A Web-based System for Providing HIV Information in Uganda

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A dissertation submitted in partial fulfillment of the requirement for the degree of Master of Science in Computer Science of Kampala International University

Supervisor: Alex Mbaziira

Approval

This work has been done under my supervision and submitted with my approval.

.....

Mr. Mbaziira Alex

Supervisor

Date.....2/11/06.....2006

Declaration

I, Henry Ssebunya, declare that the work herein presented is original and has not been submitted to any other university or institution for any award whatsoever.

Student
.....

Henry Ssebunya
Date....30/10/2006.....

Dedication

I dedicate this work to my family and parents. For, I will be eternally grateful for their contribution to my life.

Acknowledgement

I would like to express my sincere thanks to my supervisor, Mr. Mbaziira Alex for his support and precious advice. During the project development, Mr. Mbaziira Alex provided me with many valuable guidance and suggestions as well as spiritual supports

I would like to further my appreciation to my course mates, for the teamwork we had during this course. Also thanks go to Mr.Nkangi Joseph for the patience and encouragement he gave me at the work place.

Last but not least, I would like to express my appreciation to my brothers and sisters. Thanks also to my wife, Madrin, for her love and support. This project cannot be a success without their constant encouragement and support.

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Abstract

Information and technology are ever-changing characteristics of the world in which we live. This study set out to produce an information system to give a single point of access through a web interface for HIV information. The system development and implementation sought to achieve the following objectives, to develop a web-based Information system to provide comprehensive HIV information, to assess the role of Open Source Software in developing HIV Information System, Provision for downloadable hypermedia information in audio format (podcast) and video format (webcast), To develop a web portal that enhances interactivity between stakeholders of HIV/AIDS Information System. and affordability is another objective for this project, where, some one will just pay a small fee in the café, in order to get some HIV information.

The questions that guided the study were as follows; *Is there any existing web-based information systems providing HIV information? How easy can HIV information be obtained or accessed?*

The study covered HIV non-government organizations (NGOs), schools and the general public in Uganda. Since HIV/AIDS is independent of age, this project focused on age brackets of 13 years+, given the fact that, at that age, people knew how to read, and could use the computer.

The study utilized website usability evaluation methods to determine if their websites are useful and usable. And if they were not, how to make them as such? How to improve their usability? To assess website usability, HIV NGO's refer to various evaluation methods that help in assessing it. There are several evaluation methods to estimate website usability, from simple questionnaires to user testing..

In the findings of the study, the study achieved the objective of developing a web-based Information System to provide comprehensive HIV information. It also achieved the objective of accessing the impact of Open Source Software on the prevalence of HIV in developing countries –case study is Uganda. The study further achieved the objective of Affordability is another objective for this project, where, some one will just pay a small fee in the café, in order to get some HIV information. The study recommends that to add high database functionalities and that to add more content.

Chapter One
Introduction

1.0 Introduction

The emergence of the World Wide Web has raised a new generation of information systems: those combining navigation through a heterogeneous information space with operations querying or affecting that information. The WWW provides simple client-server architecture, and, most importantly, from the point of view of application design, it introduces the hypertext (or hypermedia) paradigm.

The first hypermedia applications, typically distributed in CD ROMs, were thought of as unchangeable applications that were not meant to be maintained or modified for new releases, possibly as a consequence of physical properties of their support media. The evolution of technology, most notably the phenomenal growth of the WWW, has given rise to applications that are constantly modified, that are enriched with new services, and new navigation and interface features are added according to the organization's marketing policy.

