Web Portal to Coordinate Biotechnological Activities in Sri Lanka

C.J. Wickramarathne
Registration No: 4/10060

Supervisor: Mr. D.K. Withanage

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This dissertation is submitted in partial fulfillment of the requirement of the Degree of M.Sc. in Information Technology of the University of Moratuwa.

Declaration

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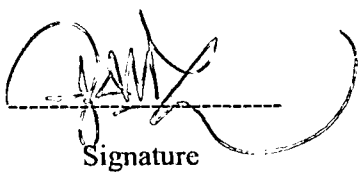

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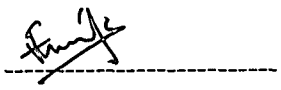

07/02/2007

Mr. D.K. Withanage
(Supervisor)

Date

Abstract

This research makes an attempt to look into the current activities taking place among Sri Lanka and create a web portal to link these institutes So that they can share information. It also attempts to disseminate such information among the various personnel involved in research work and make a good coordinating point (Web Portal) to share their newly acquired information for their advantage.

Currently, there is no coordinating point for handling Biotechnological activities in Sri Lanka. Various institutes use their own methods and practices for information management. This has been a major issue because they are not aware of others' work and standards. This is a waste of money, time and human resources.

This project addresses the need to integrate various Biotechnology communities into an online application where information is shared among users in Biotechnology communities as well as other authorized personnel in the community in a secure and accurate manner.

I started this project with a study of similar domains. The next step was the pilot study and tried to find up stakeholders clearly. In this stage I used the National Biosafety/Biotechnology database compiled by Professor Athula Perera and drafted a questionnaire. The next step started with a finalized questionnaire and a properly selected data sample. Requirements gathered during extended discussions with stakeholders included those from the Government, Semi-government and the Private sector organizations. In this task, a series of interviews were conducted and questionnaires were used to gather requirements/comments. Then the study was done to find out more, with respect to history, various types, features of Web portals and future trends. Vortals are also introduced.

At the design stage, the client side, the server-side and the database design were finalized. All the design stage decisions, tools and technology selections were justified. During the Development stage, all the coding and documentation for the

client, the server and the database were carried out. Next, was the testing & implementation stage and the system was tested before and after deployment. The BioWEB system was assessed to see how it administrates. It also addressed the related security, backups and maintenance of the system. The also incorporates self financing method too, which helps in sustaining the system for a long period as it is used.

The BioWEB is system was compared with available commercial portal software in order to do a self evaluation.

The difficulties faced and limitations of the system are addressed.

Finally, further work that could be performed in order to improve the system is also mentioned.

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List of acronyms and abbreviations

BioWEB	The name of the resulting web portal in this project
IT	Information Technology
NSF	National Science Foundation
FAO	Food and Agriculture Organization of the United Nations
GAIN	Global Agriculture Information Network
USDA	United States Development Agency
HTTP	Hypertext Transfer Protocol
MS	Microsoft
XHTML	Extensible Hypertext Markup Language
CSS	Cascade style Sheet
IIS	Internet Information Server
IDE	Integrated Development Environment
LAMP	Linux, Apache, MySQL, PHP
VB	Visual Basic
IE	Internet Explorer
GAIN	Global Agriculture Information Network
BI	Business Intelligence
ASP	Application Service Provider
NGO	Non Government Organization
OO	Object Orientation
SQL	Structured Query Language

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First and foremost I sincerely thank my supervisor, Mr. D.K. Withanage, Head, Department Information Technology, University of Moratuwa, for his invaluable intellectual advice, enthusiastic interest, and endless encouragement. It was an honor and a privilege to have had him as my supervisor.

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Chapter 1

Introduction

Sri Lanka is a country primarily based on agriculture, and is an agriculture-based society depending heavily on traditional practices handed over from generation to generation. [WWW1]

1.1. Background

Over the years these traditional practices remained very much the same providing very little increases in harvest or savings on time and money.

In such a background, Biotechnology will be useful in developing agriculture and related areas to pull the country on to the road to prosperity [WWW1].

It is revealed that various institutes currently make very little use of technology available. In addition, the little use that is made is hardly conveyed to parallel institutes, leaving a wide gap with regard to the use of novel technology. Various institutes use their own methods and practices for information management in the field of Biotechnology. This poses a major issue because they are not aware of others' work and are also not aware of standard procedures. As such, it is a waste of money, time and human resources.

Currently, there is no coordinating point available in Sri Lanka for a sharing of such information [GAIN Report 2005]. This project addresses the need to integrate various Biotechnology communities into an online system where every user in a Biotechnology community and other authorized personnel in the community share information in a secure and accurate manner. It also attempts to arrange the dissemination of such information among the various institutes/personnel involved in research work and as a result evolve a good coordinating point to share newly acquired information to the advantage of various stakeholders in the community.

Based on the pilot study, stakeholders of the Biotechnology community are identified as follows.

i	Academic Institutes	Those who conduct Biotechnology and related courses
ii	Researchers	Doing research / Experiments in the field of Biotechnology
iii	Resource Suppliers	Those who supply resources for Biotechnology such as: funding, providing equipment or consulting.
iv	Policy makers	Government and Non-government bodies that frame policies for Biotechnology.
v	Investors	People engaged in Biotechnology related Businesses.
vi	General Public	People with a keen interest about Biotechnology

Table 1.1: Different stakeholders in the field of Biotechnology

The following diagram show the main stake older mentioned in Table 1.1 and their Biotechnology activities.

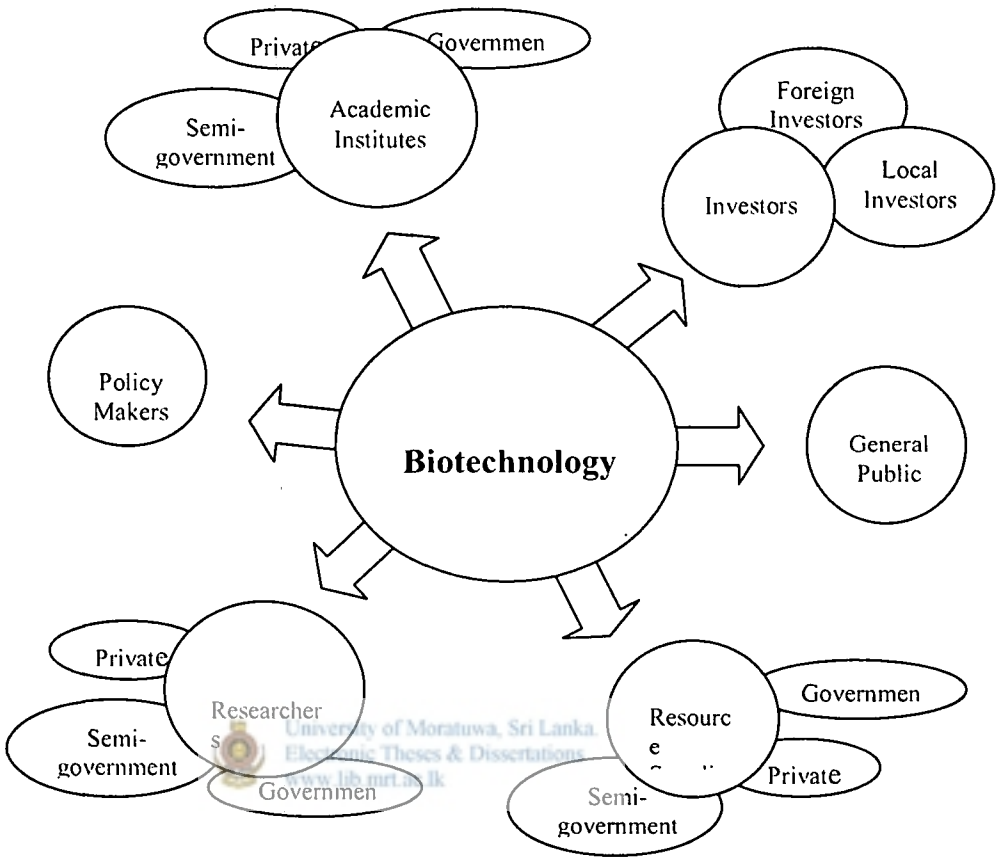

Figure 1.1: The main stakeholders of Biotechnological activities in Sri Lanka.

All stake holders actively participated to Biotechnological activities in Sri Lanka but they are not aware with others and what their doing in the field Biotechnology. They are isolated and no information flows among these stake holders. This is a waste of money, time and human resources.

1.2. Problem in brief

There is no coordinating point and a centralized place to share information for biotechnological activities in Sri Lanka.

1.3. Objectives and deliverables

The main objective of this research is to identify the current status related to Biotechnology in Sri Lanka and create a Web portal for information sharing among the various institutes that have already started Biotechnology practices.

The resulting Web portal is expected to be very useful to the Agricultural sector, Government policy makers, Investors, Universities, Researchers, Resource providers and others interested in this emerging technology. The Web portal will help facilitate and coordinate activities among various stakeholders.

1.4. Proposed solution

Telephone/Telecommunication coverage (using fixed and wireless media) of Sri Lanka is over 80% [WWW2]. Prices of computers and related equipment are rapidly decreasing. IT literacy in Sri Lanka, currently, is also at a good level [Satharasinghe 2004]. Internet access grows exponentially day-by-day. Internet service providers offer reasonable Web hosting packages. The cost to develop a Web site and hosting it has also become very reasonable and affordable. Most of the people who participated in the survey were familiar with Web technologies and most of the institutes already have their own Websites.

In such a scenario, an on-line Web portal named **BioWEB** is proposed as the ideal solution to coordinate Biotechnology activities in Sri Lanka, aimed at sharing available information.

Http connections through the Internet are to be used as http connections can help users browse the BioWEB portal.

Investigating the current use of Biotechnology in Sri Lanka, this research attempts to create a coordinating point/Web portal for the use of various stakeholders in various institutes/communities that are already practicing Biotechnology to share available information.

