DIVISION OF COMPUTER SCIENCE

Human Factors Design of a Multimedia System
The Libtech International '93 Exhibition Guide

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Abstract

This paper describe the development of a multimedia exhibition guide using a User Centred Design approach.

Problems with the gathering, capture and integration of data on disparate media using a variety of software and hardware tools are discussed.

User centred design is a well established approach to developing highly usable interactive systems. However the juxtaposition of:

- the requirements of multi media development
- the changing nature of the planned context of use of the guide as the exhibition itself is developed

make a straightforward application of User Centred Design impossible. This difficulty is explored and some pragmatic solutions are suggested.

Human Factors Design of a Multimedia System the Libtech International '93 Exhibition Guide

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1.0 Introduction

This paper describes a multimedia development carried out by members of the Human Factors Consultancy team of the School of Information Sciences at the University of Hertfordshire. The team have a long history of high standard work in the areas of human factors and ergonomics, and are at the forefront of developing applications with multimedia interfaces. Developments have been carried out on both PC and Macintosh platforms, and incorporate a variety of different interaction media, such as speech input and output, video images and the use of still images and graphics. A selection of the team's developments is described in the next section.

1.1 Practical Applications developed by the Human Factors Consultancy

ISDIP Intelligent Speech Driven Interfaces Project (PC based) [5]
This was a major systems development dealing with the full life cycle including the design, building and evaluation of a speech driven interface primarily developed for the disabled. The project ran from 1988 to 1991, and won a BCS medal and a RITA award for the best use of IT for the disabled.

SHELVS Self Help Learning for Voice Controlled Systems (PC based)
This current DTI/SERC funded project is being carried out in conjunction with Compris Consulting Ltd. and the Keep Able Foundation. The team are developing a set of tutorials for voice controlled systems to provide hands-free learning for disabled users. The tutorials will make use of interactive video, sound and speech output.

MODEMA an EC funded project (PC based) [1]
This pan-European project was funded by the EC TIDE initiative, it involved partners from 5 countries. The object was to build a prototype multimedia knowledge based system to provide advice and information for those involved in the employment of the disabled. The system makes use of hypertext, linking into the underlying databases, and utilises video clips and still images to give a rich browsing environment for the users.

PROPHET a parliamentary captioning system for ITN (Macintosh based)
This project required the design of a captioning system for on-line broadcast of parliamentary debates. It incorporates photographs of MPs to aid recognition for the operator. A development from this work is a staff directory for the University, with photographs of all members of staff.

STANDPLAN - an multimedia exhibition guide (PC based)
This was developed in conjunction with Compris Consulting Ltd. and provided a multimedia guide to exhibitors on the Magnifeye Stand at the 1992 Multimedia Exhibition at Olympia. It incorporated live video of the stand, and photographs of all stand personnel which were updated daily. The system used a touch-screen interface.

All of the above developments have allowed us to develop and improve our method for a user centred design approach, and have formed a foundation for our investigations into aspects of multimedia evaluation and design. In the following sections we describe the design and implementation of a Multimedia Guide for the 1993 LibTech International Fair

1.2 The Requirements for the Library System

We were first approached by the exhibition organisers in June 1993. We were asked if we would like to deliver a presentation on multimedia issues at Libtech International '93. We had developed a multimedia guide for a previous exhibition and thought that the development of a guide for Libtech '93 and the delivery of a presentation on the development of the guide would make a much more interesting contribution than just a presentation alone.

The initial idea was to produce quite a simple exhibition guide similar to **Standplan** (see above) the exhibition guide that we had made before. This would include the following main facilities:

- a means of identifying the exhibitors on stands from a plan of the exhibition and a way of locating exhibition stands from a list of exhibitors.
- a guide to the programme of events.
- a demonstration of some of the communications potential of multimedia systems

However additional requirements were soon made known to us:

- provision of information about products exhibited on the stands
- special events: a list of particularly important events illustrated with video stills where available
- stop Press: a brief list of very recent news. This would be useful for announcing winners of competitions etc.
- video clip demonstrations: to show the set up of the exhibition and to demonstrate simple use of video within multimedia applications.
- identification of exhibitors by key word search.