In any organization, information is a very expensive resource. By the use of computers different organizations have developed information systems to process their information, in order to generate different reports for different purposes from anywhere. This enterprise-wide computing is based on the notion of bringing most of the computing power of an organization on the desktop. This is mainly achieved through the linkage of different separate networks into an interconnected network, by employing mainly the Internet (Laudon and Laudon, 1996). Thus, the information is dispersed over a large number of interconnected repositories. The World Wide Web "(WWW)"[1] is an information retrieval tool, mainly used to provide a uniform

[1] www (World Wide Web) *is a complete set of documents residing on all Internet servers that use the HTTP protocol, accessible to users via a simple point-and-click system.*

interface for the stored information to the users. Intranets are an enterprise- secure part of Internet technologies, providing security and performance apart from the other benefits of Internet access. Nevertheless, the access to the information is not always an easy task, neither from the part of the information provider, nor from the part of the user. Problems of authoring, presentation, security and performance have to be resolved from the part of the former, whereas problems of data location, relevance and credibility have to be resolved from the part of the latter. Search engine technologies are employed to simplify the process of seeking meaningful content in the WWW.

In developing countries, especially Uganda, the HIV/AIDS problem has become a challenge affecting not only the health but also the security of the population. The UNAIDS, June 2003 report highlights that vulnerability to HIV is often endangered by lack of respect for the rights of women and children, the right to information and education, freedom of expression and association, the rights to liberty and security, freedom from inhuman or degrading treatment and the right to confidence and confidentiality. There is therefore a need for a comprehensive and coordinated approach of the global community to effectively solve this problem.

Although HIV Information Systems are being rapidly developed and are being embraced by many NGO's in developing countries via the web. In Uganda the use of the Web to disseminate of HIV information is a new approach, to control the prevalence of HIV.

1.1 Statement of the Problem

In Uganda, the mode of disseminating HIV/AIDS information has been through traditional approaches, for example meetings, field works and on-clinic visits. Although development of web-based systems is rapidly expanding and they are being implemented in many sectors in Uganda, the development of web-based systems for providing HIV/AIDS information has been impeded by the following:

- It's difficult and expensive to access HIV/AIDS information;-(for example, people don't want , to disclose their HIV status)
- No statistics available-HIV patients, infection rates
- It's quite difficult to determine which level of HIV/AIDS information needs to be stored
- Ignorance of the public about ways of disseminating and maintaining HIV/AIDS information.
- Lack of application software for design and implementation web-based information system.

The problem of this project therefore was what web-based information system would give a single point of access through a web interface for HIV/AIDS information? This formed the onus of this study.

1.2 Project Aim

The primary aim of this project was to produce an information system to give a single point of access through a web interface for HIV information.

1.3 Project Objectives

The system development and implementation sought to achieve the following objectives,

1. To develop a web-based Information system to provide comprehensive HIV information

2. To assess the role of Open Source Software in developing HIV Information System.

3 Provision for downloadable hypermedia information in audio format (podcast) and video format (webcast)

4 To develop a web portal that enhances interactivity between stakeholders of HIV/AIDS Information System.

1.4 Research Questions

This research attempts to answer the following question:

Can written audio and video formats be provided in web interface for the provision of HIV/AIDS information?

1.5 Significance / Justification of the Study

It is hoped that the findings of the study will:

i) Enlighten the public about the dangers of HIV/AIDS in order for them to safeguard themselves against the epidemic

ii) Assist doctors, counselors and health workers at the different HIV/AIDS clinics or NGO's in disseminating HIV/AIDS Information to the public/those affected.

iii) Enable scholars in different schools get more knowledge or information about HIV/AIDS.

iv) Enable the Government of Uganda to develop policies and systems to nurture and curb the spread of HIV/AIDS.

1.6 Scope of the Study

The study mainly covered HIV non government organizations (NGOs), schools and the general public in Uganda, Since HIV/AIDS is independent of age, this project focused on age brackets of 13 years+, given the fact that, at that age, someone knows how to read, and can use the computer. With the introduction of tele-centers in different districts, then it will be for the urban and the rural population. Because of

time constraint, the web-based information was developed, but its back-end database was not populated.

