COLLABORATIVE PROJECT TO CONSERVE AND PERSONALIZE THE 3D DIGITAL ARCHIVES OF HISTORICAL ARCHITECTURE

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Abstract. In this paper, we will discuss methods for supporting a collaborative experience of 3D digital archives of historical architecture. We will use a prototype system for 3D digital archives of historical architecture using VR technology. Moreover, a prototype system using web technology such as Weblogs will also be used. In addition, we are refining the present system by applying it to the Turkish Republic Gemiler Island Church Restoration Project.

1. Introduction

Digital archives can be defined as "data about a work of art or a cultural property that are semi-permanently recorded on digital media, which is accumulated and stored in a database".

Such archives are a fast and efficient means of maintaining and conserving the records of cultural properties for restoration or historical purposes. In this way, we can access information about cultural properties, such as burial sites, historical buildings, archaeological ruins, and fine arts and crafts. Because these archives can be accessed quickly and conveniently, they are widely used in schools, universities and research facilities.

Earlier digital archives had to be created from photographs, which were scanned and then converted into digital data. This was expensive and inconvenient. However, 3D digital archives are now commonplace. This is because of improvements in equipment and the corresponding fall in prices of 3D scanners, digital cameras, and software programs (Figure 1). Additionally, digital cameras can automatically calculate the form of an object and the size of the image required, and directly record the information on to digital media (Figure 2).

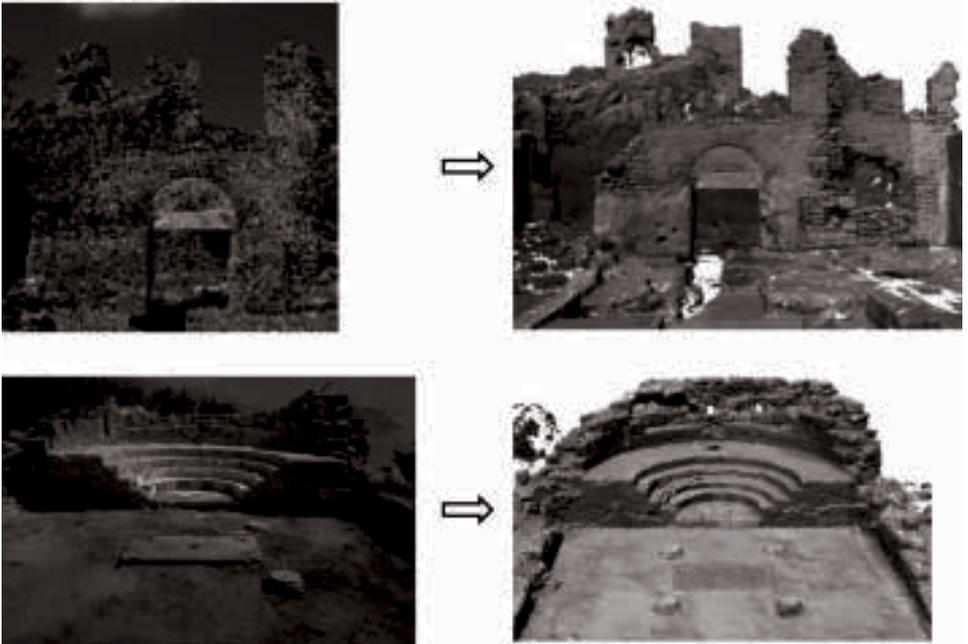*Figure1.* Scanning ruins with a 3D scanner.

Figure 2. A photograph of the unearthed ruins (Left)
and 3D model created with the 3D scanner (Right).

We carried out 3D measurements of ruins, domestic and overseas. Then, using advanced 3D-recording media, we digitally archived the excavated remains of a church. The digital archives described in this paper assume a 3D model, hence the term 3D-digital archives. We do not see just a flat 2D image of the object out of context, we can see the object three-dimensionally from all angles in its natural setting by virtually restoring it to its original condition. For example, the image

could be viewed in its original context as a 3D-scaled model of a historical building, ruins, etc. We propose a concept whereby the user can observe scale-sized images of digital archives conveniently and efficiently. When users refer to digital images, they can also view personal notes that add meaning to the experience. Moreover, users can add their own notes to the content and share them with other users in the form of a Weblog. As users become more familiar with how to use this system, it should stimulate interest in the content of digital archives. Moreover, as more people understand how to use the content we believe that such archives will become more popular.

We will now look at the technique for realizing this concept.

