Environmental Digital Library Project
Playa Lakes and the Ogallala Aquifer

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Abstract

Libraries are no strangers to resource sharing initiatives. The advent of electronic formats such as Hypertext Markup Language (HTML) and Portable Document Format (PDF) have increased both the ease and efficiency of finding and producing scholarly virtual documents. This equips libraries to share information to a far greater extent than has ever been done before.

The *Playa Lakes Ogallala Aquifer Research Bibliography and Full Text Resource* (http://www.lib.ttu.edu/playa/) is a collection of electronic environmental information at Texas Tech University Library. Interest in developing an array of digital resources is strong at Texas Tech, yet questions over how these projects will be managed and what they will cost remain unanswered. This project is now in its second year and has already experienced substantial growth. It is hoped that it will become the world's definitive bibliographic and full text resource on information related to the specific physiographic wetland feature known as playa lakes and the Ogallala Aquifer, the largest aquifer in the world. This digital library initiative is one of many now being developed in the United States and around the world. The term "digital library" has many different meanings. Our concept is one that includes full text delivery of documents digitized by retrospective conversion of print materials. It also consists of a suite of services and value added features such as indexing, searching, and interactive elements to meet the growing information needs of both local and remote environmental information consumers.

The purpose of this article is to present the tools and the methodology which have been used to build this virtual collection and to identify the components necessary to put forth a formal proposal to an administrative unit for

approval.

Project Background

The Playa Lake Bibliography began with a simple idea. A research group from the Midwest contacted Texas Tech University (TTU) Libraries, requesting information on playa lakes. They had been awarded a research grant to investigate these interesting wetland features but expressed difficulty in gathering information on the relevant research literature. They were able to identify TTU Libraries as an important repository of information. A list of holdings, primarily theses and dissertations, was provided and the researchers were queried as to the potential value of providing more of this information online. They responded affirmatively and work was begun, because we had established that there was an interest and a need for us to do so.

However, need alone is insufficient justification to launch a digital library project. There must be a reasonable likelihood of continued development. The most important element in the growth of an electronic resource is people. The body of researchers actively involved in playas and the Ogallala is large at Texas Tech, including a faculty from Agriculture, Biology, Engineering, Geosciences, and the International Center for Arid and Semi-Arid Land Studies (ICASALS). We not only had a well established group of local researchers from which we could tap expertise and insight, we also had a wealth of local research material to digitize. Due to the potential for global reach via the electronic medium of the Internet, local interest alone is insufficient justification for launching a digital project. Playas occur around the world and there is significant international interest in studying their physical, biological, and economic attributes. The Ogallala Aquifer, the largest aquifer in the world, stretches across several Midwestern states. While the Ogallala's economic influence exerts a strong impact nationally, research interest in this resource is international.

Library personnel have been key to the success of the project. Two library staff with subject specializations in biology and geology have designed this bibliographic and full text resource. Bibliographic format follows *Information Sources in Science and Technology* by C.D. Hurt and published by Libraries Unlimited of Englewood, Colorado in 1994. The initial full text component was the 1970 Playa Symposium published by Texas Tech. With such a large local body of information on which to draw, it made sense to begin with material produced on our own campus which made seeking permission to display appropriate texts from copyright holders relatively easy. Otherwise, copyright permission has been systematically sought from individuals,

publishers, and associations such as the Great Plains Foundation. It is difficult to estimate the exact amount of time devoted to securing copyright clearance, but it is not insignificant. The affiliation with the Great Plains Foundations offers the opportunity for this academic library to explore electronic publishing as we place their latest symposium proceedings online ahead of or simultaneously with the print edition.

Table 1: Playa Bibliography Server Activity

Date	Total Hits	Local Hits at TTU	% of Hits from TTU
May 1998	1806	1287	71
June 1998	2442	1151	47
July 1998	2547	828	33
August 1998	2790	980	35
September 1998	3441	1182	34
October 1998	6422	2662	41
November 1998	12354	7565	61

Presently our digital collection uses approximately 223 megabytes on the live server plus another 223 megabytes in a working directory which also serves as a backup. As of fall 1998 there are approximately 275 full-text documents and nearly 700 images in the collection. Cost for storage on the Library's server is now 46 cents per megabyte. This digital library could easily double or triple in size over the next few years. Thus, transfer to another storage medium such as CD-ROM could be expected by 2001. A CD-ROM can hold about 600 megabytes in the formats used here for approximately $2.00 (1/3 of 1 cent per megabyte). Both the University Library and Academic Computing Services at TTU have CD-ROM writing capabilities.

