**MONOGRAPH**
**Victorian Periodicals HyperText (VPHT) Project:**
**An Interactive Hypermedia Learning Environment**

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## 1. Introduction

This Monograph is an account of the context and conduct of a collaborative project between the Information Modelling Programme group (IMP), School of English, both based at Leeds University and the Department of English and History at the Manchester Metropolitan University. The first phase of the project was conducted during May to December 1992, this was followed by a second phase going on to the Spring of 1993.

The Victorian Periodicals HyperText (VPHT) Project was concerned with prototyping an interactive multimedia system capable of delivering, and giving innovative access to materials from key

periodicals published in the late 19th and early 20th Century. The periodical has been an important but neglected form of publishing, with multiple authors, a range of subject-matter, a mixture of text and graphics, and advertising copy. The project aimed to make such periodical materials, otherwise not readily accessible due to rarity and condition, available for study and to build them into a computer-based teaching and learning resource.

The project was based on a number of ideas developed over a much longer time frame. The Monograph is written as a case study, and as an expression of ideas concerning a number of key issues: the nature of hypertext, the practical development of innovative teaching and learning technology, and interactive multimedia or hypermedia systems.

The project is based upon several years of experience in interactive multimedia applications development with end users in a number of domains. This includes expertise in both humanities computing from the humanities scholars and object-oriented interactive multimedia from the technical development support team - IMP.

The VPHT Project is one of several projects which the IMP group is currently engaged in. A number of these have a focus on the development of support for end users within interactive learning environments. We are aiming to develop a generally applicable IMP environment for the development of interactive multimedia systems, including educational information resources and materials.

There is a current priority in Higher Education for the development and delivery of innovative computer-based materials as part of courseware: this is with a view both to enhancing existing teaching resources and to providing for increasing numbers of students. As is the case in the provision of healthcare, a new education 'market place' is being encouraged. A basic requirement, and constrained by the institutional availability of computers for teachers and students, is that materials and systems will need to be portable to a variety of delivery platforms.

The project is of great interest to us as a further opportunity to interact with domain and subject matter experts so that we can pursue the development of useful, quality, large-scale, interactive multimedia information systems. The "information system" is here defined as a computer-based information resource (multimedia; including text, graphics, pictures and audiovisual material) which is accessible through an interface and which includes tools for the acquisition, editing and modelling of content. On this occasion, concerning the organisation and communication of information in the humanities. This is a refreshing and stimulating change from other projects from the science, engineering and medical domains.There are distinct and interesting features of concept, procedure and operation in the humanities information domain that contrast with the mathematical and reductive processes underlying science oriented information systems.

Indeed, there is much value in dealing with a range of cultural and domain viewpoints in the design, classification, organisation and communication of information systems with potential general applicability. Types of abstraction and synthesis of information practised in the Humanities, and approaches to the classification and organisation of information in some cultures, are at variance with the traditional Western approach dominated by scientific analysis and reductionism.

The project was interesting and, following its first pilot phase, has established a good foundation for a major, longer-term project. There were some natural and exciting tensions between subject matter experts and engineers. Nevertheless, interesting prototype structures and mechanisms are being developed. This project is a model for computer-based information systems development in the Humanities.

The object-oriented paradigm, which is a relatively novel and refreshing approach to systems analysis and software engineering and which seems to fit the mechanical and systematic reductive classification systems of science and engineering, is well understood and is a basic tenet underpinning the approach to the analysis and communication of information in the humanities.

**2. Terminology**

There is an abundance of terminology connected with information technology and the development of computer-based applications. Much of this is banded about in the trade magazines, conferences and the popular media and has tended to be rather imprecise, market-driven 'hype'. "Interactive Hypermedia Learning Environment" is a part of the rhetoric from the educational technology domain. However, we believe that we can demonstrate the meaning of these words by the software and the applications we are developing and delivering to end-users, and that the VHPT demonstrates this to some extent.

The definition of 'hypermedia' is controversial (Ward and Arshad 1992), but its meaning really depends on what it needs to mean and on the context.

For example

"*I don't know what you mean by 'glory'," Alice said. "When I use a word," Humpty Dumpty said in a rather scornful tone, "it means just what I choose it to mean - neither more nor less." "The question is," said Alice, "whether you can make words mean different things". "The question is," said Humpty Dumpty, "which is to be master - that's all".*

The term "hypertext" has been preferred to "hypermedia" (Halasz and Schwartz 1990 ). The notion of 'interactive learning environments' which is becoming widely used in the literature is very exciting. Computers can become a component of, and make innovative contributions to, interactive learning environments; but it is important to take conventional methods and resources into account. They can be included or developed further and in new ways as can the social and theatrical dimensions of the interactive education process (see Norman 1990).

A number of other labels and terms are briefly defined in the Glossary Section of the Monograph.

**3. The Central Issues and Questions**

Central issues and questions relevant to the VPHT Project include, 'can innovative, interactive access be created to large bodies of text, with the means to search, link and model any variety of knowledge or argument - using the text as a resource?' and, 'will such an "environment" (computer-based) provide the support required for communication of ideas about text '.

Of the two tasks - (i) assembling the resource and, (ii) creating the means of access, the subject matter experts and application users are key informants and guides to what this means. The IMP group is developing a technical approach and a methodology for interacting with these key people and the development of applications meeting their requirements. Information modelling and designing access to information is dependent upon the identification of the appropriate resources. This is captured in Diagram #1.

*Diagram #1: "Outline of the Victorian Periodicals Project"*

An essential ingredient is a combination of insight into the domain of text (including the design of information presented on the printed page) with insight into the computer-based modelling of information (including database design and presentation / interaction design).

The author of the hypertext must provide some form of "reference structure" (syntactic, dictionary / thesaurus; semantic, topic description) to facilitate browsing and searching /querying. The "hypertext" paradigm provides for the construction of databases of linked (textual) objects. The nature of the links can determine a semantic structure for the text. External and contextual references can be created and links can be established between different texts or between novel structures created to make reference to textual content. "Hypertext" affords the possibility of creating structured access to texts. Authors can define links and create external references as a means of communicating ideas or supporting arguments. Various issues can be declared and dealt with by reference to the text and information structures can be designed and made available to an end user as a means of accessing the text.