Our trial production system allows users to view 3D images of ruins and then to experience the 'restoration' by placing overlays on to the 3D model that will allow them to virtually walk through the restored building. Moreover, they will be able to add notes automatically in the form of a Weblog.

2. Experiencing Digital Archives

When a person visits a museum, they can hear descriptions of the artefacts given by experts, thus deepening their understanding. If the curator or guide can give more details about the display, it further increases the visitors' comprehension and sense of satisfaction. With this in mind, we want to change the users' digital archive experience into a form that others can share and enjoy.

The experience should include both an intellectual experience, in which new information and new knowledge are acquired, and also an emotional experience, in which impressions and feelings are expressed. This helps to personalize the experience. Archives not only record history, they allow others to peruse and comment on it, while preserving changes and recording the experience in a form that can be experienced virtually. We refer to this as "creating content".

It is important to be able to 'virtually' experience the content while simultaneously perusing the digital archives.

Moreover, the digital archives themselves can become richer through the addition of actual experiences. Even if the content contained in digital archives never changes, we can change our perspective of it and the experience through the accumulated knowledge and experiences being added.

That is, users not only use the archives, they give them added value.

Moreover, users can become producers of new digital archives. Figure 3 shows the composition of the digital-archives experience system.

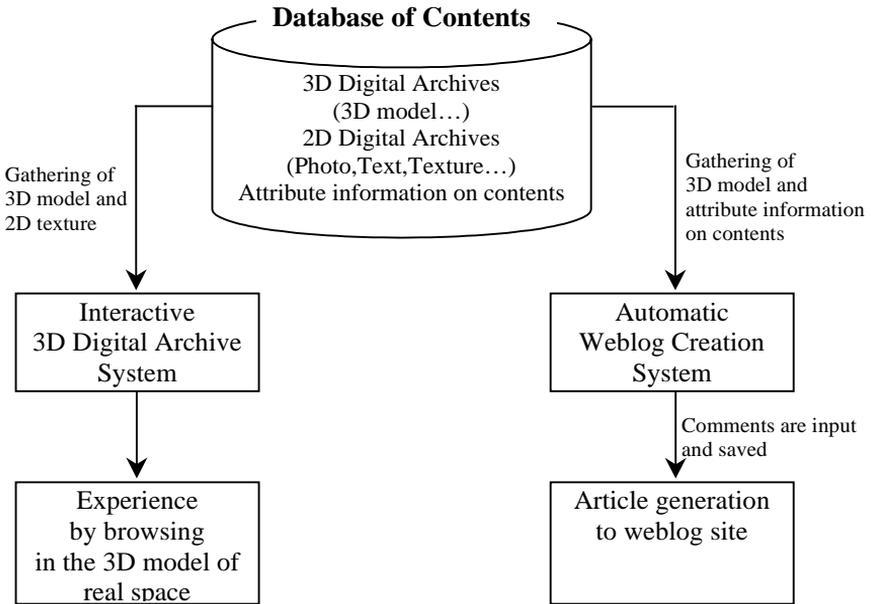Next, let's look at the interactive digital archives system.

Figure 3. Block diagram of Digital Archives Experience System.

3. Interactive 3D Digital Archive System

We will describe the function of the interactive 3D digital archive system that uses VR technology. This system allows the user or viewer to automatically control the viewpoint by selecting content based on the user's particular area of interest.

There are currently many digital archives of ruins and restorations created using 3D computer graphics (CG). However, it is not enough simply to look at the content. The user also needs to understand it. Therefore, we need systems that support the user's understanding of the content. An effective method to aid in understanding is comparison. However, comparing the present image (ruins) to the past (restoration) using existing systems is difficult because users have to locate and view their viewpoints separately.

With this in mind, we created a browser that simultaneously displays other content while automatically controlling the viewpoint, allowing the user to compare the content. In real space, people can walk through only one place. However, in virtual space, the user can walk through many spaces at the same time. This is the key concept of the system. We are constructing a prototype system using the 3D digital archives of the ruins of a church on Gemiler Island in the Turkish Republic. We have implemented the following functions:

- A walkthrough function that can capture the image while the user moves about freely in the 3D digital archives of the ruins or remains (Figure 4).
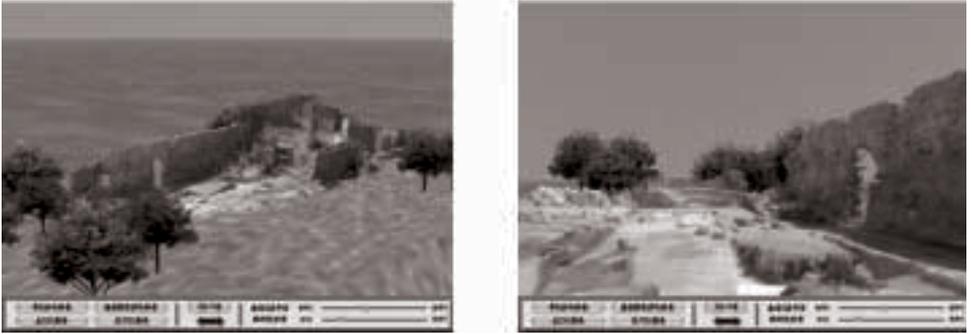
Figure 4. A snapshot of the walkthrough function.

● A concurrent navigation function that enables a comparison to be made between the present conditions and a virtual 'restoration' of the ruins or a historical building on the same screen.

In each case, a comparative screen is divided into two identically-sized sections which can be compared. Moreover, another proposal can also be displayed on a small guide screen, concentrating on one proposal greatly and looking at it mainly.

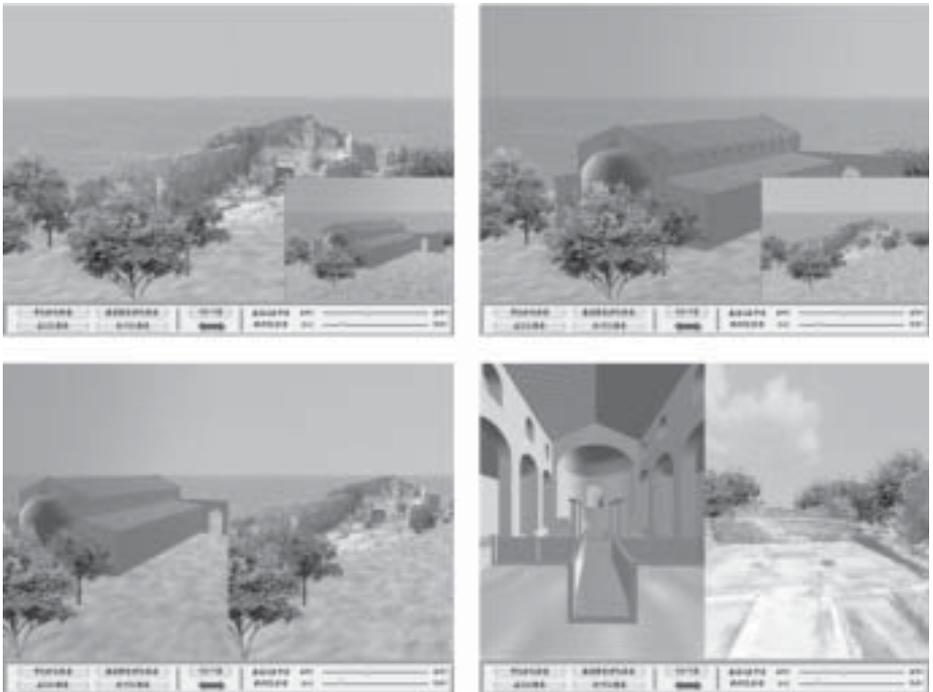In this case, it is also possible to change the screen (Figure 5).

Figure 5. A snapshot of the comparison function.