Usage

Libraries consider use statistics very important. Playa/Ogallala use statistics became available when the collection was transferred to the Library's own server in May 1998. Table 1 provides highlights of usage for recent months. A closer examination of one recent month will serve to exemplify who uses this resource and which aspects of the Playa/Ogallala site receive the most hits. Detailed information for each month is available on the site (http://www.lib.ttu.edu/playa/stats/stats.htm).

Our monthly statistics offer insight into utilization of the Playa/Ogallala resource. For example, in September 1998 we had 3,441 hits overall. The most heavily viewed subject list of citations was Geology while the single source receiving the most use as the 1996 Symposium by the Great Plains Foundation. The single most frequently downloaded file was the article entitled "Method for estimating the coefficient of permeability using

hydrologic field data" from the 1970 Ogallala symposium at Texas Tech. While many countries and a wide variety of electronic platforms use this resource, the U.S. and AOL.com are the most active countries and agencies respectively.

Future Outlook

Unlike traditional print information, electronic materials can be revised easily and frequently. They also afford the opportunity for publishers and patrons to interact. These dynamic attributes suggest that information professionals must rethink how information services will be delivered in the future.

Patrons of electronic resources expect them to provide timely information customized to meet their specific needs. Thus we are exploring several online communication initiatives such as a threaded discussion, listserv, and a current awareness service that regularly announces new content and services. Adding Geographic Information System (GIS) components such as maps is also being developed in cooperation with other academic units on campus. Forming partnerships is essential in the digital library of the future. We have also laid the groundwork for an off campus partnership by establishing an informal working relationship with the Texas Water Resources Institute of Texas A & M University.

Electronic formats should be flexible, yet standardized in order to appeal to the variety of ways in which people learn. This resource may soon offer a distance learning component whereby individuals learn library research skills plus visit an actual playa on a virtual tour. Though digital libraries offer an exciting array of information products and services, our basic mission of providing scholarly texts and citations related to playa lakes and the Ogallala Aquifer in standard hypertext (HTML) and Portable Document Format (PDF) will constitute our fundamental and unique contribution to the global digital library.

Digital libraries, like their traditional counterparts offer their institutions the opportunity to establish themselves as significant repositories of unique resources. These resources include electronic texts, user friendly bibliographic search tools, subject specialists, and technical experts with a worldwide audience. The value of these resources is difficult to measure, yet it is growing in international importance. It is one thing to gather physical materials on any given subject. However, it is quite another thing to organize information, understand the information needs of a sophisticated clientele, and contribute to the body of scholarly intellectual property that is being created around the world. This is what will set the digital library of the future apart.

Environmental Issues

Playa lakes and the Ogallala Aquifer are of interest to a wide range of researchers. Three broad areas are readily identifiable: 1)Basic Science, 2) Applied Science, and 3) Non-Science. The area receiving the most attention to date is without question, the second group - Applied Science. It seems somewhat strange that more of the fundamental research questions related to playa lakes and the Ogallala Aquifer have not been addressed prior to seeking answers to questions of an applied nature.

Basic scientific research into playas and the Ogallala Aquifer include studies of population dynamics in microbial organisms as well as wildlife species of interest to recreational hunters. Floral and faunal diversity have been examined in a small number of systems. Studies related to limnology have examined nutrient cycling and water quality. Geologic interest in mineralogy, soil profiles, and analysis of ancient sediments continue. Some archeological work is ongoing.

Studies of an applied nature have focused on habitat modification in favor of some organisms and at the expense of others. For example, several species of game birds have been favored by manipulating the vegetation patterns in some lakes while mosquito populations have been significantly reduced via alterations in playa basins. Urban flood control, pollution, and recreation have been studied in association with aquifer recharge. For example, aquifer contamination from feedlot runoff has been examined in association with some playa lakes. Aquifer recharge via playa lakes is a controversial, though frequently studied process. Finally, weather modification continues to attract attention in an area where fresh water is scarce and reliance on the Ogallala Aquifer for agricultural and domestic use is extremely important to the economy of a large portion of the country.

