Design and Implementation of
A Virtual Library in Engineering

A Thesis Submitted for Partial Fulfillment of the Requirements for the Degree of M.Sc. in communication and information systems

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Abstract

The developing revolution in the technology of on-line storage, display, and communication will make it economically possible to place the entire contents of a library on-line, accessible from computer networks located anywhere, with a hardware cost comparable to operational budget of that library.

A virtual engineering library is a collection of information that is stored and accessed electronically. The information stored in the library should have a number of topics common to all the data. At the same time, virtual engineering library represents a new infrastructure and interface that has been created by the integration and use of digital content.

The objective of this research is to design and implement a virtual engineering library, and to examine the issues that affect and are affected by virtual engineering library development.

The primary elements of this design are databases and interface tools. This framework provides a model of navigation that supports the process of discovery with predictable access points into differing collections of information.

The implemented virtual engineering library works on Windows-Server operating systems and required Apache Web-server, PHP, and HTML to interact with the database (MySQL) of the proposed application.

The research concludes by attempting to reach some conclusions about a virtual engineering library development and the validity of the proposed model of virtual engineering library. Flowing from this, recommendations are made for further research in this field.
المستخلص

إن التطور المتقدم في مجال إرسال وعرض وحفظ المعلومات مكنت من استعراض محتويات مكتبة كاملة، بحيث يمكن الوصول إلى تلك المحتويات عبر شبكات الحاسوب في أي مكان يميزه مناسبة بالمقارنة بسعر الإجهزة المستخدمة.

المكتبة الهندسية الإفتراضية هي عبارة عن مجموعة من المعلومات المخزنة التي يمكن الوصول إليها الإلكترونية. وتلك المعلومات المخزنة في المكتبة يجب أن تحتوي على مصادر مرجعية تشمل كل المعلومات، في نفس الوقت تمثل المكتبة الهندسية الإفتراضية بنيتها تحتوية ووسيلة عرض جديدة تم إنشاؤها بواسطة تجميع واستخدام المحتويات الرقمية.

الهدف من هذا البحث هو تصميم وتنفيذ مكتبة هندسية إفتراضية ودراسة مؤثراتها.

العناصر الأساسية لهذا التصميم هو قواعد البيانات ووسائل عرض المعلومات. هذا التصميم يعطي نموذج للبحث ويدعم عملية الاكتشاف المؤدي إلى مجموعة المعلومات المختلفة.

المكتبة الهندسية الإفتراضية المنفذة تعمل بنظام الـ ( Windows server ) وتحتاج إلى Apache Web server, PHP language and HTML (MY SQL ) المستخدمة.

توصيل البحث إلى محاولة الوصول إلى بعض الاستنتاج عن تطور المكتبة الهندسية الإفتراضية ومدى امكانية استخدامها، تبعًا لذلك تم وضع التوصيات لمواصلة البحث في هذا المجال.
CHAPTER ONE
INTRODUCTION

\1.1 Overview:

The Virtual engineering library is an organized collection of digital information. It is designed to support the information needs for a particular community. A virtual engineering library can offer resources from many sources.

Classical library design has focused on the physical collection, with careful calculations about current size and projected expansion. The library has been seen as a “place” where materials are stored, readers are seated, staff work many behind the scenes processing materials—service area have also been provided. This approach to library design matched the traditional paradigm of the library. User went to a physical place to gain access to recorded knowledge. They used bibliographic records and rows of shelves of printed materials.

New electronic forms of information are stored locally and accessed remotely. Computers are required to access all resource on screen as important as words on paper. Readers like to sit on the floor, with many of them preferring “noisy” spaces. All service points are to cope with an increasingly complex array of information resources.

Most of the Virtual engineering library research and development to date has centered on issues related to the technology and content of Virtual engineering libraries (creating virtual collection) this work has focused on issues such as developing effective ways to digitize and how to make digital copies of all or part of this work for personal use.

One important area where a Virtual engineering library can extend the services it provides beyond that of traditional library is in integrative and highlight user contributions. It has been demonstrated that a combination of minimal submission data can result in high quality. Such contributions enhance the value of the Virtual engineering libraries by increasing its size and diversity. For example, search and browse facilities enable users to find resources based on features such as author, and subjects, as a virtual engineering libraries grows, finding specific resources of interest among the entire collection can become more difficult. At the same time the prominence of a given contributor’s contributions become diminished as the library grows. [1]
The process for establishing the future direction to the Library began with re-evaluating the traditional library model. The virtual engineering Library offers similar services and media as the Traditional Library, but tasks are accomplished in more efficient ways, which might include a local online catalog as well as other local databases. Services are still available only to local users who depend on the opening hours of the library.

\textbf{1.1 Problem definition:}

The shift from traditional libraries to virtual libraries is not merely a technological evolution, but requires a change in the paradigm by which people access and interact with information.

A traditional library is characterized by the following:

- Emphasis on storage and preservation of physical items, particularly books and periodicals
- Browsing based on physical proximity of related materials, e.g., books on electric engineering are near one another on the shelves
- Information is physically assembled in one place; users must travel to the library to learn what is there and make use of it.

When information is digitized and accessible over a network, it makes a little sense to speak of its "location," although it is technically resident on at least one storage device somewhere, and that device is connected to at least one computer. If the information is available at multiple mirror sites, it is even less meaningful to speak of it being in a "place". While traditional libraries measure their size by number of books, periodicals and other items held, the virtual libraries expand their "holdings" by sharing digital links with other libraries. Unfortunately, there seems to be very little sharing of this sort taking place at present.
When a document is procured from traditional library, it will not remain in library, so any other can’t use it. While in virtual library, n number of users can use one document simultaneously and also it will remain in the library.

٣٫١ Objectives:

The objective of this research is to model an architecture for a virtual engineering library aimed at the enhancement of access to documents accessible via web in two different ways. Firstly, providing a cataloguing system based on intelligent software module, and secondly, supplying a virtual reality user interface that may allow a more simple access to the system.

The objectives of a virtual engineering library model are to:

١/ develop the enabling technologies for providing uniform access to the large number of information sources and collections.
٢/ provide high level concepts that can allow users to access information through interfaces that hide the unimportant details of diversity of materials.
٣/ provide ways to navigate and manage the information.
٤/ improve sharing of information between researchers.
٥/ create uniform web site and user interface.
٦/ develop resources that will support distance education initiatives.

٢٫١ Methodologies:

The first area of the design and implementation of a virtual engineering library was a comprehensive review of the literature. Bibliographic databases were selected and other articles discussed the need for improving indexing, organizing and gathering electronic resources into MySQL databases.

One area of important to the research was an analysis of how the electronic resources at the virtual engineering library compared to each other. The goal of the analysis is to examine specific details on electronic collections and services.
A list of hardware and software are used to design and implement a virtual engineering library is provided below:

Server: Dedicated server hardware.
Server software: Apache Web-server, PHP, HTML editor.
Database: MySQL.
Client: A window machine which can support Web server.
Client Software: A Web browser such as Internet explores.

\[ \textbf{Thesis layout:} \]

This thesis opens with an introduction (chapter ١) which documents the objectives and scope of this thesis,

Chapter (١) documents the virtual library concept, determines what a virtual library is, and gives consideration to why virtual libraries are being developed.

Chapter (٢) introduces the virtual engineering library services and technologies, which discusses a service-based architecture for creating the emerging library.

Chapter (٣) discusses the organization structure and development of a virtual engineering library, the discussion begins with identification of contents, interfaces, infrastructures, and prototype of a virtual engineering library.

Chapter (٤) discusses the design issues and implementation of a virtual engineering library. The virtual engineering library architecture is also described in this chapter following by a virtual engineering library interfaces.

Chapter (٥) presents conclusion and recommendation of this thesis as well as the future work for designing and implementing of a virtual engineering library.
CHAPTER TWO
LITERATURE REVIEW

1.1 Introduction:

The virtual library concept will be reviewed to determine what a virtual library is, and the components it comprises. Consideration will then give to why virtual libraries are being developed. The issues that affect and are affected by virtual library development will then be discussed.

1.2 The Virtual Library Concept:

The virtual library has been defined as the concept of remote access to the contents and services of libraries and other information resources, combing an one-site collection of current and heavily used materials in both print and electronic form, with an electronic network which provides access to, and delivery form, and knowledge sources. It contains data that is housed electronically and deliverable without regard to its location or time. [\textsuperscript{2}]

A library is "virtual" in the sense that a number of different information resources can be brought to an end-user, rather than delivering the end-user to a physical
set of resources. The World Wide Web has changed the environment for information delivery and for representation of information; the explosion of electronic information resources underscores the need for professionals to research, review, evaluate, and select authoritative sources to assist users seeking information.

