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A Tool for Multimedia Excavation Reports – a prototype

1　Introduction

This paper presents the results of the first stage of work on developing a new tool for multimedia excavation reports, using the Hypermedia system Microcosm.

2　Hypermedia in Archaeology

Archaeology is having to find ways in which to deal with the information explosion that is a result of the development of analytical techniques. The computer revolution means that a large amount of the data generated by these specialised analyses is now stored on computer. The resulting problems of publication in archaeology are well known: the sheer quantity of excavation data makes complete publication virtually impossible, and the trend is now towards summary publication with an accessible archive.

The idea of using multimedia for archaeological applications is not new. It has long been understood that archaeology is a discipline which relies heavily on data from a diversity of sources in a number of shapes and formats. It is now recognised and accepted that archaeology should take advantage of the possibilities offered by multimedia. There have been attempts at resolving some of the data management problems using novel technologies, especially electronic storage, computer and multimedia technology, for the publication of the more 'unwieldy' records generated by excavation: line drawings, photographs, catalogues and tables (Rahtz *et al.* 1989).

The points in favour of using multimedia are summarised and adopted here from Rahtz, Hall and Allen (1992: 360-361):

– Much of the information in archaeology is very specialised and full publication is not economically viable, nevertheless data must remain accessible. Even if it is not economically viable to publish material in a conventional book which will only be read by a few hundred people, some means of disseminating it is required.
– Archaeology is a very data intensive discipline, both in the field and also in the post-excavation process. Computers can help with storage and access.

– The graphical representations already included in conventional publications frequently present some problems. Oversize drawings either have to be reduced, with consequent loss of detail, or are included as fold-out plans which are unwieldy and increase the cost of the publication. There is already considerable use made of graphical representations of the data (plans, drawings, photographs, stratigraphic diagrams), none of which are reproduced easily in a traditional book format.
– Whilst colour plays an important role as part of the archaeological record for discrimination, it is hardly ever used in publication. Ceramic thin-sectioning would be an obvious example where the discipline would vastly benefit from the ability to publish in colour.
– An important point is that the proportion of data held on and generated by the computer in archaeology is growing steadily. Virtually all but the very smallest excavations now use databases to organise some aspect of their archive. Many archaeologists already have large quantities of machine readable data, and considerable experience of formalising information.
– Finally, the results generated by new computer techniques, such as GIS, now frequently used in archaeological research, are not suitable for publication on paper and thus require new methods of publication. Multimedia also provides an opportunity to publish data from the excavation archive that has so far never been published, such as colour photos or moving pictures.

Hypermedia should not be aiming to replace the book. The basic assumptions by Rahtz *et al.* (1989: 20) in their evaluation of the technology for archaeology state that we will not be able to dismiss conventional books, as linear narrative and argument have been the basis of scholarship for millennia. The book has been the repository for past knowledge, so any new form of representation must have some kind of continuity with existing methods. Nevertheless, there is an opportunity to supplement the book in certain areas of knowledge representation — especially where arguments are supposedly backed up by reference to the original data, this data should be freely accessible to allow the assessment of the statement.

A system is needed that can be added onto existing practices, which is easily understood and does not require complex mark-up languages or programming skills. The current unpublished archives are artefacts of inadequate technologies for disseminating archaeological information — the time has come now to remove this stepping stone and make the archives accessible. We are aiming to provide an electronic archive with good access, which is directly referenced back to the written report.

There have been attempts to use Hypermedia to provide a new kind of excavation report, by producing hypermedia publications of electronic books or archives. The problem with most attempts so far is that they were developed using monolithic packages and closed systems (such a Hyper-Card). In a closed system the user is constrained to finding and following the links made by an author. These usually appear as highlighted text or graphics such as buttons. These links frequently have to be explicitly defined one by one by the author, thus making the authoring effort needed for the compilation of such an application very labour-intensive. Closed systems import the data and make it their own, import or especially export facilities are relatively unusual. Link definitions are frequently 'hard-wired' into the data files; there is then no possibility to communicate with other programs, or query the information in a way that the author had not anticipated, as the data cannot be read by other programs.

