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The Capability of Greenstone Digital Library Software in Building and Delivering Efficient Services to End Users: A Case Study

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Abstract: ***Research Objectives:*** *The aim of this paper is to provide general guidelines for design of a low cost digital library providing services that are most frequently required by various categories of special library users in developing countries. This paper also aims at illustrating strategies and method approaches that can be adopted for building such projects. The paper intends to describe the phases and stages required for building such projects from scratch. It also aims at highlighting the barriers and obstacles facing Arabic content and how could such problems overcome.*
Methodology / Approach: *A system design approach is to be used for the design of the proposed digital library. This approach can be defined as the planning of the procedures to be used in an experimental study. In this approach, each phase consists of a number of stages, each stage is subdivided into steps and each step further contains a series of tasks. Consequently, the total work is broken down into manageable portions. This approach can even be applied to recognize if a specific plan achieves a preferred goal.*
Findings and conclusion: *This paper has put today's technology into practice and has exploited the latest advanced technology in this domain for developing special library services by designing a low cost digital library service as a practical solution. The outcomes have proven encouraging as the design has been shown to be cost effective. The design has also demonstrated that the digital library developed in this paper can assist to a large degree in developing the services provided to special library users in Libya.*
Keywords: Digital libraries, Content management systems, Open source software.

1. INTRODUCTION

Special libraries play a considerable role in supporting scientific research activities and considered essential institutions for the evolution of social, economic, and intellectual life in Libya.

This research originates from a belief that information services for special library users in Libya are poor and not well developed because they are suffering from a general weakness in their principles foundations, ICT infrastructure, resources, and cadres making it unable to comply with their duties and obligations towards their end users. A number of studies have revealed that almost all special libraries in Libya suffer from virtual identity problem as none of them has its own web domain. This problem is neither new, nor exclusive to special libraries in Libya, as a lot of special libraries in the Arabic speaking World suffer also from virtual identity problem. The aforementioned studies have additionally called for significant research into the best ways of providing information services to end users, and in particular, special library digital services. Developing special library services and activities in Libya should be achievable through implementing and exploiting today's technology. Therefore, it is anticipated that designing a low cost digital library services and introducing electronic services will assist in solving a great deal of problems in addition to meeting the needs and requirements of the users. Given the sense that, special libraries and information centres in Libya are suffering from loads of serious problems on various levels. Accordingly, undertaking this research was an important step for rediscovering the statues of these institutions and for developing their services to the standard level by utilizing information technology. Seeing the importance of today's technology and its capability for improving library services in addition to realizing the recommendations of the World summit on information society (UNESCO,2005) regarding exploiting modern ICT to foster productivity and expansion of research activity, the researcher come to the decision to build a low cost digital library to develop special library services in Libya in line with the current condition and available ICTs infrastructure as a forward step.

2. RESEARCH OBJECTIVES

The broad objectives of this research are as follows;

- To investigate the current state of information services in special libraries in Libya.
- To identify the current problems with regard to the information services, user requirements, ICT infrastructure and management policies.
- To design low cost digital library services to suit the needs of special library users.
- To provide recommendations and guidelines for policy makers.

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3. RESEARCH OUTCOMES

The outcomes which this research will produce are as follow:

- Reveal the current state of information services for special library users vis- á -vis the major problems with regard to the current level of services, user needs, ICT infrastructure and management policies, information skills and user requirements, and library management polices including special library staff.
- Generate a report on the specific information resources and services that are most commonly required by various categories of special library users.
- Produce the design of a low cost digital library services that are frequently required by the users.
- Produce a general guideline for the design of a low cost digital library suitable for users in Libya, and similar countries in the Arabic speaking and the developing world.