There are many advantages as well as disadvantages of the virtual library. Some of the advantages include: reduction of physical space taken up by library materials; adds enhanced searching capabilities in a digital format; materials are available at the user’s desktop, regardless of where the user is physically located; it eliminates the book being missing or off the shelf and it often allows for multiple, concurrent users.

The disadvantage of utilizing the virtual library includes the following: every product has its own distinct user interface; everything is not available in digital format; and the virtual library relies on computer networks in order to be available for use.

A scan of the library literature in the last four years shows that there are three terms…digital library, electronic library or virtual library; that are used to describe the building of a large information resources of text and numeric data to serve the demanding academic user of today.

**Electronic library:**

The electronic library, however, is somewhat a different notation: The electronic library will be realized as an aggregation of catalogs, lists and indexes of documents of every imaginable type, organized according to the schemes of classification and linked for search, so that they come to behave as a single database in which the lines between individual collections and catalogs are blurred.

**Digital library:**

There is no single definition for the digital library. The definition evolves as research progresses, some of the current definitions are:

- The digital library is a system that combines the machinery of digital computing, storage, and communication, the content, and software needed to reproduce, emulate, and extend the services of the collections, cataloging, and finding information offered by traditional library based on paper and other materials. A
full service digital library must not only fulfill all essential services provided by traditional library but also make good use of the advantages of digital technology.

- The digital library is viewed as systems providing a community of users with coherent access to a large, organized repository of information and knowledge. This organization of information is characterized by the absence of prior detailed knowledge. The ability of the user to access, reorganize, and utilize this repository is enriched by the capabilities of the digital technologies. [4]

- The concept of a “digital library” is not merely equivalent to a digitized collection with information management tools. It is rather an environment to bring together collection, services, and people in support of the full life cycle of creation, dissemination, use, and preservation of data, information, and knowledge. [4]

One issue that surfaces in the virtual library literature concerns the format of collection. Collection has traditionally been the "work matter" for libraries, and the systematic management of collections is what essentially defines a library as a social institution. The collection-centered concepts of virtual library typically touch on just one aspect of technology (that of storage) and neglect organizational issues.

The library resources provided several definitions of what professionals might consider a virtual library to be:

- a collection of materials digitized from electronic transmission,
- an institution that possesses or an organization that controls such materials,
- a library that scan all its materials to make the entirety of its holdings electronically,
- or simply a library with Internet access.

The Virtual Library Model:

The virtual libraries may be made up of a number of components, including: The internet and intranet integrated; access to information; digitization of materials; electronic document delivery; resource sharing; and, end-user services. These elements, then, may be considered the basic building blocks of the virtual library, although the nature and extent of the application of each component will depend upon the circumstances and
needs of the library and/or organization to which the virtual library is attached. One basic virtual library model may then be illustrated as shown in Fig. [3].

![Virtual Library Components Diagram]

Figure [3] The virtual library model

The development of virtual libraries appears to be heavily dependent on a number of inter-related enabling factors, comprising: client issues; organizational issues; management issues; and technological issues. Although, it is widely agreed that continued progress and ultimate success of virtual libraries is dependent on their resolution. If this is the case, then these issues make up an environment that surrounds the virtual library itself. This may be modeled as shown in fig [3].

![Virtual Library Environment Diagram]

Virtual Library Environment

**Technological Issues**
Components Of A Virtual Library:

The virtual library can be made up of a number of complementary and inter-related components. These components are:

**The Internet and Intranets:**

Libraries may use the Internet and Intranets for a variety of applications. Internet and Intranet access can allow libraries to provide access to library catalogues and other databases and information sources to remote users, as well as providing users with access to resources that are remote from the library. They can also allow improvements to exist
services or the provision of new services. The Internet and Intranets may be considered important because they allow libraries to demonstrate that they can still provide valuable assistance in an increasingly online world, as well as meeting client service expectations.

٢٫٤٫٢ Integrated Access to Information:

Integrated access to information falls into a single workstation to access multiple electronic resources. Single workstation access can allow the use of multiple resources through a single access point. Integrated access to information is significant because it provides users with a single starting point for internal searching. Likewise, access to many resources can be combined through an integrated front end, promoting ease of use. In effect, it provides users with resource discovery facility. There are, however, several issues relating to integrated access that must be considered. Full integration can be difficult, because information sources from different suppliers use differing, often proprietary, formats and standards, making it difficult to fully integrate them into a single front-end.

٣٫٤٫٢ Digitization of Materials:

Digitization of hard-copy materials has two major applications in virtual libraries. It can be used to create a body of electronic full-text material for client use. It is also valuable in allowing “special” collections, such as rare materials to be made available. The importance of digitization lies in the fact that libraries can create a body of material that clients like, and want to use, in turn allowing them to be better satisfied. There are also advantages in relation to remote access to materials, wherever and whenever a client wishes to access them. In the area of special collections, digitization allows materials that would not normally be widely accessible to clients to be made accessible. This has the dual advantage of making rich research materials available to a much wider community, while allowing the better preservation of the hard-copy resource.

٤٫٤٫٢ Electronic Document Delivery:

The actual application of electronic document delivery is basically no different from its hard-copy equivalent. However, increasing client expectations and decreasing
resources have created a much greater reliance on resource sharing in the electronic area. The importance of electronic document delivery is that it can be used to maintain adequate and rapid access to resources not held locally, in an area of rising costs and declining budgets. The major issue that affects electronic document delivery is that it needs to minimize the time delay between request and delivery to be useful. Library clients are unlikely to be satisfied with the service offered if electronic document delivery methods do not take less time than traditional hard-copy delivery. The other issue to be resolved in this area is the impact that copyright has, whether on digitization of existing paper-based materials or the supply of materials those are ‘born digital’.

Resource Sharing:

Given the variety of formats and technologies currently available, there are now many ways of providing access to information. Library users generally want to be able to access information, regardless of location and source, and resource sharing fits this model.

End-User Services:

End-user services in the virtual library environment covers two main elements: end-user access to online electronic text, and, end-user search facility. Libraries are tending to offer end-user access to materials because, in the electronic area, users have the expectation of access to materials.

In terms of access to materials, users who are able to access resources themselves are advantaged over those who cannot, both in terms of the tools available to them, and the times and places at which they are available.

The Virtual Library Environment:

Surrounding the virtual library, there are a number of inter-related issues, which directly impact on the extent to which virtual libraries can be successfully developed. Some of these issues are:
Client Issues:

User needs must be treated as paramount if virtual libraries are to work. This is because, user expectations have increased in the electronic environment – perhaps more than libraries can deliver. Library users must therefore be incorporated in system design, so that the available mix of materials and services offered fits both their information needs and information seeking practices.

Organizational Issues:

It is difficult to know to what extent organizational size will impact on successful virtual library development, given the apparent disagreement of the literature in this area. However, it is a factor that merits consideration. Overall, organizational structures will need to be less rigid, reflecting the fluid nature of the changing library environment.

Management Issues:

In order to accomplish virtual library goals, there are a number of management issues that libraries must consider. Libraries will need better strategic planning than has previously been the case, as it will be impossible to reach virtual library goals if these are not known. There will likewise be a need for better performance measurement, as current measures are unlikely to gather all the data that will need to be recorded in a virtual library environment.

Technological Issues:

Technological issues will obviously have a major impact on whether or not virtual libraries can succeed. In this area, there are several major issues that must be considered. One critical need is for ‘properly’ functioning and stable systems – if the supporting technologies fail or are unreliable, then virtual library access and use ability will be partially or totally compromised. For optimum effectiveness and use ability, there is also need for seamless integration of the technologies and digitized materials, supported by appropriate policy developments, as well as technological standards.
Another challenge is the rapidly changing technology environment; for virtual libraries to be successful, the dual issues of technological change and technological obsolescence must be properly addressed.

**The Physical Virtual Library:**

The virtual library must exist as a physical space with computer workstations. It will take on a form different from traditional library. The following space descriptions are in priority order, indicating the shift in focus from collection to accommodate users in an electronic environment.

**Conversion to digital format:**

The conversion of print materials to digital materials such as electronic reserves requires production space, as does the development of homepage information and maintenance of the website.

**Collection:**

The physical space will contain only the core collection. The engineering collection was reduced to the core of most frequently-used materials. Its present size should be accommodated in current space planning.