New requirements and changes to existing requirements continued to appear up until the last minute and it became necessary to insulate the design team from excessive requirements changes. It is in the nature of such developments that as the clients see the developing system they become aware of further possibilities. They become aware that their initial requirements have been misinterpreted or having seen the effect of a stated requirement they may change their minds. Changing requirements are a particular problem in developing exhibition guides, we discuss some solutions to these problems in the conclusion below.

In addition the development team decided that the following facilities were required in the guide:

- a guide to public amenities: telephones, toilets, refreshments etc.
- simple help facility
- a brief description of the developers of the system

2.0 User Centred Design

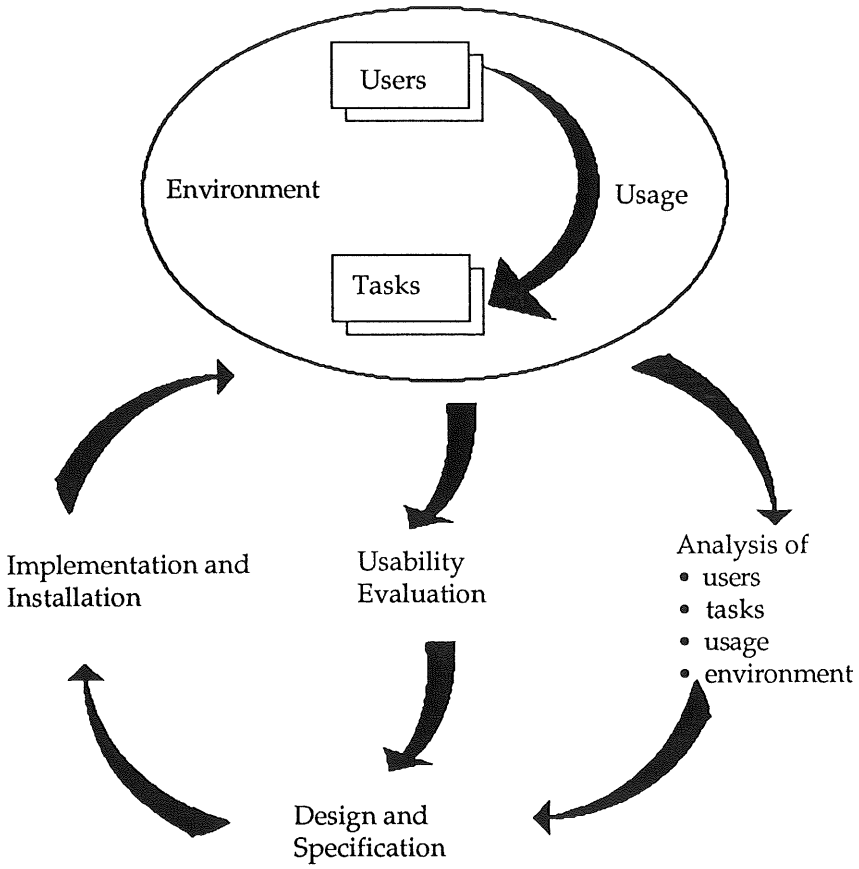
User centred design is now a well established discipline that provides recommendations for the development of usable and effective interactive systems [3]. It is an approach that we have used successfully in the development of a large number of software products (see above). Part of the attraction (to us) of developing this system was to show how the tenets of this body of theory can be applied to a practical multimedia problem.

User centred design dictates:

- early and continuing contact with the users of the system
- analysis of user characteristics
- analysis of the way that users will use the system
- analysis of the tasks that users will want to perform using the system
- analysis of the environment within which the system will be used
- continuing evaluation of the developing system

These requirements of user centred design are illustrated diagramatically in figure 1 below.

Figure 1 The Context of User Centred Design



The context of use of an interacting system is made up of four things: users, tasks, usage of tasks and the environment. In any attempt to evaluate the usability of an interactive system it is important that the context of use is adequately simulated or its absence is allowed for when interpreting results.