4. RESEARCH METHOD

A mixed approach, which consisted of a variety of research methods and data collection techniques, was used in this research. A descriptive research method was used for the first phase of this research through the application of survey techniques. A mixed research designs including qualitative and quantitative methods was used in a complementary fashion in this study to explore the research objectives. Three Questionnaires were designed to collect general and basic data for the research. This assisted the researcher to drive the information necessary to achieve the research objectives described above. Data for this research was gathered from selected special libraries through personal interviews with librarians and people in charge of running special libraries in Libya. Observation and field visits were also used as tools to collect additional data. Statistical techniques were employed to analyse the data in order to obtain information that would assist in answering the research questions. The following figure summarises the research approach applied in the first phase.

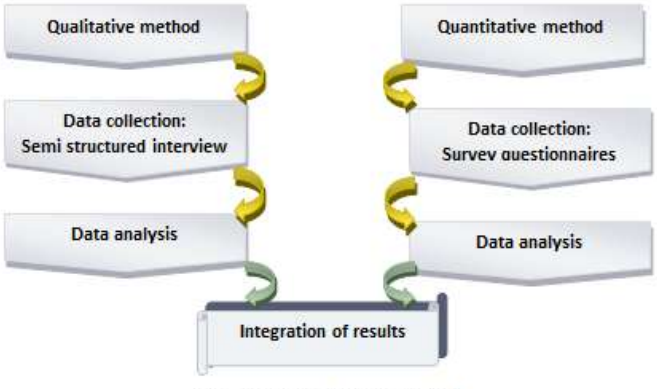

Figure 1. Mixed research approach

First phase

The first phase of the research was designed to examine and analyse the current state of special libraries based on findings from a survey in a selected sample of special libraries and information centres in Libya.

5. OBJECTIVES

- To evaluate the current services and to explore users' needs and requirements so that users can get better services in the future.
- To assess the level of the services provided to end-users.
- To conclude with recommendations for improvements.

Sampling frame

A review of published literature and directories about special libraries in Libya revealed that the current official directory of special libraries in Libya is not up to date. In the light of that, the researcher asked the Foundation of National Scientific Research to supply him with a list of special libraries and information centres in the country.

After categorising the special libraries and information centres a representative, stratified random sample was selected to represent the research population. A small manageable sample was selected to represent all sectors of special libraries and information centres in the country. It is also worth mentioning in this context that despite precautions, it is enormously difficult to avoid cross-classification when allocating institutions and organisations to sectors. The following provides information on the sectors covered in this research:

1- Government departments
2- Government organisations
3- Commercial and financial companies
4- Energy
5- Legal organisations
6- Health
7- Higher specialised education institutions.
8- Research and documentation centres

The method used to create the sample was as follows:

- Determine the size of the sample to be selected from original research population based on a 10% sampling method. A small manageable sample was selected to represent the research population for some reasons such as cost considerations (desire to minimize cost) and research deadline.

$$\text{Sample size} = \frac{169}{100} \times 10 = 16.9 = 17 \text{ libraries}$$

- Classify research categories that make up the research (categorise the libraries by sector) to identify the research population as follows:

Table 1. Categories of research population

No	Sectors	Number of libraries
1	Government departments	21
2	Government organizations	13
3	Commercial and financial companies	17
4	Energy organizations	29
5	Legal organizations	10
6	Health libraries	13
7	Higher specialized education institutions	35
8	Research and documentation centres	31
	Total	169

Table 2. To clarify how the sample was selected using stratified sample

ID	Sectors	Number of Organizations	Percentage	Sample size
1	Government departments	21	12%	2
2	Government organisations	13	08%	1
3	Commercial and financial companies	17	10%	2
4	Energy organizations	29	17%	3
5	Legal organizations	10	06%	1
6	Health libraries	13	08%	1
7	Higher specialized education institutions	35	21%	4
8	Research and documentation centres	31	18%	3
	Total	169	100%	17

Findings of the First Phase

The following are just few of the research findings:

- Special libraries are passing through a phase of dramatic changes due to the ongoing challenges being posed by information and communication technology. Accordingly, they are challenged to explore new ways to accept and implement the changes in order to be able to serve experts, scientists, and research workers, who always demand specialised services perfectly, faultlessly, and accurately. Most of the scientific information today is available in new variety of formats like CDs, DVD, magnetic tapes, Internet web sites, etc, which requires knowledge of specialised information handling techniques. Therefore, qualified, well-trained work force and modern technological equipment should be available to enhance technical procedures to the required level. The survey revealed shortage of qualified staff that supposes to run special library in an effective way in addition to provide services that satisfy users' needs and requirements.