1.5. Scope and methodology

The scope of the project covers the use of Biotechnology in Government, Semi-government and the Private sector institutes highlighting sharing of available and expected information. A pilot study was conducted first covering a sample of ten stakeholders. Next, a survey was conducted using a prepared questionnaire to cover thirty stakeholders representative of all stakeholders in the field of Biotechnology under consideration. Along with the survey, one person from each institute was carefully selected for interviews to represent the institute's view.

The final step is to identify and assess a suitable Model/Portal to be introduced to various institutes coming under Government, Semi-government and the Private sector.

1.6. Resource required

The proposed system requires Web browser as the client interface. It needs http or https protocol to control incoming and outgoing dataflow. At the server end it requires ASP 4.0 and MS Access 2005 enabled Web server to host the portal and the database. The Web server should be IIS 5.0 or higher as the server software. Further, it requires MS Access 2005 [WWW4] to implement the database. Finally, Macromedia Dreamweaver and Microsoft Visual studio are needed as the IDE.

1.7. Expected outcomes

This research makes an attempt to look into the current use of Biotechnology in Sri Lanka and create a coordinating point/Web portal to share information among the various institutes/communities that are already practicing Biotechnology.

1.8. Overview to the rest of the documents

Chapter 2 describes the current status of Biotechnological activities in Sri Lanka, innovative technologies used in this project and other research work done in the same/similar areas.

Chapter 3 describes an overview of portals including history of the Web portals, major portal types, vortals and the future trends of Web portals.

Chapter 4 describes the Methodology/Approach used to create a Web portal to coordinate Biotechnology in Sri Lanka. It describes how the requirements analysis and design was done. This also includes data gathering using a questionnaire and the client-side, the server-side and the database design proposed. It further describes the main decisions taken and their justifications

Chapter 5 explains implementation of the proposed system. Here, the client-side, the server side and the database related development processes are explained. It also justifies technical feasibility and the implementation decisions taken.

Chapter 6 contains the entire testing plan for BioWEB after and before deployment testing.

Chapter 7 explains how BioWEB works, the administration plan, updating and maintenance plan, information security and backup plan, cost and budgets plan, limitations and bugs and further improvements. It also compares BioWEB with Commercial software.

Chapter 8 contains the final conclusion for the project

Next are the reference materials, books, research papers, on-line resources and the appendices.

Chapter 2

Current status of Biotechnological activities in Sri Lanka

The literature review shows that there is no existing portal or ongoing project related to Biotechnology in Sri Lanka [GAIN Report 2005].

2.1. Background materials

This section illustrates how relevant studies conceptualize and develop Web portals/coordinating points to coordinate Biotechnology. In Sri Lanka, there is no similar study or a research done before. There is no regulatory framework in Sri Lanka for agricultural biotechnology [GAIN Report 2005].

There was only one research related to the field of Biotechnology done in Sri Lanka by **Professor Athula Perera** of the Department of Agricultural Biology, University of Peradeniya and the project is titled "National Biosafety framework development project" [WWW7]. It implements the National Biotechnology/Biosafety database under the patronage of the Ministry of Environment and Natural Resources (see appendix II). Now, the Draft National Policy on Biosafety is available for the General Public (see appendix II).

NSF has appointed a committee for biotechnology and Bioethics (see appendix III). According to the Sri Lanka country profile compiled by the FAO of the United Nations they summarize Biotechnology and the responsible entities for Biotechnology in Sri Lanka (see appendix IV). With the help of the country profile compiled by the FAO given from the NSF, a pilot study was carried out by administering a questionnaire to identify the main stakeholders in the field of Biotechnology. After analyzing the data collected from the pilot study, I extended my survey to more stakeholders for a clearer picture of their involvement and ideas for the construction of a Web portal to coordinate Biotechnology.

Chapter 4 discusses the Pilot study and the survey in more detail.

2.2. Importance and benefits of the proposed system

As shown in Table 1.1 below the main parties to benefit are the Sri Lankan Biotechnological communities from among those in Government, Semi-Government and the Private sectors. The following section explains the benefits for each.

2.2.1. Academic Institutes

Academic institutes consist of all institutes conducting Biotechnology or Biotechnology related courses. They belong basically to the Government, semi-Government and the Private sector and are to receive similar benefits.

Benefits to these institutes are as follows:

1. Right of access to the centralized information repository for Biotechnology.
2. Ability to share information while consuming up-to-date information from others.
3. Capacity to find out relevant information from the following stakeholders: Other academic Institutes, Researchers, Resource Suppliers, Policy makers, Investors, the General Public.
4. Ability to access on-line exams, journals, publications and course materials

2.2.2. Researchers

Researchers always look for new technologies (Theories, Methodologies and Equipment) with their research work. They may like to share their new findings and also look into others' research work. The benefits to researchers from the proposed BioWEB are as follows:

1. Publish new research findings.
2. Share knowledge.
3. Search for publications and research papers.
4. Search resources (expert knowledge + equipment) for their research.

2.2.3. Resource suppliers

Those who provide expert knowledge and equipment fall into this category of resource suppliers and all the stakeholders depend heavily on them. All other stakeholders can access their information when they need resource input for Biotechnology.

The benefits to resource suppliers are as follows:

1. Advertise new products/equipment or consultancy services easily.
2. Collect information on current trends and requirements of other stakeholders in the field of Biotechnology

2.2.4. Policy makers

Policy makers make/amend policies for Biotechnology. This information is very critical for investors and other interested parties.

The benefits to this category can be identified as:

1. Decision Making.
2. Publishing new policies.
3. Publishing information about amended policies.
4. Getting instant feedback about Biotechnology related policies.

2.2.5. Investors

The entire Biotechnology industry depends on investors, as their resources are essential for the success of any invention. Using the BioWEB, investors can easily find out necessary information considered valuable to their investments.

Benefits to this category can be identified as:

1. Investment opportunities and current trends in Biotechnology in Sri Lanka.
2. Biotechnology policies in Sri Lanka important for investments.
3. Search for other stakeholders in the field of Biotechnology.

2.2.6. General public

This category is very important. Without the help of the general public it is impossible to develop biotechnology in Sri Lanka.

Benefits to the general public can be identified as:

1. Increasing awareness on the day-to-day news in Biotechnology for daily living.
2. Getting help from experts or Chatting with giants in the relevant field.
3. Engaging actively in the development of Biotechnology.
4. Obtaining expert ideas in the relevant field.

2.2.7. Benefits to the Government of Sri Lanka

Progress to be made with Biotechnology obviously leads to the development of Sri Lanka as a whole. For such progress the development of the stakeholders explained above is a necessity. Undoubtedly benefits from the proposed BioWEB system could be of immense benefit to Sri Lanka with its Biotechnology Program.

The next chapter contains an overview of Web portal, vortals, Web portal history and how it evolves. It also explains the hierarchy of Web portal and major portal types. Lastly it explains future trends.

Chapter 3

An overview of Web Portals

3.1. Introduction

Traditionally, a portal denotes a gate, a door, or entrance. In the context of the World Wide Web, it is the next logical step in the evolution to a digital culture. Web pages are not completely self-referential anymore, but allow for personalization, workflow, notification, knowledge management and groupware, infrastructure functionality, and integration of information and applications. "***The idea of a portal is to collect information from different sources and create a single point of access to information - a library of categorized and personalized content.***" [WWW3] It is very much the idea of a personalized filter into the Web.

The term "Internet portal" (or "Web portal") began to be used to describe these mega-sites because many users used them as a "starting point" for their Web surfing. The term "search engine" had become inadequate to describe the breadth of the offerings, although search and navigation are still pivotal to most people's online experience. Compared to the original Internet search engines, Internet portals offer a more structured, navigable interface. Browsing an organized hierarchy of categories developed by people (rather than computers) who scoured the Internet for relevant and useful Websites is more effective than issuing a keyword search against the entire Web.

Portal is not just a conventional *Website* (which is usually characterized by static information). It exceeds the capabilities of personalized *intranets* or personalized *extranets*. Portals integrate business applications, groupware, knowledge management solutions and sophisticated search engines. Because of this we can't say portal is a standalone business application, groupware, knowledge management solution or a search engine.

Portals are often the first page the Web browser loads when users get connected to the Web or that users tend to visit as an anchor site. They offer users a surplus value of service based on the features of classic search engines: a well trained concierge who

knows where to search and find. Thus, the traditional virtual roadhouses - the search engines- become feel-good entrance halls, a gateway to the Internet, easy, one-stop point for the daily Web-surfing sessions. The hope behind the idea of a portal: surfers start their voyage into the Web through a modern entrance hall, and preferably find their way back to the starting point without major difficulty.

Many of the portals started initially are as either Internet directories (notably Yahoo!) and/or search engines (Excite, Lycos, AltaVista, infoseek, and Hotbot among the old ones). The expansion of service provision occurred as a strategy to secure the user-base and lengthen the time a user stays on the portal. Services, which require user registration such as free email, customization features, and chat rooms were considered to enhance repeat use of the portal. Game, chat, email, news, and other services also tend to make users stay longer, thereby increasing the advertisement revenue [Endre 2002].

In the late 1990s, the Web portal was a hot commodity. After the proliferation of Web browsers in the mid-1990s, many companies tried to build or acquire a portal, to have a piece of the Internet market. The Web portal gained special attention because it was, for many users, the starting point of their Web browser. Netscape Netcenter became a part of America Online, the Walt Disney Company launched Go.com, and Excite became a part of AT&T during the late 1990s.

Today, most of the world market leaders in Trading, Marketing and Finance, All major academic institutes, NGO's; Government bodies commonly use Web Portals. This becomes the main information sharing methodology which is inexpensive and convenient so far.

3.2. How does a Web Portal works?

The following diagram shows user interaction with Web portals.

