From CD-ROM to the WWW: Coming Full Circle

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ABSTRACT

This article describes the challenges faced and solutions adopted in adapting a multimedia-rich CD-ROM program, the Variétés de français program, to operation over the World Wide Web (WWW). While full web functionality offered the promise of flexible network distribution, it also had to confront the dual limitations of multimedia authoring systems and web based programming. In seeking to combine the best of full multimedia programming and centralized WWW mediated delivery, the Variétés de français-WWW program has come full circle to the CD-ROM for its base. The program runs locally to retrieve media resources, perform intelligent answer processing, and data collection and turns to the web only when necessary for data transfer, external WWW links, and electronic communication. Given the current state of the art, the article concludes that such a hybrid solution offers the most effective approach to courseware development.

KEYWORDS
Multimedia, CD-ROM, World Wide Web (WWW), Flexible Learning, Distance Education

INTRODUCTION

This article describes the challenges faced and solutions adopted in producing a multimedia-rich hybrid CD-ROM/WWW program, the Variétés de français-WWW program. As with most multimedia applications, Variétés de français was initially designed as a stand alone CD-ROM program. It was originally intended to provide supplementary support to the traditional, on-campus teaching of a course in French sociolinguistics. Use of a wide range of media (e.g., texts, maps, graphics, audio recordings, video clips) was intrinsic to the syllabus, as was a variety of tutorial exercises in phonetic transcription and linguistic analysis. The availability of multime-
dia authoring systems and CD-ROM technology allowed us to make these resources and their associated tutorial activities accessible to students outside the classroom. In order to extend the autonomous instructional capability of the program, with a view to eventually offering the course as a distance education course, development of a WWW compatible version was undertaken. While conversion of the original CD-ROM application to full web functionality offered the promise of flexible and centralized network delivery, it also had to confront the dual limitations of multimedia authoring systems and web based programming.

SYSTEM LIMITATIONS

Since the beginning of this decade, Computer Assisted Instruction has increasingly exploited the multimedia resources made available by high speed desktop computers and the large data storage capacity of CD-ROM disks. However, despite their many advantages, CD-ROM applications have been hampered by two major constraints: computer platform dependency and stand alone access. The most widely used authoring systems for the production of multimedia CD-ROM programs offer powerful control (Multimedia ToolBook, MacroMind Director), simplicity of use (HyperCard, HyperStudio), and Windows/Macintosh compatibility (MacroMind Director, HyperStudio). Unfortunately, no authoring system provides all three of these features in the same package. Recent enhancements to authoring systems (ToolBook II, Director 6, HyperStudio 3) allow varying degrees of access to the WWW and runtime computer platform compatibility via web browsers. Notwithstanding these recent enhancements, the performance of WWW applications lags considerably behind that of locally running applications.

As a consequence of the ever increasing promotion of centrally distributed instructional paradigms, CD-ROM applications have been pushed into the background in the last two years or so as courseware developers join the rush to produce networked, web based programs. Web authoring systems now extend from stand alone HTML page editors (HotDog) to full scale web site creation packages (Front Page, Dream Weaver, WebCT). It is even possible to produce and manage web based courseware, in the absence of a local web site, via WWW links to authoring/distribution facilities located virtually anywhere in the world (InfoSource). Yet, for all their flexibility, web based systems also have serious disadvantages. Access is often a major problem, especially when network connections are mediated via modem links. Slow response time on the WWW is more the rule than the exception, even for text based materials; graphics have to be used sparingly and streaming audio is only just satisfactory. Video remains well beyond the event horizon in all but the most cutting edge intranet installations.
The relative poverty of the web environment compared to that of a locally running CD-ROM is not just restricted to media usage. The most frequently used programming languages underlying web pages, HTML and JavaScript, are much more limited (and user unfriendly) than those available in multimedia authoring systems. As a result, web based interactivity seldom rises above the level of early Computer Assisted Language Learning (CALL) applications; point and click page turning and true/false, multiple choice, exact string matching question formats. More powerful programming languages, most notably CGI and Java, do exist for WWW applications, but these languages, too, have their own restrictions. The former, being server based, requires special access; the latter, being a relatively new arrival on the scene, has yet to demonstrate the stability of other full fledged programming languages.

HYBRID CD-ROM/WWW APPROACHES

Given the current state of affairs, the main challenge facing the Variétés de français-WWW project was to exploit the networked distributional potential of the WWW while at the same time maintaining the sophisticated programming capability and rich multimedia environment of a CD-ROM application. The obvious solution was to wed the two technologies through the creation of a CD-ROM enhanced web application or, alternatively, a web enhanced CD-ROM program.