The overall aim of the VPHT was the development of a platform for the organisation and communication of information and the provision of a medium for enquiry (including research into texts) and communication within an educational context. It is also potentially a way of making texts available to those who would otherwise have no access to them.

**4. A Multidisciplinary Approach**

The construction of the VPHT required a multidisciplinary approach and inherent conflicts and problems were encountered in this process. These were catalytic and informative for the development process.

Some of the problems and conflicts are natural expressions of the tensions between expectation and promise, idea and implementation, the humanities and information technology. The promise of interactive multimedia systems, capable of providing innovative, hands-on, easy to use computer-based teaching and learning tools and environments is a laudable task. The reality of delivered, available and affordable systems or packages can be rather disappointing. There is a variety of software available but it requires financial investment, time and application of skilled operations to become productive. Implementing real, high quality prototypes, which support some of the basic functional requirements and provide the end user with an interesting, usable and part-way useful system - is not easy! There will be particular and innovative methods of creating structured access to information which will be defined by the humanities scholars which will create a challenge to the implementors. There will be approaches to this taken by the humanities scholars which contrast significantly with those adopted by scientists and technologists. These are interesting and informative tensions indicating the cross-disciplinary and cross-cultural issues embedded in a project of this kind.

Basic to the methodology is the involvement of the end users.The task is to synthesise a computer-based information system from a specification derived from an analysis of end user's expressed needs and requirements. This naturally involves the representation and exchange of ideas. This is a key notion of "information modelling". In order to achieve the desired implementation, many cycles of iteration and prototyping may occur. It should not simply be assumed that the objective of building a flexible interactive information system can be achieved with a simple 'recipe'. Ideas must be communicated and an understanding of the specification must be achieved. Of course, in attempting to build the VPHT in this first phase with the available resources, we can only achieve a partial success. After all, the ideas cross the divides between many disciplines, including textual studies, computing science, cognitive science, education, graphics and design. This is an exciting mix, but to establish an interdisciplinary exercise from a cross disciplinary start requires a synthesis which needs time to develop.

IMP is a multidisciplinary group, and naturally there are tensions between ideas and implementations. Expertise varying from games programming and software engineering to educational design and technology, cognitive science and design is the mix that can implement

approximations to "Interactive Hypermedia Learning Environments". In order to efficiently address a range of requirements in a number of projects in several subject areas, new paradigms for thinking are required - in which the formalisms and methods of the individual disciplines are converted and, where appropriate, accommodated into a common model. This model must then be used to approach and conduct projects which seek to develop something like the VPHT.

There is a need to develop common models of information systems and application building, and new paradigms for working and communication.

**5. The Aims of the VPHT Project**

The School of English at Leeds University and Manchester Metropolitan University commissioned the Information Modelling Programme (IMP) at Leeds, to collaborate in a project to develop a system which would deliver materials on the Victorian Periodical to students.

Their requirements included the need to develop a computer-based information resource system which would be able to handle large amounts of text and pictures, as well as additionally supporting sound (either music or commentary). They specified that access to this material, employing the 'hypertext paradigm', was to be under the control of the student or tutor user.

The project sought to address a number of basic issues, including access (extending to include rarity, fragility, and size), editing and the representation and communication of knowledge.

The system was required by the School of English at Leeds and Manchester in order to

(i) meet the institutional challenge for more innovation in humanities teaching.
(ii) enrich existing courses at undergraduate and postgraduate levels in a range of disciplines (Art History, Social History, Literature, Publishing, Design, Librarianship etc).
(iii) put into place a new course specifically on searching and examining periodicals.
(iv) examine the feasibility of using computer techniques for making greater access available to valuable materials which would otherwise be difficult for students to get hold of and handle.
(v) contribute to methodological awareness among Humanities students and teachers

Specifically, the pilot system to be delivered was to be used in teaching a new course on Periodical Research in November 1992.

The VPHT Project provides a rich information environment and testbed for a number of conceptual and technical issues in the design and delivery of interactive multimedia systems.

In attempting to provide an information resource on the Victorian Periodical there are a number of considerations including fidelity (of the original source), editorial influence (in the way in which the text is made available for scrutiny), critical commentary (with comments and references to content) and contextualisation (with references to various relative issues of interest).

As a database (or information resource), it needs to be structured in flexible way, enabling the browser to reveal and suggest a range of levels of meaning.The system must provide access to the original structure of the text and enable various authors to create information structures highlighting various issues.

**6. The Pilot Project**

The first phase of the Pilot Project concerned with producing a demonstration model system in

May 1992 when the School of English was able to recruit a research student to provide strategic support for the identification and collation of material. The nature of the collaboration was that both the Humanities Scholars and IMP were concerned with the nature of 'hypertext/hypermedia' (its potential as a medium of representation and communication) and with the implementation and evaluation of applications giving a new means of access to bodies of text for researchers, teachers and students. IMP has been developing "information modelling" tools for the construction of interactive multimedia applications in which the 'hypertext/hypermedia' paradigm is deeply embedded. The Humanities Scholars had a vision of what they wanted as a model computer-based 'hypertext' and IMP was interested in providing technical expertise in the realisation of this model.. The project terminated its first phase in December 1992.

'The Queen' was chosen as the Periodical of focus, with some reference to other Periodicals of the time, including 'Household Words' and 'London Illustrated News'. The subject matter of 19th Century Periodical was to be delivered through a system which was designed to explore the use of computer technology in Humanities teaching. An aim of the project was to demonstrate the viability of successfully integrating computer-based hypertext and new techniques of object-oriented multimedia interface design, and to create a new means of access and supporting the way humanities students wish to explore texts, adding value to traditional materials which may not be readily available (as in the case of old, valuable textual items held by museum curators), or are often incomplete.