**Concern about Virtual Libraries:**

Virtual libraries require connectivity. If there is no Internet connection, the virtual library is inaccessible. Although Internet use is becoming more widespread, there are still many people who do not have Internet access. The term digital divide has been applied to describe the gap between those with access to the Internet and information technology tools and those without, however, connectivity is not the only concern with the use of virtual libraries, will possess the skills to access and utilize this information effectively. [^6]

Virtual libraries still requires skilled professionals to organize, maintain, and help student reap the benefits of this virtual learning environment. “The power of the Internet resources remains latent to those without the skills to use them”. Although some virtual libraries are lists of the Web sites and require little Internet searching ability, other virtual
libraries demand the knowledge of searching and advanced searching skills to realize the potential of database. [٥]

There are other issues of a more technical nature that impact on the learning potential of the resources available in virtual libraries. Storages of the digital information are relatively new and the long-term storage issues have not been settled: the primacy, or lack thereof, of digital information in digital format. [٥]
CHAPTER THREE
THE VIRTUAL ENGINEERING LIBRARY SERVICES
AND TECHNOLOGIES

\(\text{Introduction:}\)

Much of the expectation surrounding the emerging 21st century library is based on the opportunities presented by enhanced access to information resources through the use of networked information technologies. Existing library is a product on an intersection and an interaction of people resources and procedures.

Libraries are defined by a range of services developed for internal and external consumption. The provision of services to users is built upon the collective personnel, information, and technological resources that constitute the library.[1]

The internet, the Web, and digital collections provide a context for making the idea of a virtual library real. A pragmatic approach for designing a virtual engineering library is to focus on services rather than technologies. A service-based architecture for a virtual engineering library is essential and provides the framework to accommodate both digital resources and the vast collections. Another reason to focus on services is to accommodate the broad range of people involved in the preparation, collection, organization, and use of information. A simple focus on providing faster access to more information generally has only the end user of the information in mind, whereas a service-based architecture can address the roles and responsibilities of the people who staff the virtual engineering library as well as the people who use it.[2]

\(\text{A service-Based Architecture:}\)

A service-based architecture for creating the emerging library is a logical starting point. Since a virtual engineering library, by its nature, is primarily a service institution, a service should also guide a virtual engineering library.

The following elements should be considered when thinking about a virtual engineering library:

- Users.
- Services.
If services are the output of a virtual engineering library, the other elements should serve as infrastructure for the creation and delivery of services to users. Fig. [١.٣] shows the interaction of these elements.

User needs to define and shape appropriate services, which are based on available resources, including people and information. Technology, in the form of many different tools, supports the delivery of services. Management identifies the services and establishes overall policy. Management also acquires and allocates the funding necessary for the services and the infrastructure needed for their delivery (e.g. resources, technology).

A service-based architecture not only identifies elements of a virtual engineering library and indicates where funds to be allocated, it also allows the development of services quality benchmarks. For any services, we need to indicate the goals and
objectives of the services and then purposes performance metrics by which to access the utility of service and ultimately the value of the services to users. [\textsuperscript{4}]

\textbf{A Virtual Engineering Library Services for Users:}

Generally, a virtual engineering library serves many different users and, in a virtual engineering library, this will be an even more important characteristic. In existing library users are often defined by demographic characteristics or geographic location. What defines a user of a virtual library? Demographic characteristic still play a major defining role, but boundaries can be wider.

Focusing on services allows us to think about the types and levels of services we are going to provide to a variety of users. Defining the services for any group directs us to the technologies appropriate to those groups.

One key characteristic of a virtual engineering library services discussed below is that they enabled through the use of the information technology.

\textbf{Instruction Service:}

Libraries traditionally have instructed patrons in the use of library tools and technologies. With networked information available, what are the new responsibilities for libraries? The instruction service focuses on appropriate instruction activities to assist patrons. Clearly, patrons will need to know how to use the new and emerging technologies, but more important, they may need help in understanding what resources are available. [\textsuperscript{6}]

\textbf{Distance Learning Service:}

Distance learning service will include instructional tools, access to the text of course reserve materials, inter library loan and document delivery, as well as numerous types of electronic service request forms. Behind the scenes, enhanced records in the online catalogue and the Gateway will provide easier access to the disparate databases available to the remote users. Although this service housed on the Gateway, will be accessible to all patrons, they will be essential to the distance learner.
Developing A Virtual Engineering Library Services:

The above list of services is illustrative and not comprehensive. These two services are intended to provide a point departure for discussing what a virtual engineering library might provide and what a suitable architecture for service provision would be. In a service-based architecture, the infrastructure is based on the requirements to support these services. Services are the starting point. An initial focus on services rather than on technology sets the stage for identifying requirements for a virtual engineering library.

The services creation process begins by identifying a set of services to meet the needs of one or more users (see Fig. [2,3]). The services determine a virtual engineering library resource requirement. Likewise, the requirement of services drives the adoption of technology and standards in support of service deployment. [7]

Figure [2,3] Users and Services as Drivers in a virtual engineering library

Current Systems for a Virtual Engineering Library:
With virtually all system in place today, there exists a very strong binding between clients and the servers they use to locate and retrieve information. This binding takes many forms. In most systems, clients are tightly bound to particular databases, and one typically uses a predefined to access a particular database.

While a virtual engineering library systems being deployed are typically supporting amore diverse set of data types, these are largely provided simply to provide a richer presentation formats to the user. In this system, tables may be rendered from underlying database.

In all these cases, the structure is being used to provide a higher-quality rendering of what is presented on the screen, or in more advanced case, to allow a user to interact with a document.

Meeting User Expectations:

The evolving relationship between developers and users drove the development of policies and process in a virtual engineering library. A key to success was being able to manage the possible differences between the perspectives, needs and expectations of the complementary communities involved in a virtual engineering library: the librarian who was creating it and the users who would use it. Focus group and in-depth interview were conducted with user researchers.

The Virtual Engineering Library Technologies:

The virtual engineering library is one of several closely related … even overlapping … information; rich applications, that are being created or revolutionized by advancing computer and communication technology. These applications include:

- News gathering and dissemination;
- Electronically assisted databases.
The boundaries separating these several areas in some cases are appropriate, while in others they are artificial and only loosely related to technological realities. Many of these boundaries will be the subject of battles over the next decade. However, even though we can be certain that some boundaries will move, it isn’t plausible to try to innovate across the whole area and the same time within each area. Instead, we suggest that these various information-intensive fields will proceed by a process of successive approximation, will individual areas first working under the assumption that each will maintain roughly its traditional interface with the others. Then, as adjacent areas become comfortable with new paradigms, they will explore pairwise negotiation of boundaries that separate them. (There is no reason to believe that this approach is the best way to proceed, just that this is the way things will probably work out in practice.)

٣٫٥٫٣ The Virtual Engineering Library’s Defining Properties:

Even if we aren’t certain where the edges of the future library may lie, we need to locate its center. We therefore take as defining properties of a virtual engineering library, the following more or less traditional characteristics. The materials of a virtual engineering library are:

- Selective. A publisher or editor selects things to make available and a librarian or curator choose (“collects”) from among these published items. This selectivity characteristic distinguishes the library from, say, a public library, to which any one can contribute without review, and the ultimate reader must perform all selection.
- Archival. The contents of the library are expected to persist for time periods measured in decades and a user can depend on again finding things that were found there, once before.
- Shared. The collection is used by many people, and the activity of collecting is thus a shared and centralized.[\text{\ref{4}}]

٤٫٥٫٣ Technology and collections:

The traditional concept of a library collection involves both the physical books and the catalog that lists those books. As our first observation about the impact of
technology, we may note that in a virtual engineering library these two parts can, and probably will, become much more independent. In a virtual engineering library, the physical collection comprises a set of bits in computer storage that represent the words of thesis, projects, and journals. The catalog is a set of references to those bits, organized in ways to make it easy to find things. The interesting opportunity is that, thanks to communication networks, the catalog (which we should now call the “logical collection”) can refer not only to things in the physical collection of the libraries. That opportunity carries significant implications. [V]

In an electronic world, an item can be collected simply by including it in the catalog; if another library anywhere in the network already has the item in its physical collection, it is not necessary for this library to acquire another physical copy of the file of bits that represent the item. Instead, it can simply place in its catalog across-reference to the physical copy in the other library. Communication thus make it possible to share physical collections, and one even imagine future virtual libraries that consist exclusively of logical collections, a kind of space-age inter-library loan system.

Several interesting consequences flow from this single observation. One might expect to see new kinds of specialization in which some libraries concentrate on building up very large physical collection, while others instead focus on creating catalog for specialized audiences. Publishers will be very interested in understanding how such sharing of physical copies will affects their revenue streams and they may conclude that they should use copyright to restrict placement of their own publications to physical collections over which they have some control.

*The Four Advancing Technologies:*

Four technologies are driving the opportunity to create a virtual engineering library:

- High-resolution desktop displays.
- Megabyte/second data communication rate.
- Client/server architecture.
- Large capacity storage.

