06 | DATA MANAGEMENT

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Collaborative Work with Visual Index Structures in Archaeology

Abstract: Archaeological work often deals with problems of worldwide-distributed knowledge, data and artefacts. The effort in implementing digital collaborative working-processes in the daily archaeological work will open a variety of new aspects how to share data while creating a platform for the discussing of archaeological research and reconstructions. A visual approach for setting up an easy to use, yet well-structured 3D-based document index is a major element of this research. Additionally, as team members might be also physically located worldwide, we have established a publishing solution that uses the Google Earth environment together with the implementation of a publishing software that can convert and transfer various kinds of data (literature references, images, 3D models) to a Google Earth server. This collaborative working concept, with examples from excavations on Elephantine, Egypt, can easily be extended to suit various needs depending on where (e.g. excavation vs. exhibition) or how information is required or needs to be provided.

The 3D Reconstruction Process

When creating three-dimensional reconstructions from excavated buildings, several steps have to be completed to obtain a virtual object suitable for the requirements of public presentations. For an example, starting from the documentation of the excavated site a working model is created, which later on is transformed into a presentation model that can be integrated into an interactive installation inside a museum exhibition. Unfortunately the creation of a 3D model is not a linear process. Several unresolved questions about exact interpretation that cannot be answered directly from the documentation start to rise. This is a natural process, when interpretation tries to fill the gaps between excavated objects and their documentation. Often this also leads to several plausible interpretations that can be derived from the available data. Usually the "most plausible" interpretation has to be selected and converted to a museum presentable format. Scientifically, it would often be desirable to also show the other interpretations, as well as the scientific discussion process that generated the final result. The following work will focus on the iterative process of the evolution of the working model together with visualizing the reconstruction process as a visual index. This can then be included with the 3D model, so that the resulting visualization can be used as a discussion medium and documentation of the interpretation process.

Fig. 1. The 3D reconstruction process (excavation, working model, presentation model, museum installation).

Distributed Knowledge

The documentation of an excavation site, which usually is an accumulation of documents and artefacts from several campaigns, might have been generated over several decades or even centuries from different institutions. Therefore, all the necessary data might be distributed worldwide in a wide variety of different formats and styles of documentation.

The diagram of *Fig. 2* shows an overview of how archaeological information might be distributed. Usually data exists in analogue and digital formats. There are many existing document types, with different approaches used to describe content

cluded within the referred space of the model as a kind of visual index. Any unanswered questions or missing information is also included as a short text description at the appropriate location. The resulting information space, described as a "visual index" in the following chapters, creates a visual overview of all relevant information. The combined model – the working model and the visual index – is then converted into the shockwave3d format in our current implementation. It can be explored by navigating through the virtual model with real-time presentation software, which has been developed for a straightforward display of architectural models. The following 3D working model shows
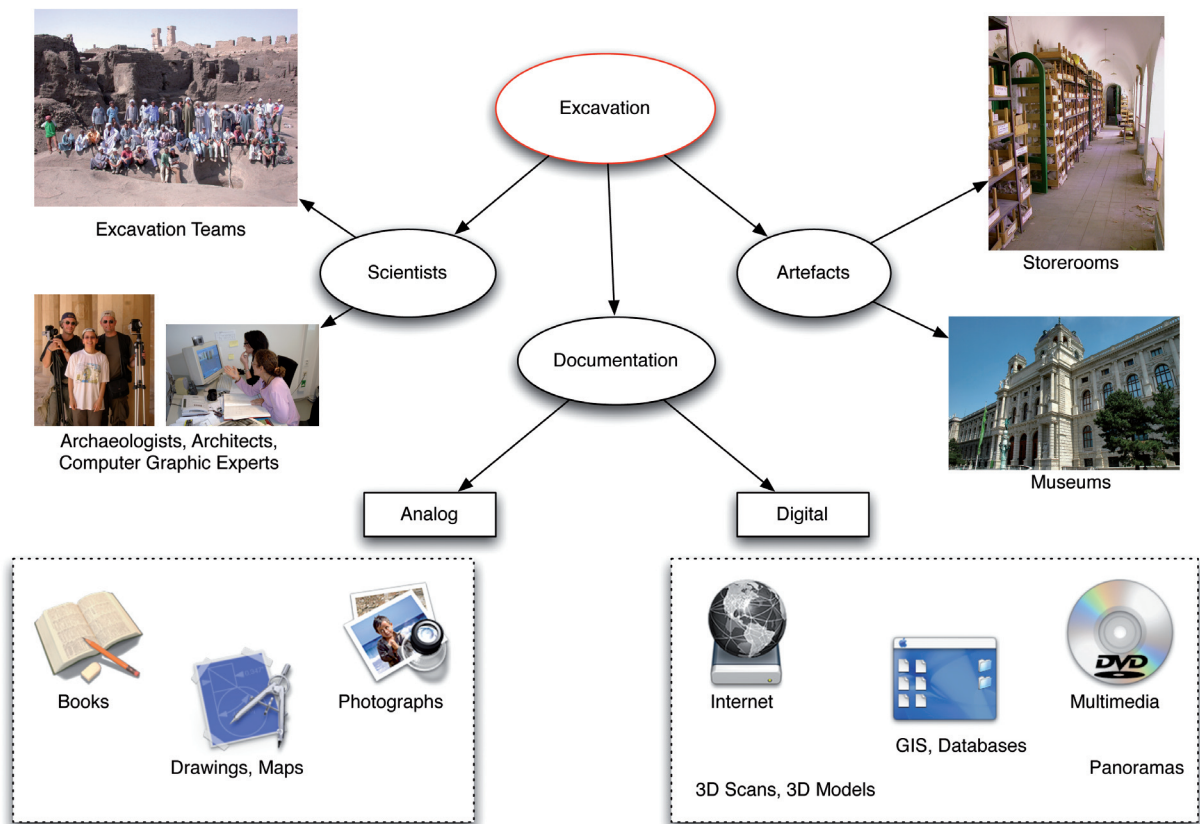