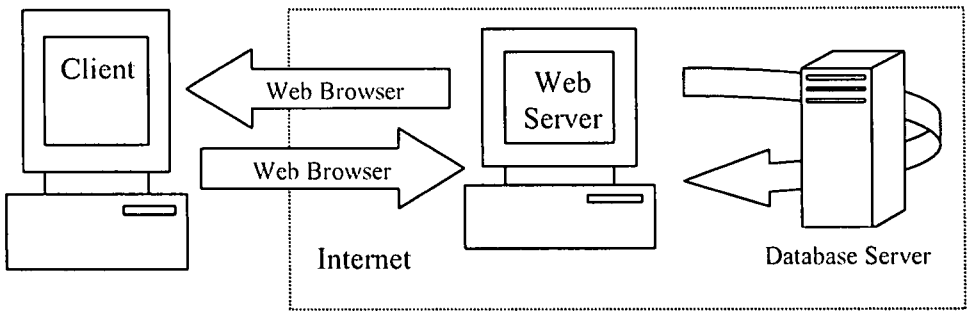

Figure 3.1: Top level architecture of web portal

Users of the Web portals can make requests for information with any compatible Web browser. This goes as an http request to the Web server. The Web server analyzes requests and creates a response page. It uses other external resources such as database servers. Then the Web server pumps the response to the client-side Web browser. The Client will get a specific error page for known errors and a common error page for others.

3.3. Major functions of portals:

According to an world class analyst and consulting company Ovum [WWW6] - as described in their study "Enterprise Portals: New Strategies for Information Delivery", 2000 - the ideal portal is based on eight functionality areas.

3.3.1. Search and navigation

Functionality forms the basis for most of the successful public Web portals meaning that a successful portal should support its users in an efficient search for contents.

3.3.2. Information integration (content management)

A portal should warrant the integration of information from disparate sources. Moreover, the user should also be able to optimally use this information. There are several mechanisms for doing this. One such promising technique of innovative interfaces is the Unified Content API (Application Programming Interface),which speeds up the development of portal applications. The Unified Content API supports all current tools for developing Web environments, such as JAVA, C++, ActiveX, Visual- and Non-Visual-Java Beans.

3.3.3. Personalization

Personalization is vital to the delivery of appropriate information to portal users: each user gets only the information, which is specifically tailored to his/her needs. Personalization should be based on user roles, as well as user preferences.

- Personalization of navigation
  e.g. shortcuts to specific information, mostly known as bookmarks or favorites
- Personalization of data/content
  e.g. which stocks do I want to see in my stock ticker
- Personalization of layout
  e.g. what information appears where on the screen, in which format, color or size

3.3.4. Notification (push technology)

Notification (push technology) is referred to as a system in which a user receives information automatically from a network server. Push technologies are designed to send information and software directly to a user's desktop without the user actively requesting it. Thus, the user has the opportunity to subscribe to active information sources such as news feeds and periodically updated reports and ask to be alerted when documents are updated.

3.3.5. Task management and workflow

Portals providing task management services can help users take part in and/or manage formally defined business processes. The workflow functionality allows the automation of business processes. Thus, as part of a workflow-automated business process, a portal should be able to prompt its users when they have tasks to perform.

3.3.6. Collaboration and groupware

Knowledge management and groupware ensure that the required information is stored in the right place and in the right mode. With this means the right persons are brought together with the right information. Groupware software assists with collaboration that is less formal than in workflow tools.

3.3.7. Integration of applications and business intelligence

In addition to the already mentioned functionalities, a portal can integrate and support a specific application type, for example:

- An application service provider (ASP) application
- Business intelligence (BI) functionality
- Support for e-commerce

3.3.8. Infrastructure functionality

The infrastructure functionality constitutes the fundament for the work environment - the other 7 functionalities mentioned above build up on this one. The runtime infrastructure associated with the portal will have a primary effect on manageability, scalability, security and availability.

Although most of the functionality is not new, what is new is the idea that the business value of the whole is considerably more than the sum of its parts. Thus, a successful portal not only consists of either a good collaboration support or a good integration of the information sources but also a well-integrated mixture of the basic portal functionalities.

3.4. Basic architecture of portals

Figure 3.2 shows the Common Architecture of Horizontal and Vertical Portals.

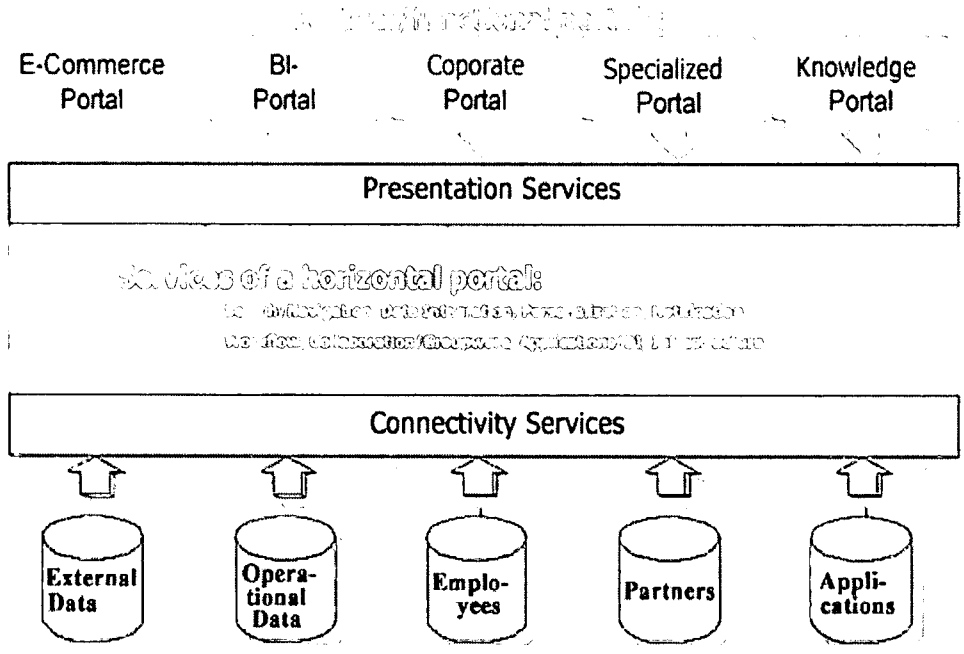

Figure 3.2: The basic architecture of portals (source: Ovum 2000)

The basic architecture of portals is depicted in figure 3.2. The middle part encompasses all the functionalities and services of an ideal portal. These functionalities should at least be fulfilled in part by any portal, no matter how narrow its focus. The bottom part - connectivity services - should be able to integrate any data type that comes into question. Finally, the upper area corresponds to the user interface, which enables the presentation of all data and applications. Any portal meets the requirements of this 3-layer-architecture and any portal should meet these basic functionalities.

3.5. Portal vs. Vortal [Horizontal and Vertical Portal]

A vortal is a jargony way of saying "vertical industry portal." A vortal provides information and resources for a particular industry. You find news, research and statistics, online tools, discussions and newsletters pertaining to a particular industry or area of discipline. For example, visit a vortal like FindLaw.com, and you can figure out how to find a lawyer to handle your divorce.

3.6. Major types of portals

The analyst and consulting company Ovum [WWW3] has set up a detailed taxonomy of portal types, their hierarchical affiliations included. **Figure 3.3**, below, depicts ovum's hierarchy of portal types. The proposed system is also a specialized portal because it uses ASP. On the other hand it falls into knowledge portal category because of its functionality.

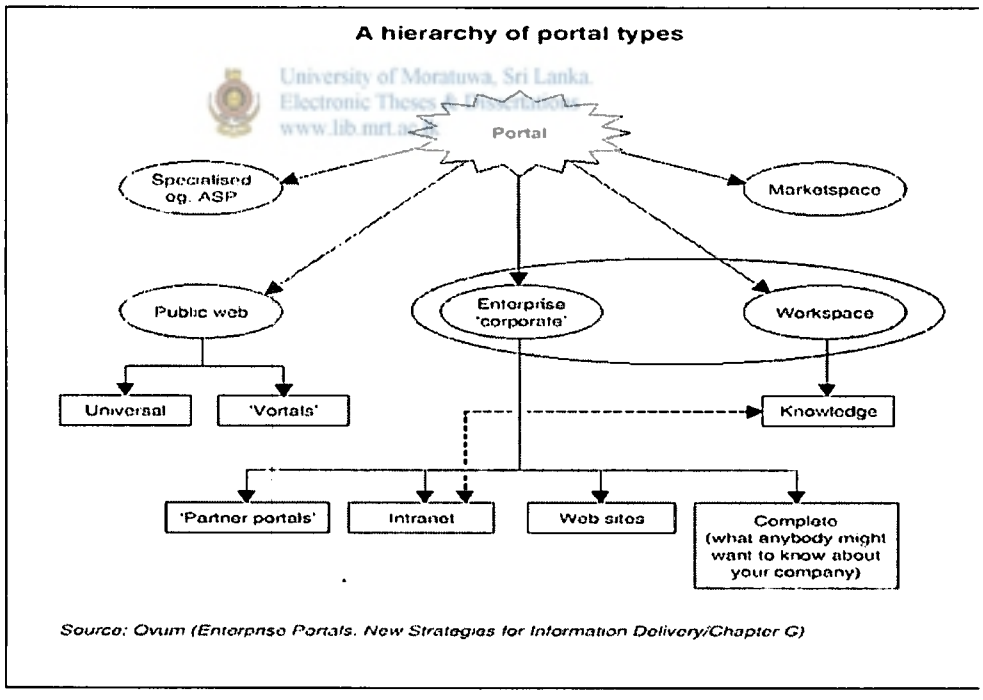

Figure 3.3: Ovum's taxonomy of portals (source: Ovum 2000)

A workspace portal is a single, coherent, integrated portal that presents its users with all the information they need to carry out their jobs. The current alternatives to a workspace portal are specialized portals.