In the absence of any hard information we had to make a number of assumptions about the context of use:

Users
Users were assumed to have at least a passing familiarity with a WIMPS interface such as the "Windows" front end to the IBM PC or the "Desktop" interface to the Macintosh. They would therefore be familiar with the idea of using a mouse controlled cursor to point and click on buttons and text. They would be familiar with other computer notions such that of "Help".

Tasks
Users will use the computer system to find particular exhibits or company stands and to get further information about them. Users are expected to want to use the guide to confirm information on the programme of events. Most of this information is available to users in the paper based exhibition guide, although more detailed input is provided in the multimedia guide. Probably the main use of the system will be a casual exploration of the systems facilities.

Usage
The majority of users were expected to have a very brief interaction with the computer system. There are likely to be 2,000 people at the fair over two days. Three computer platforms for the guide are to be provided. If the usage of the guide were shared equally between all visitors to the exhibition each user of the system would be unlikely to have more than one minutes usage.

Environment
From our previous experience of exhibitions we expect the environment to be noisy, crowded and possibly hot. Although there will be quiet times. Of the three computer platforms for the guide one machine will be placed in the Cafeteria the other two will be placed at the back of the exhibition hall.

The results of these analyses are used to produce

- measurable usability objectives
- a functional specification of what the system will do
- a conceptual design for the finished system, i.e.. how the system will be presented to the users of the system.

Main usability objectives

For the kind of user that we envisage (see above):

- the user should be able to work out how to make basic use of the system within 15 seconds.
- the user should be able to access appropriate information about stands, exhibitors, amenities, products and the programme of events within 30 seconds.
- the user will feel confident that (s)he can determine how to find any further information within the guide.

3.0 System Design and Implementation

This section describes the main aspects of the system, the implementation constraints which have a bearing on the design and the hardware and software which were necessary to put it together.

3.1 Difficulties with following the user centred approach

Much of the analysis necessary for a user centred design could not be carried out because access to users was severely limited and because the environment of use had not yet been set up. In the absence of users it was necessary to predict the tasks that they were likely to want to carry out when using an exhibition guide. Thus much of the analysis for design was projected. That is the designers made predictions about the likely nature of the users of the system, the tasks that they would want to carry out, the way that those tasks would be carried out and the environment within which this will take place.

Commitment to continued contact with users and with clients meant that there was a constant stream of new and changed requirements. This disrupted the development process yet exposure to these requirements are necessary for the design of usable systems. We took several steps to try to control this problem. These steps are discussed in the conclusion below.

The frequency of such changes and the possibility of inconsistencies developing between the same data items in different parts of the system point to the need for an underlying data model and for a system wide method of managing change to the guide. An example of such a method would be to provide a designer interface that allows and manages changes to the system and the data within it.

To a large extent the design of the guide was influenced by the quality of the information that we could obtain. For example we had to abandon the key word search of exhibitors and products because so few of the exhibitors had supplied a list of key words. In addition the keywords that were supplied to use were obviously not ideal. Many different key words were being used for the same basic concept. It became apparent to us that using such a list would convey a false impression to the user.