We explore each in turn.
High – resolution desktop displays:

Displays commonly seen today are not very comfortable to use in reading text. However, it turns out that they are just below a critical optical threshold, above which they become quite acceptable for browsing and perhaps even for extended reading. Thus we can expect that useable display technology for the virtual engineering library will be widely available well before the virtual engineering library itself will be on-line. [7]

Higher- data communication speeds:

Megabyte per second data communication speeds are gradually becoming available over communication – sized distances between the offices and virtual library. Thus data communications, for both campus-sized and nation wide, now or soon will permit moving a page text from library storage to a display workstation in about a human reaction time, again at reasonable cost.

Client/server architecture:

The client/server model, an organizing method in which a network multiple computers each separately dedicated to distinct functions, has proven very effective in large-scale system. The client/server model has matured to the point where it is directory applicable, and it looks like it may provide exactly the right modularity tool for dealing with several problems that traditionally inhibit technological progress in the library. Of the four advancing technologies, applying this one appears, perhaps, provides natural solutions to several problems: cooperation, stability, performance, modularity, and so on. [7]

Large-capacity storage:

If there a single technological advance that in most strongly driving the opportunity to build a virtual library, it must the rapid decrease in cost of magnetic disk storage. However, such observation applies exclusively to the cost of storage media; getting all thesis, projects, and scanned journals; the cost of scanning, which is potentially quite
labor-intensive, is another matter. Images of future publications may be materializable from the machine representation that were used in their preparation, but scanning of the existing materials will probably not much progress until it is forced by conservation requirements of storage space costs.

**Research Challenges:**

For the driving technologies, availability of those technologies only enables the solution; creating a workable system involves many interesting engineering problems. At the highest level, workable engineering of a system is a grand challenge: finding the proper modularity, finding techniques that simplify operations and maintenance, finding a logarithm that allows working at very large scales. At the level, there seem to be two major problems, plus a list of more modes ones. The two major ones are:

- Applying client/server design.
- How to represent links.

**Applying the client/server model:**

Although the client/server model appears to be well adapted to solve several obvious problems of applying technology of the virtual engineering library, each of these obvious examples needs to be verified in the field:

**Hardware ownership:** Traditionally, the presentation device (for example, the display of a public access catalog of library) has been owned by the library, so library budgets limit the range of locations of those displays, but with a client/server model, the presentation can equally well be a workstation or personal computer that is owned by the customer.

**Another sources:** With the client/server model, presentation management, customizing, and inquiry state all become the responsibility of the program that runs on the customer’s workstation. Improvements in these areas can thus go on somewhat independently of the library itself, and can be the subject of competition. Network
protocol standards can be stable interfaces in the face of evolution of both user facilities and searching systems.

**Function separation:** With a client/server model, one can easily separate indexing and search systems from storage devices (the physical collection). This separation brings both the administrative benefit of decoupling physical from logical collection, thereby permitting sharing of physical collection, and also the performance benefit of allowing bulk storage to take place on a large, slow, cheap system without impeding search speed. Similarly, the circulation management system, which needs fast response, has traditionally operated in the same computer as the bibliographic search program, which soaks up lots of computing capability and degrades response to other activities. With the client/server model, one can separate these functions and place each on an appropriately configured computer.

**Modular evolution:** Modularity also simplifies change. In traditional library systems, any change is a big deal; the effort involved in changing everything at once inhibits needed change, but with client/server components plug together, allowing modular replacement of any obsolescent component without replacing whole system. One would expect modular replacement to be the key way of achieving the system longevity requirement of a library.

**Links:**

The second area of research interest is links. A link is the cross-reference that allows one data object to mention another one, perhaps stored elsewhere in the network. In a virtual engineering library system, links potentially appear everywhere:

- Many titles contain explicit references to other thesis, reports, and project.
- A user's request for "other things by this author" is actually an inquiry about an implicit work consisting of a list of works by the author; the user has asked about the links in that implicit work.
- Similarly, a request for "other things in this journal" follows links from its table of contents.

Most research on distributed systems has been on a program-oriented model of cooperation (remote procedure), in which one machine asks another to run a program. Links for a different model of cooperation in which one machine needs to maintain over a
long time references to data stored by the other. They require a carefully engineered blend of direct reference (for performance), and stand (for insulation against failures, change, and lack of cooperation). Links appear to involve, but are not limited to the rendezvous provided by naming services. [γ]
CHAPTER FOUR
ORGANIZATIONAL STRUCTURE AND DEVELOPING A
VIRTUAL ENGINEERING LIBRARY (VEL)

١،٤ Project Goal:

The project of a (VEL) focuses on scientific data. The primary purpose is to offer users as much relevant scientific data. However, the same applies to a (VEL) as to traditional libraries: collections can-and have to- contain not only materials but also channels to the materials, therefore, in addition to projects, thesis, and so on, a (VEL) can offer links to other web pages which include tables of content, abstracts, and author instructions.

٢،٤ Collections and Contents:

The quality and relevance of collections available through a virtual engineering library will be the ultimate measure of its value to the user community. The information in electronic form must be selected. A typical academic library’s collection development statement articulates a need to support the strategies, directions, and goals for its academic programs. While the principles of collection development do not change in a virtual engineering library based on format, and specific selection guidelines must be adjusted significantly to incorporate electronic collections within a virtual engineering library and to identify management strategies that facilitate the assimilation of new information technologies into collection development. These are management strategies that:

- Promote flexibility in the organization
- Facilitate coordination and collaboration
Across organizational divisions, currently a virtual engineering library provides a variety of electronic services and collection to the user. In addition to indexes and abstracts information from thesis, projects, and so on.

**4.3 Organization Structure:**

As a virtual engineering library respond to rapid changes in the information environment, organizational structure must occur. There is integral link between human resources, and organizational structure. If there is a weakness in any one component, it will negatively impact the other. In Higher Education Information Resources on developing an organization that intensively utilizes information technology, a key component to success is the ability to show flexibility and rapid response to change. This is mirrored in the qualifications necessary to work effectively in a rapidly changing environment. The literature points to two key components in creating an effective organizational structure: The flattening of the structure and developing project management structure.[^1]

**4.4 Interfaces and Infrastructure:**

During the 1990’s the costs of computer storage, memory, and processing power decreased at impressive rates. At the same time the Internet made available large quantities of networked client-server software products available at low-cost or no-cost to educational environments. Much of this software is currently in use commercial networks and has the potential for solving longstanding library infrastructure problems. The virtual engineering library planning strongly concurs that the innovative use of these and other technologies will produce a competitive advantage to the networks in fulfilling its mission and core values. To be innovative in today’s computer environment requires a willingness to investigate opportunities, to accept risk, and to develop a positive attitude towards change. [^2]

The demand of computer has been increased; widespread use of bibliographic databases to identifies the existence and content of local and remote information, the emergence of full-text electronic resources; and a network databases, protocols, and applications growing piecemeal through out the academic setting. Library services are
provided on large infrastructure technologies ranging from a centralized computer to a modern client-server system, that emphasize distributed storage and processing. Each of these systems represents the best computing solution for its time.

System support is also necessary to operate and maintain on a daily basis the new computer-based systems supporting the virtual engineering library. The purpose of this service is to plan, design, and/or acquire new or improved systems.

Systems services must be available during prime operating hours of a (VEL), computer batch process must be initiated and monitored, and new software must be tested and installed. Hardware, software, and database integrity problems must be reported.

**Standards:**

A virtual engineering library is committed to implement standards to facilitate access and to share data between systems. In response to universal acceptance of the World Wide Web, a (VEL) project is proposing the development of a Web-based interface, which will allow access to other information resources. Structural Query Language (SQL) and Remote Database Access (RDA) protocols used to provide access to these databases.

**Prototype:**

Using client-server infrastructure already in place at a (VEL), a (VEL) projects proposes a library Web-server that will provide a seamless interface for accessing disparate databases.

A listed of hardware and software provided below:

- **Server:** Dedicated server hardware
- **Server Software:** Apache Web-server, PHP, HTML.
- **Database:** MY SQL
- **Client:** A window machine, which can support Web browser. The connection can be through local area network
Client Software: A web browser preferably browser such as Internet explore is required. Access Restrictions: Access would be restricted by network using Web server. This is especially important to retain the rights to use proprietary databases and other software application.

**The important of standards:**

With the promise of access by a virtual engineering library, issues of digital storage and dissemination of information must be met with an infrastructure that allows for technological change. An effective technical infrastructure for the optimized use of networked resources must be designed and built using standards to ensure interoperability across multiple environments.

The primary components of electronic distributions are production, distribution, and behavioral changes. Data storage versus online delivery, network topology and protocols, archiving, and user interface are a few of issues that must be addressed in the implementation of a virtual engineering library.