1.7 Research Methodology

The study adopted an evaluative research design. Under this design, the study utilized website usability evaluation methods to determine if their websites are useful and usable. And if they were not, how to make them as such? How to improve their usability? To assess web portal usability, HIV NGO's refer to various evaluation methods that help in assessing it. There are several evaluation methods to estimate website usability, from simple questionnaires to user testing. This study was descriptive in nature using a telephone interview, questionnaires, and the survey used a random sample basing on Organizations dealing in HIV/AIDS

Chapter Two
Literature Review

2.0 Introduction

Information Systems is the discipline concerned with the development, use, application and influence of information systems. An information system, following a definition of Langefors (1995), is a technologically implemented medium for recording, storing, and disseminating expressions or information, as well as for drawing conclusions from such expressions. The technology used for implementing information systems

by no means has to be computer technology. A notebook in which one lists certain items of interest is, according to that definition, an information system. Likewise, there are computer applications that do not comply with this definition of information systems. Embedded systems are an example. A computer application that is integrated into clothing or even the human body does not generally deal with linguistic expressions. One could, however, try to generalize Langefors' definition such as to cover more recent developments.

The role of information systems in curbing the HIV/AIDS; First of all these systems, do convert the different raw data at different places in knowledge/ information for people to access.

Lack of knowledge HIV/AIDS, is another problem, so the role of these information systems, is to disseminate HIV information. This makes people aware of the cause, effects, types of HIV, Medications available, etc.

2.1 Benefits of a Web-Based System

Web based information system has the ability to communicate in a user friendly way. Since the HIV information on the web is in simple, understandable language.

The ability to have access to HIV information at low cost is another benefit for a web-based HIV information system.

Availability is another benefit for an HIV web-based information system, where users can access that information 24/7 any time from the web.

Provision of information in different formats, i.e. podcasts and webcasts is a benefit of web-based information systems.

Another benefit a web based information system, provides is support/free consultancy. Given that the system will not have any security features for those, who need to access such information?

2.2 Architecture of Web-Based Information Systems

The development of a web-based information system lies on the architecture of the three levels; namely global, local and atomic level. The global level is used to describe the Web-based Information System as a whole, the local level, used to describe each Web site and the atomic level dealing with each specific resource. It is important to note that each of the three levels can be viewed either isolated from its higher levels or in relationship with them. Furthermore, each of these levels can be viewed from three different perspectives: Conceptual, Logical and Physical.

The conceptual model provides a description of information with a way, which is very close to the perception of the user; the physical model deals -more or less- with the details of storage and access of the information. Between these two extremes, the logical level hides several implementation issues but can be directly represented in a computer system in order to be able to both give an intuition of the data organization to the users and be close to the physical details of the organization. In the sequel, below is the description of these models for each level and perspective in more detail.

2.2.1 The Conceptual Perspective

In the conceptual perspective, an abstract, high-level representation of the Information domain is provided.
The most commonly used model for the conceptual representation of an application domain is the Entity-Relationship (E-R) model (Chen, 1976). Since the E-R model is a well documented, established and powerful model, it is normally chosen to be used for the conceptual representation of a Web-based Information System for all its levels. Entities mostly provide patterns for the organization of information in Web pages, whereas relationships mostly determine navigational paths between these pages. We will distinguish between the different levels of granularity of the conceptual perspective.

At the upper level, the global conceptual model exists. The global conceptual model represents the overall information domain covered by the distributed Web-based Information System. At each site, a local conceptual model exists, representing the information found at the specific site. Finally, each resource can have its own conceptual model for the high level representation of its contents and structure. This approach is open in order to incorporate the cases where the information of an organization is distributed across various Web sites -which by definition are semantically related to each other. Therefore the global conceptual model should be the central reference model of the organization instead of considering it as the union/merge of the conceptual models of the lower levels.

This approach provides the organization with the potential to detect anomalies in the design at each level, since a global conceptual model can capture the relationships between different parts of information, distributed in different Web sites.

The same rule can be applied for the relationship between the conceptual models of systems sites and their resources. The relationship between two different Web pages, for example, can be modeled at the local level and not at the atomic one -

therefore it is wiser to deal with the conceptual content of the specific pages in the context of an overall, local conceptual content, rather to do it the other way around.