Fig. 2. Distributed knowledge.

and metadata. Information might be stored at different institutions, or only found in the unpublished work of other team members involved. Collecting all the necessary information can therefore be a very time consuming process.

The Working Model as Visual Index

When the working model is created in the 3D reconstruction process, all referenced data is in-

a reconstruction of house 70 on the island of Elephantine, Egypt; uncertainties were discussed directly with the excavator as well as consulting the relevant publications (PILGRIM 1996).

The Visual Index of house 70 shows several examples of information that has been integrated into the working model *(Fig. 3)*. The top left image compares a photograph with the reconstructed steps at the entrance, and comments on the visible difference with "check the step heights".
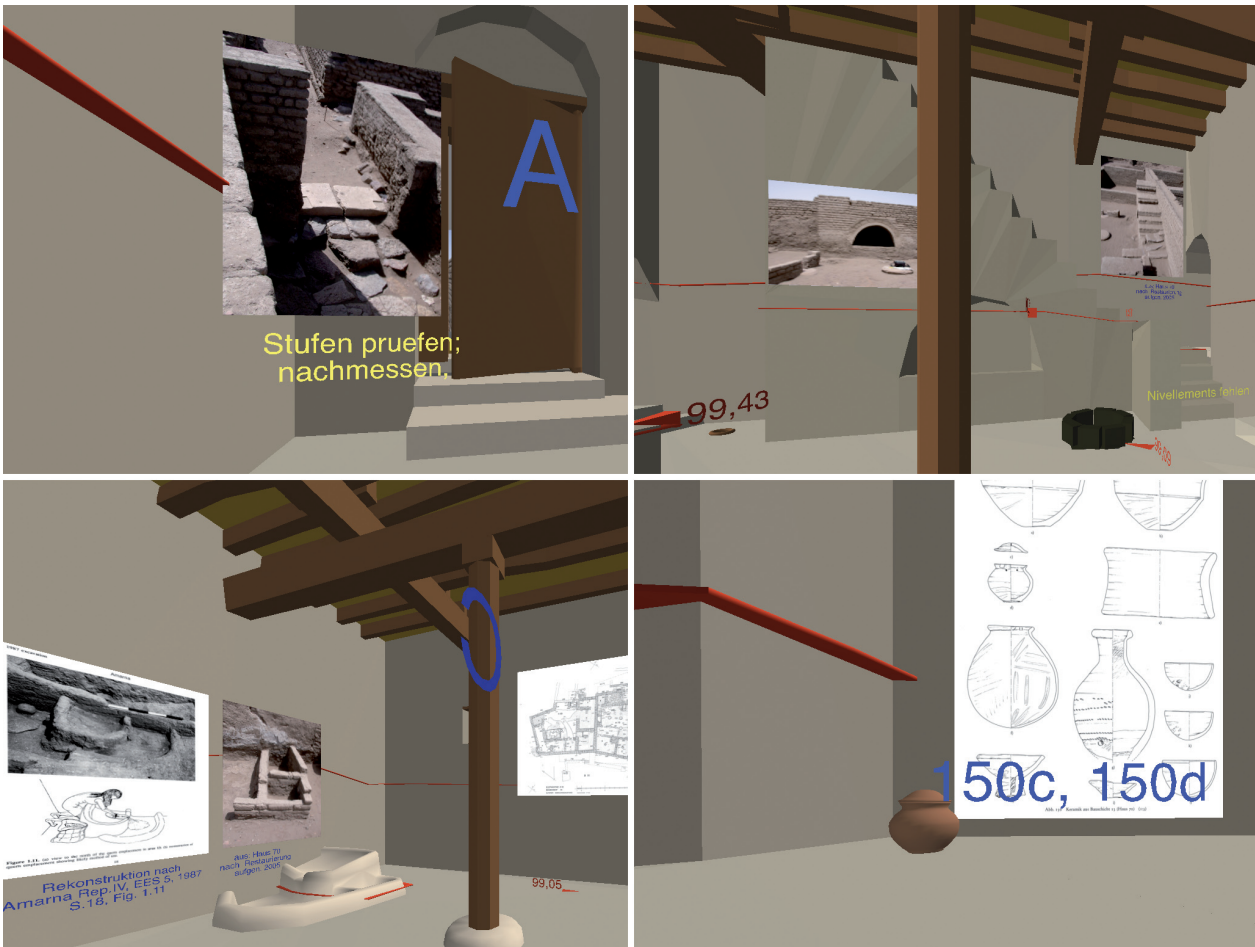
Fig. 3. Working model as visual index, house 70, Elephantine / Egypt.