A 'complete' enterprise portal - an enterprise portal that provides efficient personalization with the appropriate information - is a promising candidate for a workspace portal.

Knowledge portals increase the effectiveness of knowledge workers by providing easy access to information that is necessary or helpful to them in one or more specific roles. Knowledge portals are not mere intranet portals since the former are supposed to provide extra functionality such as collaboration services, sophisticated information discovery services and a knowledge map.

3.7. Future trend of portals?

A great number of analysts' reports inquire the future development of portals. One of the most popular reports is the hype cycle of emerging technologies for 2000 released by the Gartner Group. The cycle is depicted in Figure 3.4:

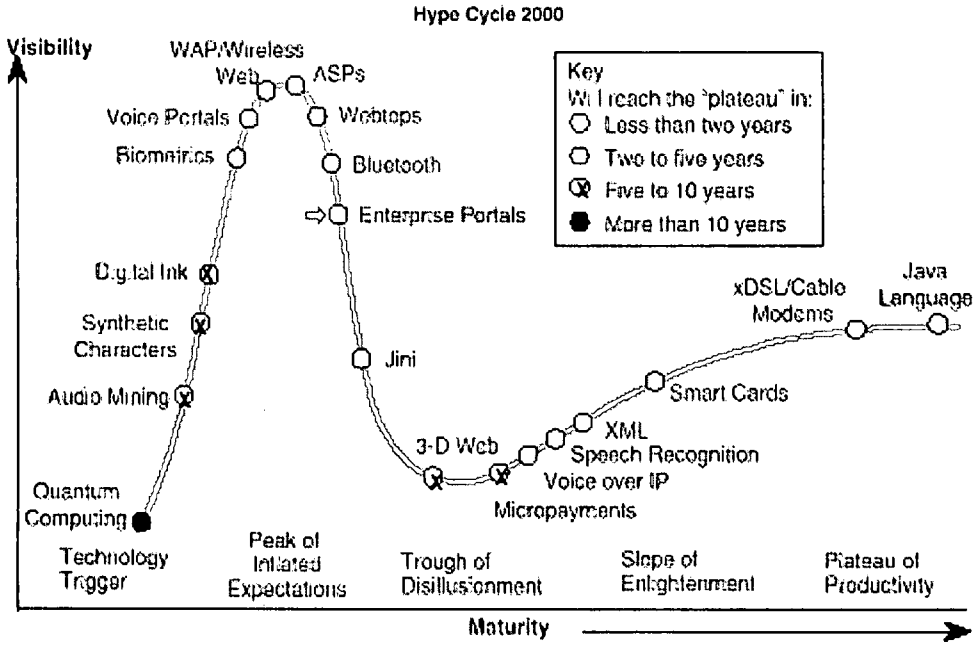

Figure 3.4: Hype cycle of emerging technologies (source: WWW3)

The hype cycle covers information such as which emerging technologies should early adopters be examining for competitive advantage and how technology planners should identify the technologies and applications that will generate maximum benefit for the organization. Technologies at the peak of inflated expectations in this hype cycle include wireless Web/WAP, ASPs, and Webtops.

The next chapter contains the methodology followed for the requirement gathering and analyzing. It also includes how the survey was done. Finally it describes the design phase, tools and technology selected and justification for the selection while further explaining the structure and the features of the proposed system.

Chapter 4

Methodology

A number of Government, Semi-government and Private institutes/communities already practice Biotechnology. But they are isolated and use their own methods and practices for information management in the field of Biotechnology creating a major issue because one is not aware of the others' work and standard procedures. Obviously this ignorance leads to waste of money, time and human resources. The proposed system attempts to resolve this issue.

The procedure followed for the Methodology with the design of the BioWEB consists of two sections: Requirements Analysis and Design. Requirement Analysis is further divided into sections discussed in detail below.

4.1. Requirement analysis

Biotechnology in Sri Lanka is at an ascent stage; biotechnology policy and regulations are still evolving. There is no biotechnology regulatory system at present (GAIN Annual Report, Global Agriculture Information Network, 2005).

There is no central authority or a media in government to publish or distribute policy information regarding biotechnology among the relevant users. Such information is very important for the Investors, the Research community and the general public.

From the investor's point of view there is no place or a source for information related to investment opportunities in the field of Biotechnology. As a result many investment opportunities can suffer in a background where investors and their investments have a strong hold on the entire future of Biotechnology.

Biotechnology is evolving rapidly making it compulsory for academic and research communities to share their new findings and be willing to be

updated in the field. Sadly, in Sri Lanka there is no place for this coordination. The general public is also very keen about new trends in biology related sciences. They may wish to have the information and be actively involved with the critical issues that affect their society.

On the other hand students ranging from secondary education up to post-graduate level appreciate this type of in formation resource.

In addition, the business community, already involved with Biotechnology has no information source to fulfill their requirements. They need information on new policies, new trends in the industry and advertising opportunities. They want to publish/advertise their business to those interested, mentioned above.

4.1.1 Data gathering

This is the most crucial and important stage as all further work of the project depends on the success of data gathering. Requirement gathering was done from a representative sample of stakeholders by using the following methodology.

A Pilot study in the initial stage, with the use of a preliminary questionnaire helped gather information from a selected sample. The main concern here was to finalize the questionnaire and to select an unbiased representative sample. The following sections describe the methodology used and how this requirement gathering was carried out in reality.

4.1.2 The research methodology

Using existing documents, similar studies, questionnaires and interviews User requirements were collected. Then these requirements were converted into essential features of the Web portal. The following diagram shows how user requirements convert into the Web portal features.

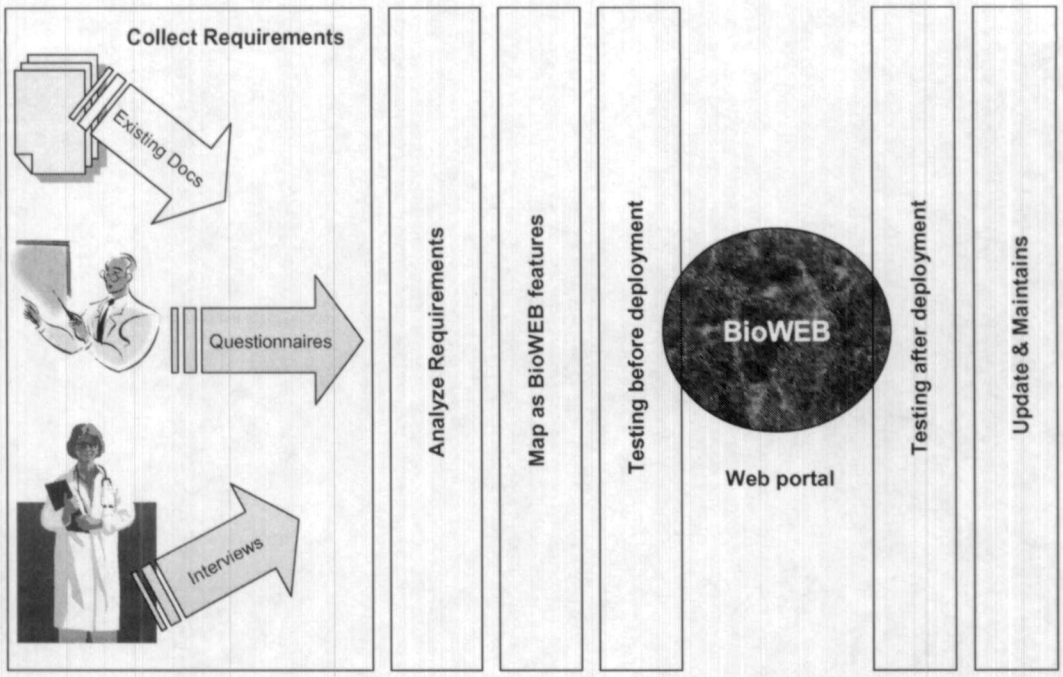

Figure 4.1: The Research methodology

The following methods were used for requirements gathering.

- Study existing resources/documents

  Here, I refer to existing materials in both printed and electronic form.

  - Books (printed books & e-books)
  - Research papers
  - Company annual reports
  - Useful Web sites

- Use the questionnaire

  The basic questionnaire was used in the preliminary investigation/pilot study to collect requirements. Next, the finalized questionnaire was used.

- Interviews

  Several interviews were carried out with the stakeholders. Requirements were collected in verbal form and later mapped with the questionnaire.

The main steps in requirements gathering were as follows:

I. Questionnaire Preparation:

The drafted questionnaire was prepared and a preliminary study was carried out among ten stakeholders using the drafted questionnaire.

Outcomes:

i. Identified the modifications to the questionnaire drafted.

ii. Gathered some main requirements.

II. Pilot study:

The drafted questionnaire was used during the pilot study to collect requirements. This proved very helpful to finalize the existing questionnaire. This also helped to select an unbiased representative data sample by including all stakeholders.

Outcomes:

i. Useful to construct a suitable sample frame.

ii. Identified the points to be revised in the questionnaire.

III. Questionnaire Revision:

Based on the results and information gathered during the pilot study the drafted questionnaire was revised. Major revisions were done and new questions added.

Outcome:

Finalized questionnaire was drafted.

IV. Sampling

At the initial stage, a reprehensive sample was selected. It was a very difficult task because there is no exact place to get correct and up to date information relevant to all stakeholders. Therefore, after a consultation with an *experienced statistician, five members of each category were selected and the following procedure to collect information was used.*

- Handing over questionnaire to relevant people with a request to fill it.
- Interviewing and filling the questionnaire in front of the interviewee.
- E-mailing / Faxing the questionnaire with a covering letter, guidelines and the returning mail address.
- Using the on-line Web form and temporally hosting in free hosting Web server (http://web.1asphost.com/BioWEBSrilanka/questionnaire.html) and asking users to browse and fill.

Outcome:

Actual (customer) requirements were identified.