- Despite the availability of training courses for special library staff as confirmed by managers interviewed, still the majority of the present cadre unable to deal with IT application especially in some sectors such as legal and health sector. Librarians at higher-specialised institutions in particular do not possess appropriate skills in this domain.

- The study also revealed shortage of library staff with qualification in library science especially in the sector of higher specialised institutions as well as shortage of subject specialists in all sectors in addition to scarcity of well-skilled staff members in IT.

- Despite books are not the core source of information for special library users, this source of information represents 41% of the total stock in the selected sample of special libraries and information centres. The high rate of books in comparison with non-book materials and electronic resources in the selected sample does not indicate a healthy phenomenon but rather a sign of undeveloped acquisition process. Special libraries supposed to acquire a variety of resources that can assist in satisfying users' diverse needs and requirements

- As the concept of ownership has left behind. Nowadays, digital materials and electronic resources is becoming more and more important than ever before. Accordingly, there is more emphasis on accessing electronic resources available anywhere rather than building strong physical collection. Despite the importance of the availability of such materials, still special libraries in Libya a way from acquiring digital and electronic resources. The survey revealed that only two libraries in the selected sample acquire electronic and digital resources. This means that over 85% of special libraries and information centres still relying upon traditional resources in providing users' services whereas there is a tendency among special libraries around the globe to gain and acquire digital materials. Nowadays, reliance on conventional technical procedures in libraries in general and in special libraries in particular has proved by information scientists to be the wrong path to success. For that reason, a shift to information technology and its applications is compulsory corridor to grant these institutions the capability of providing reliable services to targeted end users. The issue today is how to accomplish this with less cost and as soon as possible. Special libraries in developing countries have to go through

this passage and have to embark the implementation of developing their ICTs infrastructure and drawing information policies that assure the exploitation of information resources to the optimum to increase the national productivity by utilising information infrastructure. Improving IT education and research environment will create new business and facilitate the industrial research. This in turn will foster related human development and enhance the total economy. Seeing the importance of today's technology and its capability for improving library services in addition to realising the recommendation of the World summit on information society regarding exploiting modern ICTs to foster productivity and expansion of research activity, the researcher come to the decision to build a low cost digital library to develop special library services in Libya in line with the current condition. The point of designing low cost digital library services originates from the actual need of users to have access to information resources that support their research work and everyday job. This was evident from the findings of the first survey and lessons learned which have shown great necessity of designing electronic services to meet users' diverse needs and requirements. The following section incorporates the design of low cost digital library using Greenstone software which is open sources software. It enlightens the design framework besides the stages of designing the proposed digital library.

Digital libraries

There is no doubt that there are many different views in the literature as to the actual nature of digital libraries. This paper does not intend to provide a comprehensive collection of definitions of the digital library, but rather a number of representative definitions. A variety of terms are still used interchangeably worldwide such as electronic library, hybrid library, library without walls, cyber library, virtual library etc. Arms (2000) views digital libraries as "managed collection of information with associated services, where the information is stored in digital formats and accessible over a network". Witten (2003) define the digital library as a focused collection of digital objects, including text, video, and audio along with methods for access and retrieval, and for selection, organisation and maintenance of the collection. The digital library federation (DLF) define digital libraries as "organisations that provide the resources, including the specialised staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities." A digital library in the 21st century has the following characteristics (Jeng, 2006)

- It is an organized and managed collection of digital objects
- It is accessible over internet or server
- It is a global information infrastructure and;
- Should over service.