In Figure 1 the conceptual perspective of a Web-based Information System is presented.

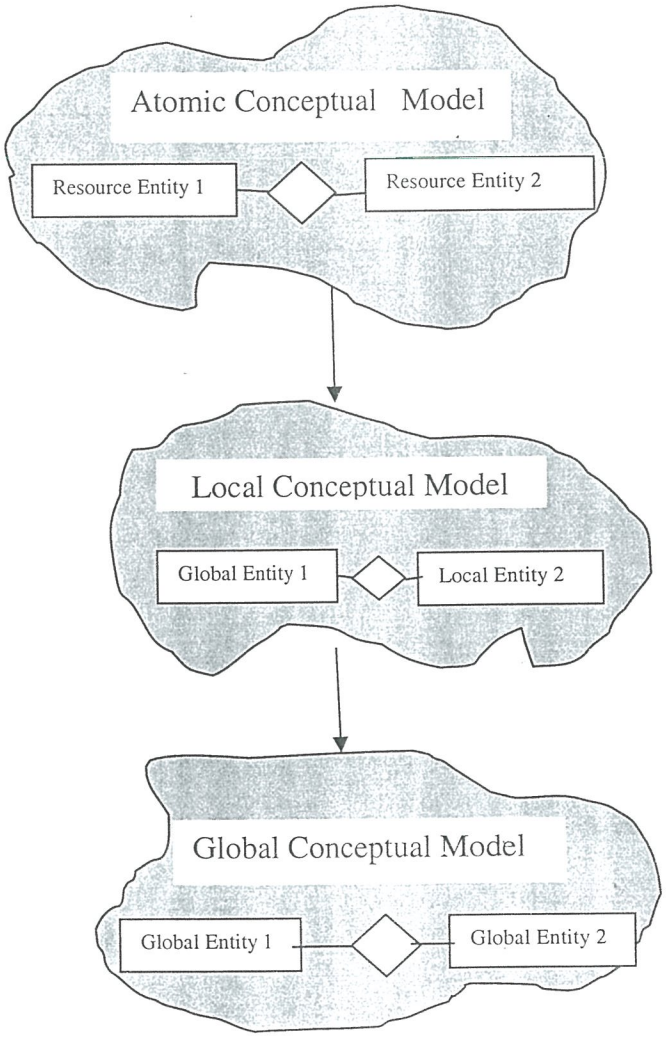

Figure 2.1 The Conceptual perspective of a Web-based Information System

2.2.2 The Logical Perspective

In the logical perspective, one should try to determine how the conceptual model of a Web-based Information System can be organized in abstract structures,

independent from the physical attributes, yet close to the actual representation of the information. In the atomic level we consider that a logical schema can exist for a resource. Focus was made on the logical schemata of Web pages. The logical schema of a Web page defines its internal structure. In all markup languages for documents, tags are embedded in the text, either for semantical or for presentational reasons. HTML has mainly presentational tags; consequently the logical structure of HTML documents (denoted by the parse tree of each document) mainly concerns their presentation. On the other hand, XML is based on a logical scheme (also denoted by the parse tree of each document) which is oriented more towards the semantical structure of the document; in that sense it is very close to the conceptual perspective of the document.

As far as the local level of a Web site is concerned, although there exists several proposals for logical models, there does not seem to be a common agreement on one of them. Consequently, therefore a common platform for such models was derived. This approach is based on the assumption that a logical model, based on page patterns and navigational paths can (and must) be the cornerstones of the design of a Web-based Information System. This has already been the approach followed in several other proposals (Isakowitz, Stohr, Balasubramanian, and RMM, 1995; Garzotto, Mainetti, and Paolini, 1995). In the sequel of this section, a description of the minimum requirements for a logical model for a Web-based Information System should fulfill and present the minimalistic approach, which has been taken towards this specification.

