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Reporter Research Page

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subject : applied research into frameworks and components for delivering Computer-Based Educational Materials for application on campus networks

title : "An approach to 'Supporting Multimedia Interactive Learning Environments' through applied prototyping" Peter Ward, IMP in the School of Geography

Abstract

In Reporter Summer 1992, I described in my article - "Interactive Multimedia" -something of my view and an approach to this subject area adopted in the IMP initiative - an area whose application in business, entertainment and education has become of so much current focus and interest.

The technology, operational possibilities and realisation of the commercial potential of computer-based multimedia, has been progressing by what seems like leaps and bounds in the last couple of years. However, along the way there has been a lot of 'hype-a-medium' rather than 'hyper-media'. This has caused considerable confusion and circumspection in prospective or suggested users. This article describes some applied research into interactive multimedia applications which we have been conducting in the IMP group over the past two years or so since the first Reporter piece. It attempts to address some of the important and pragmatic aspects of working prototype multimedia, with some reference to its application to the educational environment. The proposition is that multimedia systems need to deliver large amounts of (digital multimedia) material, including real-time audiovisual files, to many users simultaneously, and in a flexible yet controlled fashion. There are a number of generic and general purpose features and utilities required. In an educational setting, these systems need to provide support for tasks such as the construction and delivery of courseware and interaction (communication) between teachers and learners.

"An approach to 'Supporting Multimedia Interactive Learning Environments' through applied prototyping"

Abstract

Distributed computer-based multimedia is a subject area whose application is of much current focus and interest. The technology has been progressing by what seems like leaps and bounds in the last couple of years. This article describes an applied approach to research into "interactive multimedia systems" conducted by the IMP group over the past two years or so. It attempts to address some of the important and pragmatic aspects of developing working prototypes.

Systems which need to deliver large amounts of digital multimedia material (including real-time audiovisual files) to many users simultaneously, and in a flexible yet controlled fashion, require powerful computing and a number of generic and general purpose features and utilities. In an educational setting, these systems need to provide support for tasks such as the construction and delivery of content as organised courseware and to support interaction and communication between teachers and learners.

Computer-based Information Systems

The new paradigm is the network, group working and distribution of digital multimedia on information superhighways. A number of key generic system features are needed which (i) provide access, (ii) to a varied population of users, who (iii) want to model, and (iv) to distribute information in, (v) all its richness, (vi) in order to communicate, (vii) abstract ideas, (viii) discrete

knowledge, or (ix) specific information. Systems should attract and engage the end-user and support a range of basic information modelling tasks e.g. the creation and delivery of a small or medium-sized presentation-interaction module. They should provide simple-to-use access to digital multimedia resources with a flexible high performance interface, supporting multiple simultaneous users, and providing the means to scale, manage, distribute and monitor applications.

We are interested in the prototyping of such systems, in mechanisms for the organisation and distribution of digital media materials, and the design of new communication structures e.g. interfaces, browsers and hypermedia documents. Underlying our approach is the notion of "information systems" as complex entities, comprising people (first), information, processes, and (when required and appropriate) machines. A basic interest is the support of various processes of communication - between people, between machines and between people employing machines as a medium for communication.

The Applied Research : Context

The IT and telecommunications industries are committed to the evolution of the next generation of "superhighways" and "intelligent terminals". Among main R&D threads are office support, computer supported collaborative working and video-conferencing, electronic publishing and tutoring systems.

It is important to recognise that in the user community, there may be a considerable gulf of misunderstanding and a considerable aspect of intimidation and alienation about the technology and its potential application. It is a difficult task to represent and explain new technology and its benefits. Making the new generation of information modelling and communications technologies more "user friendly" and accessible is vital. One approach is to involve "end-users" at an early stage in design and prototyping. This is a considerable task. It is consistent with prototyping systems which aim to please, and to the development of generic and general purpose functions. In order to engage end-users from any domain, it is essential to focus on content from that domain. The task is to fulfil end-user's needs for content and delivery, while developing a general purpose framework.

The Applied Research : Process

We have been pursuing an applied multi/interdisciplinary approach to the development of generic mechanisms and tools for information modelling, presentation and interaction, using digital multimedia resources. Our approach to design and development is applied, with user-centred rapid prototyping of working models. At the outset in 1988 there was no system, no tool, no simple solution to the construction of hypermedia applications. Our aim was the development of high performance graphical user interfaces (GUI's), and mechanisms for the support of the acquisition, organisation and presentation of information (multimedia materials), with a variety of support for access and interaction.

Rather than simply developing a specific application in isolation which is tied to a particular machine, our strategy has been to engineer components of an application development framework which can become integrated into a modular information system. Such a system would be inherently flexible and would provide the means to deliver resources in a variety of circumstances to a variety of users. This is rather a tall order and there are many alternative starting points and strategies. In contrast to developments exploiting proprietary and stand-alone technologies and tools, the technologies of UNIX, X11 windows, 'client-server computing' and RISC (Sun Microsystems Sparc) have been employed in combination with object-oriented technology (OOT). The "client-server" architecture provided by workstations running the UNIX operating system is a type of approach to organising the storage and distribution of data, and the provision of services (such as word processing, graphics processing, desktop utilities, and database tools). It is a

development beyond the mainframe with its "dumb" terminals, and the stand-alone PC. It is a network enterprise model of computing enabling communication and collaboration, with user access provided through an interface on a "terminal" (user seat) through which requests for services, applications and files can be connected from a client process to server machines.