The last point indicates that there is a difference between a digital collection and a digital library in that a digital library should offer service to end users. Therefore, a digital library is considered a collection of information objects and a collection of services that should be provided by the digital library. "The definition of a digital library that came up in March 1994 in Digital Library Workshop emphasised that a full service digital library must accomplish all the essential services of traditional libraries and also exploit the well-known advantages of digital storage, searching, and communication. (Chowdhury , 2002) At the initial meeting of the WG (held January 7-8, 1998 at Stanford University), the following definition was proposed by (Leiner, 2009) "A digital library is:

- The collection of services
- And the collection of information objects
- That support users in dealing with information objects
- And the organisation and presentation of those objects Via electronic/digital means

Second Phase

The second phase was based on the findings of the first phase and involved the design of an appropriate digital library services to assist in developing current services. An experimental and system design approach was used for this phase of the research. In this stage, one sector of special libraries in Libya was chosen according to its significant contribution to the economy of the state.

The second phase of this research focused on developing low cost digital library to suit the needs and requirements of special library users and to provide services that were most frequently required by selected users. The design was aimed not only at providing access to or retrieval of information but rather, to deliver electronic services to special library users. Based on the findings of the first phase, the research identified a number of special collections – printed and /or digital – that were of importance to users in special libraries, and a user-centred digital library was designed to meet their requirements.

6. Design of a Low - Cost Digital Library

Design Framework

This section focuses on the design of low cost digital library for National Oil Corporation which is considered one of the energy sectors that includes a number of oil enterprises. It discusses the methodology approach applied for designing the proposed digital library, the framework, and the steps implemented to reach the final goal. Designing a digital library comprises usually several phases and stages. These are shown in the following diagram.

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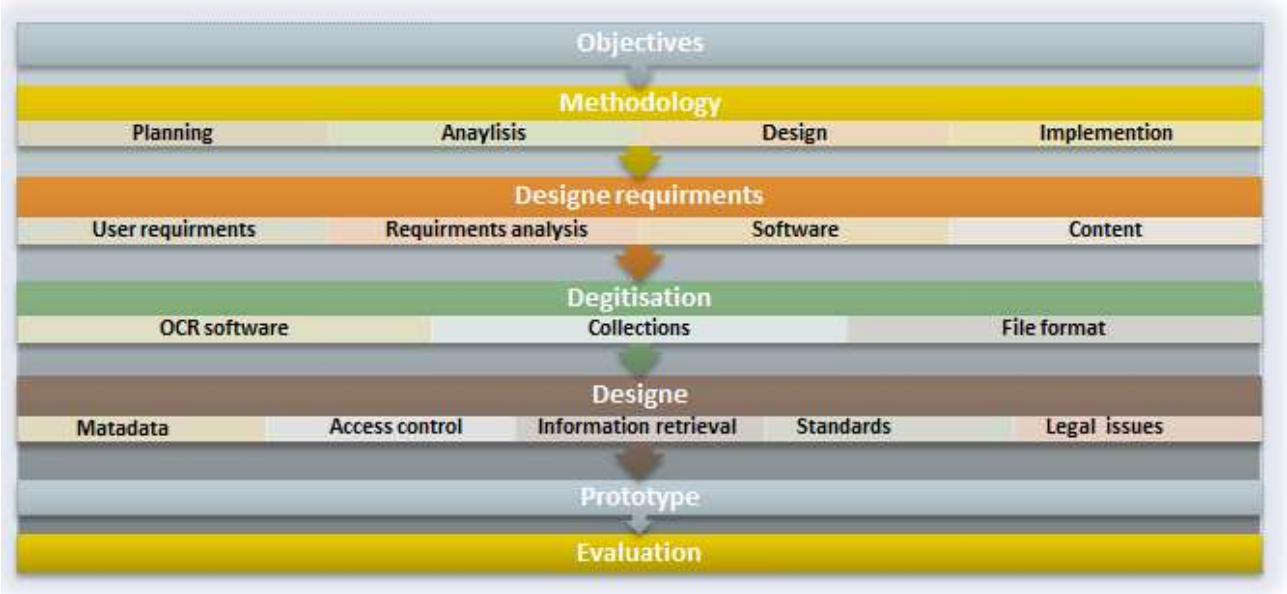