Included in the specification was the need to meet certain milestones/deliverables,

(i) demonstrate the innovative technology of using interactive multimedia for Humanities/English teaching and research at the CATH Conference on the 11-12th July at Metropolitan University of Manchester.
(ii) demonstration and evaluation by Marilyn Deegan and colleagues (Leeds) from the Oxford CCTI Centre for Textual Studies.
(iii) Workshop assessment of the systems content and interactivity held at Leeds in October.
(iv) final delivery of system in November for teaching Periodical Studies in School of English, Leeds and to be presented at a further CATH Conference in December.

The strategic goals of the system which IMP proposed to build in collaboration with the humanities scholars included the issues outlined below;

(i) The Pilot System would need to provide some support for a variety of end users, including the humanities scholars (our English partners who conceived the application), teachers, students. As well as providing support for information modelling and communication as the educational process, the system is potentially useful and would need to developed in the future to include support and facilities for textual researchers and archivists.

(ii) The system built would address the need for portability. Most institutions make provisions for their students to get access to computer-based materials using standard PCs. As well as the PC operating system MS-DOS, and the access provided by MS-Windows, Apple Macintoshes and a variety of other machines and operating systems, including increasingly Workstations and Unix/X, are also institutionally available. Workstations are often the platform of choice for application development - as was the case in this project. As such the delivery platform would be different from the development platform, therefore, the system as it evolves must address whether it will be possible to deliver all features of the interactive multimedia system on networks of PCs and other machines.

(iii) As the system to be developed would in the first instance be a demonstrator model, dealing with

only example topics, and not a complete set of topics, clearly the system would have to be designed to cope easily with extension/increase in content materials.

(iv) The large amounts of text which the system would have to deal with necessarily entails adding value to the way it is presented to the user. Rather than merely presenting a whole page of text, the textual information would be "chunked", displayed and arranged in different ways on the screen. New means of access can be created including superstructures such as maps and networks and through hypertext links. The hypertext linking is especially important when dealing with large amounts of textual information and is an inherently flexible means of creating structured access in texts. The superstructures and other means must be designed and made available to users of hypertext to aid them in exploration, navigation, and goal fulfilment. Hand-crafting hypertext links can be a huge task and tedious. As such the system would need to provide a combination of automatic and hand-crafted pre-defined methods for the creating the links.

(v) Other key functionality of the developing system would need to address includes interoperability (with other computer packages and databases) and re-usability (materials can be edited and customised to suit any individual needs.

For the textual component of the system, there were several technical constraints which needed to be addressed. Apart from there being a large quantity, much of the text was extremely small, it was printed on A3 paper using a font type which did not lend itself easily to scanning and manipulation. (Scanning, using a flat-bed scanner to capture text as bit-mapped images, is a standard technique. With the additional benefit of Optical Character Recognition (OCR) software, it is possible to capture scanned text as ASCII text characters - a standard data format suitable for further processing e.g. in a wordprocessor or desktop publishing package). However in the case of much of the Periodicals material, large portions of it had to be typed in (by the English partners) on a word-processor. It was important to identify parts of the text which could be logically shortened without losing the flow and sense. This was necessary in view of the fact that the system developed would be a demonstration model, therefore, it was not necessary to have all of the text on all of the topics which the 'Queen' covered. Hypertext capabilities were added so that large sampled text items could be "chunked", with smaller chunks accessible through key words and labels (acting as 'hypertext links or buttons') derived from the text. This would allow the user to get access to any specified piece of information through a hypertext link with the same label. Chunks of text can be referenced for definition etc. and accessed from an index and any part of the text where the relevant key word or label occurs.

In providing access to the original structure of the text, it was specified that facsimiles of the covers and internal pages of the Periodicals would need to be included.

For pictures, once again, many of these were from older books and printed material, ranging from black and white to colour and from matt to glossy finish. Many of the images selected to accompany the text were very detailed and hence required photo-realistic presentation.

For sound, this capability was thought important because it could convey a flavour and extra dimension of the period of the subject area. This could be achieved by accompanying the text and pictures with commentary or perhaps including music of the period.

This capability was not required for the first two Milestones.

Three things were apparent

(i) the system would be used by some people who have never used a computer who might regard it

as alienating unless it was immediately clear how they could get access to the information of interest to them.

(ii) the system would potentially have to deal with large and increasing amounts of information, both in terms of pictures and text

(iii) further, the large amount of information would have to be organised and made accessible through high level structures designed so that people have an idea of the range of the subject area they are expected to handle.

Among the end users defined for the system are:

(i) students (reading, browsing a hypertext and discovering information structures, creating information structures and communicating ideas amongst peer group or in testing); possibly also library and museum users

(ii) researchers

(iii) archivists (concerned with the preservation of texts and the creation of new and extended access)

(iv) historians

(v) teachers

A measure of access for both teachers and students/learners was required. This was not confined to authoring of declarative structures to be examined by students but was to include support for textual modelling and the creation of individual links as expression of understanding or opinion, by students.

Along with browsing of structured and semi-structured material, "readers" may wish (and need to be enabled) to construct links amongst the resource material. In such a way can information structures representing various philosophies, arguments, and viewpoints, be composed. Ideas can be "discovered", structured and communicated through the medium of a computer-based information system.

**7. Implementation**

(i) Background

Given the scale of the materials and the functionality required by the English partners, IMP proposed the development of an interactive computer-based, multimedia system which would be inherently extendable, easy to use and useful to both the students and the tutors to access and organise (text and pictorial) information. Interaction with the materials was to be possible through a high quality, easy-to-use interface suitable for computer novices, allowing movement to and between materials through a simple point and click method (either on a button-label in a menu or network map or on text which is hypertext).

IMP suggested a system which would require several tools;

(i) an authoring facility for organising the text in terms of topics (to be defined by the subject matter experts) represented as network maps.

(ii) a facility for accommodating text processed using other computer packages.
(iii) a tool for accommodating and porting scanned pictures, including a variety of processing for photo-realism and visual effect.
(iv) a facility for accommodating and making access available for capturing and storing sound.

The core development system for the IMP Environment (so far, the "Media Language") is a C-based OOPL (object-oriented programming language) operating in a Unix operating system and X-windows environment. Such an application can be delivered from a Unix server across a network of clients running X-windows.