Non-scientific studies involve economic issues and water rights. While the relative amount of scholarly communication taking place on these subjects is less than the other areas, this is not a reflection on their perceived importance. The nature of research into playa lakes and the Ogallala Aquifer is highly interdisciplinary. Researchers from increasingly diverse fields have understood for some time the importance of communication and the exchange of ideas. It is with this in mind that we hope the Playa/Ogallala Bibliographic Database and Full Text Resource will contribute the most - to the interaction of people from many fields with a common interest in the global physiographic feature known as playa lakes and the Ogallala Aquifer.

Literature Review

Concept of the Digital Library

The volume of professional literature on digital libraries, like the number of digital initiatives being started, is growing at a phenomenal pace. Though no attempt is made here to be comprehensive, we have endeavored to include a number of relevant articles and sites that place our own initiative in the context of what others are doing and reporting in the academic community.

Based on our review, two initial observations are worth noting. First, the concept of a digital library is quite unsettled. Many regard a Web page with a simple list of related sites as a "digital library," while others refer to massive retrospective conversion projects as "digital libraries." Clearly, these concepts represent opposite ends of a continuum, from broad to narrow, from specific to general. Our project, and most digital initiatives undertaken by academic libraries, will fall somewhere between these two extremes. Secondly, most of the dialog about digital libraries is not being done by librarians [1]. Computer specialists have a great deal to say about system architectures, interoperability, and software engineering. However, their views on library workings, and on classification and organization of information in service to specific patron groups suggests there is a desperate need for more input from librarians. Stronger partnerships between these two professions is now more important than ever [2].

Digital Library Participants

Digital library initiatives should be considered by all participants (computer specialists, librarians, publishers, authors, users) as offering new opportunities for collaboration rather than continuing sources of conflict or competition [3]. As these groups interact with increasing frequency, we should see a corresponding increase in understanding for the contributing role each must play in the development of digital libraries. In the meantime, we occasionally hear premature assertions made by one party about the activities of the other.

Predictions about the demise of librarianship in the digital age appear as a favorite theme among some computer specialists, due to the greater degree of direct access to information provided to patrons by electronic resources [4]. Yet more access to more information may actually create a greater need for the information skills of librarians. The so-called, "intermediate services" of editors, indexers, and publishers have also been called into question by some [5]. For example, there are those claim that authors will be free from concerns over the *presentation* of their work. Such claimants fail to consider the value and impact of presentation upon an audience. Authors are, in fact, very interested in the presentation of their work and the impact of that

presentation upon an audience. [6]. The fact that a piece of writing is in electronic format rather than a print format actually gives some authors more control over presentation than they have ever had previously. Often, these predictions of the demise of certain groups are accompanied by contradictory statements suggesting that such predictions are not based on objective information. Many conclude that the information services provided by intermediaries will be just as important in the digital library, only manifested differently.

Much of the dialog about digital libraries compares electronic resources with traditional libraries and is written by individuals who are outside the library community. One quickly becomes curious about assertions that traditional libraries are "passive" [7] and that "cost-free" models of access only work when small amounts of information are used by small numbers of people [8]. Even a routine "reference interview" is anything but passive. Libraries are quite busy taking their services out of the library in a proactive fashion, so that by the time patrons come in the front door they know who can help them and what resources are available. It is strange to hear someone advocating free universal access to information in the electronic library, when so many libraries have been working so hard for so long to make this a reality, regardless of the information's format. Libraries too, have traditionally made their print and electronic catalogs, large and small, freely available to small, specialized groups along with national audiences (Library of Congress) [9]. Despite the differing perspectives we bring to the table, it is important to listen to the views of those from other professions so as to better equip ourselves to work together to build the library of the future.

Information Use in the Digital Library of the Future

Often, discussions of digital libraries suggest that print is no longer considered a viable medium of information exchange. Yet, the presses keep rolling and research indicates that paper remains a powerful and valuable format to document facts, share information, disseminate ideas, and conduct a number of practical information tasks [10]. Other reports acknowledge that many Americans, let alone those from less-developed countries, do not yet own a computer [11]. Thus, it is little more than common sense that print materials will remain a viable means of information exchange for some time to come.