Figure 2. Flow diagram

7. OBJECTIVES

The first crucial step is to decide the objectives of designing the digital library. This step has to be considered early – before any further steps are taken. The whole project will be worthless without clear objectives. The objectives of this design are summarised as follows:

- Developing the standard of services presented to targeted end users to enhance the level of research activities within the organisation.
- Using and putting into practice modern ICT to improve the current level of services and to solve the problems that the central library at the National Oil Corporation faces.
- Producing a design for a low cost digital library that provides not only access to and retrieval of information, but also the services that are most frequently required by the users.

8. METHODOLOGY

A system design approach is to be used for the design of the proposed digital library. This approach can be defined as the planning of the procedures to be used in an experimental study. In this approach, each phase consists of a number of stages, each stage is subdivided into steps and each step further contains a series of tasks. Consequently, the total work is broken down into manageable portions. This approach can even be applied to recognize if a specific plan achieves a preferred goal. This approach was employed due to its suitability for such types of projects as it has been proved by different studies that this approach is the most appropriate method for creating digital libraries. The design of a low cost digital library consisted of the following stages;

Planning

The planning stage comprised a survey of the current state of special libraries and information centres in the energy sector which was chosen from previously mentioned sectors. Energy sector was chosen due to its significant role for supporting the economy of the state as the Libyan economy relies mainly on the revenues from the oil sector, which account for almost all of its export earnings and about 25 percent of its GDP. Oil currently said to be provides the government with its main source of revenue and constitutes 99% of Libya's exports. The National Oil Corporation was chosen from a number of local and foreign oil companies in the country because the NOC is considered the corporate under which all oil enterprises running their business in Libya. The planning phase is considered a fundamental process of understanding why a digital library should be built and determining how the researcher will go about building it. Questions examining economic feasibility and organisational feasibility (i.e. if we build digital library, will it be used) should be answered in this phase to determine the expected value of designing digital library services. The first and second survey which comprised questionnaires and interviews with librarians and managers of information units in the National Oil Corporation have focused on the real statues of the following:

- Type of internet connection and speed of internet connection
- Policy in related to:
  - Computers
  - Networks
  - Internet
  - Internet
- Policy related to content: focusing on
  - Electronic resources

- Budget
- Access control

❖ Policy related to: management
- Familiarity
- Willingness
- Vision: e.g. visions with regard to developing ICT policy.
- Plans: e.g. any plan for moving towards an electronic library service.

❖ Policy related to training
- Users training
- Librarians training
- Cost of training

The first and second surveys which were conducted in order to reveal the actual state of library services in different sectors has shown that special library services in Libya is poor and not well developed. Therefore, designing low cost digital library services may possibly assist in solving some of the problems faced by this category of libraries and strengthen the services presented to target end users. The survey has also revealed that the demand for such services is enormous. Because special libraries supposed to serve experts, scientists, and research workers, who always demand specialised services perfectly, faultlessly, and accurately, the design of low cost digital library could assist in providing the most wanted services that satisfy users' diverse needs and requirements. Regarding ICT infrastructure in the energy sector, the survey revealed that this sector is well equipped with ICT infrastructure.
As regard policy related to:

- Computers
- Networks
- Internet
- Intranet
- Access control

The survey has revealed that oil companies in general and NOC in particular has a written policy on this particular. Some oil companies have issued decisions and a number of resolutions to regulate the use of the internet, internet, and access control.
As regard policy related to management with reference to:

- Familiarity
- Willingness
- Vision:e.g. visions with regard to developing ICT policy.
- Plans: e.g. any plan for moving towards an electronic library service.