The logical model consists of page patterns and link patterns between them. The page patterns can be derived from the entities of the conceptual model, as subsets, conjunctions or unions of different entities. This stems from the fact that the Web pages are not normalized relational tables rather than structures used for the presentation of information to the user; consequently, their content may combine information from various underlying entities. The link patterns can be derived from the relationships -possibly transitive- between entities. The direction and cardinality of a link are important, as well as a description of the link. The links between pages

can be of different types (HTML 4.0 already supports two different types of links, namely "anchor" and "link").

In quest for an open architecture, we do not constrain the model to a single type of links, rather present a generic. In the future, it is anticipated that more types of links will exist in the WWW. XML (Bray, Paoli, and Sperbreg-McQueen, 1998) and its XLink specification (Maler and DeRose, 1998) specify the way links might be provided for the Web pages, if any XML compliant language is used (instead of HTML). The approach was customized to those specifications easily through a specialization mechanism.

It's believed that a logical model is a key component in the design process of a Web-based Information System, and is mainly used by the people involved in this process. Thus, it should be concerned, on the one hand with the representation of conceptual entities and on the other with their internal structure. Consequently, an inherent structure to each page pattern: a Document Type Declaration (DTD) is used to define the syntax of markup constructs through element definitions, to deal with the combination of information within the page pattern.

A logical model with the above characteristics prescribed, offers several advantages to the designer and administrator of a Web-based Information System application. First of all, it is oriented towards the presentation of mixed information from various sources and the support of navigational paths from page patterns -in other words, it is very close to the real world structure of the Web-based Information System. Second, such a model is high level enough to avoid the problem of mixed representation of schema and instance information. This is the main reason for which the models are chosen from different levels in different levels: schema information should be present at the local model, whereas instance information should be present at the atomic level. Furthermore, under this light, updates on specific pages do not always have to directly affect the logical model of the application; on the other hand sometimes this might be inevitable.

As far as the global level is concerned, the objective of a logical model should be to detail the global search space of the organization, based on the global enterprise conceptual model. To achieve this goal a set of Global Queries was provided each global query represents a possible request for information and is related to a set of concepts of the global conceptual model. Obviously, the set of global queries grows incrementally over time. It is not advisable for one to predict all the possible queries from the first moment of the Web-based Information System operation. Rather, we claim, that based on the global conceptual model, one can create a first basis for search on the global information space. The answers to the queries (which can be either page patterns or atomic resources) can be obtained by relating the involved global conceptual entities to the respective patterns or pages.