Using the data collected from the Requirement Analysis the next stage was the Design stage discussed below.

4.2. Design

Here, I explain my approach to design BioWEB. This is very important because this will convert user requirements into a working system/model by mapping user requirements into programming language specific syntaxes.

4.2.1 Structure of BioWEB

BioWEB is a dynamic on-line Web portal. The following diagram shows an overview structure of BioWEB.

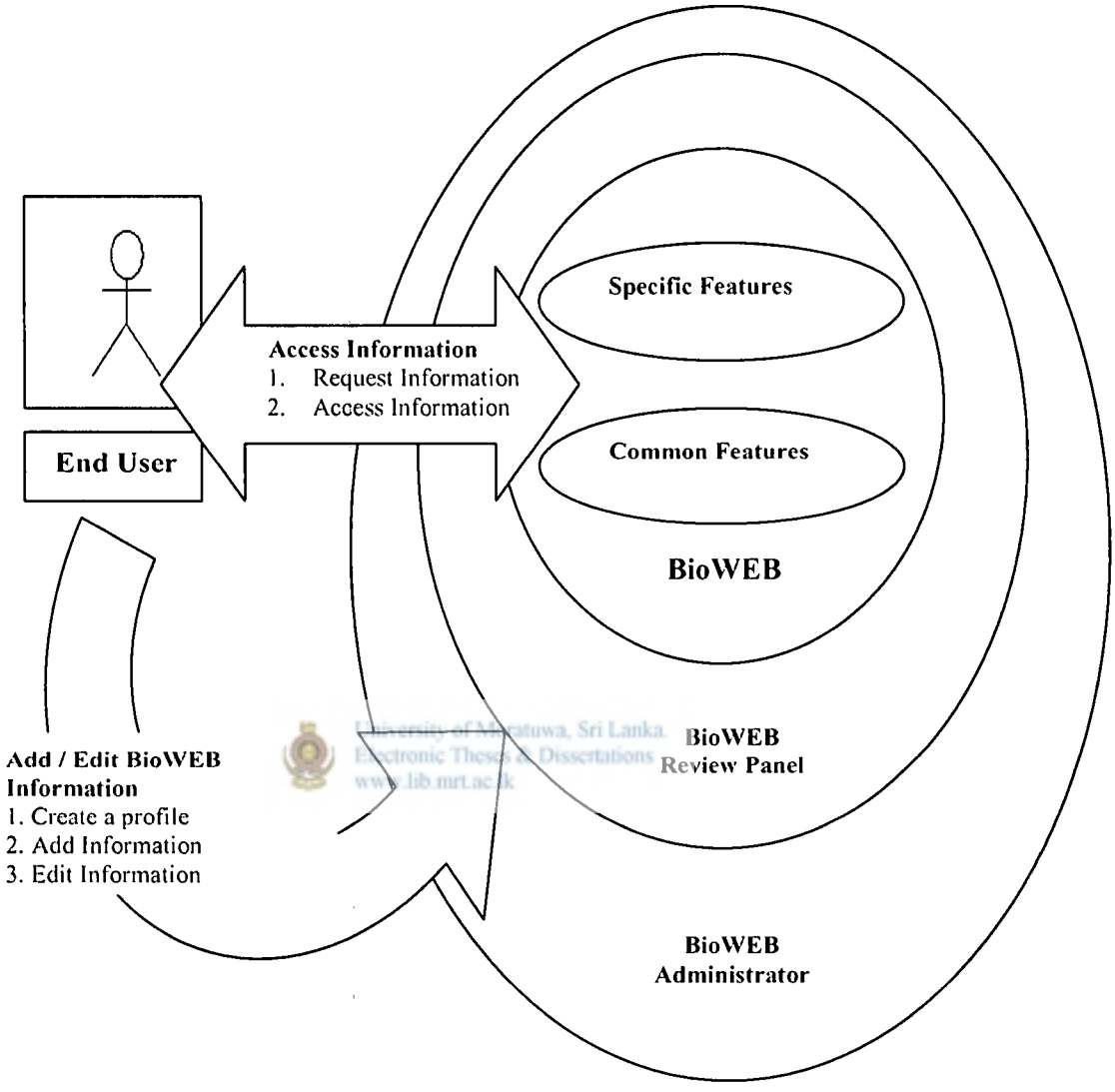

Figure 4.2: Top level architecture of BioWEB

End users represent the client-end and use Web browsers to request information from the BioWEB. The Server side response by provides common features and specific features. End users can access common features without any restriction but they cannot modify it. Users can add or modify their own Web content but with approval from the review panel.

i) Client side design

BioWEB provides a separate Web interface for each stakeholder. Basically it uses XHTML and JavaScript and is generated dynamically.

Design decisions & Reasons

Created a Cascade style sheet and the same Cascade style sheet was used for the entire client side for uniformity. One Cascade Style Sheet is enough to change the appearance and color schema of an entire portal. It is not necessary to change each page manually.

ii) Database design

Microsoft access is used to create Relational database schema.

Design decisions & Reasons

Dedicated tables for each and every feature of BioWEB were designed. Then it is easy to maintain and capable enough to fulfill the requirements of the stakeholders [WWW4]. Views were created when tables required additional security instead of normal queries. Users deal only with the view not the actual table. Add prefix ***tbl*** for all tables.

iii) Server side analysis and design

All the information passes through the client side and the information requested by the client processes at the server end using Microsoft Active Server Pages.

Design decisions & Reasons

Default scripting language for the server is set to VBScript. There is no need to define script language for ASP anymore.

It provides a separate interface for each of its stakeholders; namely Academic Institute, Researches, Resource Suppliers, Policy makers, Investors and General Public.

The next section summarizes the available Facilities, Current status and further enhancements for each category.

4.2.3 Technology and Tools used

The Following table shows the Technologies used for the BioWEB. It also contains the latest versions of the technologies. This will help with further improvements.

	Technology used	Latest versions
Web Page Development	**XHTML 1.0**	**XHTML 1.0**
	CSS	**CSS**
Programming Language	**MS ASP**	**MS ASP.net**
	JavaScript	**JavaScript**
	XML	**XML**
Software Tools/IDE	**MS Visual Studio**	**MS Visual Studio .net**
	Macromedia Dreamwever MX	**Macromedia Dreamwever MX**
Database	**MS Access**	**MS SQL Server**
Software	**MS IIS Server**	**MS IIS Server**

Table 4.1: Technology and Tools used for BioWEB

4.2.4 Main design decisions and justifications

During the survey I found that most of the institutes use Microsoft Web products instead of the LAMP technologies due to ease of use. Most of the Institutes and people who were interviewed were familiar with Microsoft Access than other database technologies available (Oracle, MS SQL server and MySQL) and MS Access database specifications are capable enough to fulfill the user requirements [WWW4]. Further, it is cost effective. So I decided to use MS Access for this portal.

According to the information collected from using the questionnaire it was found that many of the interviewees who are familiar with web browser IE. Both ASP and IE are Microsoft products. This will ensure support of Microsoft ASP and Access for highly increased productivity using lightweight technologies.

BioWEB is open for users using different operating systems. We have to use a platform independent scripting language for this. There is no other option than the JavaScript.

For the on-line exams section I used XML to store questions. It is easy to use and is fast as against a database driven question engine.

IIS server is the recommended server from Microsoft for the Active Server Pages.

The following chapter contains relevant information regarding the Implementation phase. It also describes how the Implementation, Coding, Features were implemented and the technical feasibility of features to be implemented in the near future. Finally, it concludes with future enhancements for the BioWEB.

Chapter 5

Development of BioWEB

At the end of the implementation it is necessary to ensure user requirements (collected from the survey) are converted to the BioWEB features. All features of BioWEB represent the collected information needs of biotechnology stakeholders.

5.1 Introduction

Implementation of the BioWEB consisted of three main components.

- Client - Side Development
- Server - Side Development
- Database Design

The entire site development (coding and documentation) was divided into these three sections and completed.

In the Implementation stage I made several decisions to reach the final target with critical implementation matters. I used the following tables to summarize the decision made during the implementation stage.

5.2 Client - side development

All the client side html pages, CSS and JavaScript fall into this category. W3C specification for the XHTML and HCI concepts was used for the designing of each page.

Table 5.1 explains how the decisions were taken with respect to the implementation of each of the client side components.

Client - Side Development	Implementation decisions	Reason of development
HTML Pages	XHTML	XHTML comes with a proper Nesting, Tagging mechanism
Page Formatting	CSS	The entire page formatting for the entire portal can be stored as a single CSS. By changing CSS, we can change all the referred pages.
Client side validations	JavaScript	Cross platform capability.
Manipulate browser settings	JavaScript	Object Oriented capability

Table 5.1: Implementation decisions for Client - Side Development

5.3 Server - side development

Table 5.2 explains how the decisions were taken with respect to the implementation of each of the sever side components.

Server – Side Development	Implementation decisions	Reason of development
Server side programming	ASP	Consume less resources than ASP .net
Database connection	Use Query strings instead of ODBC	Can't use ODBC for external database servers and Query strings are relatively faster than ODBC.

Exception handling	Major exceptions handled	All exceptions are not handled due to the time factor.
Web server configuration	Disable anonymous access. Set connection time out. Set customer error pages.	Prevent from unauthorized access. Prevent from very slow connections and very low bandwidths. Display attractive, User friendly and customized error pages.
SQL	The only way to manipulate databases.	
Dynamic HTML pages	Generated by using ASP.	Necessary for display database driven results pages.
XML	Use to generate questions in online exams	Easy to store questions using XML and faster than a database driven question engines.

Table 5.2: Implementation decisions for Server - Side Development

5.4 Database design

Table 5.3 explains how the decisions were taken with respect to the implementation of databases.

Database Design	Implementation decisions	Reason of development
Number of tables	Use separate table for each functionality and for each stack holder.	To generalize the database.
Manipulate database	SQL queries used.	The only way to manipulate databases.
Manipulate database in secure way	Views used.	More secure than the queries.