In the top right image, the red line with the numeric labels indicates the levels of the building that were excavated – the parts above the red line are reconstructed. The bottom left image explains how a grinding site was reconstructed by showing the photograph of the excavated part, as well as a reference image from the literature, together with its references. The bottom right image shows reconstructed ceramics with corresponding documentation drawings from its original location.

Fig. 4. Collaboration at distributed locations.

Collaboration at Distributed Locations

As the specialists, who are involved in the reconstruction process, might also be physically located worldwide, the idea of the visual index needs to be extended to include remote collaboration environments.
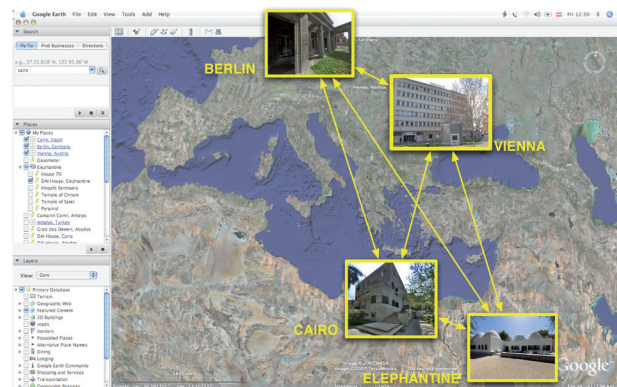
Collaborating by Distributed Publishing to a Google Earth Server

For a collaboration environment, that allows the interactive display of different data types, Google Earth was chosen. A publication solution was developed that converts all the necessary data into Google Earth supported file formats (KML, COLLA-DA, PNG, JPEG) as well as adding space and time

attributes. The converted data formats are then transferred to a web server by a secure connection and each data object linked into a structured KML file system. This makes it easy to generate a distributed environment, which can then be explored from different locations by Google Earth Network links.