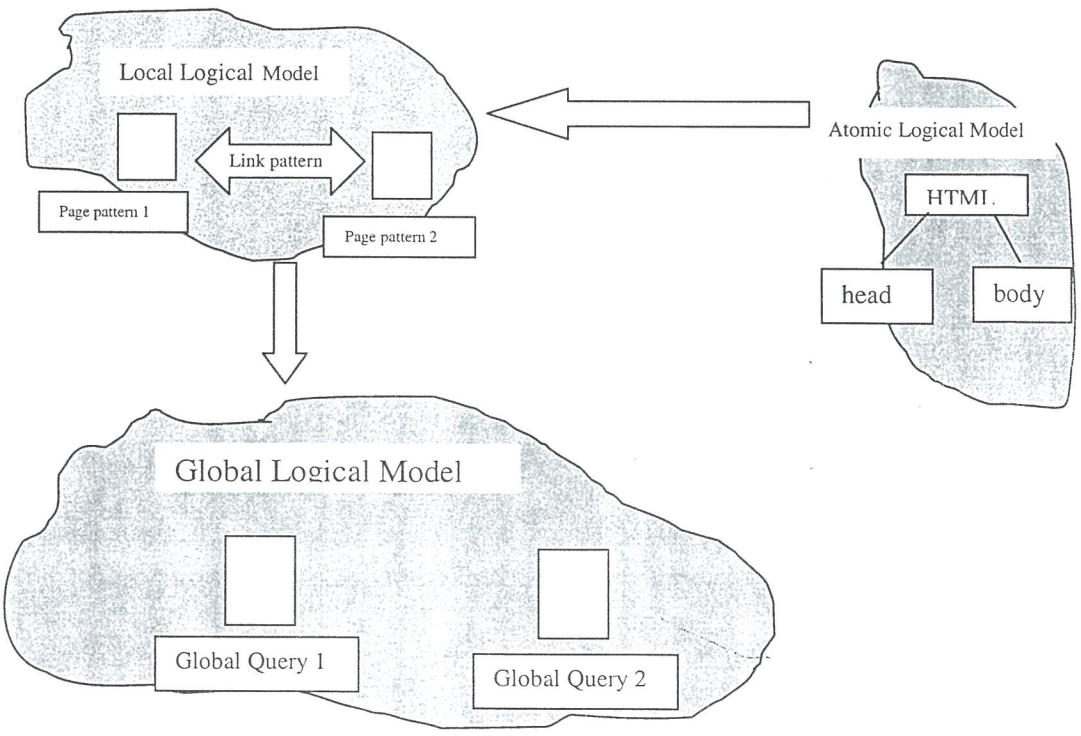

Figure 2.2: The logical perspective of a Web-based Information System

Source: National Technical University of Athens, Greece,Panos Vassiliadis, Yannis Stavrakas

2.2.3 The Physical Perspective

In the physical perspective, the objective is the description of the physical characteristics of the Web-based Information System. At the atomic level, the physical instance of any resource on the World Web Web (WWW) covers two issues: on the one hand, it deals with the location of the resource in the WWW;[2] on the other hand it deals with its physical characteristics (e.g. size, date of last modification, type, and transfer protocols).

As far as the local level is concerned, there exist two main groups of information about the physical characteristics: on the one hand there is the specification of hardware and middleware supporting the Web site (machinery, Web server, proxy, DBMS etc.). On the other hand, there is a description of the physical characteristics of the local information space (e.g. the directory structure served from the Web server).

Finally, at the global level, there may not exist at all any global physical interconnection other than the Internet. In this case, there is no need for physical description of the Web-based Information System at the global level. If, on the other hand, the different Web sites are connected with private lines (e.g. in the sense of a Virtual Private Network), then there can also be a model for the physical description of the overall organization. In Figure 4, the physical perspective is graphically presented.

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[2] World Wide Web

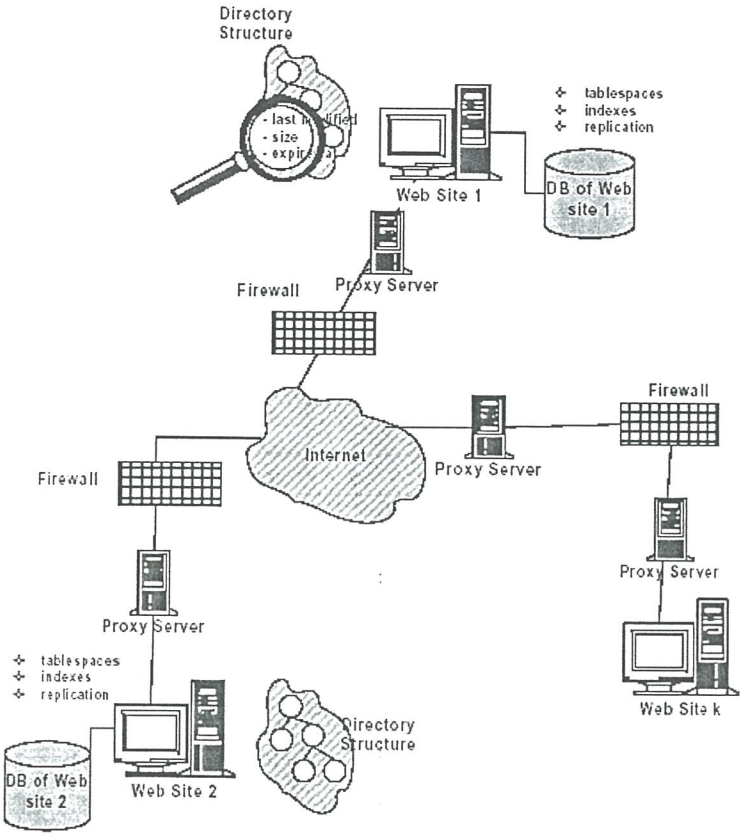


Figure 2.3: The physical perspective of a Web-based Information System

Source: **National Technical University of Athens, Greece, Panos Vassiliadis, Yannis Stavrakas**