Table 5.3: Decisions on implementation of Database Design

BioWEB is a dynamic on-line Web portal. The following diagram shows an overview of BioWEB.

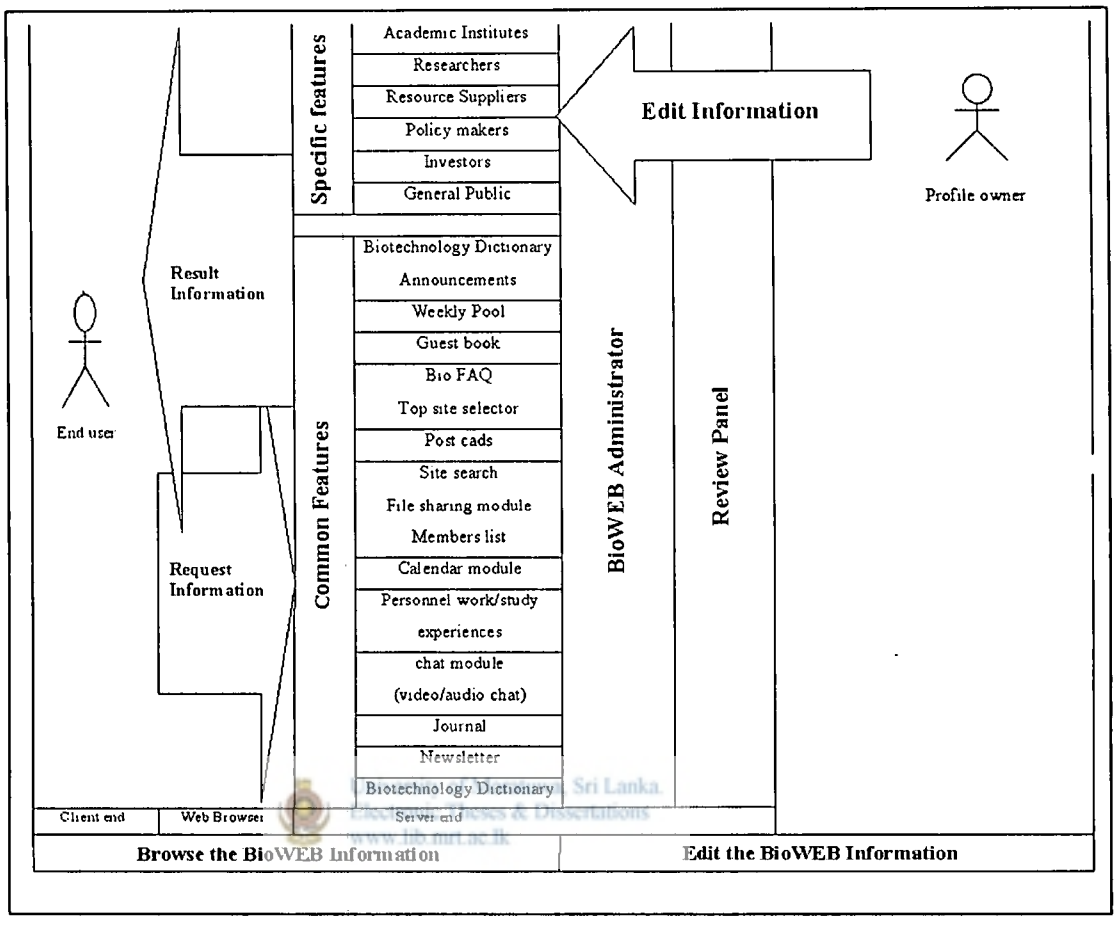

Figure 5.1: Overview of BioWEB

End users represent the client-end and use Web browsers to request information from the BioWEB. The Server side provides common features and specific features. Profile owners can access common features without any restriction but they cannot modify it. End users can modify their own Web content with approval from the review panel.

5.5 Features in BioWEB portal and future enhancements

The following Table shows BioWEB features that are already finished and future improvements envisioned. Category column contains the target stakeholder category and the last column displays the technical feasibility of the feature.

Feature	Category	Technical feasibility
Biotechnology Dictionary	ALL	Fully implemented
Announcements	General Public	Fully implemented
Weekly Pool	General Public, Academic	Fully implemented
Guest book	ALL	Fully implemented
Bio FAQ	General Public, Academic	Fully implemented
Top site selector	ALL	Future implementation
Post cads	General Public	Future implementation
Site search	ALL	Fully implemented
File sharing module	ALL	Future implementation
Members list	ALL	Future implementation
Calendar module	ALL	Half implemented
Personnel work/study experiences	ALL	Half implemented
Chat module (video/audio chat)	ALL	Half implemented
Journal	Researchers, Academic	Fully implemented
Newsletter	ALL	Half implemented

Table 5.4: Features in BioWEB (Common module) portal (Current status and future enhancements)

The Table below shows the features available under the academic category and its technical feasibility.

Feature	Category	Technical feasibility
Profile search	Academic Institutes	Fully implemented
New Registrations	Academic Institutes	Fully implemented
Edit Registrations	Academic Institutes	Fully implemented
Delete Registrations	Academic Institutes	Fully implemented
Academic Institutes	Academic Institutes	Fully implemented
Biotechnology Courses	Academic Institutes	Fully implemented
Academic Professionals	Academic Institutes	Fully implemented
Scholarships	Academic Institutes	Fully implemented
On – line Exams	Academic Institutes	Fully implemented
Course Materials	Academic Institutes	Fully implemented

Table 5.5: Features in BioWEB (Academic Institutes) portal (Current status and future enhancements)

The following Table contains the features and technical feasibility of Researchers

Feature	Category	Technical feasibility
Profile search	Research	Fully implemented
New Registrations	Research	Fully implemented
Edit Registrations	Research	Fully implemented
Delete Registrations	Research	Fully implemented
Research Institutes	Research	Fully implemented
Research Opportunities	Research	Fully implemented
Funds Scholarships	Research	Fully implemented
Publications	Research	Fully implemented
Research Search	Research	Fully implemented

Table 5.6: Features in BioWEB portal (Research) (Current status and future enhancements)

Policy makers' category contains the following features and future improvements.

Feature	Category	Current status
Profile search	**Policy makers**	**Fully implemented**
New Registrations	**Policy makers**	**Fully implemented**
Edit Registrations	**Policy makers**	**Fully implemented**
Delete Registrations	**Policy makers**	**Fully implemented**
Policy Making Bodies	**Policy makers**	**Fully implemented**
Policy Archive	**Policy makers**	**Fully implemented**
Policy Search	**Policy makers**	**Fully implemented**
Policy For Investors	**Policy makers**	**Fully implemented**
Policy Downloads	**Policy makers**	**Fully implemented**

Table 5.7: Features in BioWEB (Policy makers) portal (Current status and future enhancements)

The following features are available for Resources suppliers.

Feature	Category	Technical feasibility
Profile search	**Resource Suppliers**	**Fully implemented**
New Registrations	**Resource Suppliers**	**Fully implemented**
Edit Registrations	**Resource Suppliers**	**Fully implemented**
Delete Registrations	**Resource Suppliers**	**Fully implemented**
Create Profile	**Resource Suppliers**	**Fully implemented**
Resources Suppliers	**Resource Suppliers**	**Fully implemented**
Resource Search	**Resource Suppliers**	**Fully implemented**

Table 5.8: Features in BioWEB (Resource suppliers) portal (Current status and future enhancements)

The available features for the general public are as follows:

Feature	Category	Technical feasibility
Profile search	**General Public**	**Fully implemented**
New Registrations	**General Public**	**Fully implemented**
Edit Registrations	**General Public**	**Fully implemented**
Delete Registrations	**General Public**	**Fully implemented**
Biotechnological News Search	**General Public**	**Fully implemented**
News Letter Subscription	**General Public**	**Fully implemented**
Your Responsibilities	**General Public**	**Fully implemented**

Table 5.9: Features in BioWEB (General public) portal (Current status and future enhancements)

BioWEB contains four kinds of users and the following Table shows the responsibilities of each.

User Category	Privileges
User/End user	**Browse public pages.**
Profile owner	**Search, Edit, Modify or Delete its profile**
Review panel	**Authorized body to approve pending activities**
Site Admin	**Super user of the entire BioWEB**

Table 5.10: Different user categories and their privileges in BioWEB

The next chapter describes the testing methodology for the proposed system. It also contains the two testing phases, before and after deployment. Testing is divided into Client, Server and Database testing and is included in tabular form. The last topic, post implementation audit summarizes the testing phase.

Chapter 6

Testing

Testing is very crucial for any software product. It is very necessary to have a proper and complete testing methodology towards the software to meet its real requirements. The following sections describe how the testing was done before and after deployment.

6.1 Test plan

The aim of this test plan was to build a proper testing methodology for BioWEB. Without such a plan we cannot guarantee whether this portal succeeds or not. Here, testing was done in two phases before and after implementation.

- Testing before deployment
- Testing after deployment

6.2 Testing before deployment

Tests were done before deployment. Each module was tested individually, after finishing the coding. BioWEB is a collection of a number of individual components providing BioWEB features. These modules consist of the following components.

- HTML interface
- JavaScript validation code
- MS ASP as a server - side script
- Database table

End users for BioWEB use different operating systems and different Web browsers. Therefore, testing for interoperability is essential, as this will ensure all end users look at and feel the same BioWEB. BioWEB requires a

proper validation mechanism to prevent user mistakes. All hyperlinks were properly tested to facilitate a better navigation system throughout the BioWEB. Page loading time (time units taken to load a particular Web page) and the site loading time (time units taken to load the home page of a particular Website) are very important to give fast access and provide more information within less time on low bandwidth. Without a proper exception handling end users cannot get the full advantages of BioWEB. All possible errors/exceptions were handled.

Macromedia Dreamviewer was used as the primary IDE and it comes with the following built in testing tools and is used when needed.