Portability and operation across networks of machines is an inherent design principle.

Client machines running the application in such a configuration can include a variety of platforms including Intel-inside (IBM-type), Motorola-based (Mac, NeXT), Risc-based (Sun and other workstations) and custom X-terminals. It is possible for such platforms to run other applications (such as word processors, graphics packages and spreadsheets) under their own native operating system (such as MS-DOS or Mac-OS), with the X-window as an additional option.

(see diagram 3)

Currently, there are a number of "off-the-shelf" tools which would support various aspects and tasks of the VPHT Project (see Discussion, section 2). These include 'Guide', 'Hypercard', 'Macromind Director' 'Toolbook', and 'Authorware Professional' and a host of others. These provide a variety of "authoring" and information organisation and hypertext functionality on a variety of platforms (see for example, 'The CTISS File Theme Issue: Multimedia'). Rather than using these, IMP is developing an information modelling environment, with a variety of tools and techniques for rapid application prototyping and development. At the stage of its development for this project, it is referred to as the "Media Language".

(ii) Resources

The project overall required and involved the use of the following hardware and software resources;

(a) Development Platform
- SUN Sparc workstation with 12 MByte memory or better, and 150 MByte hard disc storage or better; colour 8-bit display; with audio capability (IMP)

(b) Flatbed Scanner
- preferably 24-bit with 300 DPI or better (University Computer Services and IMP)

(c) Apple Macintosh 11x/fx or similar
-for image and text manipulation, with 12 MByte memory or better, and 150 MByte hard disc storage; colour 8-bit display; with image-processing and text processing software (IMP)

(d) Text-Processors and OCR
-IMP and end users both have access

(iii) Tasks

IMP strongly advocates the notion of participative design with the involvement of end users throughout the life cycle of design, implementation and evaluation. This entails considerable organisational overheads, often involving the negotiation of a consensus and common view on

technological feasibility and design concept. It is essential as a realistic basis for high quality software which meets the target user requirements. These latter are rarely defined in detail at the outset and are naturally identified in increasing detail as a cycle of prototyping and evaluation is established.

Tasks were clearly worked out in collaboration with the end users and the jobs divided as necessary (for example due to the large number of images which were to be included, the task of scanning was shared - the English partners scanned in most of the black and white pictures using the university computer services scanner, whilst IMP did some of the scanning using their own colour scanner). All scanned images were then manipulated using a software processing package by IMP to optimise the size and quality of the images. The whole of the text to be contained in the system was typed and provided as ASCII (standard file format) text on floppies to IMP. The images scanned over in computer services were also saved on floppies as PCX (standard file format) and then transferred onto the Macintosh for processing and then ported to the Sun Sparc workstation.

Diagram #2 : "Flow of Information from Domain Experts to Target Users", illustrates this.

(iv) The Prototype

A VPHT Pilot Prototype was constructed and tested.

This is shown in the Diagram #1, "Outline of the Victorian Periodicals Project".

The feedback from various assessment exercise has provided further insight into the next planned phase.

The development project was conducted in a standard fashion as shown in the format below

<u>Phase I</u>
Project definition (end users & IMP)
Identification of Content (end users)
(collation of Text + Pictures) (images scanned by end users & IMP)
(System Architecture and Implementation)(IMP development)
Incorporation of Content into system; definition of Organisation of Content - superstructures and menus (IMP & end users)
First Deliverable - evaluation (endusers)
Milestone 1 (Manchester Conference)
<u>Further Phases 2 & 3</u>
Following evaluation, adjustment of content and organisation, with the addition of new content and organisational structures; repeated iterative cycles.

This process is outlined in DIAGRAM #1.

It was agreed that the English partners would specify the content, the scope and particularly to decide carefully on the depth of the subject matter they wanted the system to include. For example, to explicitly indicate the organisation of the hypertext in terms of the topics and the superstructures from the 'Queen' which was to be include. Based on the topic labels, materials (e.g. associated text and pictures) had to be collated and these passed to IMP.

IMP - would develop the means to incorporate the specified content and organisational structures into the system being prototyped (using the "Media Language"). Further, it would develop means of communication (in terms of interaction between the user and the system) i.e. how the individual

pieces of content can be examined by the user.

The specification produced for each phase of the project includes formalising the material in terms of its pedagogical and didactic structures (Arshad and Kelleher 1993). In other words, the content topics identified would be organised into networks consisting of nodes and links using a drawing tool (developed as part of the authoring facility). Organisation of the content into these network provides the first level of superstructure . This includes the notion of creating hypertext links and networks. Labelled nodes on networks and the textual material can act as selectable 'buttons' or text. Linking is automatic - anything which is given a topic name and subsequent items which refer to or share that name will become hyper textable. Topic names and superstructure items are made accessible by accessing the nodes in networks. Graphical as well as textual segmentation of this type is possible, with links between graphical and textual objects in a 'hypermedia' network.

All such material content is available by accessing the nodes in networks or equivalent segments of an image.

For the first phase, it was decided that topics, organised into a series of hierarchical networks would serve as navigation aids to providing information to the user (i.e. accessing the textual descriptions and further accompanying pictures).

Hierarchical networks are an intuitive way of expressing the structure and the organisation of information. Typically based on structuralism and reductionism, there are other alternative logical ways of representing the structure of information. This is a fundamental research issue of interest. Hierarchical networks are very useful in the construction of computer-based information systems and were used in the development of the textual superstructures in this project.

To make the topic information which the user wants to explore apparent, it was necessary to develop mechanisms of attracting and directing the users attention. This was achieved through an interface which employed the mechanisms of buttons, different colour and font sizes - movement between different pieces of information was possible by simply positioning the cursor on the button "more', "next" or "dismiss". Items which had been examined do not disappear, but are miniaturised and remain as icons in a section of the screen forming a visible history. These items can be recalled by simply positioning the cursor and clicking on the desired item (see next section for more details).