2.3 Design Methodologies

There are a number of proposed methodologies for Web-based Information System design, mostly model driven, namely RMM (Relationship Management Methodology), OOHDM (Object-Oriented Hypermedia Design Methodology), UWE (UML based Web Engineering Methodology) and Hera (as illustrative representatives, although there are more approaches dealing with the design of personalized Web applications as for instance XAHM [3] or WebML [4]), and focus on their navigation and adaptation models. Typically, the methodologies consider the design process in terms of process phases and their deliverables, often models.

A typical Web-based Information System design methodology has the following phases:

Requirement Analysis: gathering and forming the specification of the user requirements.

Conceptual Design: constructing the Conceptual Model (CM) for the domain.

Navigation Design: building the Navigation Model (NM) as a navigation view of the application.

Adaptation Design: building the Adaptation Model (AdM) and defining all associated mechanisms.

Presentation Design: defining the appearance of the navigation units and their behavior during user interaction materialized in the Presentation Model (PM).

Implementation: implementing the application.

The problem domain containing the concepts Doctor, painting, and Treating technique and relationships between them, is to be used in order to explain, the different methodologies used for developing web-based information systems as explained below.

2.3.1 RMM - Relationship Management Methodology

RMM is a methodology that covers the navigation design phase and uses the Entity-Relationship (E-R) approach for the conceptual modeling. The NM, in RMM called the Application Model (AM), consists of navigation/presentation units (slices) and relationships among them. Slices represent meaningful chunks of information that typically will be displayed within one web page or a meaningful part thereof. Slices contain sets of attributes from one or more (related) concepts in the CM. For instance, the slice Technique. Detail in Figure 2.4 below has the name and the description attributes from its root concept Technique and an index of name attributes from the Treating concept. The relationships among the slices are of the following two types: aggregations (e.g. exemplified by) used for slice nesting, and references creating (hyper) links between the slices. Slices can contain access structures of the type index (for list access to multiple instances - for instance Painting. Name), or guided tour (for sequential access). Although RMM does not

explicitly support adaptation, it is still possible to manually build multiple application models based on the same conceptual model suiting different users or user groups/platforms.

