

# User Interface Design Challenges for Digital Libraries

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## ABSTRACT

Digital Libraries are evolving rapidly with the usage of Internet and WWW technologies. Since the digital libraries are running on the Internet and the users are from various psychological, educational and social backgrounds, the usage of digital libraries is varying from user to user which entail the need of best user interface. In order to design usable and useful interactive systems, designers need to ensure that good design features are incorporated into the systems, taking into consideration end-users' needs, experience and cultural backgrounds [1]. Hence, this paper presents the users' study in various aspects and identifies various challenges for designing the user interface system for university digital libraries for its effective implementation.

## Keywords

Digital Libraries, Human-Computer Interaction, User Interfaces, User Interface Challenges.

## 1. INTRODUCTION

All knowledge of humanity is preserved in the form of hard material and is spread over across the globe. The first libraries, as such, arose in the ancient civilization of Mesopotamia for the preservation of administrative records [2]. Libraries play a significant role in promotion of culture and education with its key functions. The key functions of libraries are knowledge archival, preservation and maintenance of culture, knowledge dissemination, knowledge sharing, information retrieval, education, and social interaction [3]. Hitherto knowledge was accessible through Libraries of various statutes and also through personal subscriptions to knowledge bases in the form of magazines and journals. . These tasks are, however, not trivial to accomplish: many libraries are rapidly growing out of storage space as the amount of publications keeps increasing; some editions may not be available at the local library; and old documents may be all but impossible to obtain. It is a natural quest to make this knowledge accessible at any corner on earth in the present day technology scenario.

The Internet and the World Wide Web (WWW) technologies are providing the technological environment and intellectual impetus for the development of 'Digital Libraries' – libraries without walls, with contain less data and more ideas.

Digital libraries are disseminating the knowledge globally by breaking the physical barriers. Digital libraries are truly a technology for the masses, which plays a vital role in sharing of knowledge and culture. The fundamental reason for building the digital libraries is to disseminate the better information in

most convenient way which was not possible earlier [4]. Huge sum of money has been spent on building the digital libraries, however research has shown that digital libraries are under utilized, due to their infancy user interfaces [5][6][7] and information overload. User satisfaction is a key to quality in digital library services [8], the user interface system, has gained much deliberation due to the fact that it affects the usability, which is a key factor for the success of the digital library system. Digital libraries are intrinsically interactive systems, which are not a specific collection, or an organization of collections, but are instead a unified means for a user to access the full range of information and services on the local and global network. Hence, it varies from the traditional workstation environments that shaped current graphical user interface (GUI) technologies. Designing the effective user interface system for digital library needs to understand the larger context that determines the users' information, needs and purposes for using the DL, that is, the context of the users' work; the individual user's specific work and tasks. User-studies are necessary not only for planning and designing information systems but also for their efficient and effective operation. Hence, this paper presents the users' study in various aspects and identifies various challenges for designing the user interface system for digital libraries for its effective implementation in universities. This paper is organized as follows section 2 presents the literature review section 3 presents adopted methodology for studying the users section 4 presents the study findings section 5 presents the identified user interface challenges for digital libraries and finally conclusion follows.

## 2. LITERATURE REVIEW

The information needs of individuals have long been studied by researchers in marketing, education, and information science. There is a long history of studies of what types of information needs people bring to libraries [9] [10] [11] [12]. Information science researches recognize that there are different levels of information needs like specified visceral, conscious, formalized, and compromised levels [13].

That individuals vary on a host of physical, mental, and emotional characteristics is a defining condition of humanity [14]. Much of psychology is devoted to identifying the essential dimensions of human behavior [15] [16]. Designing the user interface for universal access is more complex than designing for specific populations because the entire range of human characteristics and needs must be supported. Thus, assessing needs and designing User Interface System for digital libraries in Indian Universities require systematic examination

of many communities and will likely to lead to multiple system solutions.

In general the users of the digital libraries can be grouped into practitioners, teachers, students, researchers, counselors, policymakers, parents and administrators and most of the users access the digital libraries for research reports, project descriptions, position papers, evaluative reports, literature, teaching guides, books and conference papers [17].

We conducted a study to identify the potential groups of contemporary users or stakeholders and their requirements in Indian University Digital Libraries for designing the better user interface system.

### 3. ADOPTED METHODOLOGY

The studies have conducted with a broad approach based on common industry specifications and other standard research works, using a variety of research methods including surveys, participant observation, usability testing, ethnographic studies, focus groups and transaction log analysis.