Access to the large amounts of text, enabled by the computer system had to be sufficiently different from examination of similar items in books. This was achieved in part through hypertext mechanisms and by "chunking" the text into small/shorter items. Further it was considered necessary to be able to indicate that some items of text were 'special', e.g. a primary reference source, which in this system was indicated through italics. It was decided and agreed with the English partners that certain items would be logically linked and accessible through button labels and hypertext links, while some of the items would be accessible through button labels alone.

Escape or termination of the interaction should be possible by simply clicking on a 'Quit' button.

(v) the Interface

Given the nature of the detailed pictures the interface had to be of a sufficiently high quality to allow presentation of photo-realistic images to be viewed with all their necessary detail. Also it was important to bear in mind that a lot of people likely to use the system would not have used computers at all, apart from for word-processing, so it was necessary to design the interaction part of the system to be as apparent as possible, with minimal room for confusion and potential for getting 'lost'. The interface can essentially be described as a Graphical User Interface (GUI) in

which information is accessed by positioning the cursor (using a mouse) over the item of interest and clicking the mouse button. This action causes the immediate change in textual and pictorial representation of information which the user is able to subsequently view. Various means of access can be created through the design of menus, networks and other superstructures. These can organise and provide customised and individualised access to content.

The layout of the screen was especially important as we did not want the users to get confused about where in the system they were. It was decided that unlike conventional screen layouts, 'windows' containing chunks of either pictures or text of interest, selected for display, would not be allowed to overlap. As much as possible, related information (be it text or images) would be displayed together - providing screen area permitting. In the event of insufficient screen space, an earlier item would be shrunk, iconised and put away in the right side of the screen thereby making space for the new item. All previous interaction with information is inconised to an overflow strip displayed on the right of the screen. The latest items being at the bottom and the oldest at the top. When the overflow icons become too numerous and there is insufficient space for any more new items, then the oldest ones scroll 'off' the screen. They will be placed into the history store - which will be a history icon. Items which scroll off can be 'bought' back by effectively working backwards through the items of recently examined pieces of information - this has the advantage of acting as a reprise and reminder cue.

*Picture #1 : "Title Screen"*

*This illustrates the high quality, photorealistic interface with buttons enabling simple point and click interaction.*

Interaction with the actual information content of the 19th Century Periodical, 'The Queen', is organised generally through a series of networks - representing topics and issues of focus and interest. The user merely has to click the mouse pointer over the topic of interest.

*Picture #2 : "Contents Network with Writers Sub Network"*

This provides
(i) either, textual or pictorial content for the topic
(ii) or, it will take them deeper into other related networks covering topic items which make up the area of interest or issue contained in the 'Queen' being examined, e.g. Etiquette, followed by the item 'Wealth' from within a chunk of information already being examined (see picture 3 & 4). Alternatively, items can be selected from the Index (see picture 5).

At any point, if there is more information available to be displayed associated with the topic being examined, then the user has a choice of actions. Either the button 'More' (which will reveal the new material) can be selected. Or the user can terminates the current interaction with the particular information chunk being examined - by dismissing it, thereafter it becomes miniaturised. Interaction with the programme can also be terminated any time by selection of the Main Application Navigation Screen and selecting the 'Quit' button for terminating the programme.

**8. Technical Details of the Development**

**(i) Hardware and software**

The system is being developed in an object-oriented programming environment which includes the relatively new object-oriented programming language - Eiffel. It is being developed on an "open

systems" platform, using UNIX/X-11 windows. The aim is to retain the ability to port the system on any network to a variety of machines.

Over the period of development, the VPHT has grown to 20 Mbytes (with 100 pictures). The next phase of the VPP planned is to include X issues of each Periodical Title and the resource is estimated to grow. Clearly, acquiring and modelling resources such as these could easily grow to fill the 600 Mbytes currently offered by a CD-ROM.

Dealing with (increasingly) large amounts of information was one of the technical objectives of the VPHT Project.

**(ii) Milestones achieved**

**Deliverable 1:**
The system was demonstrated at the Annual Conference of the Research Society for Victorian Periodicals, held at Manchester Polytechnic (now Metropolitan University) in July. At this stage the kernel of the system was only partly complete, therefore only some of the content had been incorporated. The approach to the organisation of content and interactive functionality - the definition of the way information was accessed - was defined initially by IMP through a series of hierarchical networks. Later on, alternative e.g. wheels as organisational superstructures were defined by the expert target users. The system components for handling text, images and tool for drawing the networks was complete. However, sound was not a feature offered by the system at this stage in the development.

It was possible to demonstrate the notion of automatic linking of text and the compilation of the index. However, the system was not at this stage able to cope with delivering the tools to end-users to hand-crafted the links. The automated feature expected only specially flagged items as linked (hence hypertextable as button labels) appearing as nodes in the networks. As such only related topics could be linked. For example, the topic author would link in where ever the word 'author' occurred in the text with a network.

Originally, the Research references, the equivalent of footnotes in an article, were included with information chunks. Then it was decided that these textual references ought to be hidden and only revealed if explicitly requested by the user.

**Deliverable 2:**
The system was demonstrated on the event of a visit by Marylin Deegan and colleagues from the Oxford CCTI Centre for Textual Studies. At this stage, the general architecture of the system remained the same, but significant improvements in the content had been made - minus the sound capability. Further, improvements were made to take on board the notion of using less hierarchical networks for navigating around the information spaces. The English partners wanted some networks to be represented in the form of 'wheel' structures, these being less directional and more in line with their notion of "free-browsing". The 'wheel' networks represent another way of structuring information. They are visual metaphors for a non-linear way of learning.

The goal of hiding the references at this stage was still proving to be a problem - mainly because quite often, if there was insufficient screen space, the reference would only get displayed if the parent text or picture to which it belonged was put away. This was not an ideal solution as references need to be displayed in conjunction with the material/topic to which it belongs.

**Deliverable 3:**
Specifically, this delivery aimed to present, as much as possible as a prototype, the system as it

would appear when complete (in December). The system was used and evaluated by various experts in a workshop evaluation. The aim of this was to determine the content accuracy, feasibility/acceptability of such system to convey the content in an efficient and innovative way. Secondly, the workshop activity was also to provide feedback regarding the interface and interactivity issues which need`to be addressed when delivering systems for teaching and learning in the humanities.