2.1   OPEN HYPERMEDIA AND MICROCOSM

Microcosm has attempted to overcome the problems of closed systems. Since 1989 the Microcosm team has been working on it and the third version has been released (Davis *et al.* 1992c; Fountain *et al.* 1990; Hall *et al.* 1992; Hill *et al.* 1992a). Microcosm is not just an authoring or presentation system, it should be seen as an extension of an operating system (Hall *et al.* 1992: 14), organising the access to the documents. It consists of a message passing system, which allows a number of autonomous processes to communicate with each other. The information about the links is held in a database separated from the document files. This separation of links from the actual data files is an advantage (Davis *et al.* 1992a), as it allows for far greater flexibility. Files can be updated and accessed from applications that are not part of the hypermedia application itself.

A Microcosm (MCM) application comprises a set of documents (individual files in the file system) that the program knows about, together with a set of relationships defined for those documents. MCM allows relationships to be defined between objects and ideas in a variety of document types such as text or graphics. The user is provided with a core set of viewers; these are programs which allow the viewing but not the editing of any files of

supported formats. These documents are prepared in various software packages and viewed through the MCM viewers. MCM also comes with a core set of filters. These are programs which provide it with its information processing and retrieval functionality. As it consists of a set of independent programs which communicate with each other, the functionality of these can be altered according to the user's requirements.

A minimum definition of an open system as used by Microcosm is (Davis *et al.* 1992c: 6):

– A system which does not impose any mark-up on the data which prevents it from being accessible to other processes that do not belong to the system.
– A system which can integrate with any tool that runs under the host operating system. Data produced by tools that are not part of the hypermedia system may be used within it without adding any special value to that data and without compromising the continued use of the data outside the system.
-– A system in which data and processes may be distributed across a network, and across hardware platforms.
– A system in which there is no artificial distinction between readers and authors.
– A system in which it is easy to add new functionality, i.e. new program modules may simply be inserted.

An important way of accessing the documents inside Microcosm is by following links. The system allows a number of different actions to be taken on any selected item of interest; links are specified either as buttons or invisible links. A button simply binds two items of information whereas the links can be of four different types:

Specific Links: specific links are similar to buttons, however the link anchor is not highlighted.

Local Links: if a destination for a local link has been defined in a document, the user can select the anchor anywhere in the current document to follow the link.

Generic Links: The user can follow the link after selecting the anchor in any document in the current application.

Dynamic Links (Compute links): This allows the user to follow links not explicitly defined by the author. The available links will be calculated based on the anchor selection anywhere in the application.

With the design of Microcosm the developers have also tried to address the question of what users expect from a hypermedia system (summarised in Davis *et al.* 1992b: 182), which is also applicable to the archaeological environment:

– Users want a computer environment which is adaptable for the integration of data, tools and services as required. Users remain free to use whichever text editor or

drawing package they prefer, without being bound to the one provided for the particular hypermedia system. By separating the links from the documents, this independence has been maintained.

– To maximise exchange with other persons active in the field, a system that is platform independent and allows distribution across different platforms would be an advantage. UNIX and Macintosh versions of Microcosm are under development.

– A system that comes with powerful navigational aids to allow the user (both the author and the reader) to find and update the information without having to wade through large amounts of irrelevant data. Text may be pre-indexed (Li *et al.* 1992) to allow a general search of text files. Other kinds of links also help to reduce the authoring effort. A differentiation between public and personal workspace and links is achieved by using personal linkbases.

– Finally, a system in which all data types are treated in a similar manner. If making links to data of one type of package differs widely from the next package, the learning will be more difficult and familiarity with the more advanced features will progress more slowly.

3   A tool for Archaeology

It has to be accepted that nobody actually reads a complete excavation report; they are clearly not designed to be read from cover to cover. They are expected to give an overview of the excavation and allow a fairly detailed view of the data which the conclusions are derived from. However, with the increasing trend towards summary publication all that detail will be lost to the average reader by being kept in the archives. These archives require extra effort for access and in some respects are even worse than microfiche. Excavation reports were supposed to be written with specific reference to the data like a good index to the site. If it is easier to access the data maybe people will change their attitudes and consult and work with it more.