Surveys and questionnaires represent one of the most inexpensive and easiest methods of collecting user opinions and attributes [18]. The survey has been conducted through email and personal data collection mode. Questionnaire has formulated based on the Question for User Interface Satisfaction (QUIS) [19] and other standard research works that are relevant to the digital libraries. Questionnaire has been sent to various persons in various capacities in selected Indian universities and higher learning institutions of different kind. The specific research questions include.

- Age and Gender
- Academic Qualifications
- Type of the Stakeholder
- Skills in Computer Usage and Computer Ownership
- Type of Information
- Information searching behavior and methodologies
- Internet access at home
- The frequency of Internet usage
- The length of Internet usage
- Internet skills
- Experience in creation and sharing of digital content
- Experience in usage of contemporary websites developed on Web 2.0 technologies
- Experience in usage of digital libraries

### 4. FINDINGS OF THE USERS' STUDY

We received 67% (335) of responses among 500 users. Among the received responses 42% (141) are female and 58 % (194) are male. 5% (17) are below 20, 15%(50) are between 20-25, 35% (117) are between 25-35, 23% (77) are between 35-45, 19% (64) are between 45-60 and 3% (10) are above 60. The table1 shows the profile of the respondents in terms of age, gender.

**Table 1: Demography of Respondents Surveyed (n=335)**

Gender	
Female	42%
Male	58%
Age	
Below 20	5%

20-25	15%
25-35	35%
35-45	23%
45-60	19%
60 and above	3%

The majority of the respondents are Post graduates i.e. 55% (184), M.Phil/Ph.D holders are 25% (84) and under graduates or pursuing under graduates are 20% (67). Most of the respondents are Research Scholars those are pursuing either Ph.D or M.Phil i.e. 35% (117), 15% (50) are academic assistants/teaching assistants, 10% (35) are Lectures/Assistant Professors and Readers/Associate Professors, 5% (17) are Professors, 10% (34) are Research Fellows, 17% (57) are Postgraduate Students and 3% (10) are Undergraduate students. The respondents belong to various faculties like Engineering/Technology 40% (134), Sciences 30% (101), Humanities 28% (94), and others 2% (6).

**Table 2: Academic Qualifications of Respondents Surveyed (n=335)**

Academic Qualifications	
M.Phil/Ph.D holders	25%
Postgraduates	55%
Undergraduates	20%

**Table 3: Positions of Respondents Surveyed (n=335)**

Students	
Research Scholars	35%
Postgraduate Students	17%
Undergraduate Students	3%
Faculty	
Academic Assistants/Teaching Assistants	10%
Lecturers/Assistant Professors	15%
Readers/Associate Professors	5%
Research Fellows	10%
Professors	5%

**Table 4: Faculties of Respondents Surveyed (n=335)**

Faculties	
Engineering/Technology	40%
Sciences	30%
Arts & Humanities	28%
Others	2%

We observed that the respondents are using the Internet for mailing, downloading music, instant messaging, social networking, online banking, online shopping, knowledge and information seeking. Very few respondents only reported that they have not accessed the Internet so far. In terms of usage of the Internet 30% (101) respondents are having novice experience, 40% (134) are having moderate experience and 28% (94) are having skillful experience. Most of the respondents are the users of the social networking sites and they have been influenced by rich user interactions and contemporary technologies. The following table depicts reasons and frequency of using the Internet by the respondents.

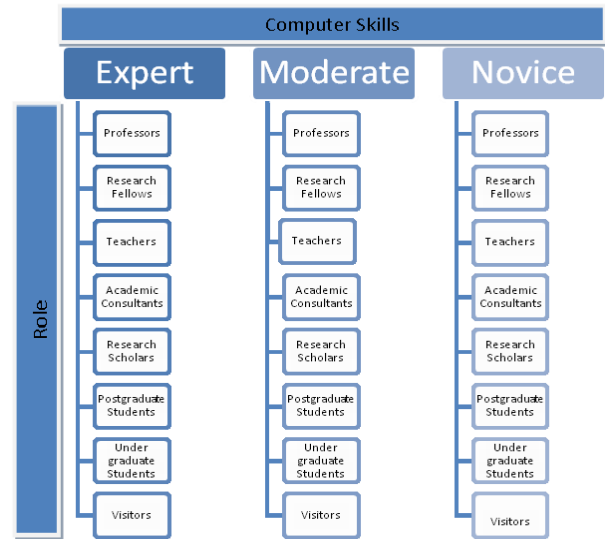
**Table 5: Reasons for and Frequency of Browsing the Internet (n=335)**