Almost all of the content - both text and pictures - was incorporated, and the sound capability was a feature at this delivery. Many more hypertext links had been made. However, the hand-crafted links would only operate once all of the content is available for the program to manipulate. The references were successfully hidden and displayed in conjunction with the parent topic.

The workshop participants highlighted some inconsistencies in the text content and organisation. Generally, accessing the materials through the 'wheel' network structure was considered an attractive and easy-to-use feature. However, there were mixed feelings about the way references were revealed because, no distinction was made between primary and secondary source.

## 9. Discussion

### (i) The VPHT as a Model for Humanities Computing

The VPHT is a model for the development of computer-based systems, networked, and supporting a society concerned with modelling and communication through the medium of text.

There are myths and realities concerned with intimidation, alienation and inaccessibility with respect to information technology and computers. A significant component of the feedback for evaluation with end users, many of whom were new to computer use, was that as a first-time experience, interaction with and use of the VPHT was enjoyable and stimulating, opening up a whole new possibility in their minds about new methods for handling textual material.

There are fundamental problems in the development of such computer-based systems, including problems of scale. The challenge is to develop interfaces providing easy and stimulating access into very large bodies of text, including much pictorial content. The interface can be designed with a number of alternative metaphors and means of access, enabling retrieval and navigation, through graphical and multimedia structures, to suit a range of target users.

### (ii) Methodological considerations

The IMP strategy 5 years ago was to pursue the development of an information modelling technology that was human centred, intuitively object-oriented, multimedia, interactive and both easy and enjoyable to use. The alienation and intimidation created by IT was a basic concern. An "open systems" approach was established. This means that software, applications and systems would operate on a wide range of hardware platforms and be fully network compatible. Another basic concern was for visual quality and style and the fidelity of information such as images.

At the outset, we used a number of the then available tools, such as GUIDE, HYPERCARD/SUPERCARD, MACROMIND DIRECTOR, but they simply would not support intuitive demands and processes (at least not easily and flexibly), they were not consistent with "open systems" and they were really not based on the reusable object-oriented code and functionality. We intuitively decided that the development of object-oriented information systems, applications and applications development environments, would be the measured approach in the longer term.

Users who are authoring new material can undoubtedly achieve considerable results with any "off-the-shelf" tools. Interactive menu selection i.e. point-and-click graphical interfaces to structured information can be created in various ways by a number of packages available in the market place. It is our current view that rather than abandon the IMP development strategy, and revert to the use of such available and "standard/generic" tools for application development - we will continue our "open systems" object-oriented approach to information system design and implementation. This includes incorporating standards in data formatting, data communication and presentation/interaction as far as is necessary (which is in any case a research theme). We employ the "Media Language System" that we have been developing as an application building and authoring environment. This is slowly and surely evolving in its functionality as we use it to develop applications with end users. We aim to refine and simplify the "Media Language System" so that we can deliver it to independent authors and applications developers.
The effort, skill and resources that go into the development of a system that will enable teachers to develop and deliver innovative teaching and allows learners to engage in exploratory, discovery and guided learning - are divided into reasonably distinct phases.

It can be useful to separate the tasks of content (specification, authoring and acquisition), organisation (of content in various conventional and generally useful ways to enable retrieval), and communication (the representation and communication of meaning, knowledge, competency).

These processes and the resources developed can be integrated at a later stage in the implementation of the final, delivered system.

First Phase: The definition of the content and the specification for the organisation and communication of the content (the interactivity with organised materials). This is a task for the domain experts. They can, on paper, outline the content and various means of organising it together with various keys to access, and then build a prototype using a suitable package such as 'Guide', to be evaluated for effect with target students. Others could engage in a similar process, say using 'AuthorWare Professional'.

Second Phase : A somewhat separate phase is the design of general rules for interface design, presentation interaction and for ease of use for the learners (and teachers). A final phase would be the integration of ideas, content, design of organisation and interaction, into a manageable accessible entity.

If there was simply the best "authoring" or "computer-based learning" tool, then it would be taken up in remarkable numbers. There are several candidates for these tools. This is a rich field of opportunity. It is a labour and skill intensive exercise and one which many would choose to avoid. There is much variety, incompatibility, confusion and frustration to be experienced.

It is important to note here, that generally speaking, end users (especially those who commission the development of applications such as this one) tend to underestimate the labour costs of creating applications - no matter what the tool!

**(iii) The IMP Environment**

Our approach is consistent with both a futuristic "open systems" and an immediate term pragmatic approach to the development and delivery of usable prototypes. IMP uses object-oriented designs for information systems and tool development resulting in object-oriented code, which can be delivered with small adjustment onto delivery platforms which are substantially different from the development machines used to construct the applications. Rather than be tied to any particular operating system or proprietary windows-presentation system, we deliver our system through the X-11 windowing system which is inherently machine independent.

The IMP Environment (currently the "Media Language") is being developed to be able to accept standard data (e.g. from word and graphics processors) and to enable simple authoring tasks in the organisation of material and the creation of interfaces and information structures (such as hypertext). It might be possible to re-engineer the rich content and organisation achieved by multiple authors using many different tools into a coherent entity. This entity would be an information system built on object-oriented lines and would have many distinct advantages of scale, portability and reusability. These latter are essential practical considerations.

Apart from the issue of what (simply the best) "authoring" or "computer-based learning" tool to choose, there is another issue concerned with the machine operating system. The choice is mainly between MS-DOS on the Intel 386/486 chip on a PC, Unix on a workstation and Apple System 7 on the Motorola 68030/40 chip. Versions of Unix run on the Risc, Intel and Motorola chips. Unix is becoming available with increasingly user friendly utilities protecting non-technical users from Unix. The Sun Microsystems Solaris is an example of an enhanced-Unix operating system. A new operating system which will soon be available on the Intel 486 chip is NeXTStep. This is also an enhanced-Unix system with object-oriented tools and resources to enable rapid application prototyping and development.