What is needed in archaeological publication is a tool which will give access to the material in the excavation archive for research. The computer can improve on access and versatility and is a much more flexible tool than microfiche. For example, images can be manipulated, their brightness and contrast or colour maps can be altered interactively to enhance special features of the image. We have to stress here that this program will not be aiming at the 'public' level of archaeology, but at research, which will be able to make sense of the mass of fairly unrefined data we propose to disseminate.

Initially we will be aiming at the excavators who have to write up the paper report text. The new system will allow

them to organise their data and establish links between the text and the supporting data. It is then possible to release this electronic archive, probably on CD-ROM, on request. This would be in addition to the conventional printed volume, allowing researcher and readers access to the levels of archive not usually accessible at all unless the archive is visited. There are cases where archives can be split over several locations, making access even more difficult. We are not denying that there are instances where a visit is essential, but generally it can help to disseminate more archival information about a site.

One aim of the prototype is to remove from the user the need to recognise the functions of each Microcosm 3.0 icon by uniting them all into a toolbar. The toolbar is a relatively simple program; it simply calls up individual Microcosm 3.0 components which can also be accessed directly from their icons. The toolbar should reduce the user's confusion about the 10 icons along the bottom of the screen. Obvious components to be called are 'show links' or 'open a document'. Furthermore the archaeology toolbar will allow users to integrate into Microcosm the other types of tools now routinely used by many archaeologists such a Harris matrix program, databases and spreadsheets. If all these could be linked on a common identification such as the context number, the data would become more useful.

4   Key study: the excavation at St Veit Klinglberg

The excavation selected was carried out at St Veit Klinglberg (SVK) in Austria by Shennan in the summer seasons of 1985-89. The site is situated in western Austria about 60 km south of the city of Salzburg. It lies between the small towns of Schwarzach and St Johann im Pongau (Shennan 1995).

The excavation archive is relatively small (approx. 1350 contexts), and only slightly stratified. A large part had already been entered onto computer. The context, pottery and botanical record were readily available as database files. Finally all single context plans had been digitized with AutoCAD (approx. 1360 files). Larger phase plans and site plans were then compiled by amalgamating these plans.

The archive at the moment represents the excavation report as submitted for publication, with the addition of the complete database and illustrations archives.