Preservation of digital materials for long periods of time, across multiple generations of hardware and software technologies and standards is critical. A virtual engineering library must be able to recognize formats and have the technical ability to display, perform, or other wise interact with materials developments for obsolescent computer system written in forgotten programming languages. Encoding of structure and content may vary and affect both use and ability to archive.

The use of standards will reduce confusion from incompatible tools, formats, and models; insulate developers and users from technology instability; support increasing degrees of data complexity; allow inclusion of technologies on an “as-needed” basis, and allow the sharing of research and development results from the virtual engineering library.

Developing a Virtual Engineering Library:

**Collaboration:**

Collaboration can be defined as a formal set of relationships between individuals and organizations in a development process that exits through the cycle of idea
formulation, design product text and implementation. This form of collaboration relies on a significant input of human energy, resources and commitment over a sustained period of time. The range of possible collaborative ventures encompasses one product at one time partnerships to complex relationships that develop successive products or technologies over a period of years. [@]

The rapid evolution of new information technologies presents fertile opportunities for collaborative effort in high education. Collaboration has become an important concept in technological development primarily because of its potential to better leverage resources, including access to critical hardware and software products. Other advantages of collaborative efforts include the minimization risks, the encouragement of innovative thinking, shared expertise, expanded access by users, and improved productivity.

Sectors and the economy under rapid change, such as information technology, require collaborative efforts to develop effective hardware and software solutions because of the significant investment in technical design and problem-solving for a short product life-cycle. An essential advantage in partnering is the ability to cut costs and improve outcomes for each organization by allowing broader (aggregated) resource inputs in the design through implementation stages of a project.

The collaborative model is becoming fairly prevalent in the development of the virtual engineering library resources. It is clear that the scale, a critical mass of documents to digitize, remote access opportunities and financial support and most importantly shared intellectual resources for ideas, development, and problem-solving.

**Scale:**

A virtual engineering library by definition will be large… a complex or network of databases. It is meant to serve the information needs of over full-time. In a recent issue of library technology, the levels of complexity in building a virtual engineering library, bases on the construct the Web-based access, although other browser or interface approaches are equally valid. The levels of complexity are defined as:

Level \( \downarrow \): Identification of a collection of digital resources i.e. links to Web site.
Level \( \uparrow \): Identification of individual resources, e.g. a Web home page created with links.
Level \( \uparrow \uparrow \): Local content management with files, such as a Web page with standalone files.
Level ٤: Local content management with a program or search engine to access files.
Level ٥: Local content management with a locally developed program or interface.
Level ٦: Local content management with a database management system. [٩]

These progressive levels of a virtual engineering library development establish a clear model for building or scaling functionality. The effort involved in developing more complex functionality presents one aspect of scale, the other aspect would be the amount of content and the number and types of databases that are digitized and organized. [٣]

A virtual engineering library will have to include locally unique materials produced by library archival materials that no other library holds. These materials must be made searchable locally and remotely. A virtual engineering library will become publisher of student and faculty work that have not been previously collected or generally accessible.

The scaling effort to build a virtual engineering library rapidly incurs many considerations: number of items to be shared and accessed, the number of databases to be supported, the level of functionality to be implemented and the size of digital items relative to bandwidth capability. Some of these issues are management problems, some are resource question, and several are technical considerations that must be taken into account. Together they represent a complex problem-solving opportunity that must be carefully planned and executed.

٤٥٦ ٦ Current Evaluation Approaches:

Evaluation has always been an important part of the research on and development of information systems. Systems, which provide little or no information of interest, or relevance to their users, will quickly find themselves with no users. However, the methods for evaluating systems to date are in large part derived from ideas, which have little empirical basis regarding why people use information systems, what they are seeking when they do use them, and how they should express those decisions.[٣]

Further, a major challenge of a virtual engineering library is avoiding information overload. The even-growing availability of data can reduce the amount of the effective information that user can retrieve from the system in an acceptable amount of time and with reasonable ease. Our goal is to enable users truly to profit from the amount of available information by providing them with tools that simplify the retrieval of
meaningful information from this mountain of data. Several ramifications of these challenges influence the design of a virtual engineering library:

- The network must be flexible enough to allow information resources to be placed on or taken off the network without impacting the network in any significant way. We aim to achieve this by enforcing communication protocols among agents in the network for the dynamic construction of processing strategies.
- The vastness of the amount of information on the network can render undirected searching impossible, to ensure an efficient search, we must develop intelligent, well-informed search strategies customized to the true needs of the user and we must also exploit the structure of information on the network. The latter must include two categories of structure: First, hierarchical bibliographic structure must be imposed on the collection of the information sources may have the information being sought second, individual information sources themselves must be structured to facilitate an efficient local search.[8]

CHAPTER FIVE
DESIGN AND IMPLEMENTATION OF THE VIRTUAL ENGINEERING LIBRARY

\[\text{Design A Virtual Engineering Library:}\]

Assumption:

This research was based on three major assumptions. First, with the development of a virtual engineering library, library would be developing services in accordance with the user’s requirement for the usage of electronic mechanisms in improvement to, and efficiencies in, the delivery of services. Second, the virtual engineering library would be responsible for the development in its respective organizations, either singly or cooperation with other functional area. Third, there was more than just searching in a virtual engineering library.
Design Constraints:

One of the first issues in the creation of a virtual engineering library is to prepare a list high-level requirement. This list includes what information the library will contain, how that information will be generated, and how the data will be accessed. To answer these questions, possible interface designs were presented to a virtual engineering library. The two best solutions included a standalone executable program to run on a client machine or a web-based version to run on a web server. The standalone executable would allow a virtual engineering library employee to run the program on a particular machine and access the data. This would restrict clients who did not have a copy of the executable from performing access. The web-based solution would more flexible in allowing outside users to access the data; the web application could be hosted on web server and allow anyone with an internet connection to access all the data and with the proper user name and password to edit or view the data in the database. In this situation, measures must be taken to prevent data being entered into the system by inexperienced users. Depending on the login provided, two version of the interface can be displayed. The administrative version would allow library staff to have more options and control of editing the data. The user version would allow user to read data.

After a discussion with a virtual engineering library’s management, it was determined that a database with a web-capable programming environment is needed. This will alleviate virtual engineering library employees from making each and every change to text file.

The virtual Engineering Library Architecture:

The architecture of the virtual engineering library system is shown in figure [0,\]. The system consists of the virtual engineering library server and a number of the virtual engineering library topics.
A virtual engineering library server is connected to the web server by its PHP-interface. It houses all the program code for the basic function of a virtual engineering library, and includes the automatic services as well.

The virtual engineering library consists of a database to store information (entries = meta information + link) and a HTML interface. With individual scripts and individual HTML interface the library, it is possible to run different structured meta information and with different look and feel (design) with one installed virtual engineering library server.

**Software specification:**

The software specification requires a web server and database that can perform successful data transfer. The web server must support a programming language capable of data retrieval from a database. The operating system is windows that support the required web server and database server specification.

**MySQL Database:**

Research was conducted on available database package that could potentially perform the tasks required. MySQL database package is used in this application. It has specific performance benefits, it support standard relational database feature such as

![Figure 1. Component of a virtual engineering library system](image-url)
stored procedures, views, etc. My SQL is able to handle a number of concurrent connections before its start refusing connections and giving error.

**Server Side Scripting Language:**

The free server side scripting language that was found is PHP (a recursive acronym for PHP: Hyper text Preprocessor). PHP is embeddable so that the web page can be created in a visual editor, and the proper functional calls be inserted into HTML code where necessary. Since it is also interpreted by a standalone program and not compiled, the PHP code can be written once and run on many different platforms. Creating a web site in a language and using a database to store the information, or some of it, has many advantages over a normal static site. One of the most common and most useful ways to use a database in your website is in a content management system.

**Ⅲ. Design Phase:**

At the beginning of the main design phase, it was necessary to set up the software used to develop and test the management system. Installations included the MySQL database server used for storing the virtual engineering library information, a web server to host the system, and the PHP scripting language for interfacing between the database and web server.

System developed was performed using windows platform running the apache web server and MySQL database server. These platforms were chosen for its network file sharing and ease of configuration for development purposes. The design phase was broken down into:

**a) Database Table Creation:**

The virtual engineering library was designed using standard relational database development methods. The tables were designed to effectively store in a database and the information contained in a text file such as thesis, journals, and projects.

During the initial design of database tables, it was found that a key field was necessary to uniquely identify each individual thesis, report, journal, and project. Essentially, whenever an import operation is performed or thesis, project, and journal are added to the virtual engineering library, a number is generated to that thesis, report, and journal, and stored to database as an identification key.
A content management system is a set of programs (basically, web pages containing programming code) written in a language PHP. The content management system displays the content of a website to a visitor and allows for easily add, edit or remove content from the site without creating a new webpage.