The choice between the two approaches is essentially a matter of where one decides to maintain the locus of control, on the network or in local computers. In turn, this decision is very much determined by the nature of the network environment. A Local Area Network (LAN), such as one might find within a language center facility, offers the greatest possibility of controlling local computers. Hardware platform, operating system, and web browser installation are all determined in advance, all of which allows central management of CD-ROMs. In addition, no external security barriers interfere with manipulating the content of centrally controlled hard disks. To the extent that its hardware and software components have been standardized, a Wide Area Network (WAN) offers the same possibilities of control over connected computers as does a LAN. However, the wider the intranet, the greater the likelihood of diversity of components and the presence of security protection devices which can block effective management of local computers. This situation typically occurs in university WANs and allows little control of CD-ROM programs beyond that of setting them in motion. To use a metaphor, the network can talk to CD-ROM programs easily enough but is deaf when it comes to listening to the response. Whatever transpires locally with respect to users’ records, activities, data created, etc., lies beyond the network’s data processing ca-
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pacity. Moreover, because of the security risks involved in allowing network initiated access to local hard disks, the ability to update CD-ROM based resources is severely constrained.

As soon as one leaves the secure and standardized environment of a LAN, the only feasible way to produce an interactive multimedia CD-ROM/web application is by means of the creation of a CD-ROM managed network environment. Flexible delivery of instructional content in general and distance education in particular need to function over the WWW. Off-campus, where the vast majority of actual and potential users are found, easily available alternatives to modem connections do not currently exist. And though bandwidth has improved considerably with even greater transmission speeds promised just over the horizon, the WWW will continue to be largely restricted to text based materials for some time to come. As long as these restrictions continue, graphics, audio, and video resources will need to be locally accessible, and the most cost effective way of achieving this goal is through CD-ROM storage. Once developed, the content of entire courses, as well as the administrative and pedagogical infrastructure needed to sustain autonomous learning, can be distributed to students on CD-ROM at minimal cost. Running programs from a CD-ROM, rather than centrally via the WWW, also means that it is possible to use powerful programming languages to control local computers. Data of all types can be collected, manipulated, and stored without the security restrictions intrinsic to network installations. Practical economic considerations, which bear critically on the issue of equitable access, also argue strongly in favor of working from a local CD-ROM environment. As WWW usage accelerates, educational institutions are increasingly requiring students to obtain (and pay for) their own Internet Service Provider. A CD-ROM managed network environment allows applications to run locally for instantaneous access to media resources, intelligent answer processing, and data collection, has to connect to the WWW only when necessary for data transfer, external links, and electronic communication.

SOLUTIONS ADOPTED

Given the need to have full multimedia functionality, there really was no alternative but to design Variétés de français-WWW as a web enhanced CD-ROM program. Consequently, it was decided to avoid the restrictions and overhead of authoring systems and take full advantage of the local operating environment by completely reprogramming the application in C++. Code was written for the Macintosh platform and then recompiled (with minor adaptations) for Windows applications. The central issue involved in managing web based resources from an external CD-ROM program is that of gaining access to key components of the host network.
From a programming standpoint, standard protocols (TCP/IP, PPP) make logging on to the Internet a straightforward operation. Connecting to a specific web address is equally unproblematic and can be accomplished with protocols antedating the WWW. A web site, in reality, is no more than a set of directories (and subdirectories) on a dedicated computer. Well established non-web protocols (Telnet and FTP) are in fact commonly used to maintain such sites, as often as not via modem links to remote computers.

It is through the use of these various protocols that multimedia authoring systems are able to offer web access from within locally running CD-ROM applications (which could also be stored on hard disk if storage space is no obstacle). Once connected, such applications link to WWW sites either via an internal viewer or an external browser (e.g., Netscape or Internet Explorer). When finished, the applications return to the initiating program. However, since control during the interim has effectively been turned over to the network system, any data generated during the process is not communicated back to the local computer. This situation, of course, is the mirror image of what happens when web based systems manage CD-ROM resources.

The key to creating a truly interactive web enhanced CD-ROM program resides in keeping the locus of control on the local computer after contact has been made with the host network. Recent additions to the CD-ROM programming arsenal (Live-CD) accomplish this objective by placing programs on the web site which can be custom designed to receive commands from (and exchange data with) locally running CD-ROM applications. In the case of Variétés de français-WWW, the limited range and particular nature of required web functions allowed the same result to be achieved through the use of standard protocols.

To meet the web based needs of our project, seven specific functions were required.

1) Class bulletin board
2) Group discussion forum
3) Individual e-mail communication
4) Access to WWW links
5) Tutorial exercise record keeping
6) Assignment submission and retrieval
7) Updating of CD-ROM resources

As it turned out, the Distance Education Centre at Monash University, the home institution of the Variétés de français-WWW project, had already developed a web site which offered most of the required functionality. Moreover, because the site was intended for use over the Internet, it was intrinsically designed to operate with standard protocols. When students use Variétés de français-WWW, they begin by logging in for record
keeping purposes. Linking to the web site from the CD-ROM was thus easily accomplished by storing this information on the local hard disk, along with server based logins and passwords, and transferring this information when needed. Providing WWW links was similarly handled by activating the local web browser and passing to it whichever Uniform Resource Locator (URL) had been selected from a CD-ROM based program, exactly as is done with popular communications packages like Pegasus. Although receiving feedback from web sites is beyond the program’s capability, the history file from web sessions is retrieved from the browser and recorded.