4.1   PREPARATION OF THE ARCHIVE

As AutoCAD is a program that requires large resources of computer memory and speed, and can behave sluggish at the best of times, an alternative had to be found to present the digitized plans and sections. It was decided to convert them into DXF (data exchange format) files, as there is a viewer for Microcosm under development that can access
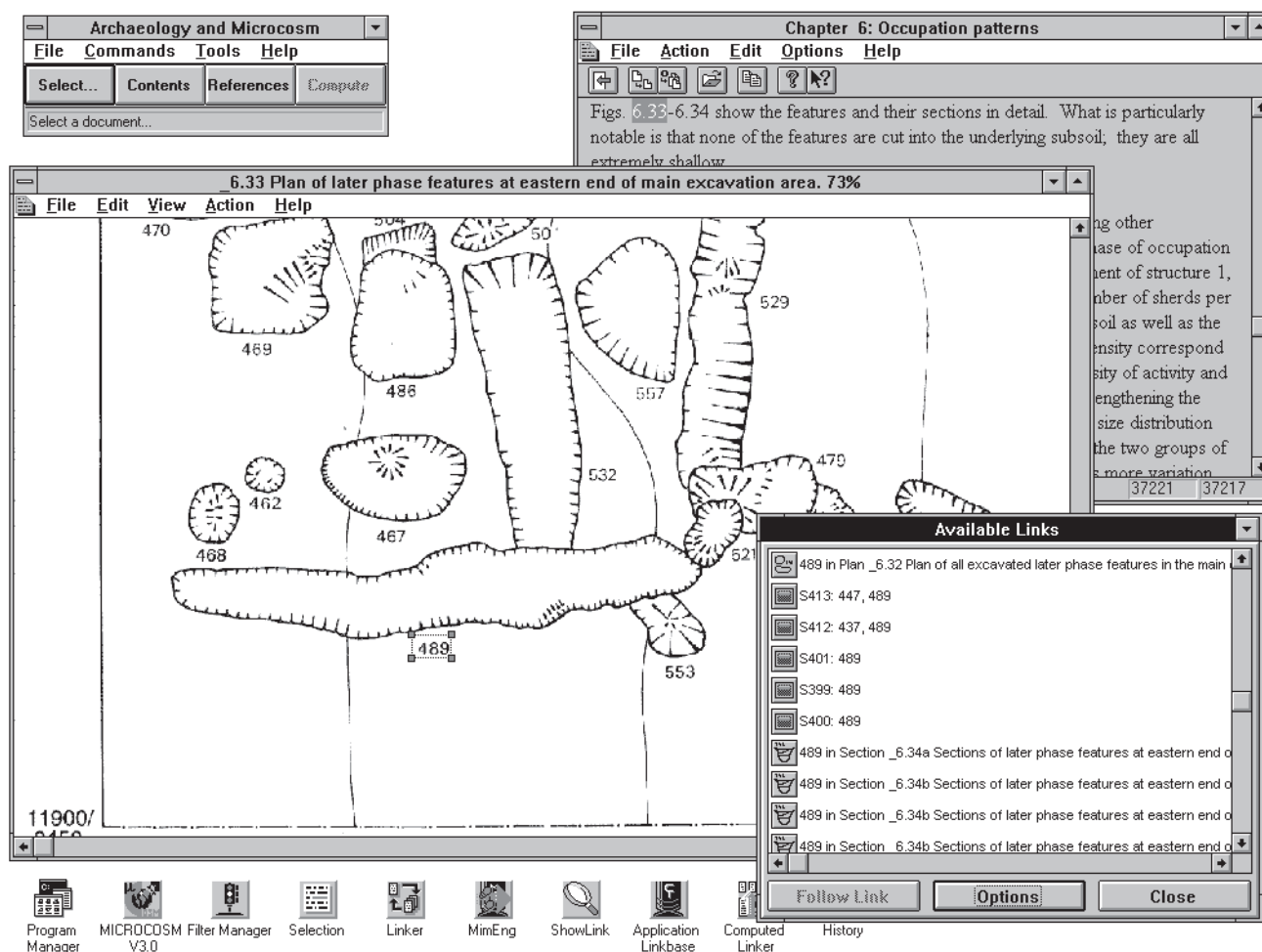
Figure 1. An example screen of Microcosm running with the sample data, showing a rich text document, a bitmap plan and the available links that exist with regard to the selection made from the plan. Along the bottom the icons can be seen which represent the individual Microcosm components. The Archaeology Toolbar is in the top left hand corner.

these files and block attributes if they are defined. The multiple context plans have at the moment been scanned from the publication drawings on a flatbed scanner due to time constraints. Once the visualisation tool has been developed all plans and sections are expected to be available as DXF or AutoCAD files to build up a three-dimensional visualisation of the excavation records.

The report text has been preserved in chapters and appendices as written for the published report. As the current objective of compiling this electronic archive is to make available the existing archive, no attempt has been made to make new arrangements for the text by splitting it into smaller sections. The files were saved in rich text format (RTF), which preserves their formatting and is used to exchange word processor files between different programs. As Microcosm 3.0 is supplied with a RTF

viewer, the formatting of the text could be maintained and all footnotes were preserved as pop-up boxes. Tables and Excel Charts were originally supplied as large Word for Windows files; the chapter files contained both tables and figures (Excel charts) grouped by chapter; these were separated into individual files, named with the figure numbers. This allowed the establishment of direct links and the multiple display of tables or graphs for comparison and made their management and labelling more straightforward.