This is accomplished by storing the content of the site in a database. Rather than creating a "page.html" with a layout, title, content, etc. we would store the title and content in the database, along with any other information we wanted like the author name, keywords, etc.

There are many reasons to use a database-driven content management system as opposed to many static web pages. Several are:

1. Easier to Change Site Design With a database-driven site, there is really only one webpage. The content of the site is inserted into this page dynamically when it is requested based on information passed to the page (such as the title). This means changing the look of the entire site can be as easy as changing the HTML in that one page. The page would contain both HTML and programming code for whatever language we chose.

2. Easier to Update Our Site Using a database-driven content system, we no longer have to create a separate webpage for each piece of content we want on our site. By setting up a form which submits information to add to your database, we can update the site just by copying and pasting a piece of content into the form, and adding it to the database. If we write the site to take articles based on date, for example, the new content could appear immediately on our site.

b) Create Text File and Database Conversion Program:

Two functions were designed in PHP to interact between the text files system and the database structure of the web application. One of these functions converts the information contained in the text file into tables in the MySQL database. The other reads the information contained within the database.

C) Web-based Virtual Engineering Library Editor Creation:

The entire user interface of the system was created with the use of a PHP template. Program that allows the interface to remain separate from the data been displayed. Each component of the system is controlled via its own PHP script containing
all necessary logic for operation (including database access). This script parses a static HTML document template for the particular function that contains the necessary formatting, and inserts data where necessary. For example fig (٢٫٥) shows the thesis’s table. Details of each component in the table can be seen in Appendix (B).

![Thesis's table image]

**Fig. [٢٫٥] Thesis’s table**

The whole idea of a database-driven Web site is to allow the content of the site to reside in a database, and for that content to be dynamically pulled from the database to create web pages for user to view with a regular web browser. So on one end of the system we have users to our site they use a web browser to load the virtual engineering library site, and expect to view a standard HTML web page. On the other end we have the content of our site, which sits in more tables in MySQL database that only
understands how to respond to SQL queries (commands). These operations can be displayed in figure (٣٫٥)

![Diagram of web page transfer operation](image)

**Fig.(٣٫٥) Web page transfer operation**

As shown in the diagram above, the PHP scripting language is the go-between that speaks both languages. It processes the page request and fetches the data from the MySQL database, then spits it out dynamically as the nicely-formatted HTML page that the browser expects.

- The user's Web browser requests the Web page using search engine statement.
- The Web server software (Apache) recognizes that the requested file is a PHP script, and so the server interprets the file using its PHP script, before responding to the page request.
- Certain PHP commands connect to the MySQL database and request the content that belongs in the Web page.
- The MySQL database responds by sending the requested content to the PHP script.
- The PHP script stores the content into one or more PHP variables, and then uses the now-familiar echo function to output the content as part of the Web page.
- The PHP plug-in finishes up by handing a copy of the HTML it has created to the Web server.
- The Web server sends the HTML to the Web browser as it would a plain HTML file, except that instead of coming directly from an HTML file, the page is the output provided by the PHP.
Simply, the implemented virtual engineering library was broken down into three tasks:

\(\checkmark\) **Create a database with tables:**

All categories, whether they are thesis, journals, or reports will be assigned the following Metadata fields: Title, Author, Date of publication, and so on. Building database will remain our largest challenge.

\(\checkmark\) **Create a Web-base staff module with input and editing screen for each category.**

The system would automatically identify and locate fields that constitute the database. In the meantime, input to edit screens would be done by humans with some subject expertise. The principle tasks would be to enter new records, create/delete disciplines, create/delete any of the core field and edit existing records. This portion of the system had been developed by using (MySQL) statements, Web page design using HTML editor and PHP languages.

\(\checkmark\) **Create a Web-based patron module with search option.**

This portion had also been developed and displayed the input of data. It was designed to be integrated with search tools. It design was intended to meet the requirements of system would perform best for the more inexperienced users. Search options included selection on one or more categories, selection of a discipline, and subject search.

**Results:**

The result of this work is the creation of a database shell. The shell allows a librarian to easily create a searchable database on any discipline. The collection model resembles the collection management policies of traditional librarians. Collection can be tailored to fit the needs for engineering on their requests.
Searching is quite flexible. All hits that are on the virtual engineering library are presented as links. The searcher can choose one, or all the categories to search at the same time. Each subject search returns hits for all records for which that subject in the heading in the record. Keyword searches query all fields in the selected category(s).

4.5 Design Verification:

As with all software products, system testing and verification is critical for a stable, useful product that meets the desired customer specifications. In this project, system testing was performed to verify proper error handling, adequate system performance, platform/browser independence, reliability and import/export structure.

System testing was an ongoing process throughout the software development cycle. First, a portion of the code would be written and testing of that particular segment would be performed to verify proper functionality. Then, if a problem was found with a module in this manner of testing, it was known exactly which portion of code was causing errors. Also, as each individual portion of code was being pieced together, the combined system was again tested. This process occurred until the entire system was completed, at which point the overall system was tested.

Problems Encountered:

One problem came from the specification to identify overlapping information within the virtual engineering library. This helps to minimize the size of the library and enables system to be more accurate to identify the required data and reduced the search time.

Another problem encountered involved determining how to transmit data from the server to the web browser. Initially, print statements were used within the PHP script to send hard-coded HTML to the browser for display. This proved to be very time consuming and difficult to modify. It was found that the use of the structure markup language such as XML would ease much of the labor associated with displaying variable
length tables in the browser. Essentially, raw data and a formatting template could be sent to the clime browser that would lend use the template to display the data.

The Virtual Engineering Library interfaces and browsing:

The virtual engineering library interfaces offer different type of browsing facilities. Fig [4.5] shows the browsing interfaces of the virtual engineering library. When users open the virtual engineering library web page, they are offered the choice of either the search or browse.

![Virtual Engineering Library](image)

Fig. [4.5] Virtual engineering library home page

The infrastructure for a virtual engineering library should include the following component:

- Shared information representation models, services representation models, and access protocols. These will facilitate the sharing of information and services across a virtual engineering library.
- Information “content” sharing agreements. This will take the form of communities of organizations that agree to share their collections.
• Resource directories. The infrastructure should describe available information resources and relative models and protocols to characterize the contents.

Among these components, to establish common schemes for the naming of digital objects, and the linking of these schemes to protocols for object transmission, metadata, and object type classifications is the most urgent need. Naming schemes for digital objects that allow global unique reference is the basis for facilitating resource sharing, and linkages among a virtual engineering library system and for facilitating scale-up of a virtual engineering library prototype.

Another essential requirement is a public key infrastructure, including the development of a system of key servers and the definition of standards and protocols. This is necessary to support a virtual engineering library needs in areas such as right management. Only after these problems are addressed, is it possible for the publishers and other information suppliers to make large amounts of high-value copyrighted information broadly available to a virtual engineering library user. This in turn; will restrict the development of research prototypes and may be a distorting factor in the studies of user’s behavior.

Information needs:

Information needs and how to provide access to information has remained a central theme of study. It is commonly a greed that the provision of information begins when a user has an information need.

The information needed by a user to accomplish a goal- to solve a problem, to answer a specific question- may be quick and brief factual data or exhaustive and detailed. Fig [5.5] shows a simple model of information access. Although it appears to be very basic, in essence several complex processes take place throughout. Some of these technologies are related to the information retrieval system, user interfaces, and so on. Other process relate to the nature and characteristics of the content as well as the specific user. The process may take more or less time, and may become simple or complex depending on the nature of the user- their cognitive abilities and background, the specific nature of the information need, and so on.
Information need

Query information

Submit query to the system

Receive search result

Study search result

Information need satisfied?
No
Users often learn during the information search process. For example, they may across some information that influences their information need. The user may also acquire new knowledge about the system, and thus be able to formulate queries more skillfully and appropriately to retrieve better output.

**Database Search Tools:**

Database provide the content storage for many tables which dynamically create web pages around them. Internets often contain large amounts of text stored in database as well.

The database generally has its own search functions, which may appear to take the place of a full-text search engine. Text search engine is often the right solution, moving the processing load from the database to the search engine.

Database store its information organized into fields, such as title, author, description, and soon. While database can setup complex queries to find out the search words in all applicable fields, this makes them slower to respond, requires more memory, and more difficult to program. Text search engine store this information in a single index and can find words in any field for a record. Many high-end search engines can also store field information, so searcher can be limited to a specific field as well.
Flexible Search Processing:

Database search functions trend to look for exact matches in characters. If someone searches for a specific title, he will find records with that specific title. A new trend in text search engine is to incorporate spelling checkers, which are particularly useful for queries which do not find any matches. By checking the word already in the index, the search engine spelling checker can often suggest which apply to this particular content, is extremely useful.