Currently, access to the Google Book engine is implemented as a prototype. This allows the user to enter keywords into a text field, gePublish will forward the search to the selected search engine (e.g. Google Books), and the resulting list of entries from the search result generated in XML will be
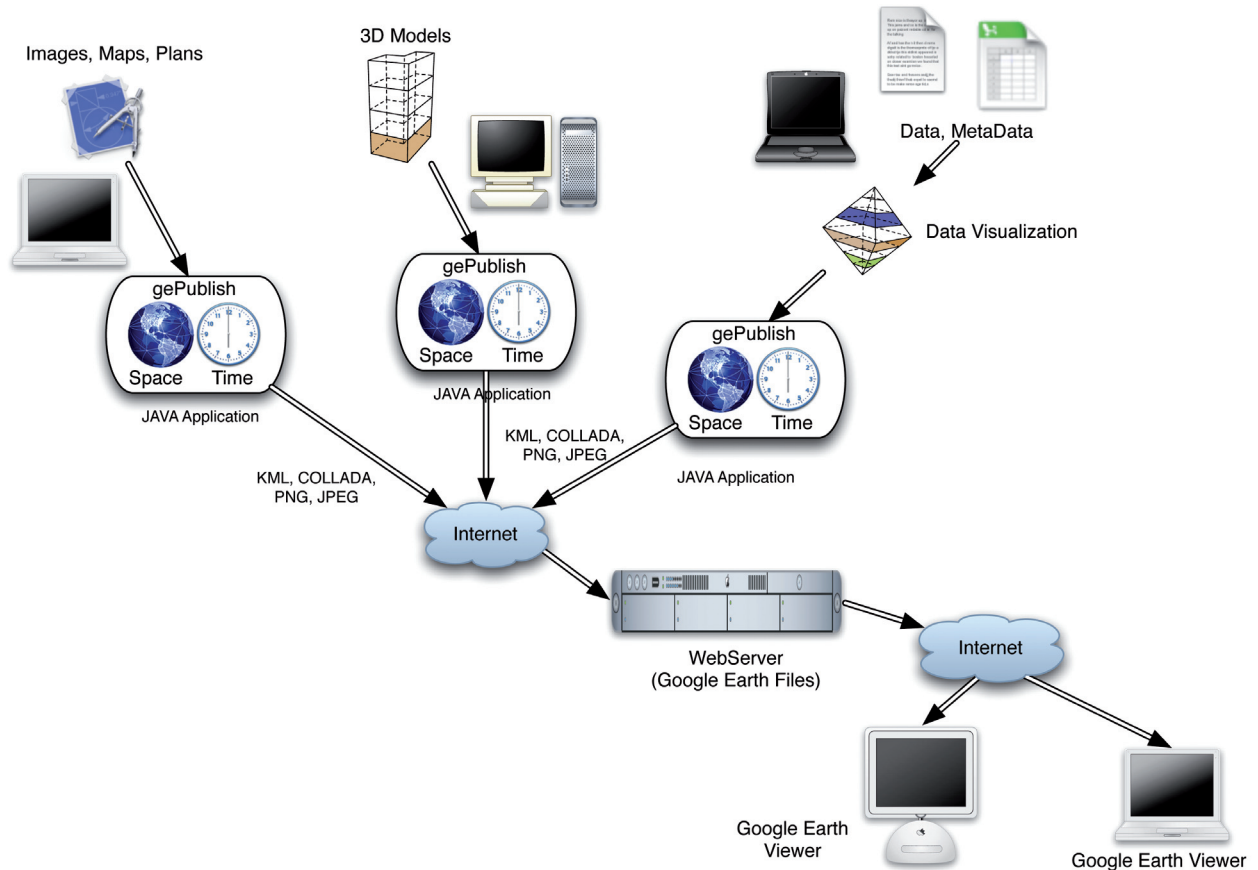

Fig. 5. Workflow – distributed publishing to a Google Earth Server.

Fig. 5 illustrates the principal workflow scheme in remote collaboration. The application gePublish was developed to allow the distributed publishing to a Google Earth server. Developed in JAVA, it can be installed on various platforms and requires only an Internet connection, so it can convert and upload all of the distributed data. The main idea of the user interface of gePublish is the "drag and drop" principle. The file or data to be published can be dropped on the displayed window and gePublish will create a preview version of the data. The space and time tags (which can be created from Google Earth as placemarks or from a text-editor such as KML) can also be added by "drag and drop" and the corresponding information (longitude, latitude, altitude and time span) is displayed in the lower part of the window. A special way of obtaining and publishing data is by using web-based search engines.

converted to KML code. The publishing can then continue as described above

Fig. 6 shows a list of book references that was generated by using the Google Books search engine with the keywords "Elephantine Satet". The georeference was created from a Google Earth Placemark that has been saved at the geographical location of the "Temple of the Goddess Satet on Elephantine". To illustrate the possibility of adding time attributes a time tag "Middle Kingdom" was added as well. This was generated separately as KML code in a text editor, as currently, Google Earth (version 4.0) does not have the ability to directly add time information.