The approach to this adopted in the development of the IMP Environment is to recognise these

developments and different opportunities for delivery, incorporating them into the "open systems, object-oriented, distributed system" strategy.

**(iv) The Application**

There is a requirement for high quality computer systems that will enable teachers to develop and deliver innovative teaching to captivate increasingly large numbers of students. Teachers will be important agents in the operation of such interactive learning environments with computer-based materials available - even when "open access". There is a need to be network compatible. There will be a need for group-working support. Large amounts of (multimedia) information will need to be stored safely, securely, and be readily accessible. Tools to enable teachers to create access and to test the understanding of students will have to be made available. There is a real need for high quality interaction. All these are the predictable requirements. A large-scale system will need to be designed and implemented to deal with the various needs outlined above. It will be necessary to integrate the individual components of administration, management, design and communication in such systems.

The computer systems that will enable teachers to develop and deliver innovative teaching to captivate increasingly large numbers of students, could also support research and scholarship by providing key resources and mechanisms for representation and communication. The products of scholarship and (other) professional activity can be almost seamlessly built into the information system, capable of being accessed by learners. This could be done as descriptions of operations and the development of simulations, which could be developed into task support. This would be as true in a biomedical as a periodicals computer-based information system. A computer-based, interactive teaching and learning resource in medicine for example, would be greatly enriched with the latest imaging technologies contributing a whole range of new images of structure and function, and could include case studies. A similar system for periodicals would benefit from scholarship and the definition of structures of criticism and opinion that can act as specific filters and browsing structures for those seeking that knowledge. There is a great potential for the involvement of many contributors to the developing system. It might almost be developed so that true technology transfer occurs from designer to target user, and furthermore, that the system develops 'a life of its own'. From a collaborative involvement in the first prototyping phase, control of the system and its development could be transferred to the humanities target users.

While there are those who are interested and motivated to use such systems and assist in their development, there are many who are not so moved and do not necessarily require or want complete authoring and organisational control. They might prefer, as authors, to develop material for inclusion, organised as they would for a textbook or practical manual, and to leave the information technology and the crafting of interactive, pedagogically sound material to others (much as they would to a designer, printer and publisher of a book).

There will be a need to develop technology: tools and methods, which can be transferred as required. These will have a core of general application, and may also include a domain or subject-matter specific component.

**(v) Next Phase VPHT**

The VPHT Project in its next phase will model several issues of one or more periodicals. The scale of the information base is very large and the variety of access structures is great. The key target users of the system would include scholars, librarians and archivists, teachers, students at a number of levels and with a variety of needs.

The system will have to support representation and communication within the context of education and within the context of research and scholarship. Research is an activity which requires a set of

competencies, and it will as a process become an increasingly important competency for the independent "enterprising student" (responsible for their own learning and as consumers of education) and essential component of the learning process.

The first phase of the VPHT has been over a time-frame of 9 months (a good gestational period!) and required about two person years commitment. The next phase of VPHT planned will involve 4 or 5 person years and will occur over 2 years.

The VPHT current version is the first prototype. It has certain shortcomings and considerable potential for further development. In many ways it is a model project in this area of application development. The first phase pilot prototype has been both very well received and has generated many ideas and controversies. End users, many of them naive to computers, were delighted and excited by what they were able to do and the new means of access within textual materials provided in the system interface. The aims of a further phase would include (i) the exploration and modelling of a whole variety of access, guidance and and browsing mechanisms with aids for navigation in information space and time; (ii) to provide tools for a range of target users for the editing of the text; and (iii) to further explore the possibilities for developing a system with support for teachers and learners in a new society of institutional networks of machines and people.

We will explore as part of the development of VPHT, the "interoperability" issues and develop within the IMP Environment the means to import data and to facilitate the remodelling of information structures derived from other tools and "authoring" packages.

**(vi) Conclusions**

The "open systems", user-centred approach which we have adopted in the development of the IMP Environment and which we have applied to the VPHT Project, chooses to address the people first, the information/ communication issues next, and the supporting technology last.

The power of the computer-based and telecommunications technologies can be harnessed to support creative, exploratory and intelligent information modelling and communication processes. The end-users of the technology, should not be intimidated or disorientated by the technology - they should be empowered by it. It is important to enable the representation of their ideas. When properly involved in the development of the generic technology, and the development of individual applications, end-users can have commitment through involvement.

We believe that open systems and object-oriented computing is the future of distributed multimedia: where open systems will provide an enabling platform for wide participation and access and where open systems will provide for the evolution and manageability of software systems. We believe that high quality visual displays and less rather than more in visual interface design is to be preferred by end users.

Computer-based mechanisms of capture and archiving - here, of precious, rare and delicate materials (like victorian periodicals) - will provide a good resource for access, for research and for learning in the future.

## GLOSSARY OF TERMS

**application**
a package that delivers a certain function e.g. word processor; an interactive learning package on the Victorian Periodical

**interactive**
when selected by the user e.g. an item of interest in the display by pointing and clicking with a mouse, an event is launched by the program that returns a desired result e.g. the sound of the drum if the displayed item selected was a picture of a drum, or, the definition of a word or linkage to other material, if selected from a piece of text

**multimedia**
a recently much used word; the representation of information in all its forms, including text, graphics, pictures, sound

**information system**
an infrastructure as a means of containing and delivering information; in this context, computer-based, including information as organised subject matter, with various means of accessing and editing information

**development platform**
the hardware an software employed to develop an information system or application; a delivery platform (used by the end-user) may in contrast be less sophisticated and of a lower specification

**browsers, filters**
structures and superstructures which can be designed and made accessible to the user (author or other type of end user) in the interface, and which can encapsulate information and provide a high level overview and link to lower granularity information

**hypertext/hypermedia**
a paradigm for the linking of information, in which networks of nodes (hypertext labels) and links can be created, enabling a variety of ways of accessing information to be created; can include multimedia information ('hypermedia'; see *****)

**implementation**
in the context of computer-based applications, the transformation of concept and specification into reality by step-by-step procedural programming in software in order to produce the required result

**information structures**
these can include menus, graphical networks e.g. hypertext networks and content browsers; a first level of organisation beyond which knowledge structures can be organised

