A link to Google Maps is also added here.
4. ABOUT – default page that contains context information about the project
5. SITE MAP – helps navigation by showing an overview of all the key website pages

9. Conclusion

The advantages of digital publication certainly include greater access to information, dissemination, and communication with much wider audience. Unfortunately, archaeology is currently in a paradoxical situation in which technology for capturing and generating virtual reconstructions of the past is advancing at a fast pace, while the modeling in a wider and more useable way of these results is not developing at the same pace. Still a majority of the data collected in the course of archaeological research which is digitized remains unposted online.

Even less frequent are presentations intended for wider audience published in an appealing and accessible way.

In this project, which is aimed to present archaeological and artistic content to much broader audience, the expertise of the archeologist, in this case the chief researcher at the site of Vinča, was respected. For this occasion, scientific texts were written and the proper system of classification, based on the types of figurines, was applied. At the same time, this project was a place for expression of an artistic inspiration and interaction with the past and artistic relationship with the medium. Although publication in the field of computer networks often requires demanding solutions, in this project the potential of art was used to provide simple solutions at the same time making the publication interesting for the public. The creative use of technology resulted in a digital publication that uses the advantages of the Internet as a medium and avoids its potential disadvantages.

We believe the interdisciplinary approach to digital publication contributes to the strengthening of the visibility of the archaeological research that will attract attention of both professionals and the general public. Although it is hard to predict the influence of this experimental approach, it remains a fact that it presents the current situation in which interdisciplinary thinking and collaboration of scientist and artist is used as an alternative in the forming and digital publishing of knowledge about the past.

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