Reasons	Frequency			
	Always	Seldom	Occasionally	Never
E-mail	46%	39%	13.50%	1.50%
Chatting	24%	48%	26%	2%
Music Download	8%	15%	50%	27%
Images Download	2.40%	27.30%	40.60%	29.70%
Software Download	5%	11.30%	25%	58.70%
Playing games	5%	15%	32%	48%
Using search engines	42%	37%	20%	1%
Browsing for general information	45%	27%	26%	2.50%
Accessing digital libraries	25%	40%	25%	10%
Browsing for advanced/ research oriented information	30%	20%	10%	40%
Online shopping	12%	28%	10%	50%
Online banking	14%	30%	15%	41%
Creating web pages	6%	13.30%	22%	58.70%
Digital content creation and sharing	10%	11.30%	21%	57.70%
Using the wikis	45%	27%	26%	2.50%
Using the blogs	45%	27%	26%	2.50%
Instant Messaging	24%	48%	26%	2%
News groups	30%	20%	20%	30%
Multimedia sharing	20%	50%	25%	5%
Social networking	35%	32%	28%	5%
Others	13%	15%	52%	20%

We observed that most of the Indian universities and higher learning institution libraries are automated but not digitalized; very few universities have established the digital libraries. Among them 48% of the institutions are using DSpace digital repository software, 33% of the institutions are using Greenstone digital library software, 16% of the institutions are using either EPrints or Fedora Digital library Software and only

3% are using other software systems including custom/proprietary build for building the institutional digital libraries. This study further identified most of the digital libraries are build upon the open source software systems with their core architectural paradigm without providing any enhancements.

We identified the potential groups of digital library users in Indian universities based on computer usage skills as Expert, Moderate and Novice users. And each potential group is further classified based on their role as Professors, Research Fellows, Teachers, Academic Consultants, Research Scholars, Post-Graduate Students, Under-Graduate Students and Visitors. The following diagram depicts the potential user groups of digital libraries in Indian universities.



**Figure 1: Potential User groups of digital libraries in Indian Universities**

We observed the following primary purposes of using the library by the various user groups in Indian universities.

**Table 6: User Groups-Primary Purposes of Visiting Library**

User Group	Primary purposes of visiting library (sequential order)
Students (including PG and UG)	<ul style="list-style-type: none"> <li>For notes preparation by using prescribed texts</li> <li>General reading</li> </ul>
Research Scholars	<ul style="list-style-type: none"> <li>For research journal, technical and term papers</li> <li>Preparing for Teaching by referring the prescribed books</li> <li>Reading of some advanced level books</li> <li>General reading</li> </ul>
Teaching Faculty	<ul style="list-style-type: none"> <li>For teaching preparation by referring prescribed texts</li> <li>Gathering additional information for teaching from other than the prescribed texts</li> <li>Reading of research oriented books</li> <li>General reading</li> </ul>
Research	<ul style="list-style-type: none"> <li>For research journals, technical and term</li> </ul>

Fellows	<p>papers</p> <ul style="list-style-type: none"> <li>• Reading of advanced level research oriented books</li> <li>• General Reading</li> </ul>
Professors	<ul style="list-style-type: none"> <li>• For research journals, technical and term papers</li> <li>• Reading of advanced level research oriented books.</li> <li>• Teaching preparation by referring some advanced level texts</li> <li>• General Reading</li> </ul>

The following user activities/goals are identified in using of the digital libraries in both real time and test bed environments.

- **Information Discovery:** This is the primary activity of all groups of digital library users. Users discover the information in a way of searching and browsing the digital library according to their need.
- **Information Access:** After successful discovery of information by using either searching or browsing, user access the information either for reading or for printing.
- **Information personalization:** User wants some set of personalization features while accessing the digital libraries. Search results storing and filtering, bookmarking the information are some of the goals.
- **Information Creation:** Users can create new information and deposit into the digital library.
- **Information Review/Comment:** Existing information can be reviewed by the user and he comments the information.
- **Information Sharing:** User shares the discovered search results, information with other likely interested people in order to enrich the rich the knowledge.

Further we observed the following related to user interests in using of the user interface system.