Received responses have revealed that oil companies and NOC in particular has a plan towards providing digital library services in the near future. The research also revealed a tendency among oil companies towards moving to electronic library services. However, libraries in oil companies are still in early stage to move entirely towards electronic services.
As regard policy related to:

- Users training
- Librarians training
- Type of training courses
- Cost of training courses

Received responses showed that just under a half of the selected libraries 47% have a documented policy regarding training of human resources and the type and cost of training courses. The NOC is one of the companies that have such a documented policy.

Requirements Analysis

Developing services that meet the expectations of users and customers is critical to success. Requirement analysis is the foundation of a user-centred approach, creating projects and services that appeal and meet user needs (Ebeneze,2012). User requirements analysis is not about asking users what type of services they want. User requirements analysis is about understanding users' current practices and the problems they encounter. This stage comprises the analysis of fieldwork, which have been done to insure the availability of required components in favourite of the design of the digital library. This stage should provide answers to questions such as:

- For whom the digital library is going to be designed?
- How many users are going to benefit from the proposed digital library?
- What is the real status of ICT infrastructure in the organisation?
- What type of materials is already in digital form?
- What sort of materials to be digitised?
- What Items are distributed within the organisation or the institution?
- What Items or resources are outside the organisation or the institution?

The requirements analysis has also indicated the followings;

❖ Internal documents which includes:
- Reports
- Statistics
- Standards
- Technical data
- Publications by people within the organisation

❖ External documents
- Purchased materials:
  - Hard copy
  - Electronic format

❖ Documents obtained from other resources

Design

Having the so-called requirements analysis concluded, the researcher has started designing the proposed digital library.

The design phase decides how the system will operate, in terms of hardware, software, and available infrastructure. The first step in the design phase is to develop the design strategy or the framework. In fact, there are several points that need to be considered before starting the creation of the proposed digital library. These are as follows;

Software

There are various software available for the creation of the proposed digital library. However, because the main principle of this research is to design low cost digital library therefore selection from diverse freely available software was a complicated question. Moreover, due to the availability of a variety of open sources software that can serve the purpose of designing the proposed library, selection of appropriate software was vital issue. Greenstone software was selected due to its good reputation and supporting of different languages which is an essential aspect required for the design of bilingual content. Greenstone considered one of the leading software in this domain and has the ability of handling documents in many languages. In addition, the software is capable of display users' interface in multiple languages and handling collections of text, pictures, audio, and video. The program offers also flexible browsing facilities and can run on Windows and UNIX.

In fact, the most important reason for selecting Greenstone software lies in its capability for building bilingual content as this feature is not available in all other open sources software. None of previously mentioned software is capable of building Arabic content or display users interface in Arabic language. Greenstone software is capable of that because the software is supported by the UNESCO, which encourages developing countries to participate in the current information revolution by adopting modern ICTs.

Content Creation

This step covers the digitisation processes and prerequisite selections and decisions, in addition to the subsequent manipulation and management processes (Dawson,2008). A variety of decisions has to be made on various aspects before starting the actual design. For example, should OCR carried out on text files held as image or text. If OCR as image found to be feasible thereafter must be carefully checked before dissemination. Choice of formats was another challenge, so it was determined to choose the format according to the nature of original documents. Decisions also have to be made on aspects such as whether to use XHTML or rich text to display plain text. For this, it was determined to use HTML for displaying plain text. Other issues related to PDF files, whether to use PDF or other plug-in such as Ms Word plug-in for displaying documents. PDF plug-in is ideal for retaining complex layouts. There are also various formats for image and even more choices. Whilst JPEG is common format, PNG is spreading widely, and TIFF possibly recommended for printing or preservation.