The screenshots in *Fig. 7* show two scenes from data stored on our Google Earth server, generated with the gePublish Software. The left part of the illustration shows the interior of house 70 on El-
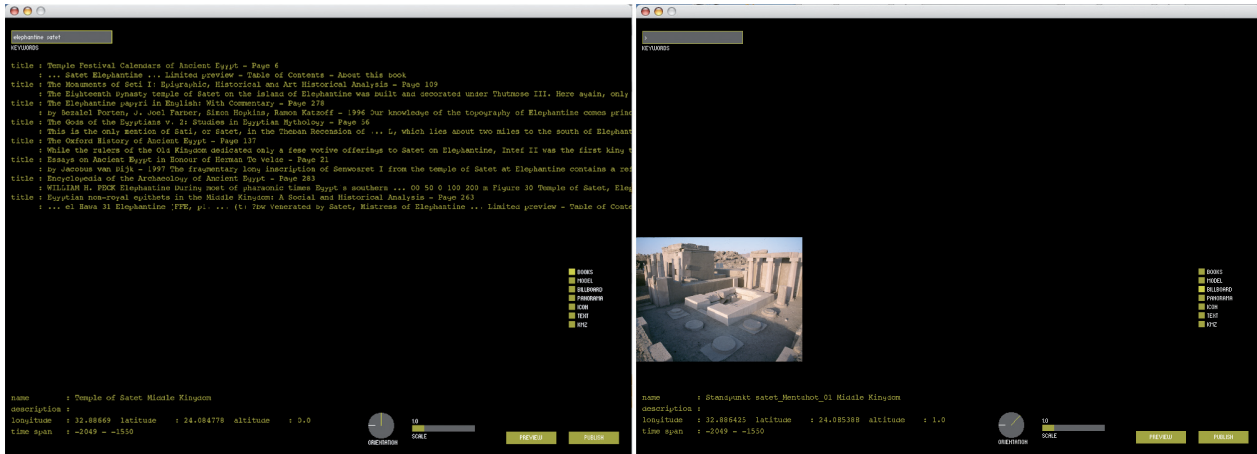
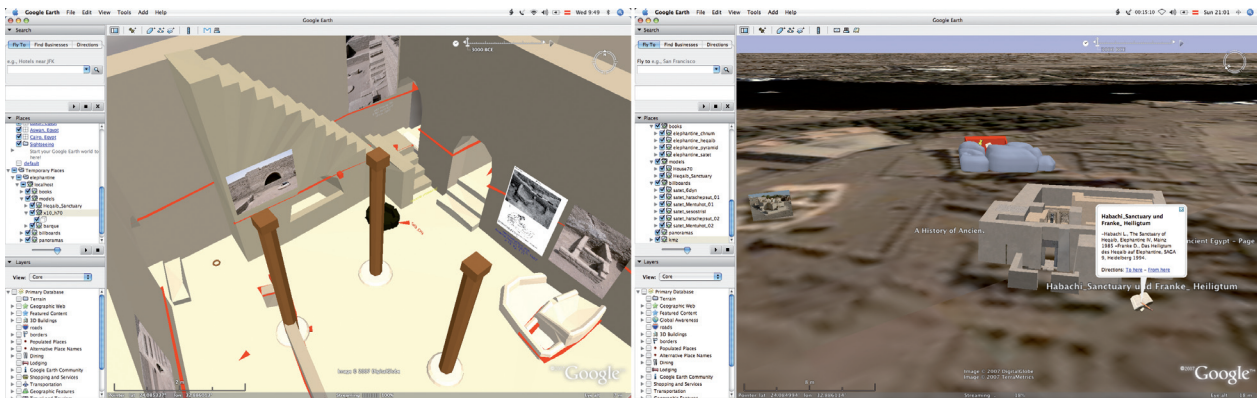Fig. 6. Screenshots of the Google Earth publishing software gePublish.

Fig. 7. Google Earth as collaborative working environment.

ephantine, with the concept of a visual index as described in chapter "The Working Model as Visual Index". The right part shows the display of several literature references that were found by using the Google Books engine. A manual entry of relevant literature is shown in detail in a pop-up window.

Conclusion

The proposed approach shows the importance of distributed collaborative work in the area of archaeology. We have demonstrated the concept of a visual index to integrate all necessary data in a visual overview, as well as how to implement a distributed publishing solution from Google Earth. Further work will extend the functionality of the publishing system by using additional search engines or online repositories, as well as incorporating established database systems used in the original documentation process at the excavation.

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