- A cross-section function that can display a cross-sectional view of the ruins or the whole historical building (Figure 6). The user can control the cutting plane. This is useful for understanding the inner structure in detail.
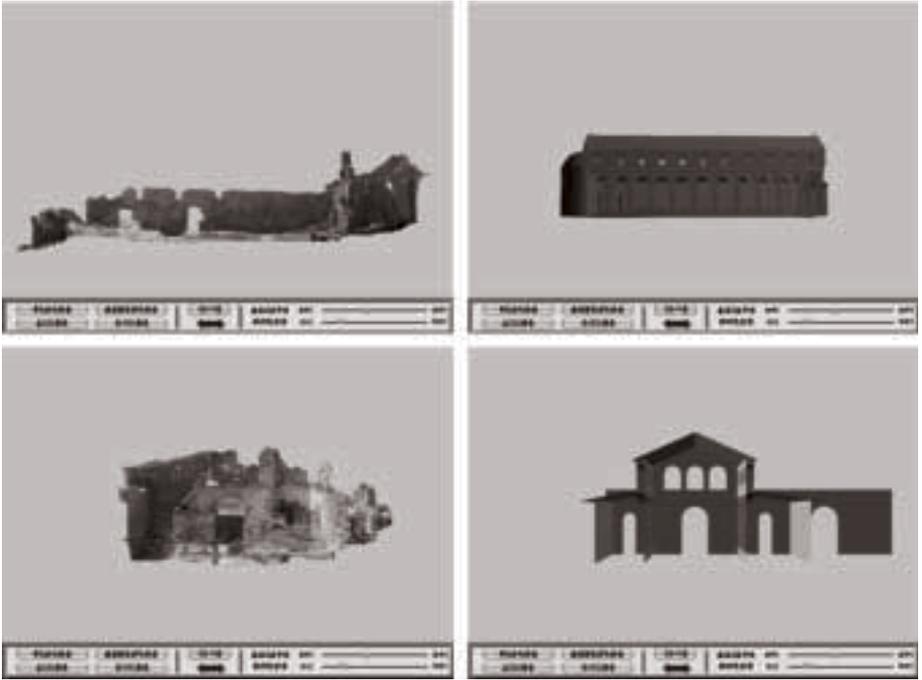

Figure 6. A snapshot of the cross-section function.

Advantages of adding notes to interactive 3D digital archive system,

- Even if the user does not actually go to a place with ruins, he/she can have the experience of actually looking at the ruins.
- In contrast to a photograph or text, in which the presence of the ruins is not conveyed, a feeling of position and a feeling of the quality of the material can be experienced.
- he user can compare the original site in ancient times with the restoration proposal which will restore the unearthed ruins.
- The user can understand the structure by visiting various sections of the ruins.

Thus, the user can walk through the 3D digital archives freely, and the system provides comparative views of other related content, such as restorations.

4. Automatic Weblog Creation System from Attached Comments to 3D Digital Archives

Content creation is mainly concerned with comments or opinions added in the form of memos that allow users to personalize the image content. It can be realized by changing the image content into a web page in the form of a Weblog.

If position-dependent comments attachment is performed while the automatic Weblog creation system is doing a walkthrough of the 3D digital archive model, a Weblog web page will be generated automatically.

A "Position-dependent comments attachment" happens when a user specifies a portion of particular interest and attaches a comment while walking through the 3D model of real space by which 3D digital archives are arranged.

When other users walk through the same 3D digital archives, they can refer to the comment when they approach the place where other people put the comment.

An explanation is added and the system automatically generates a summary of the Weblog entries, including a snapshot of the specified portion, comments, the 3D position information about the target, 3D position information about the viewpoint, etc.

The automatically created Weblog can be simultaneously referred to when perusing the 3D content. This system can connect the user to a 3D real space model through the saved content and exhibit comments as a Weblog that includes the user's viewpoint position information, if comments are attached.

System procedures:
1. User logs in and a 3D screen appears (Figure 7).
2. When the user selects an interesting scene by pointing and clicking his/her

Figure 7. A snapshot of the trial production system.

Figure 8. Entering notes.

Figure 9. An example of a web page automatically generated by the trial production system.

mouse, a window for inputting notes will pop up (Figure 8).
3. If notes are input and saved, then the digital content will automatically be added to his/her Weblog site (Figure 9).
4. A thin-blue rectangle appears in the scene at the place to which the notes are attached.

Advantages of adding notes to digital-archive Weblogs:

- Web exposure is easy and can promote the use of digital archives.
- It is easy to add supplementary information to the notes of other users.
- It is possible to create a function that can peruse related Blogs.

As mentioned earlier, we believe that being able to add notes to digital archives will be a popular idea.

5. Conclusion

We proposed a system that promotes the use of digital archives and content using a software program that allows users to interact with the archives, thus raising the users' level of satisfaction. This interactive perusal system allows site creators to add relevant notes to their archives.

Moreover, on start up, the system automatically generates and opens notes and converts images into a 3D-weblog model. We developed a trial production system to realize this system.

In the future we want to create a system that can attach notes directly to 3D images to allow users to interactively peruse the digital archive system. To accomplish this task, we developed a new user interface for attaching notes while conserving the 3D-images as the main focus.

Additionally, we want to realize an environment where detailed 3D-images will be easier to access, more interactive, and easier to create and maintain. This will enrich peoples' lives and contribute to their cultural knowledge base.