Digitisations

Before starting the digitisation process, it was crucial to find out the types of available resources that will be part of the collections and comprise a great deal of its compilation. Therefore, the second survey and interviews conducted with librarians and people in charge of running the central library of the NOC have focused on this matter. Suggested collections were divided into two groups. The first set comprises those already in electronic form (digital born) or converted to digital form. The second set comprises traditional documents (printed). Suggested documents were also divided into two sets Arabic and English documents.

Metadata

Regarding metadata, the question of which metadata standard to use and implement was a key issue. Because of the availability of diverse metadata standards, there was a need to find out which standard could serve the purpose of building the collections of the proposed library. Dublin core metadata standard is expected to meet the requirements of building the required collections. However, the standard was tested and some field elements needed to be added to correspond with the methods of information retrieval by targeted users. Metadata elements were added for example to the collection of technical library (data centre collection) to correspond with the method of information retrieval by targeted users as it was necessary to add some new metadata to make retrieval process more efficient and effective.

Authentication or Access Control

This issue is concerned with policies for controlling access to different types of content therefore it raises different questions. For example, should all digital content be accessible for all users over the internet? Is it necessary to control who can access specific collection and make use of it? Should the content of the proposed digital library contain sensitive documents that would affect the company business harmfully in case such documents were accessible over the internet? In fact, such issues were discussed and studied before starting the actual design of the digital library. Greenstone software has a built-in access control mechanism allows collections, and even individual documents, to be restricted to authorized users using a password protection scheme. This mechanism can be applied if the company prefers to apply restriction on access to some specific content. A policy for controlling access to different digital content should be written by managers of information units in companies seeking building digital libraries and should take into consideration the negative and positive impact of open access. Accordance with the recommendations of the Director of the information unit in the National Oil Corporation it was decided to authenticate some sensitive collections such as technical library collection, Thesis collection, and NOC subscribed journal.

9. USERS INTERFACE

As users' interface considered an important issue and comprises an essential part of the proposed digital library, the design of the prototype has to take into consideration simplicity, consistency and flexibility. The main issue before starting the design of users' interface is to understand the main priorities form users' perspective. Because users interface can be designed in different ways, it is crucial to understand users' primary preferences in order to produce a practical design. The interviews carried out with librarians and some potentials users from the NOC have shed light on their preferences. This was an essential step before starting the design of the prototype.

Prototype

After designing the proposed digital library, the library was tested in order to discover if there were any problems within the design. The prototype was useful in many ways. In fact, it was built to test the function of the constructed library and to solve unexpected problems. The objective of the prototype is to assist in building the full design.

Third Phase: Evaluation of the prototype digital library

Evaluation differs from testing. When a digital library created, evaluation of the library is necessary as it leads to the full design. This is different from integrated systems which have to be tested to explore their functionality.

This phase comprises the evaluation of a prototype and considered the last stage in designing the prototype.

Evaluation of the digital library was an important part of developing the NOC digital library. Different approaches have been used for different goals by digital library developers. For the NOC digital library, usability – centred approach was applied due to its suitability to such projects. Usability in this context is about choosing useful functionalities. Usable means in this context useful, easy to use, and appreciated by users.

10. CONCLUSION

This paper has investigated a number of key issues affecting the special library in Libya and its services such as staffing, funding, and technical procedures. The role of special library services and its influence on the achievements of an organisation's overall goals has been explored along with the problems facing special libraries in Libya which hinder their improvement. This paper has put today's technology into practice and has exploited the latest advanced technology in this domain for developing special library services by designing a low cost digital library service as a practical solution. The outcomes have proven encouraging as the design has been shown to be cost effective. The design has also demonstrated that the digital library developed in this thesis can assist to a large degree in developing the services provided to special library users in Libya. This paper has also shown that digital libraries ought not to be seen as an end in themselves, but rather as a means for enabling end users to access a variety and wide range of frequently required services.

Additional research may be needed to capture deeper and more meaningful manifestations of ICT infrastructures in Libya and IT applications in special libraries such as integrated systems, gateways, portals, and digital repositories.

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