The photographic excavation record and the smallfind photos were digitised from slides and negatives using a Nikon slide scanner. The resolution chosen was 635 dpi, which will enlarge the slides to a size of 800*600; this proved a satisfactory resolution for displaying them on colour monitors. Further editing involved the sharpening of the image and conversion from 24 bit (true colour) to 8 bit

colour (256 colours) to reduce storage requirements. The editing carried out involved some adjustment of brightness, but essentially the aim was to preserve the details including brightness of the slides as it was first captured in the field. This means the multiple photographs of contexts were all scanned, so that comparisons between different brightness settings are possible. All files were converted to JPG's which allowed a compression of 75 percent with minimal loss of detail. The increase in display times is a necessary and acceptable drawback, given the fact that the files are now considerably smaller than the other format (Windows BMP) that can be viewed with Microcosm 3.0.

4.2   ARRANGEMENT OF ARCHIVE WITHIN MICROCOSM 3.0

An example of running Microcosm with the digitized data can be seen in figure 1, which shows a screen shot of the Microcosm SVK application in action, showing multiple windows of different document types.

To enter the files into the Microcosm application they were dragged into the *Select a document* window. To facilitate the organising of types, the following logical types were defined:

– *Report* to include all textual material included in the excavation report
– *Figures* to include all figures as referenced in the report, including plans, sections and charts
– *Sections* to include all referenced sections, of which most so far have been scanned rather than digitized
– *Plans* to include all referenced plans, of which most so far have been scanned rather than digitized
– *Finds* to include all smallfind photos
– *Slides* to include all excavation slides

These classes will allow users to locate the material by type at a glance. Some items will inevitably appear in more than one class, as figures include sections and plans, as well as tables and charts. The advantage of logical types is that the files will not have to be duplicated on the hard disk and can nevertheless be listed in more than one place.

4.3   ESTABLISHING LINKS AND DESCRIPTIONS

The main way of organizing the cross-referencing of the documents was defined by context number; searches on context numbers will reveal links to every reference to a particular context number, in both text and image files. For all bitmaps, named selections were defined on each context number listed on these, with generic links anchored on each of them. Sections and plans were treated in the same way. Slides also have generic links ending on them according to the context numbers represented on them. A list of such links as displayed by Microcosm can be seen in figure 1.

For the report text the computed links filter provided a good mechanism for searching across all text files for the occurrences of the relevant word. The user can select any word and search in the created index for any matching passages. However, this is only possible for text files and may not be adequate for some kinds of searches. All author names in the references were defined as generic links, as were all figure numbers as mentioned in the text. Figures were given descriptions containing both their original numbers as used in the report and their descriptions as copied from the captions.

5   Presenting it to the user – the toolbar

In our view Microcosm suffers from a slightly confusing interface, presented by the 10 icons along the bottom which all have different functions. As this is meant to be a system for the casual and one-off user, it is important to make it usable in moments rather than hours. Therefore the toolbar unites the access to the icons in a group of menus and buttons — to make it all more manageable and understandable.
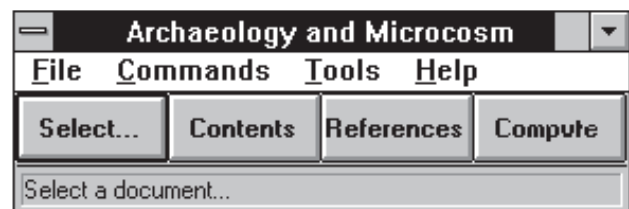

Figure 2. The Archaeology Toolbar prototype.

The tool bar (fig. 2) gives the user a more straightforward interface of MCM. Rather than having to understand the functions of the icons along the bottom of the screen and having to double click on MCM to open the *Select a Document Window*, it was decided to write a simple toolbar front end which gives a button and menu interface that will stay the same throughout. Direct access to certain core documents which are pre-defined by the author is provided as an entry point. Another key element to the usability is the ease of preparation of the archive and therefore it is desirable that the excavator should not have to specify links by hand.