- Users prefer to use the well designed high resolution screens with standard colors.
- Users prefer to use standard icons which are familiar to them.
- Users prefer to read the content with high intensity of foreground and plain light colored background.
- Users prefer to read the text with proper alignment and spacing.
- Users prefer to use navigation links placed on the left side of the screen comparative with other sides of the screen.
- Users prefer to use the standard menus comparative with the other types of menu styles.
- Users prefer to use the Search Pan placed on the top right of the screen comparative with other sides of the screen
- Users prefer to use Submit and Cancel buttons placed Submit button fist and Cancel button next with the placement of the right side bottom of the screen.

- Users prefer to use simple and quick response screens.

We observed that presently Indian university digital libraries are comfortable for expert users that to faculties of Science and Engineering/Technology only. Most of the users from faculties of Arts and Humanities and the users with moderate and novice computer knowledge are not using the digital libraries due to either lack of content or the hindrances in using of infancy user interface of the digital library system.

## 5. USER INTERFACE DESIGN CHALLENGES FOR UNIVERSITY DIGITAL LIBRARIES

After careful analysis of users' study we identified the following user interface challenges of digital libraries which are to be addressed in designing of the user interface system in order to increase digital library access in universities.

### User oriented challenges

- The characteristics of the users like social, psychological and cultural backgrounds etc...
- User's Intensions, Skill sets and Experiences
- The conceptual framework presented to the user
- The roll of feedback
- Operational characteristics command language, displays, responses, etc...
- Personalization of users
- User experience with other contemporary systems.
- The task to be performed
- Unexpected or Anonymous user behavior

### Search oriented challenges

- The constraints of the computer IR techniques
- The effect of the IR system on the user interface for search
- Natural language queries for searching
- Context of the user for searching
- Handling misspelled and multiple forms of keywords
- Search facilities to the user
- Image/Multimedia object searching
- Collaborative search results

### Content oriented challenges

- Multimedia content
- Multimodal interaction
- Multilingual content

### Network oriented challenges

- Network speed
- Distributed systems

## 6. CONCLUSION

The above users study strongly demands the integration of contemporary technologies like Web 2.0 and Semantic Web technologies for building effective and usable digital libraries. The integration of user studies, user-centered design patterns with contemporary technologies in designing of the user

interface systems for digital libraries would defiantly increase its usability. The above users study and the identified user interface design challenges would definitely helpful in

designing the effective user interface system for digital libraries.