While digital libraries will not be the only libraries in the future, they will play increasingly important roles. How are they expected to satisfy the information needs of our society into the 21st century? In short, digital libraries will play a significant role facilitating the completion of information-intensive work [12]. These resources will enable patrons to accomplish

practical and specific tasks, requiring every component of their design to reinforce this mission. These so called applied information systems, targeted to specific needs, will be the most important elements in a self-sustained information economy [13]. In order for a digital library project to accomplish this goal, a number of issues must be addressed. For example, what criteria are used, by which documents are added to an electronic collection, how are these collections evaluated, and how are they promoted among potentially interested parties? [14] The issue of copyright must also be addressed. Anderson, Lasher, and Reich have pointed out that the author rather than the institution usually owns copyright, yet it is institutions that typically build digital libraries [15]. Finally, meeting this goal of enabling people to work may require systems designers to devise methods of providing access to information at the topical level rather than the document level [16]. Patrons have typically sought the answer to a question rather than the reference to a source containing the answer. Not until the advent of powerful digital libraries has this ability to take the patron right to the online answer been feasible.

A word of caution about "media byte" mentality is in order. Two reasons may be cited for preferring to deliver information in larger packages rather than mere bits of data or answers to specific queries. First, the nature of many queries suggests that the context in which an answer is found is just as important as the answer itself, for taking the information out of context may change the meaning of the information provided. In other words, there is often the need for maintaining the "big picture." Secondly, many queries do not accurately characterize what the patron really wants. Often, by reading through the related material in a larger document, the patron discovers just what they need, which would have been missed entirely had they simply been given or directed to the specific information requested. It is the responsibility of information professionals to interpret what is being asked, to place it in the context of the total information available related to that topic, and to verify with the patron that their information need has been satisfactorily met. Unfortunately, information professionals often lack sufficient product knowledge and time to do so.

Balancing Technical Solutions and Personal Services

Just as traditional libraries have devised a number of technical solutions to their information related problems, so must digital libraries come up with a suite of solutions and services to meet the ever-changing needs of information seekers in the coming years. The prospect of having an obsolete technical configuration in as little as five years appears costly in terms of both time and system infrastructure [17]. Yet, it is likely that system upgrades will simply constitute an ongoing effort to improve the user

interface and increase system efficiency rather than completely rebuilding a collection. Due to this highly dynamic environment, it is critical that digital library designers opt for the technical solution offering maximum flexibility to reach the broadest audience.

One of the hottest concepts in digital library design is that of interoperability [18 & 19]. The rationale for this is obvious - a seamless interface between systems which makes it easier for patrons to use a suite of distinct collections simultaneously. While this challenge is essentially limited to large scale projects, it is important for anyone contemplating a digital library project to survey similar undertakings so that common solutions can be incorporated and common problems avoided. This may also result in certain project features being repeated Thus patrons will find it easier to incorporate a series of digital initiatives in their search for answers to related queries. Another result may be the building of bridges between digital library designers as they communicate about their work with others, thus forming broader collaborative networks. There is still much to be said for maintaining a distinctive "look & feel" in a project, for this may serve as a major attraction to present and potential users.

Other technical issues involve mechanisms to convert print documents into electronic documents. Many Optical Character Recognition (OCR) programs involve a great deal of effort to "clean up" the material scanned, which may force one to rely more heavily on images rather than simple text in an electronic collection [20]. Additionally, creating distinct work areas, one for public display and the other for making changes, updates, and other editorial activities should be considered [21]. This will require additional computer space and will also serve as a back up for much of your collection. It is important to remember however, that just as traditional libraries are more than printed materials arranged on shelves in buildings, so too are virtual libraries more than electronic materials located in files on various servers around the world [22]. Digital libraries must continue to provide a number of unique personal services just as their traditional counterpart has done for as long as anyone can remember.

The provision of personal services through a digital library project has received relatively little press compared to discussions of technical considerations. Yet, it is service that will continue to distinguish libraries, no matter the type, from other kinds of institutions. What sort of services may be built into a digital library? Services that take advantage of the technology upon which digital libraries stand will be the most sought after. For example, in order to create a measure of interactivity, forms should be used to allow patrons to contact the designers of a digital library to make suggestions and ask questions [23 & 24]. This service relies upon having topical or technical

experts on hand to provide answers in a timely fashion. Current awareness features and research assistance are other possibilities. Services rely on people. How many people are needed to design create, and operate a digital library? The answer to this question may be less elusive than you might think, for a digital library is only an extension of the traditional library, requiring many of the skills already in operation there [25]. Perhaps it would be better to ask how present staff in a traditional library could be equipped and encouraged to develop digital initiatives. Many of the same skills are required, though new tools will be needed to perform them.