The provision of essential communication facilities can be achieved from a CD-ROM based system either through the remote manipulation of a web program or the creation of a local function. Either way, the heart of any such system is the storing, sorting, and distributing text files. If communication needs are relatively uncomplicated—as they were with the class bulletin board, group discussion forum, and individual e-mail messages—it can in fact be advantageous to manage these functions locally. Doing so with Variétés de français-WWW, for example, allowed the original graphics interface to be maintained. On the server end, all that is needed is storage space: a public directory to store text files for class announcements and discussion groups and individual directories for student e-mail messages. Messages created off-line are automatically distributed to their proper storage destinations when students connect to the web site. Data transfer is bidirectional since the locally running program also retrieves all new files to update public messages and deliver individual e-mail messages. To keep matters simple and to restrict exchanges to class related business, the communications program does not handle mail to external addresses. The CD-ROM program does, however, allow students to link to locally available e-mail facilities.

Data transfer also takes place on log-in to update automatically student records of WWW usage and tutorial exercise results. Since all communication and record keeping files are text based and relatively small, data transmission takes place with minimal delay, even when connected via a modem. The mechanism for updating the media resources of the CD-ROM is the same as that used for transferring other data. The program compares the contents of a special resource directory on the host network to a counterpart located on the local hard disk and compiles a list of new files. However, because such data is likely to be substantial and may involve executable files, a simple message is sent to users to inform them of new material. In a computer laboratory installation, only the system administrator is so informed. Transfer takes place whenever appropriate and, being user initiated, does not have to overcome security obstacles. By default, in looking for its files, Variétés de français-WWW first checks the contents of the resource directory on the local hard disk; material submit-
Inasmuch as normal communication and automatic data transfer operations of the CD-ROM program are at most restricted to class usage and of limited personal consequence, security and confidentiality are not major concerns and can be easily handled locally. On the other hand, the submission and retrieval of major pieces of course work require secure network facilities, as does, more generally, management of enrollment, grades, credits, and the like. Because the Distance Education Centre routinely has to deal with these matters, it has built a sophisticated system into its website to oversee academic administration and to track submitted work. For maximum security, all student assignments are sent as encrypted files to a dedicated server. Assignment submission is subject to strictly enforced due dates, which instructors can of course extend according to individual circumstances. Once work is accepted, students receive an e-mail confirmation of the name of the person responsible for correction. Marked assignments are returned to student accounts, the detailed results of which are kept in a secure database. In order to avail ourselves of this course management system, a remote control algorithm was devised for the CD-ROM program. Essentially, this process involves mirroring the assignment submission form used by the web server on the local computer and then compiling the results into a data file that can be sent to its intended destination. From the student’s perspective, this process is completely transparent.

END RESULT

The Variétés de français-WWW CD-ROM functions most of the time as would any stand alone application. It is dual platform (Macintosh/Windows) and operates on any suitably equipped computer. Installation involves little more than the creation of storage directories on the local hard disk. If required for computer laboratory access, directories for individual students can be set up on the laboratory’s server. The program operates autonomously until there is a need to access web based materials. Web functions, such as composing e-mail messages or making a contribution to a discussion forum, are handled locally unless the user chooses to do so online. When a web function is requested, the CD-ROM automatically connects to the host network and uses standard protocols to transfer stored data files between the local hard disk and web as required. At this stage, students are free to pursue activities on the web or to disconnect and consult newly received materials off-line. Course administration, including submission and retrieval of assignments, is taken care of by a secure server based system which the CD-ROM program accesses remotely via the transmission of data packets prepared off-line.
CONCLUSION

In seeking to combine the best of full multimedia programming and centralized, Internet mediated delivery, Variétés de français-WWW has come full circle to the CD-ROM for its base. Current web applications, for all their flexibility, simply cannot efficiently do everything that is possible in a stand alone computer environment. Above all, in the real world of modem mediated network connections, adequate access to multimedia resources remains in the future. The construction of sophisticated tutorial exercises, intelligent response handling algorithms, and storage of media resources is unquestionably best handled through locally running CD-ROM programs. On the other hand, centralized management of resources, record keeping, electronic communication, and links to the WWW are only possible through a web site. However, as has been shown by the approach embodied in Variétés de français-WWW, use of such facilities does not necessarily mean that the locus of programming control has to be on the web. On the contrary, most basic functions can be managed locally, with the host network merely serving as a centrally accessible storage space. When more complex functions are required, locally running programs can quite satisfactorily provide access to web resources, provided that the data used by server based programs can be transferred by standard protocols. When a WWW link is required, connect time can be kept to a minimum by using the same protocols to retrieve essential data for off-line applications. Lastly, by storing updates of CD-ROM based materials on a web site, it is equally possible to modify and augment the contents of the original CD-ROM program itself. The prototype of this hybrid CD-ROM/WWW system is already being tested, and reprogramming of the entire application is expected to be completed before the end of the year. Its effectiveness during actual student use will be the subject of our next research project.

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