**IT**
information technology: computer hardware and software; methods, skills, and products which are computer-based

**computer-based**
developed and delivered on a computer; including implementations of paper-based materials and mechanisms and non-machine based activities

**operating system**

an essential component of the computer, providing a means of processing data from software programs e.g. MS-DOS, the popular Microsoft Disc Operating System for Intel-based machines; System 7, the current version operating system for the Apple Mac; Unix, a sophisticated operating system becoming increasingly employed and popular with the requirement for multitasking, networking and the management of large quantities of data

**windows**
a means of displaying and managing the display of information on the computer screen; pioneered by Apple on their Macintosh machines, taken up and currently offered on Intel-based machines as an extension of MS-DOS, and otherwise available e.g. the X-windowing system as part of the Unix operating system, and portable to most machines as a means of displaying material from a Unix-server

**visual display surface**
the area provided on the computer screen for the display of information; the size, and the quality in terms of the resolution (in pixels) and colour (in bit planes) varies from screen to screen and is related to the display capabilities of the computer e.g. PC's with Intel 386 and 486 machines with SVGA display capabilities, in common use as end user machines, have a visual display quality of 640x480 pixels resolution and 8-bit (256 colours simultaneously) colour; workstations, in common use as development platforms

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## 11. TECHNICAL ANNEX

**Development and Delivery Platforms and Application/System Development Environments**
There are a number of alternatives competing in the market place for the attention of developers and end users.

The Intel-based Microsoft Multimedia PC with Extended Windows 3 and windows for Workgroups, competes with the Apple Motorola-based Multimedia Station with System 7 and Mac Windows. Various enhancements and hybrids of these two alternatives e.g. Windows NT and PINK are promised. NeXTStep already available for Motorola will be available soon for the Intel chip. There is a definite move towards graphical user interfaces, icon-based object-oriented visual programming

in all these systems. IBM's OS/2 will never catch on. Unix seems to be gaining more and more ground as applications need to become large scale and manageable for multiple users and multiple tasks. The X-11 windowing system is designed for the delivery of network applications. It needs improvements to support new demands e.g. of networked teaching and learning systems and these are being made and included as components of some workstation operating systems e.g. Sun Solaris.

The key is to get access to the machines on the network with the application which is substantially untied from the physical platform. Various interface mechanisms best suited to individual hardware platforms can be separately engineered.

According to one strategy (the IMP Environment) the database or information resource would be constructed as an 'object base', separate from an applications model, and separate from an interface model, which is actually what the end users would interact with. The data/object base could be on any one or all of the following digital storage media - hard disc, tape, floppy disc, CD-ROM. The system would need to recognise and use these storage media. data standards would need to be observed for consistency and interoperability. Other non-digital media, such as analogue audiovisual tape or laserdiscs may also be included - with their stored material either digitised for full integration or co-displayed in a special window.

It all depends. The dependencies, the constraints and the requirements are legion and there is no one simple solution. This goes for the hardware, the software and the methods.

CD-i is an example of a low-cost interactive multimedia system which is a home consumer technology because it doesn't require a separate computer and works with the domestic tv set. It uses CD-ROM as the medium for storage of data and software to enable interaction - everything on a disc. CD-i can be used as a delivery platform for games and learning materials. To say that CD-i is interactive multimedia is true - up to a point. It all depends.

**'Future Proofing', Genericity and Interoperability**

What does 'future proofing' mean? An excellent ideal, how is it to be achieved? There are rapidly unfolding developments in hardware and software which are taking the desktop PC revolution and small systems into the next revolutionary age of networks, cooperative working, and large systems. The developments will influence the design and delivery of teaching and learning and other flexible resource modelling systems.

As far as the issue of "off-the-shelf tools" compared with the IMP Environment is concerned, the questions are whether the products are portable, flexible and can be easily modified and customised and whether they will in some way be interoperable (i.e. can communicate with other systems). These are all questions raised by DELTA - the European initiative for educational technology (Ward 1990).

An important idea to consider is that as well as the individual units of hypertext or modules of interactive material which may be delivered on a computer to an end user, there is the context for all this - and this context must be modelled and available as a component of the system. At a higher level there needs to be a means of managing structured and unstructured information resources - a control structure to provide facilities for authors, editors, and teachers building courseware and learning resources.

A system, once finished, is not fixed but can grow and change according to changing user needs and new information. The computer system is an organic, growing type of entity.

An essential concept in the idea of the new global information environment is that there will be opportunities and demand for access to very large amounts of information in very many and varied locations. Information systems will require several levels of access and varieties of interfacing to be created - enabling communication between authors, experts, readers, learners and between the prescribers, the providers and the consumers of information or information services.

**User Manual**

## INSTRUCTIONS FOR USING THE SYSTEM (which were used in workshop)

### The System in General

All of the material on The 19th Century Periodical (e.g. 'The Queen') is represented and accessible from a series of network wheels. The topics are linked in a series of related clusters of (red circular) nodes. A main wheel provides information about the major topics, this will lead to further items (i.e. network wheels) which can be accessed.

As well as the series of network maps the system also provides an index to aid navigation. This can be used to instantly jump to particular parts and defined components of the system.

Select those items of interest by pointing and clicking with the mouse. Objects that can be selected include buttons, selectable text (indicated by bold print) and network wheels.

When there is no room left on the screen to display a new item, the system automatically shrinks (and moves to the side of the screen) enough old items to make space for the new one. These old items can be brought back with a single click of the mouse.

### Mouse

Interaction with the system is via a 'mouse'. Do not worry if your mouse has more than one button, they all perform the same function in this demonstration. You position the cursor on items of interest and press any button on the mouse.

If you are experiencing difficulty with your mouse, check that you are holding the mouse at right angles to the mouse mat. (This is something required by optical mice only.)

Most buttons cause a new item to be displayed.

If required, items that are no longer of interest can be dismissed by clicking on their Dismiss buttons.

### Hypertext

Certain words and phrases are displayed in bold print and change colour when beneath the mouse pointer. A single mouse click on such text will display further information about the word or phrase in question.