The Applied Research : Application Content, Organisation & Distribution

The 'SMILE' Project is concerned with the idea of supporting people within new computer-based interactive learning environments. It has as an aim the extension of general purpose mechanisms for the modelling, organisation, distribution and management of multimedia materials and computer-based 'hypermedia' to application on instructional networks in an educational environment. Pedagogical interactivity - between the teacher and the pupil - is a type of interaction which requires a number of processes and features. 'SMILE' (Supporting Multimedia Interactive Learning Environments) is focused on delivering this variety of interactivity as a functional enhancement (module) of a general purpose (modular) system. Our aim is to implement an "educational advisor", to be accessible as an interface module.

A number of 'pilot' and 'demonstrator' application development projects have enabled us to investigate mechanisms for enabling a subset of basic information modelling tasks. The aim was to develop working prototypes demonstrating and supporting aspects of the organisation of information by 'authors', and its delivery through a high quality graphical interface. The first phase of case studies included - 'STILE' (supporting textiles interactive learning environments), 'VPH' (victorian periodicals hypermedia), 'Access' (a library system), 'EVE' (a system for midwifery education and training). These applications were developed using the 'Media Language', constructed with the Eiffel object oriented programming language. 'Media Language' enables the hand-crafting of high quality interactive browsable presentations in the form of linked 'Chunks', using imported content generated in external packages. "Chunks" are fixed canvas presentation frames, displaying text including selectable 'hypertext', buttons, sound, pictures and animation.

While 'Media Language' supported the development and delivery of small-to-medium scale applications to small groups on the network, and the interface was generally liked, the delivery to each end-user involved the complete model being assembled into the memory of their machine. To provide scaling with good performance on heavily used institutional networks, supporting requests from multiple users, a better development and distribution model was needed. Furthermore we believed that a level of 'automation' in the construction of high quality presentation-interaction frameworks and the organisation of content would be more appropriate with 'authoring' separated into a number of tasks. These tasks include, (i) the specification and supply of 'paper-based' content as domain materials, to be digitised and imported into a framework; (ii) the editing and mark-up of content for presentation and interaction; and (iii) the management of access permission and distribution to users on the network. A new prototype tool - 'GARDEN' (General Application Realisation and Development ENvironment) has been developed. 'GARDEN' re-used some of the X11 windows and GUI components from Media Language, and in order to provide a better distribution model, some useful features of the UNIX Operating System were encapsulated.

'GARDEN' provides application developers with an effective mechanism for organising large numbers of text and image files into high quality interactive applications. The first prototype provides a flexible, expandable, enhanceable and distributable 'electronic book'. The framework for an application can be constructed by information designers from a resource of templates and re-usable features. Content can be organised into modules and nested menus defined and simply constructed providing access to an information model. Editors can work with authors and originators of materials to ensure content location and mark-up for presentation. System administrators are provided with security mechanisms, providing log-in permission for multiple users, with time-stamped logging for all user actions and a flexible network distribution model,

enabling precisely controlled and monitored access to large scale textual and pictorial information resources and multiple applications.

The prototype features an advanced graphical user interface capable of adaptation to practically any display resolution and size (with display support for 256 colours), enabling a wide range of machines to act as delivery platforms for 'GARDEN' applications. One of the first prototype applications was delivered to the new Leeds University Environment Centre as the the 'EFC' (environment foundations course) in October 1993, and has been used by their first intake of students. Some of the special needs of educational and training applications are supported in the first prototype : with control files, the editor or administrator can define prerequisites displayed to the user enabling specific orders of interaction with materials.

Summary and Future Directions

A holistic approach to information systems and interactive multimedia has been combined with the development of working prototypes, involving applied research and the prospective user community. We have pursued an "open systems" approach which is consistent with the needs for multiple users, multiple processes, and controlled distribution on the network. The basic idea is that the infrastructure for the communication of digital information is open and can accommodate all data types, all distribution protocols, and all types of machine.

Key issues addressed have included portability across machines, attraction, engagement, ease of use, scalability of applications, and the ability to deliver on networks to multiple users, smoothly and with good performance from their viewpoint. Our strategy has been the development of components through rapid prototyping of working approximations to the ideal. We have employed UNIX and X11 windows technology to enable multiprocessing, multitasking, and distribution - both for application development and delivery, and object-oriented to enable evolution and re-use of components and portability. We believe this to be a pragmatic and practical approach to delivering working applications and to designing and prototyping the appropriate tools.

Currently, would-be developers of high quality distributed multimedia materials supporting teaching and learning processes have a difficult choice among the rich and varying possibilities for technology, tools and methods. In our view 'authoring' tools is too narrow a definition of what is required. In any event, tools require time to learn and skill to use, and it takes time to develop quality applications. Maintenance and extension of applications must be accounted for, as must be support for multiple authors and versions management. Distribution must be controlled with monitoring of use. Powerful and sophisticated computing technology and tools are required. Indeed, the multiprocessing, multitasking and support for networking provided by UNIX and the Risc machine are becoming integrated into a new generation of proprietary multimedia technology and tools e.g. Windows NT, 'Chicago' and 'Cairo'.

A complex market place exists in which selecting appropriate and best-of-breed technology is a considerable if not impossible task. The entertainment market is probably the most focused driving force for technological innovation and the delivery of interactive multimedia.

We have demonstrated that OOT provides a mechanism to deliver working prototypes. These prototypes not necessarily the perfect, ideal or complete solution, but a logical step along a technical development. In our programme of applied research, Eiffel has proved an effective tool in the rapid prototyping of general purpose and re-usable components, and we have demonstrated that working systems can be developed with it. 'GARDEN' requires considerable development to satisfy the need for graphical and visual programming tools and compliance with various data and communications standards.

Rather than seeking to acquire or develop the perfect application "authoring" tool, an alternative strategy suggested is the identification and integration of a variety of best-of-breed technologies and components - each providing a key functional feature, with interoperability among components as part of a greater information system framework.

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