Microcosm is composed of many communicating processes or components, allowing for different features or services depending on which components are currently active. This feature exists in keeping with the open hypermedia philosophy. The communication between the outside world and Microcosm is effected using Application Programming Interface (API) used by Windows. Messages are passed to Microcosm components to initiate actions. The Visual Basic application uses API to communicate with

Microcosm, to interrogate settings in the Registry, a central file where all Microcosm settings and details of imported documents are defined. In this way details about existing documents can be accessed and specific documents can be opened. Similarly individual components such as the *Select a Document* window or the *About* box can be called up.

5.1   TOOL BAR FUNCTIONS (fig. 2)

In keeping with other Windows programs, the *File* menu gives access to functions such as *Open* and *Exit*. It also gives the option to open specific documents which the user might want to access with ease. These were previously specified in the registry. In this case the Contents and References were defined as such fixed documents.

The *Commands* menu includes all Microcosm functions such as compute links, show history and show links, which connect to the functions of the Microcosm filters which perform *Compute Links*, *History* and *Show Available Links*.

The *Tools* menu so far gives access to one simple function called *Change Titles* which will organise the re-naming of a list of documents contained within the same directory. After the user has specified a directory, and selected whether to change titles or types, the following window will appear, giving the option to either skip the current document, if no change is intended, or to type in a new title or type and to change the document's record in the Registry.

The *Help* menu currently points straight to the Microcosm 3.0 help file which is executed using the windows help program (winhelp.exe) as there should be very little explanation necessary for the tool bar itself. The second help option allows users to seek help for any specific key word. The standard *About* box for Microcosm is also included.

Finally, the buttons repeat selected menu functions, adding ease of use and a visible reminder of available commands.

6   Future options

The current version of the toolbar program provides a simplified entry point to Microcosm for the user; it does not provide any specifically archaeological tools such as stratigraphic visualisation or data analysis modules, which are the main aims of this project.

The setting up of applications should become far more automated, so that the user only has to specify which files to include, and possibly one additional text file which contains the appropriate file descriptions. The program would be able to complete the set-up and renaming of documents by itself. The current facility for easing file renaming after import is still very limited as it will only examine a list of files contained in a directory, when it

might be advantageous to examine all documents imported under a certain logical type.

Another important aspect that should be added is the automatic linking. Currently it is possible to search for a specific word using the 'Compute Links' filter to search text files. These automatic links will probably be defined on file names or the file descriptions, which will then need to contain the context number represented in the specific image file for example.

Stratigraphic relationships are used extensively by the excavator to understand the excavated site and material. Stratigraphic relationships are identified which influence the final interpretation of a site. It is thus crucial to allow the user to centre the organization of the dataset around the stratigraphic relationships rather than the report text as the example application currently does. Possible approaches would be to provide an extension of the program so that an existing stratigraphic program can be used. Other data visualisation tools that will allow users to examine site reconstructions generated from the plans are the elements which are needed to make the program uniquely archaeo-logical. Possibilities include interactive find distribution plotting from selected finds, projected directly onto a plan.

7   Conclusion

We hope that it has been shown that the use of open hypermedia is the way forward for archaeology. It will allow archaeology to deal with its data dissemination problems.

The first experiments with Microcosm and the excavation archive under consideration have shown that the proposed tool is possible with existing technology. The materials present in the excavation archive could be digitized satis-factorily and proved to be suitable for electronic representation. Microcosm provides a useful and flexible framework for grouping the data within the excavation report lay-out. Windows API with Visual Basic means that most programs can be adapted to add the archaeological functionality that distinguishes it as an archaeological tool. It will now be necessary to add the specifically archaeologi-cal analysis tools to the toolbar under development.

The tools which make the compilation of an electronic excavation archive easier will also make it easier to re-assess the excavator's conclusions. These days it is very hard to do anything but take the excavator's report on trust. In order to really examine an excavation report in depth takes too much time and effort. Hypermedia excavation report tools can make the excavator's argument much more open to criticism and reassessment as specific details can be found and examined more quickly. This may be uncom-fortable for the excavators but is certainly important for the discipline.

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