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## APPENDIX

Survey Questionnaire				
Name				
Age	<input type="checkbox"/> 18-25	<input type="checkbox"/> 26-30	<input type="checkbox"/> 31-35	<input type="checkbox"/> 36-40
	<input type="checkbox"/> 41-45	<input type="checkbox"/> 46-50	<input type="checkbox"/> 51-55	<input type="checkbox"/> 56-60
	<input type="checkbox"/> 61-65	<input type="checkbox"/> 66 or above		
Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female			
Occupation	<input type="checkbox"/> Employee <input type="checkbox"/> Student			
If Occupation is Employee, select your cadre of employment	<input type="checkbox"/> Professor <input type="checkbox"/> Research Associate	<input type="checkbox"/> Associate Professor <input type="checkbox"/> Technical Officer	<input type="checkbox"/> Assistant Professor <input type="checkbox"/> Other(specify) -----	<input type="checkbox"/> Academic Consultant
If status is student, select your course	<input type="checkbox"/> Under graduate <input type="checkbox"/> Post graduate <input type="checkbox"/> Research			
Major/Area of Specialization	<input type="checkbox"/> Arts & Humanities	<input type="checkbox"/> Sciences	<input type="checkbox"/> Engineering/Technology	<input type="checkbox"/> Others(specify)-----
Usual Purpose of visiting library (More than one option may be opted)	<input type="checkbox"/> Research	<input type="checkbox"/> Lecture preparation	<input type="checkbox"/> Study notes preparation	<input type="checkbox"/> General Reading
How often do you use a Computer	<input type="checkbox"/> Never <input type="checkbox"/> Occasionally <input type="checkbox"/> Monthly <input type="checkbox"/> Weekly <input type="checkbox"/> Daily			
Rate your familiarity in usage of computers	not familiar <span style="margin-left: 100px;">very familiar</span> 0 1 2 3 4 5 6 7 8 9			
<b>Have you used the computer for any of these activities? <i>If you have not done any of these activities please do not tick.</i></b>				
Word processing (MS-Word, Pagemaker etc..)	<input type="checkbox"/>			
Spread Sheet (MS-Excel, Lotus 123 etc..)	<input type="checkbox"/>			
Slideshow/Presentation (MS-Power point etc..)	<input type="checkbox"/>			
Database (MS-Access etc.)	<input type="checkbox"/>			
Internet	<input type="checkbox"/>			
Multimedia playing (Medioplayer, DVD player etc..)	<input type="checkbox"/>			
Drawing (Paint, CorelDraw etc..)	<input type="checkbox"/>			
Scan Images	<input type="checkbox"/>			
Edit Images (Photoshop, Picture Manager etc..)	<input type="checkbox"/>			
Build Websites	<input type="checkbox"/>			
Simple Programming	<input type="checkbox"/>			
<b>Internet Usage</b>				
Have you used the Internet	<input type="checkbox"/> Yes <input type="checkbox"/> No			
How long you have been using the Internet	<input type="checkbox"/> Less than 6 months <input type="checkbox"/> About a year <input type="checkbox"/> About 2 years <input type="checkbox"/> 3-4 years <input type="checkbox"/> More than 5 years			
How Frequent your using the Internet	<input type="checkbox"/> Everyday <input type="checkbox"/> At least every 2 days <input type="checkbox"/> Weekly once <input type="checkbox"/> Monthly Twice <input type="checkbox"/> Monthly once <input type="checkbox"/> Three Months once <input type="checkbox"/> Occasionally			
Level of Expertise in usage of Internet	<input type="checkbox"/> Novice <input type="checkbox"/> Moderate <input type="checkbox"/> Expert			
<b>Which of the following aspects of the Internet have you used? <i>May tick more than one answer. Also indicate the frequency of use.</i></b>				
Reasons	Frequency			
	Always	Seldom	Occasionally	Never
E-mail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Chatting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Downloading music	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Downloading images	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Downloading software	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Playing games	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using search engines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Browsing for general information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accessing digital libraries	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Browsing for advanced/research oriented information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Online shopping	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Online banking	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Creating web pages	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Digital content creation and sharing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using the wikis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Using the blogs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Instant Messaging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
News groups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multimedia sharing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Social networking (Twitter/Flicker etc...)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Whether your institution is having digital library	<input type="checkbox"/> Yes <input type="checkbox"/> No			
Software system employed for building digital library	<input type="checkbox"/> DSpace <input type="checkbox"/> Greenstone <input type="checkbox"/> Eprints <input type="checkbox"/> Fedora <input type="checkbox"/> Proprietary build Other----- <input type="checkbox"/> Don't know			
Whether your institution digital library serves information other than in English language	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know			
Purpose of using the digital library (May tick more than one option)	<input type="checkbox"/> Research <input type="checkbox"/> Lecture preparation <input type="checkbox"/> Reference <input type="checkbox"/> Study notes preparation <input type="checkbox"/> General Reading <input type="checkbox"/> Other-----			
Usage frequency of digital library	<input type="checkbox"/> Never used <input type="checkbox"/> Frequently <input type="checkbox"/> Daily <input type="checkbox"/> Occasionally <input type="checkbox"/> Once in a while			
What type of content you access from digital library	<input type="checkbox"/> Text <input type="checkbox"/> Images <input type="checkbox"/> Audio <input type="checkbox"/> Video <input type="checkbox"/> Statistical/Numerical Data			
Whether the digital library provides unanimous access	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know			
Whether search facilities are good with the digital library	not at all very much 0 1 2 3 4 5 6 7 8 9			
What type searches are possible with the digital library	<input type="checkbox"/> Keyword <input type="checkbox"/> Full-text <input type="checkbox"/> Image <input type="checkbox"/> Video			
Do you locate the information in digital library what exactly you are looking for	not at all very much 0 1 2 3 4 5 6 7 8 9			
Whether the digital library provides Accessibility futures like audio announcements, magnification of the screen etc...	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know			
Whether digital library system shows site updating date	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know			
Whether DL system provides Multimodal interaction like providing thesaurus etc...	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know			
Whether incite and support user participation in document annotation (text and image annotation features) is possible with your digital library	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know			
Please describe your experience with the digital library				
Are you satisfied the existing features of the user interface of your digital library?	not at all very much 0 1 2 3 4 5 6 7 8 9			
What new features are to be added to the interface of the digital library?				