3.2 System Description of the Exhibition guide

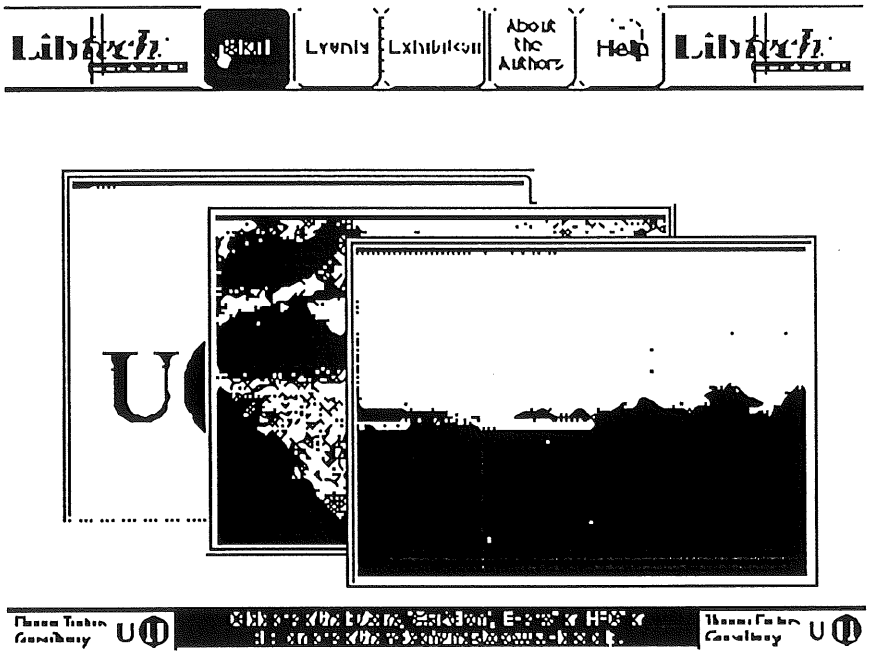
One major usability problem with hypermedia and multimedia systems is that of user navigation [4]. Typically the user finds it difficult to tell :

- which part of the program he is in
- how much more there is to see
- how to get to other parts of the program.

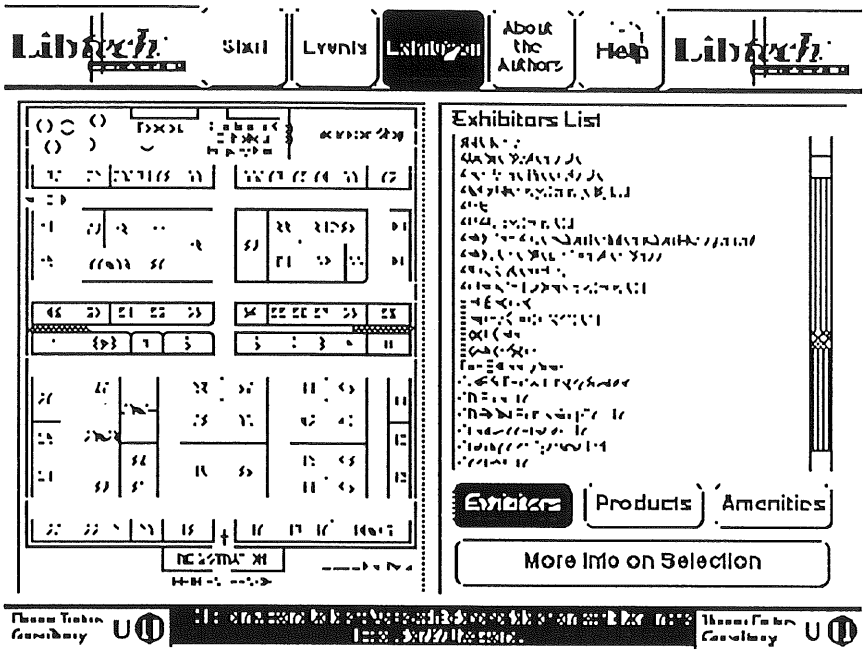
This is one of the major conceptual design issues that we address. The Exhibition guide is presented as having five main parts. These are denoted by the five standard buttons present at the top of each screen. The buttons allow the user to navigate between the five main parts of the system. The button selected by the user is highlighted. This acts as a reminder to the user, indicating where in the program he is.

Each of the main parts of the system is implemented as a separate Hypercard stack:

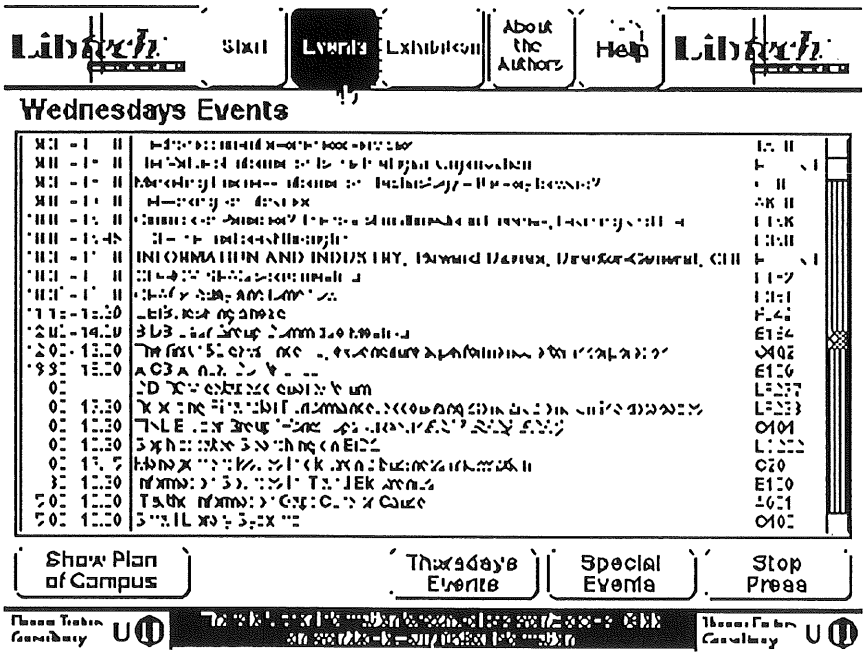
1. **Start:** the start screen which gives the title of the application, displays three video clips and allows access to the other parts of the system.



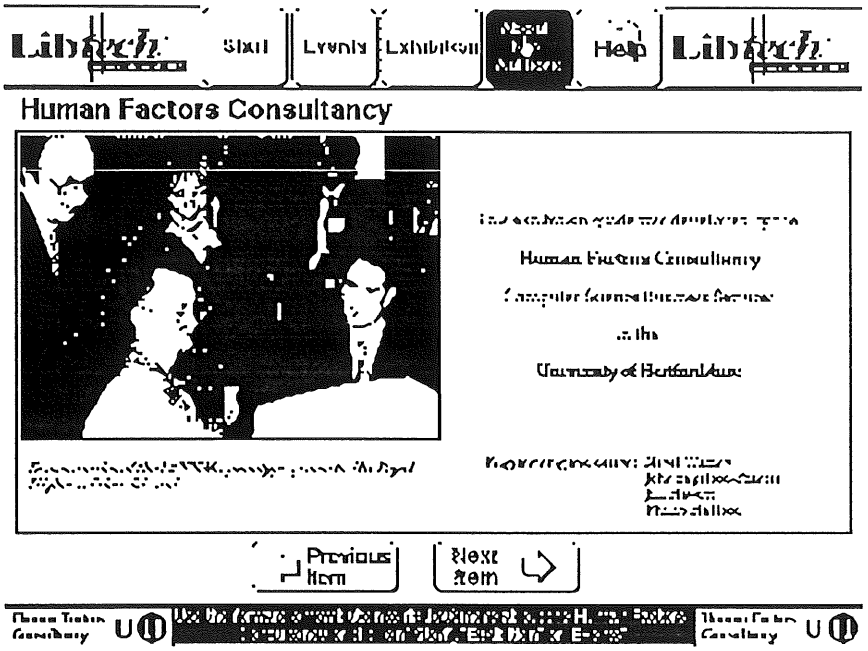
2. **Exhibition:** the exhibition plan which provides a plan of the exhibition, lists of exhibitors, products and amenities