Database is optimized to search for exact words and phrases. So if a user wants to find a specific word in two categories, database will tend to do searches and then merge the results. Full text search engine is designed to store these words in a single index, so it can perform these kinds of searches efficiently and return quickly.

Search engine is very different from subject directories. With a search engine, keywords related to a topic are typed into a search “box.” The search engine scans its table’s records in MySQL database and returns a link to page containing the word or words specified. Because the database is very large, search engine often return a number of results. Without search strategies or techniques, finding what we need can be very difficult.

The search engine will look for words matches within the entire title or author name in a specific thesis. It also generates a log file in simple text format that details all the searches. This is a useful method of finding out what users really want from the virtual engineering library site.

The four-phase framework for information search:

Information searching is a complex process. It involves a number of stages and at each stage has a number of actions are taken and decisions made. The information retrieval system and the user interface may provide support in performing these actions and in making appropriate decisions. The major activities divided in an information search process into four major phases: formulation, action, review of result, and refinement. The four-phase framework for interface design will provide a common structure and terminology for information searching while preserving the distinct features of individual virtual engineering library collection and search mechanisms.
Phase 1: Formulation

Since virtual engineering library doesn’t have any physical presence, users do not get a view of the collection and the contents as they do in printed library. In fact, users of a virtual engineering library may not know much about its contents, and may find it difficult to formulate a query to get access to the required information. User may not know how exhaustive the collection is in their area of interest or the size of the entire collection. Hence, it may become difficult for them to assess how exhaustive the retrieved information set at the end of a search is, and how precise the search results are.

The formulation of a search is triggered by an information need, and several decisions are made regarding source and field what to search for.

The selection of source (collections and/or databases) is an important step in a search process. In a virtual engineering library environment, users may have access to many collections, therefore users need to have some idea about the nature and content of the collection and databases and use this to make a selection. The virtual engineering library interfaces show a list of the available collection and allow user to select on particular collection; for example, Fig [6.5] shows the search interface of the virtual engineering library. In this case users are asked to enter a search expression, and the system searches across the database and produces an output of best–matching records. This gives the user an idea of the contents of the collection and thus facilitates the selection of sources. Appendix (A)
Fig [٦٫٥] Search interface of the virtual engineering library

A major challenge for user comes in writing the actual search statement. A search statement tells the system what to search for in the database(s).

**Phase ٢: Action**

Usually a search button needs to be pressed to conduct a search, but in this case the user just need to press [search] bottom to begin the search process. Once the searching begins, the user is usually expected to wait till the searching process ends. A very appealing method of information searching is “dynamic queries”, and the result set is continuously displayed and updated as phases of the search are changed.
Phase ٣: Review of results

Information retrieval interfaces usually offer the user various choice for viewing results such as the size of display format and the order of the retrieved items (sorted by author, title, and so on).

Phase ٤: Refinement

Different search interfaces provide different facilities for modifying and refining queries. In some cases, users need to reformulate the search statement and conduct a new search, while in others; users can refine a search and conduct a new search on the retrieved set.

١١٫٤ Virtual Engineering Library Development:

Throughout the design process many suggestions were made on features that could be integrated into the web application. Due to time constraints and software limitations, many of these suggestions were not possible for this first version of the project. In the future, more time may be allotted for further development of the application and improved tools may be available. Specifically, improvements could be made in the area of the user interface and performance aspects of this project.

User Interface Improvements:

Currently, navigation through the application requires the use of specialized links on each web page. The browser’s back and forward buttons do not work properly due to information that must be submitted by the browser to the server each time a page is displayed. This behavior is distracting to most users, but cannot be remedied at this time due to limitations in the available web browsers. Hopefully future browser releases will alleviate this problem.

Performance Improvements:

As mentioned previously, XML was suggested to be the basis for data transmittal from the server to the client browser. Implemented in this manner, the server would only be required to send a single formatting template to the browser and merely transmit the raw XML data to the client where it would be assembled for on-screen viewing. In the
system that was developed, the entire page is generated on the web server (an HTML page with data and formatting) and then transferred to the client machine. This unnecessary transfer of formatting data could be eliminated if client browsers had the capability to properly handle XML data.

Lastly, when a request is made to display the database, the application returns the information for each of the information contained in the library. The system would still function in this manner regardless of the library size, but a significantly larger number causes very long transfer times to modem users. A possible solution to this problem would be to limit the returned results to a user-specified number and integrate navigational links to allow the user to navigate through the result sets.
CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

\textit{Conclusion:}

Computers are becoming more prevalent in every aspect of our lives. The traditional roles of public library are vastly changing. Computers and the internet challenge familiar notions of community and defy assumption about what, how, where, and when we learn and communicate.

A virtual engineering library has been defined as the concept of remote access to the contents and services of the library and other information resources, combining an one-site collection of current and heavily used materials in electronic form, with an electronic network which provides access to, and of delivery from external resources.

There are a number of issues that need to be accounted for when create the virtual engineering library. The most important issues are flexibility, another important issue is maintaining the quality of the data in the virtual engineering library accepts all submissions; it will probably contain a lot of information and accept changing the technology.
There are several factors that affect the design and implementation of the virtual engineering library user interface. Economics played an important role in choosing which web server, database engine, and programming language to use to develop the user interface. MySQL database server and Apache web server were both approved by virtual engineering library Systems since they both met their financial criteria. In addition, virtual engineering library currently uses an Apache web server, and MySQL is being considered as the database server of choice for all of their applications. Thus, virtual engineering library employees will have an easier time maintaining and modifying this new library interface in the future.

As a mechanism for providing a new service paradigm on the web, the virtual engineering library goes further to address the “trails” problems for hierarchically organizing information and also making it shareable.

With a virtual engineering library, a user will be able to have information at his fingertips by: following trails, browsing across virtual engineering library, or by using the virtual engineering library searching mechanism. With information readily available, a user may then focus his energy on thinking or being creative, searching for information, or browsing across huge volumes of thesis, reports, journals, and so on. With virtual engineering library, the effort of retrieving relevant information has been made minimal.

\*\* Recommendations:  
- A stronger collection for a virtual engineering library through the addition of full-text databases; electronic journals; academic resources; and locally produced databases which can include full-text, images, sound, and video.
- The development of resources that will support distance education initiatives,
- The avoidance of costly duplication of the virtual engineering library through a cost-effective approach to information delivery.
- The use of standards to ensure ease of access to multiple formats, archiving, and preservation of information and consistent application of technology across functions within a virtual engineering library.
- Acquisition of computer systems to automate library circulation operations and improve collection control and management.

References:


Appendix(A):

**Thesis Search Code**

```php
<?php require_once('../Connections/lib.php'); ?>
<?php
```
mysql_select_db($database_lib, $lib);
$query_Recordset1 = "SELECT * FROM thesis";
$Recordset1 = mysql_query($query_Recordset1, $lib) or die(mysql_error());
$row_Recordset1 = mysql_fetch_assoc($Recordset1);
$totalRows_Recordset1 = mysql_num_rows($Recordset1);

<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<title>Virtual Engineering Library</title>
</head>
<body bgcolor="#FFFFFF" text="#666699" link="#FF0000" vlink="#333366" alink="#FF9999">
<p align="center" class="style4">Virtual Engineering Library</p>
<table width="100%" border="2" cellspacing="3" bordercolor="#000000">
<tr align="center" bgcolor="lightgrey"><td><b><span class="style3">Menu</span></b></td></tr>
<tr bgcolor="white"><td><div align="center"><a href="/testserch/expert.php">Experts in engineering</a></div></td></tr>
<tr bgcolor="lightgrey"><td><div align="center">International conferences</div></td></tr>
</table>
</body>
</html>
<table>
<thead>
<tr>
<th>Projects</th>
<th>E_Journal</th>
<th>Thesis</th>
<th>Home</th>
</tr>
</thead>
</table>

<form name="f">
<p align="center"> &nbsp; </p>
<table width="375" height="31" border="3" cellspacing="2">
<tr><td width="365" height="83" align="left" class="style1">search for: Thesis: </td></tr>
<tr><td height="63" align="left" class="style1">Search for <input name="var" type="text" value="" size="4" maxlength=" ">
<select name="typ" size="1" id="typ">
<option value="" <?php if (!(strcmp('all', $row_Recordset1['TITLE']))) {echo "SELECTED";}?>>all categories</option>
<option value="1" <?php if (!(strcmp('Title', $row_Recordset1['TITLE']))) {echo "SELECTED";}?>>Title</option>
<option value="2" <?php if (!(strcmp('Author', $row_Recordset1['TITLE']))) {echo "SELECTED";}?>>Author</option>
</select> <input type="submit" value="Search">
<input type="reset" name="Submit" value="clear" onctype="f"></td></tr>
</table>
</form>
<?php