- Compatibility check for various browser types/versions and resolution.
- Page validations for W3C specifications.
- Hyperlink testing & Tag inspector.

Database is the centralized information repository of the BioWEB. So, it should be properly secure and prevent errors and unauthorized access. The site administrator is the only one to directly deal with the database and crash recovery. Security features are also used to secure the database provided by the operating system

So, the following Table 6.1: shows what parameters are checked against all modules and how the test was done. It also summarizes the out comes of the each test.

Test Entity	Test	Outcome
Interface Testing *	Test all the HTML interfaces with different web browsers. [IE6,IE7Beta,Mzilla Firefox]	Uniform and well tested web interface
Target Browser Compatibility Check *	Check for popular web browser types and different browser versions.	Same appearance / functionality for different browser users.
Inter Operability Testing * [client-side only]	Test with different platforms. (Redhat Linux9, Sun Solaris and Window XP)	Same appearance / functionality for different Operating system users.
Form Testing / Login form #	Test for valid inputs and invalid inputs.	Form validations to minimize user mystiques.
Hyperlink Check *	Analyze and validate all the hyperlinks in BioWEB.	Ensure the navigation mechanism of BioWEB.
Page Loading time #	Count the time taken to load the requested page.	Quickly access BioWEB and its relevant section.
Site Loading Testing #	Count the time taken to load the BioWEB to the client's Computer.	
Server-side Script Testing Pages #	Check for the common server-side exceptions only.	Ensure correct functionality.
Database Operations Testing #	Check Four basic database operations [Input new records, Delete existing ones, Append and Display records] by querying database.	Implement consistent data flow from end user to the database and vice versa

* Tests are done by using Macromedia Dreamweaver # Tests are done by manually

Table 6.1: Post implementation tests of BioWEB

6.3 Testing after deployment

The aim of this testing is to check whether the stakeholders really used and benefited with the BioWEB and to make sure BioWEB fulfills their requirements. This testing phase provided a post implementation questionnaire to stakeholders to check whether the BioWEB met the real requirements of the Sri Lankan biotechnology community [appendix D]. This questionnaire contained several questions to the end users to identify how far BioWEB satisfies/fulfills the user requirements. The post implementation questionnaire was distributed among all stakeholders covered through the survey.

Users of BioWEB can send their feedback on-line by using the hyperlink "***Feed Back***" or they can contact the panel of reviewers' or BioWEB portal administrator through e-mail or telephone.

6.4 Post implementation audit

After the portal BioWEB is successfully launched resources of the projects are devoted to maintain and improve the site's operations.

A post-implementation audit is a formal review of a project after it is up and running.

This gives an opportunity to examine the context for Objectives, Performance, Specification and Cost estimates. This audit establishes the project in its planning stage and compares to what actually happened.

A post-implementation audit allows discussions to questions raised about the project and the project's objectives and feed back on strategies for the project's initial design. With this post-implementation audit valuable information to be used to improve the final product BioWEB was obtained.

6.4.1 Outcomes of the post-implementation audit

The main benefit of this audit verified whether the user requirements are really implemented. This also helped to get a clear picture of new features they need and what implemented features need to be revised. In another way this gave an idea of what the implemented features needed by way of modifications or improvements.

The earlier chapters explained all the steps followed to develop the proposed system and the previous chapter concludes testing. The next chapter gives an overall idea of the proposed system, how it works. Further, it describes the proposed plan for BioWEB administration, content update, and maintenance.

Finally, it compares BioWEB with the popular commercial software; Limitations of the BioWEB, Bugs and Future improvements are also included.

Chapter 7

Implementation of BioWEB

BioWEB portal is free and open for every one but it is mainly focused on the Biotechnology community in Sri Lanka. BioWEB provides separate interfaces for all its stakeholders, namely, Academic Institutes, Research, Resource Suppliers, Policy makers, Investors and the General Public.

7.1 How BioWEB works

Anyone can visit BioWEB without any restriction. On the home page, there are six links to select for each stakeholder category. One can find out useful information for his/her category. The User must register in order to create, edit, and delete profiles. These requests go to Review Panel. Then, the panel of reviewers goes through the requests and makes a decision whether to approve or reject the request. If it approved, the relevant user will be notified. Then the user can continue to work with BioWEB. Otherwise users have to re apply. After three rejections the user will be added to the black list. They cannot apply again. Information facilities are freely available for all.

7.2 BioWEB administration

To do day-to-day maintenance and updating, BioWEB needs to have an administrator. The Administrator can access BioWEB through the Internet (using http) anytime and from anywhere. So, time and the location of the administrator is not a problem any more.

7.3 BioWEB review panel

Review Panel (panel of reviewers) is the governing body of the entire BioWEB. It contains six persons from the fields of Academic, Research, Resource Suppliers, Investors and General public to represent their categories in BioWEB. They should be experts in their respective fields.

7.4 Updating and maintenance plan

Two major updates have to be done.

- **Update and Maintenance of the portal**
- **Update the individual contents**

Update and Maintenance of the portal

For the maintenance and updating, BioWEB needs to have an administrator and the review panel.

Administrator is the super user of the portal and he can access BioWEB through the Internet (using http) anytime and from anywhere. So, time and the location of the administrator is not a problem.

Portal administrator has to update Biotechnological news section, weekly newsletter, weekly pool and announcements weekly after approval by the review panel.

Maintenance for the BioWEB includes adding new features, bug fixing for existing features and user accounts maintenance. The administrator also has to help and solve the technical difficulties of the panel of reviewers.

All modifications and updating should be approved to maintain accuracy of the BioWEB.

Update individual contents

Each authorized member can update individual site contents. It is allowed twice a month only. Otherwise, review panel hasn't enough time to go through modified data seriously.

7.5 Information security and backup plan

The following table summarizes all those who are involved with BioWEB and their security privileges.

	Maintain portal features	Backup/Restore Crash recovery	Review/Approve portal contents	Maintain individual profiles	Data backup, restore & crash recovery	Browse the portal
Portal administrator	X			X	X	X
Review panel			X	X		X
Academic				X		X
Resource Suppliers				X		X
Research				X		X
Investors				X		X
Policy Makers				X		X
General public				X		X

Table 7.1: Information security and Backup plan

Portal features maintained include add, edit and remove features. All can add, edit or delete their individual profiles. Only the portal administrator can backup data to ensure data security. Anyone from anywhere can browse the portal.

7.6 Cost and budgets plan

After finalizing the BioWEB portal development, the final step is the hosting. According to the portal requirements it needs ASP enabled Web server space with MS Access database. According to the comments made by the

stakeholders they prefer free service. (For the testing purposes I used the free Web hosting server; http://www.1asphost.com)

BioWEB needs 200Mb approx. Initial Web space to store site file, and Database. It needs additional space when the database is growing. Based on the present, Web hosting cost can be covered by advertising. Advertising rates are based on the banner ad size.

7.7 BioWEB Vs Commercial software

BioWEB is only one approach to create a coordinating portal for Biotechnology in Sri Lanka. Many commercial products are available in the Global software market to create Web portals.

The market leader for the portal software is also the software giant Microsoft. The Java founder Sun micro systems and the database giant Oracle cooperation and others supply software for high end portals [WWW5].

Prices varying from $36,425.42 (Enterprise Edition Content Management Server from Microsoft) to $49.0 (Amazing Portal Generator from RTG Data Systems) [WWW5]. Other third party software are also available as free downloads without any warranty. Many of the portal software venders charge per processor basis. The after sales service and updates are given free only for a fixed time period and depended on the service agreement.

The BioWEB is totally free and developed after a proper requirement gathering. So, available Features, Limitations, Bugs, Source code are very well understood. It comes with a complete user manual. Because of that, Modifications were the further improvements made easy.

Conclusion of the whole project is included in the next chapter. It concludes with what was done, results gained and problems encountered, limitations to the BioWEB and further work with the project.

Chapter 8

Conclusion

This research makes an attempt to look into the current use of Biotechnology in Sri Lanka, identify its main stakeholders and create a coordinating point to share information among the various institutes that already practice Biotechnology.

There is no coordinating point for Biotechnology communities currently available. During this project I tried to develop an on-line Web portal as the coordinating point. I have achieved the objectives in this project. Next, I briefly describe how we achieve each objective.

8.1 Introduction

The first objective of this project was to study and analyze the current status of Biotechnological activities in Sri Lanka. It is a fact that at present, there is no coordinating body for Biotechnology in Sri Lanka. I found that National Science Foundation, the Central Environment Authority, the Ministry of Science and Technology, the Ministry of Health and the Ministry of Agriculture playing key roles in this field in Sri Lanka. The Government of Sri Lanka, Semi-government bodies and the Private sector are involved with Biotechnology activities but on a very small scale as compared to other Asian countries. The main Biotechnological activities identified during this research were: conducting courses, doing researches, making policies, supplying resources (equipments, grants and consulting) and investments.

Identifying main stakeholders with Biotechnology was the second objective. There are six main stakeholders identified, namely: Academic, Research, Policy Makers, Investors, Resource supplier and the General public. We can find Academic institutes, Research, Policy Makers, Investors, Resource suppliers with the government and the Semi-government sector. The Resource

suppliers and investors play a key role in the private sector. The required information was collect from them using a questionnaire.

As the first step, information sources were identified to collect requirements from the main stakeholders. Then, from the sample of stakeholders representing the whole community, requirements were collected. At the design stage, user requirements were transferred as features in the proposed system and tools and technology relevant to the requirements were also selected. The features of BioWEB with its implementation reflect the needs of the stakeholders and their real requirements.

Post implementation tests were done to make sure the features of the BioWEB really reflect the needs of the stakeholders.

User feed back from information collected during the post implementation test, the features of BioWEB benefited all stakeholders. This recognizes that BioWEB contributes towards the development of Biotechnology in the country as it is entirely dependent on its stakeholders.