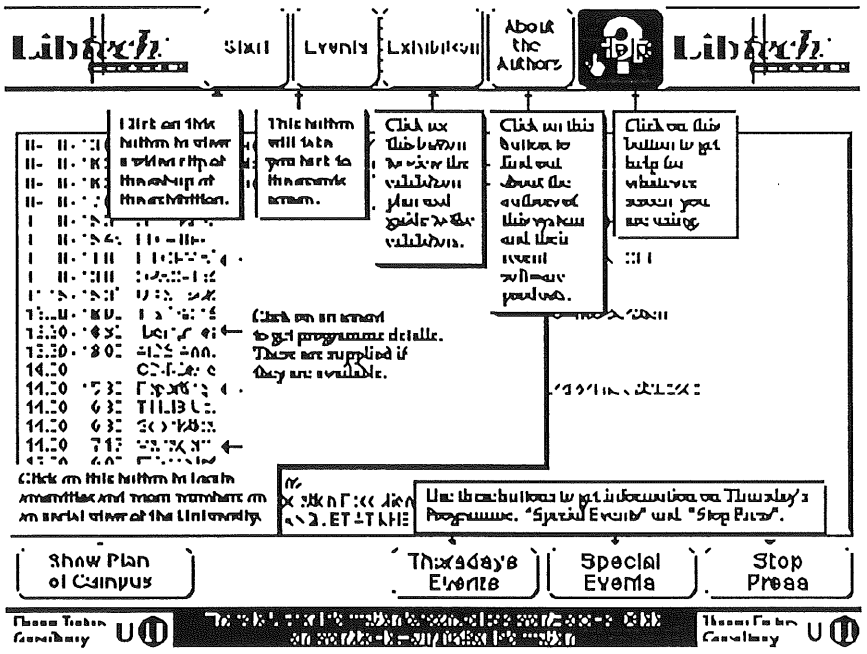
3. **Events:** the programme of events for Wednesday and Thursday



4. About the Authors: information about the developers of the guide



5. Help: a simple help system that explains the functions of an example screen taken from this part of the stack.



User navigation is also assisted by the use of instruction bars. these act as "signposts to frequently used routes through the system. There is an instruction bar at the foot of each screen. Because screen space is limited the instructions in this bar only explain how to carry out the most frequent and the most likely user actions.

The conceptual design of the exhibition screens is driven by the concept of a map combined with the notions of highlighting and selection. Thus if a stand on the exhibition plan is selected then the appropriate exhibitor in the exhibitor list is highlighted. Similarly the user can select an exhibitor from the list and have the appropriate stand in the exhibition plan highlighted. It is possible to get further information on

the exhibitors by selecting the exhibitor name and then pressing the "More info on Selection" button. Similar principles apply to information on products at the exhibition and amenities.

The events part of the system is necessarily represented as a timetable, although it is possible to represent the list of events alphabetically as well as chronologically. Here too it is possible to obtain further information on most of the events. The "Stop Press" and "Special Events" information is presented using a fundamental concept from Hypercard: the concept of a stack of cards through which one can browse using forward and backward arrows.

The same simple conceptual design is also used in the "About the Authors" part of the system.

3.3 Implementation Constraints and Tools

A feature in the design of current multimedia systems is the large number of software and hardware tools that are necessary in order to create a system and which in turn impose their own constraints on the design. In addition, disparate skills are needed in the design [2], such that it requires of necessity a multidisciplinary team. The diagram in figure 2 shows the resources that went into the system and the tools used to transform them into a suitable format. The customer requirements provided a framework for the development, whilst the limited time available for the developments imposed a major constraint on the system design.