Webliography of Related Digital Initiatives

General Resources

Center for the Study of Digital Libraries
: Full text technical reports and proceedings of the Conference on Digital Libraries. http://csdl.cs.tamu.edu/

Digital Libraries Resource Page (University of Waterloo)
: Links to digital library sites, proceedings, articles and papers on digital libraries, course syllabi, journals and associations. http://www.ece.uwaterloo.ca/%7Ektrgovac/digital/digital.html

Digital Library Source Book, 1993, ed. E. Fox
: Book available to download. http://fox.cs.vt.edu/DLSB.html

Telematics for Libraries Projects
: List of 50 Telematics projects for libraries, many links are no longer active. http://www2.echo.lu/libraries/en/lib-link.html

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Specific Science Projects

BIOSCI
: Free set of electronic community forums for biological scientists around the world. Links to electronic journals and newsgroups, database of user addresses, index to Web sites for biosciences. http://www.bio.net/

CalFlora Database from UC Berkeley
: Part of the NSF/NASA Digital Library Initiative. Geographic and ecological distribution of information for over 8300 California vascular plant taxa, links to other environmental sites. http://elib.cs.berkeley.edu/calflora/

Carbon Dioxide Information Analysis Center
: CDIAC is the primary global-change data and information analysis center of the U.S. Department of Energy (DOE). CDIAC's scope

includes potentially anything and everything that would be of value to users concerned with the greenhouse effect and global climate change. http://cdiac.esd.ornl.gov/

Earth System Science Community

Curriculum for high school and college students. Based on Earth observing and many NASA online educational resources. http://www.circles.org/

Environmental Documents from UC Berkeley

Part of the NSF/NASA Digital Library Initiative and California Environmental Resource Evaluation System Project. Mission is to provide access to collections of photos, satellite images, maps and full text documents. Includes environmental documents, photographs, aerial photos, geographic data, and botanical database. http://elib.cs.berkeley.edu/docs/

HORIZON: A Public Scientific Data Server

Digital library for public to access integrates and analyzes earth and space science data. http://www.atmos.uiuc.edu/horizon/home.html

Human Genome Project

Provides information on worldwide Human Genome Project, includes "Research in Progress" site, full text publications. http://www.ornl.gov/TechResources/Human_Genome/home.html

Los Alamos National Laboratory: Library Without Walls

Provides fee-based services with electronic journals. Los Alamos National Laboratory reports are available without charge. http://lib-www.lanl.gov/lww/lww_noframes/welcome.html

NASA Information Infrastructure Technology and Applications (IITA)

Designed to increase public awareness to scientific databases. Produces curriculum products and tools for K-12 and K-14. http://iita.ivv.nasa.gov/iita1.html

NASA's Earth Observing System

EOS consists of a science component and a data system supporting a coordinated series of polar-orbiting and low inclination satellites for long-term global observations of the land surface, biosphere, solid Earth, atmosphere, and oceans. Some full-text reports, documents, and books are available along with access to many images. http://eospso.gsfc.nasa.gov/

National Biological Information Infrastructure

The NBII is an electronic gateway to biological data and information maintained by federal, state, and local government agencies; private sector organizations; and other partners around the nation and the world. A good source for location biological information housed elsewhere, though a number of images are archived on site. http://www.nbii.gov/

National Center for Biotechnology Information

NLM/NIH joint venture provides links to Human Genome Project, GenBank Sequence database, full text staff publications and other database services such as Medline. http://www.ncbi.nlm.nih.gov/

National Library for the Environment

In addition to an extensive Web site of links to environmental information, the NLE provides access to congressional reports, online journals (some with free full-text articles), directories, technical reports, and more. http://www.cnie.org/nle/

PhysicsWeb

For physicists, links to ten online services (patents, book reviews, physics net, jobs, web resources), presently free to users, after April 1998 certain services will be restricted to Physics World subscribers. http://physicsweb.org/

PLANTS National Database

Standardized plant names, symbols and plant attribute information, photo gallery, plant project database with various plant information – threatened and endangered species, wetlands, economically important plants etc. http://plants.usda.gov/plants/

World data Center System

The World Data Center system works to guarantee access to solar, geophysical and related environmental data. It serves the whole scientific community by assembling, scrutinizing, organizing and disseminating data and information. http://www.ngdc.noaa.gov/wdc/wdcmain.html

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