8.3 Major problems faced

Major issues rose to identify the stakeholders. There is no proper documentation or a place to collect information of stakeholders including their contact details. I collected information and prepared a list of stakeholders for requirements collection by visiting several institutes one after the other.

Issues that occurred during the requirements gathering stage included the difficulty to contact top level management by making an appointment. Lower grade people are easy to access but they may not know the exact technical situation and they cannot provide information without permission. Among those interviewed many would like to gather important and up-to-date information from others while sharing little of their information.

Collecting data from the private sector is difficult because they are business oriented and do not like to devote time for researches. It is very difficult to collect details from Government/Semi Government sectors due to Political issues.

In the phase of implementation, I faced many problems in ASP and resolved these by referring several books in ASP, following an online tutorial in advanced ASP controls and contacting people involved in the software development industry. I also referred several source codes downloaded from the World Wide Web for implementation issues.

8.3 Limitations

- Effectiveness of the BioWEB depends on how popular Biotechnology in Sri Lanka.

- The quality of BioWEB and its services are totally depended on the web hosting company and Internet service provider. The loading time (time taken to prompt the home page of BioWEB) is depending on the transferring rate of data and the bandwidth of the communication link.

- This requirement gathering was based on only a few months of data gathering and analysis. A further detailed analysis of the problem domain is required.

- BioWEB should be hosted in an ASP/Access enabled Web windows Web server. To host it on other operating systems, it requires additional software components.

- BioWEB was totally tested for two popular Web browsers namely Internet Explorer and Mozilla in 1024 x 768 pixels resolution. The appearance may vary due to other computer configurations.

8.3 Further work

The newest trend of the Web is service-oriented architecture. By implementing a Web service, BioWEB can easily access other Web portal services. By adding a searching mechanism for other Web services, BioWEB can be more intelligent. It automatically consumes other Web services and gives information instantly.

Mobile devices are developing rapidly and getting popular day by day. So, BioWEB can be introduced as a mobile interface to mobile phone and other hand held devices.

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Appendices

Appendix A

C.J. Wickramarathne
Faculty of IT,
University of Moratuwa.

Dear Sir / Madam,

I'm a postgraduate student of Faculty of IT, University of Moratuwa and currently engaged in a research study on the M.Sc. in IT degree program.

This questionnaire is a part of the research study. My intention of this to identify the current status of the Biotechnology in Sri Lanka among various institutions including Government, Semi-government and Private sector.

Information contains in this questionnaire will remain completely confidential and be used solely for the academic purposes. Further, if you wish you to undisclosed your name and other personal information please leave the relevant cages in questionnaire blank as I want to ensure your anonymity.

Please take few minutes to fill this questionnaire, which is greatly helping me to meet the objectives I aimed.

Your cooperation for this is highly appreciated.

.....
C.J. Wickramarathne

Appendix B

Date:	Serial No:

Information Collection Sheet

(For Individuals)

01) Name of the Professional :

a. Designation :

b. Professional Level/Qualifications : (use √)

Tertiary	1	Undergraduate	2	Graduate	3	Postgraduate	4	Higher	5

c. How far you worked in the same field ____ Years

02) Contact Details :

Address:	Telephone / Fax :	
	E-mail :	
	URL :	http://

03) Major Field/Business :

04) Connection to Biotechnology : (use √)

Academic Institute	1	Research	2	Resource Suppliers	3	Policy making	4	Investor	5	General Public	6

05) Use of IT :

Are you familiar with Information Technology? (use √)	Yes	No	
If 'Yes' select the relevant fields : (use √)			

	Very Good	Good	Poor	No Idea
a) Computer Literacy				
b) Internet				
c) E-mail				
d) Software – Office packages				
e) Software – Other packages				
f) Software – Programming				
g) Software – Web development				
h) Software – Portals				
i) Hardware				
f) Networking				

06) Use of Bio Technology : (fill)

How you describe Biotechnology			
Do you believe that it is useful to develop Sri Lanka? (use √)	Yes	No	
If "Yes" indicate your reasons :	If "No" indicate your reasons :		

07) Biotechnological Issues Related to the Field/Carrier and Solution Expected :

	ical Issues Related to the Field / Business	Solution Expected
I		
Ii		
Iii		

08) What is your Idea about usefulness of web portals? (use √)

Useful	No idea	Not useful

09) Idea of Integrating/Coordinating portal for Biotechnology in Sri Lanka :

10) D o you have Information to share with Biotechnology community / Others? (use √)	Yes		
b) If "Yes", do you like to share information? (use √)	Yes		

i) If "yes", what information?	ii) If "no" please indicate your reason

11) What are the information you need from others/other institutes :

I	
ii	
iii	
iv	
v	

12) **Idea of proposed coordinating portal (BioWEB) : (use √)**

	a) Like to pay	b) Need free service	c) Can manage using own staff
i) Information access			
ii) Information upload			
iii) Information update			
iv) Site maintenance			
v) Information Security			

13) **Can you believe this type of portal is useful to you(r) business?** Yes | No (use √)

If it is "yes" reason(s)	If it is "No" reason(s)

14) **What are the features / functionalities you proposed to BioWEB :**

Feature(s) / functionalities	Reason
i)	
ii)	
iii)	
iv)	
v)	

15) **Other remarks :**

Appendix C

Date:	Serial No:

Information Collection Sheet

(For Institutes)

01) Type of Institute : (use √)

Private	1	Government	2	Semi government	3

02) Contact Details :

Address:	Telephone/Fax	
	E-mail	
	URL	http://

03) Major Field/Business :

04) Connection to Biotechnology : (use √)

Academic Institute	1	Research	2	Resource Suppliers	3	Policy making	4	Investor	5

05) Use of Internet & e-mail : (fill)

	a) Internet		b) E-mail	
	yes	no	yes	no
i) None				
ii) Only for selected people				
iii) For all Employees				
iv) No response				

06) Use of Website : (use √)

i) Do you have a registered domain name?	Yes				no
if "Yes" please indicate	http://				
ii) Do you have a Website?	Yes				no
if "Yes" please indicate	http://				
iii) Do you have a Webmaster/Web development team?	Yes				no
if "Yes" please indicate their technology					
Interface	HTML	DHTML	XHTML	XML	Other
Validation & Dynamic programming	Java Script	J Script	VB Script		Other
Server side programming	ASP / ASP.	JSP	PHP		Other

	net				
Database	MS Access	MS SQL Server	MySQL	Oracle	Other

07) Software, Hardware: (use √ / Fill)

a) Software			b) Hardware
i) Operating system	ii) Office packages	iii) Other	i) Computers only
Microsoft	Microsoft office		ii) Computer Network
Linux	Open Office		iii) Other pheripharels (scanner, printer etc.)
Sun Solaris			
Unix			

08) IT Staff : (use √)

a) Category	b) No. of Employees	c) Qualification (summery)			
Operating staff Eg. Operator					
Administrating staff Eg. System administrator		i) Lowest Qualification:			
Development staff Eg. Programmers		Certificate	Diploma	Degree	Post Graduate
Management staff Eg. IT Manager		ii) Highest Qualification:			
		Certificate	Diploma	Degree	Post Graduate

What is your Business related to the biotechnology? Yes ☐ No ☐
Is it a Service or a Product?

If it is a product		If it is a service	
Name(s): Eg. Orchids	i)	Service(s): Eg. consulting	i)
	ii)		ii)
	iii)		iii)
Technology: Eg. Tissue culture		Resources: Eg. Labs/Equipments	

09) Biotechnological Issues Related to the Field/Business and Solution Expected :

	Biotechnological Issues Related to the Field / Business	Solution Expected
i		
ii		

10) Biotechnology Products and Services : (fill)

11) Idea of Integrating/Coordinating portal for Biotechnology in Sri Lanka :

a) Do you have to share Information to Biotechnology community / Others? Yes | No	
›es you like to share information? Yes No (use √)	
i) If "**Yes**", what information?	ii) If "**No**" please indicate your reason

12) What are the information you need from others/other institutes :

I	
Ii	
Iii	

13) Idea of proposed coordinating portal (BioWEB) : (use √)

	a) Like to pay	b) Need free service	c) Can manage using own staff
i) Information access			
ii) Information upload			
iii) Information update			
iv) Portal maintenance			
v) Information Security			

14) **Can you believe this type of portal is useful to you(r) business?** Yes | No

If it is "**Yes**" reason(s)	If it is "**No**" reason(s)

15) **Other remarks :**

Appendix D

Date:	Serial No:

Post Implementation - Information Collection Sheet

01) Type of Institute : (use √)

Private	1	Government	2	Semi government	3

02) Contact Details :

Address:	Telephone/Fax	
	E-mail	
	URL	http://

03) Major Field/Business :

04) Usefulness : (use √)

		A (Enough)	B (No enough)	C (Poor)
I	Information			
Ii	Up to date			
Iii	Accuracy			
Iv	Information Security			
V				

05) How frequent you use BioWEB:

Daily	Weekly	Monthly	Never

06) Usefulness of available Features: (use √)

	Relevant		Usefulness	
	Yes	No	Yes	No
Announcements				
Bio FAQ				
Biotechnological News Search				
Biotechnology Courses				

Biotechnology Dictionary Calendar module				
Course Materials				
Create Profile				
Delete Registrations				
Edit Registrations				
File sharing module				
Funds Scholarships				
Guest book				
Journal				
Members list				
New Registrations				
News Letter Subscription				
Newsletter				
On – line Exams				
Personnel work/study experiences				
Policy Archive				
Policy Downloads				
Policy For Investors				
Policy Making Bodies				
Policy Search				
Post cads				
Profile search				
Publications				
Research Opportunities				
Research Search				
Research Institutes				
Resource Search				
Resources Suppliers				
Review panel				
Scholarships				
Site search				
Top site selector				
Video/audio chat				
Weekly Pool				
Your Responsibilities				

07) Other remarks :