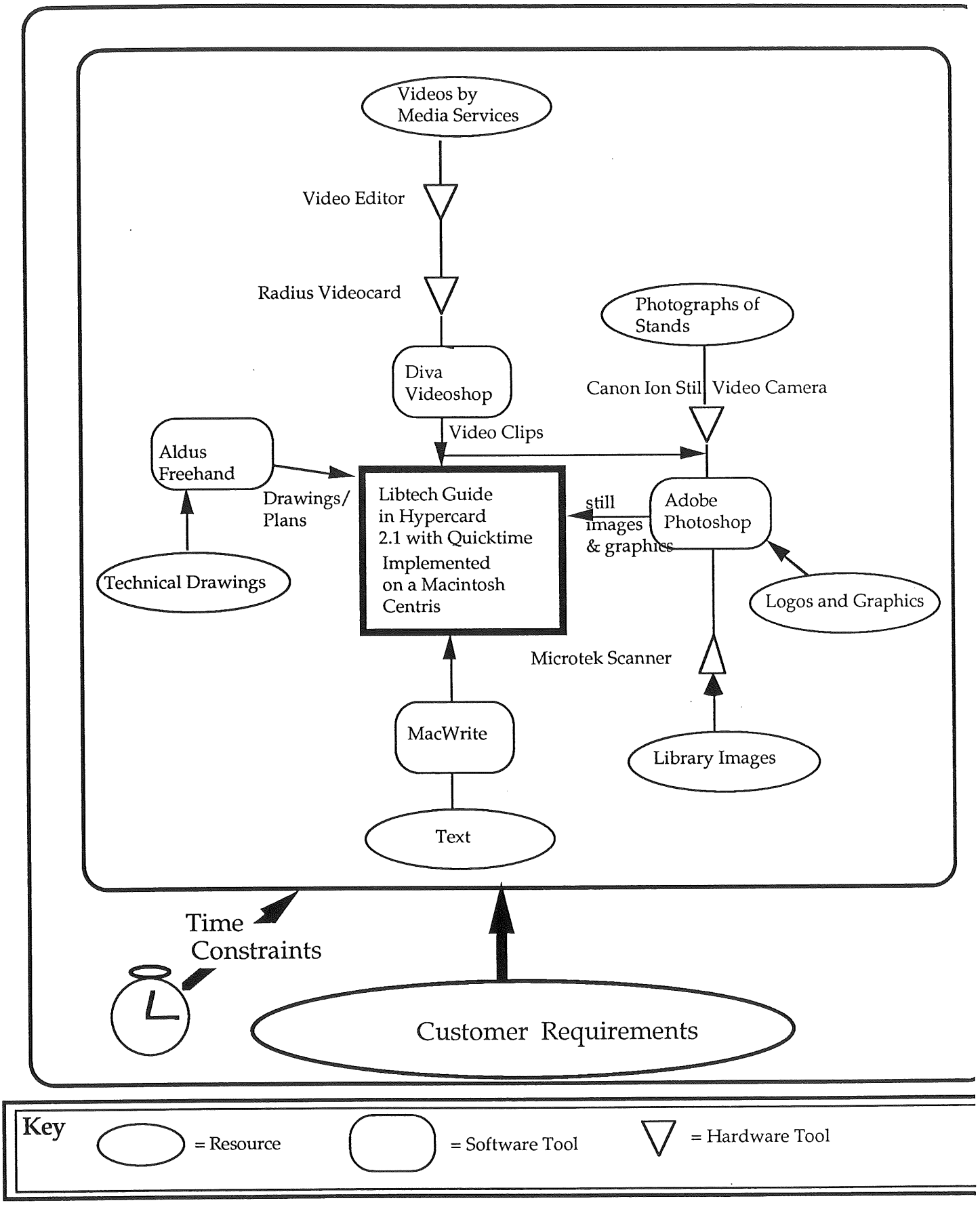
Hypercard
The system was implemented in Hypercard 2.1 on a Macintosh Centris with 4Mb of RAM and a 80 Mb hard disk. Hypercard was chosen as the implementation tool as it provides a rapid prototyping environment and has links to the Macintosh Quicktime software which allows the incorporation of digital video material in a form suitable to be played from a hard disk with no extra hardware. Hypercard does however have some limitations, the most important being its lack of facilities for using colour in screen objects. Any colour objects in the system must be created separately as PICT files and imported to the system, where the flexibility for manipulating them is severely limited. In addition it has only limited data manipulation facilities.

Videos
The video clips used in the system are not an essential part of the guide, but add impact and provide a focal point for the front screen which is designed to attract the users' attention. They were created by professionals in the University's Media Services department and initially edited to provide short sequences of about three minutes each. The material was then transferred to the Macintosh from a video camera via the Radius video card which enables the input of a video signal.

Photographs
Two types of still images were used in the system, existing photographs of locations and personnel and images of the stands captured at the exhibition. In the case of existing photographs, these were scanned into the system using the Microtek scanner. To capture new images, we used a Canon Ion still video camera and input them to the system through the Radius Videocard. In both cases, the images were further processed through Adobe Photoshop, to format to the required size for the application and to reduce their storage size by saving them in indexed colour format. The images were converted into PICT format for use in the Hypercard system.