// Example

$pieces = explode(" ", $var);
if ($beginsearch=='\'){

$conn=mysql_connect("localhost","root","");
mysql_select_db("library");

    if($typ=='\'){
        $result1=mysql_query("select * from thesis where TITLE like "'%'$pieces[0]%'" or AUTHOR like "'%'$pieces[0]%'",$conn);
    }
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where TITLE like "'%'$pieces[0]%'",$conn);
    }
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where AUTHOR like "'%'$pieces[0]%'",$conn);
    }
}
if($pieces[0]!=" & $pieces[1]!=" & $pieces[2]="){
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where TITLE like "'%'$pieces[0]%' or TITLE like "'%'$pieces[1]%'",$conn);
    }
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where AUTHOR like "'%'$pieces[0]%' or AUTHOR like "'%'$pieces[1]%'",$conn);
    }
}
if($typ=='\'){
    $result1=mysql_query("select * from thesis where TITLE like '%$pieces[0]%' or TITLE like '%$pieces[1]%'","conn");
}
if($typ=='\'){
    $result1=mysql_query("select * from thesis where AUTHOR like '%$pieces[0]%' or AUTHOR like '%$pieces[1]%'","conn");
}
}
if($pieces[0]!='' & $pieces[1]!='' & $pieces[2]!=''){
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where TITLE like '%$pieces[0]%' or TITLE like '%$pieces[1]%' or TITLE like '%$pieces[2]%' or AUTHOR like '%$pieces[0]%' or AUTHOR like '%$pieces[1]%' or AUTHOR like '%$pieces[2]%'","conn");
    }
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where TITLE like '%$pieces[0]%' or TITLE like '%$pieces[1]%' or TITLE like '%$pieces[2]%'","conn");
    }
    if($typ=='\'){
        $result1=mysql_query("select * from thesis where AUTHOR like '%$pieces[0]%' or AUTHOR like '%$pieces[1]%' or AUTHOR like '%$pieces[2]%'","conn");
    }
}
echo "<br>Search Results:<br><br>
while ($row=mysql_fetch_array($result1)){

    ?>
    <a href='thesis\search.php?ff= <?echo $row['TH_ID']?>'>
    <?
    // echo $row['TH_ID'];
    //echo "</a>";
<?php require_once('../Connections/lib.php'); ?>
<?php
$colname_Recordset1 = "\";
if (isset($_GET['ff'])) {
    $colname_Recordset1 = (get_magic_quotes_gpc()) ? $_GET['ff'] : addslashes($_GET['ff']);
}
mysql_select_db($database_lib, $lib);
$query_Recordset1 = sprintf("SELECT * FROM thesis WHERE TH_ID = %s", $colname_Recordset1);
$Recordset1 = mysql_query($query_Recordset1, $lib) or die(mysql_error());
$row_Recordset1 = mysql_fetch_assoc($Recordset1);
$totalRows_Recordset1 = mysql_num_rows($Recordset1); ?>
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=windows-1256">
<title>Untitled Document</title>
</head>

<body>
<table width="\"" border="\"" cellspacing="\"" cellpadding="\""}
<table>
<thead>
<tr>
<th>Thesis_ID</th>
<th>Type of Material</th>
<th>Title</th>
<th>Author</th>
<th>Supervisor</th>
<th>Date of Publication</th>
<th>Physical Description</th>
<th>Abstracts</th>
<th>Description</th>
<th>Document List</th>
</tr>
</thead>
<tbody>
<tr>
<td>$row_Recordset['TH_ID']</td>
<td>$row_Recordset['TM']</td>
<td>$row_Recordset['TITLE']</td>
<td>$row_Recordset['AUTHOR']</td>
<td>$row_Recordset['SUPV']</td>
<td>$row_Recordset['DATEP']</td>
<td>$row_Recordset['PHDESCRIP']</td>
<td>$row_Recordset['ABSTRACTS']</td>
<td>$row_Recordset['DESCRIP']</td>
<td>$row_Recordset['DOCALIST']</td>
</tr>
</tbody>
</table>
Appendix (B):

**Thesis table code**

```php
<?php require_once('../Connections/lib.php'); ?>
<?php
function GetSQLValueString($theValue, $theType, $theDefinedValue = "", $theNotDefinedValue = "")
{
    $theValue = (!$get_magic_quotes_gpc()) ? addslashes($theValue) : $theValue;
    switch ($theType) {
        case "text":
            $theValue = ($theValue != "") ? "" . $theValue . "" : "NULL";
            break;
        case "long":
        case "int":
            $theValue = ($theValue != "") ? intval($theValue) : "NULL";
```
break;
case "double":
    $theValue = ($theValue != "") ? "" . doubleval($theValue) . "" : "NULL";
    break;
case "date":
    $theValue = ($theValue != "") ? "" . $theValue . "" : "NULL";
    break;
case "defined":
    $theValue = ($theValue != "") ? $theDefinedValue : $theNotDefinedValue;
    break;
}
return $theValue;
}

$editFormAction = $_SERVER['PHP_SELF'];
if (isset($_SERVER['QUERY_STRING'])) {
    $editFormAction .= "" . htmlentities($_SERVER['QUERY_STRING']);
}
if ((isset($_POST['MM_insert'])) && ($_POST['MM_insert'] == "form") {
    $insertSQL = sprintf("INSERT INTO thesis (TH_ID, TM, TITLE, AUTHOR, SUPV, DATEP, PHDESCRIP, ABSTRACTS, DESCRIP, DOCALIST) VALUES (%s, %s, %s, %s, %s, %s, %s, %s, %s, %s),
        GetSQLValueString($_POST['TH_ID'], "int"),
        GetSQLValueString($_POST['TM'], "text"),
        GetSQLValueString($_POST['TITLE'], "text"),
        GetSQLValueString($_POST['AUTHOR'], "text"),
        GetSQLValueString($_POST['SUPV'], "text"),
        GetSQLValueString($_POST['DATEP'], "text"),
        GetSQLValueString($_POST['PHDESCRIP'], "text"),
        GetSQLValueString($_POST['ABSTRACTS'], "text"),
        GetSQLValueString($_POST['DESCRIP'], "text"),
        GetSQLValueString($_POST['DOCALIST'], "text"));

    mysql_select_db($database_lib, $lib);
    $Result = mysql_query($insertSQL, $lib) or die(mysql_error());
}
<?
<!DOCTYPE HTML PUBLIC "-/W3C//DTD HTML 4.0 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=windows-1258">
<title>Untitled Document</title>
</head>
<body>
<form method="post" name="form1" action="<?php echo $editFormAction; ?>">
<table width="546" border="2" align="center">
<tr align="center" valign="baseline" bgcolor="lightgrey">
<td nowrap><div align="left"><b>TH_ID:</b></div></td>
<td><div align="left"><b><input type="text" name="TH_ID" value="" size="20"></b></div></td>
</tr>
<tr valign="baseline" bgcolor="white">
<td nowrap>TM:</td>
<td><input type="text" name="TM" value="" size="7"></td>
</tr>
<tr valign="baseline" bgcolor="lightgrey">
<td nowrap>TITLE:</td>
<td><input type="text" name="TITLE" value="" size="23"></td>
</tr>
<tr valign="baseline" bgcolor="white">
<td nowrap>AUTHOR:</td>
<td><input type="text" name="AUTHOR" value="" size="6"></td>
</tr>
<tr valign="baseline" bgcolor="lightgrey">
<td nowrap>SUPV:</td>
<td><input type="text" name="SUPV" value="" size="5"></td>
</tr>
<tr valign="baseline" bgcolor="white">
<td nowrap>DATEP:</td>
<td><input type="text" name="DATEP" value="" size="4"></td>
</tr>
</table>
</form>
</body>
</html>
<table>
<thead>
<tr>
<th>PHDESCRIP:</th>
<th>&lt;input type=&quot;text&quot; name=&quot;PHDESCRIP&quot; value=&quot;&quot; size=&quot;5&quot;/&gt;&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACTS:</td>
<td>&lt;textarea name=&quot;ABSTRACTS&quot; cols=&quot;6&quot; rows=&quot;1&quot;/&gt;&lt;/textarea&gt;</td>
</tr>
<tr>
<td>DESCRIP:</td>
<td>&lt;input type=&quot;text&quot; name=&quot;DESCRIP&quot; value=&quot;&quot; size=&quot;4&quot;/&gt;&gt;</td>
</tr>
<tr>
<td>DOCALIST:</td>
<td>&lt;input type=&quot;text&quot; name=&quot;DOCALIST&quot; value=&quot;&quot; size=&quot;5&quot;/&gt;&gt;</td>
</tr>
</tbody>
</table>

<input type="submit" value="Insert record">