Graphics
Two other types of graphic were used in the system, logos and screen backdrops which were designed using the drawing facilities of Aldus Photoshop, and the Stand Plan which was designed using the more powerful drafting tools of Aldus Freehand.

Figure 2: The Implementation Environment



3.4 Evaluation

It was not possible to have a full scale evaluation of the exhibition guide because

- because of the problems in getting access to representative users and to a realistic environment of use.
- because the system could only be completed at the last minute; information was arriving and being changed right up until the start of the exhibition

Early prototypes were demonstrated to the conference organiser, but it was hard to get access to someone who was so busy.

Scenario [6] driven walkthrough evaluation was carried out by various members of the design team. This required us to collect likely scenarios of use and then try to meet these scenarios using the system. This approach was necessarily limited because it was dependant on the development teams view of likely scenarios of use and because it was not possible to carry out the evaluation within a fully functioning exhibition. This approach did identify a large number of bugs and did lead to a number of improvements to screen design.

As a "hallway and storefront " summative evaluation we have provided a brief form for users of the guide to complete.

4.0 Conclusion and Recommendations

Multimedia tools: it is apparent from the multitude of tools needed to produce this system that as yet no integrated package is available to implement this type of application. There appears to be a great need for such a package, to eliminate the problems of converting between applications, or perhaps for a set of standards for multimedia design objects that make transfer between applications seamless.

User centred design: although user centred design suggests important and effective ways of developing usable interactive systems, it may not always be possible to follow these recommendations. In these cases the designer often has to rely on experience: his own mental model of the context of use.

To a large extent the quality of systems such as exhibition guides are influenced by the quality of the information provided. A public information system can only be as good as its information. It is possible to create a technically perfect system that it is hopelessly inaccurate as far as guiding the visitors to the fair in concerned. Ideally systems developers should have some involvement in initial data collection from exhibitors and presenters so that they can protect the quality of their software.

Managing change: there is some danger that as the exhibition is set up, original decisions made about the layout of the exhibition and the programme of events will necessarily have to be changed. New requirements for the functionality of the system may come to light almost continually because the development of the exhibition is somewhat unpredictable. Each surprise development suggests new facilities and new requirements for the exhibition guide. It is important to be prepared for this. There are a number of stances that one might take

- design a guide system that allows simple customisation of all its features. (A watered down version of this approach is to use an extremely flexible software development platform that allows incremental change. A danger of this last approach is that it inevitably leads to badly structured systems) Accept that the system will have to be changed as inconsistencies become apparent to the organisers of the exhibition. In this scenario one is dependant on the organisers to realise that inconsistencies between the guide and the exhibition have developed.

- build a guide with a designer interface that allows the management of change to be handled by the system. This approach requires a much more costly development approach.

- build the guide to the system first and then develop the exhibition using the exhibition guide as a master plan. As it becomes apparent that the plans must be changed change the guide. this suggests that the developers of the guide must also be involved in the organisation of the conference. Rather

than users being drawn into the development environment we suggest that developers work in the task domain in a manner similar to that used by some knowledge engineers.

- define cut-off points for change to various parts of the system. This can be done in an ad hoc fashion, although this makes decision making more difficult, or it can be done by having a pre-planned cut-off point for each part of the system. After the cut-off point the system is frozen. Of course with this approach one runs the risk of providing poor or inaccurate guidance. It may be necessary to include last minute advice on errata, new events etc.

In the development of the *Libtech* '93 multimedia guide we have used a combination of the first and last approach.

Evaluation: The formative evaluation of interactive guides to events that are themselves going through a development process is fraught with difficulty. The quality of such evaluations depends on the ability of the developers to gain access to organisers of such events and on the correctness of the assumptions of developers about the context of use of the guide: the users, the tasks that they will wish to carry out, the way that they will carry out those tasks and the environment in which this will occur.

Recommendation:

To overcome the problems we have identified with following a user centred design approach, with managing change and with carrying out an effective formative evaluation we propose a radical solution:

- develop the guide in the exhibition organisers' workplace
- the development team become involved in the set-up of the exhibition
- involve the exhibition organisers in the development of the guide
- encourage organisers to use the guide to keep track of the developing exhibition

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