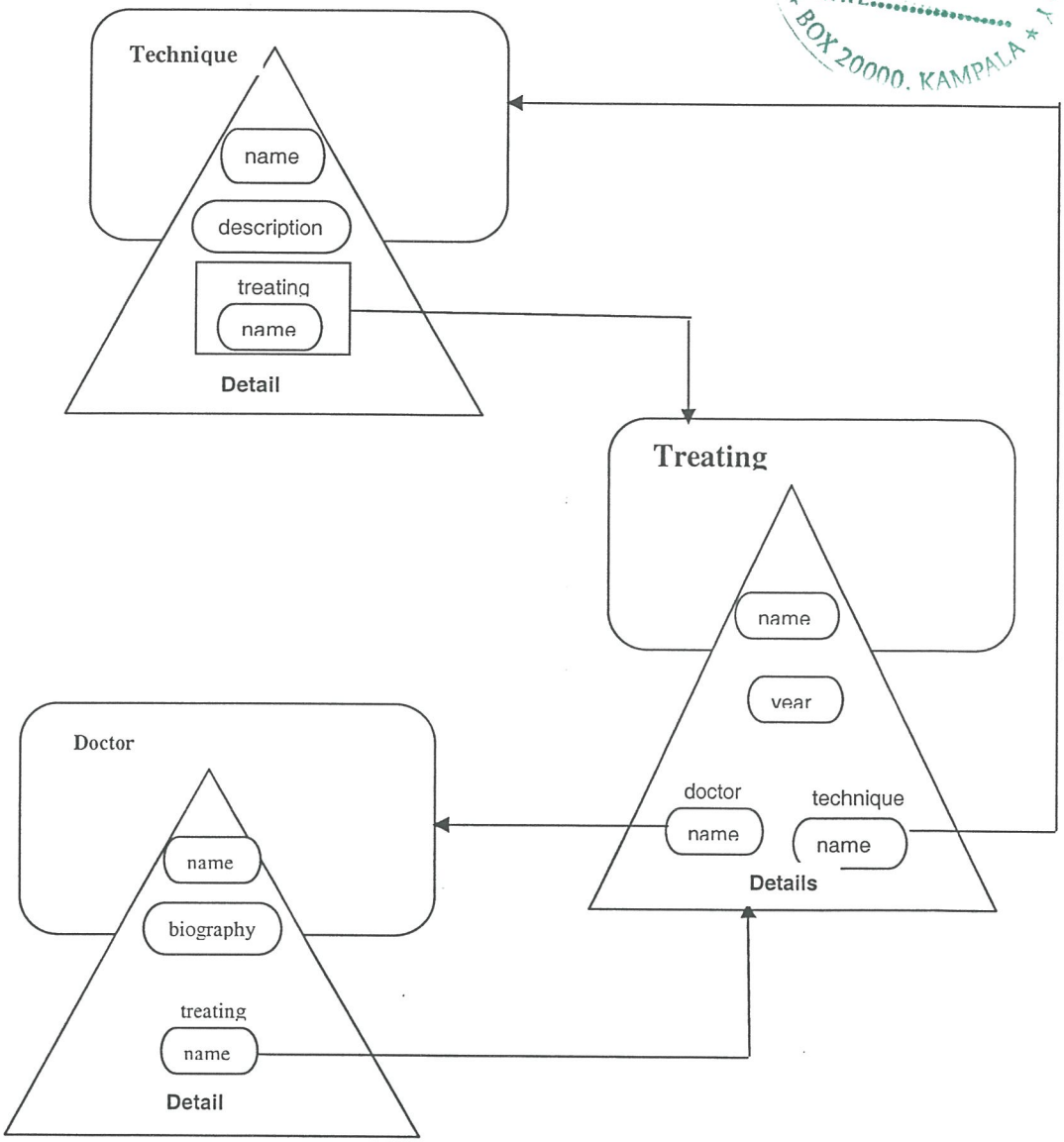


Figure 2.4: RMM Diagram for the above Concept

Source: National Technical University of Athens, Greece, Panos Vassiliadis, Yannis Stavrakas

A strong point of RMM is that the problem domain model is clearly separated from the application (navigation) model: for one conceptual model it is possible to build different relationships between them. Application models. The simplicity of the

methodology and its precise description prove to be a solid foundation for its extensions.

2.3.2: OOHDM - Object-Oriented Hypermedia Design Methodology

The OOHDM methodology represents an object-oriented approach to Web-based Information System design. The NM in OOHDM consists of the Navigation Class Schema and the Navigation Context Schema. The Navigation Class Schema contains navigation classes (nodes) derived from the conceptual classes by selecting and combining attributes from (possibly) different related conceptual classes. Attributes are of the type data or of the type hyperlink anchor. Figure 2.6 gives the navigation class structure of the example. The Navigation Context Schema represents the navigation structure of the application and consists of navigation contexts. The navigation contexts are composed from the navigation classes, hyperlinks, and access structures (e.g. indexes, guided tours, indexed guided tours, menus) and represent collections of navigation classes instances that can be explored in some way (e.g. sequentially). For example, Figure 2.5 shows a particular instance of a Treating technique. The behavior of the navigation contexts (the conditions for instance selection) is specified in context classes definitions.

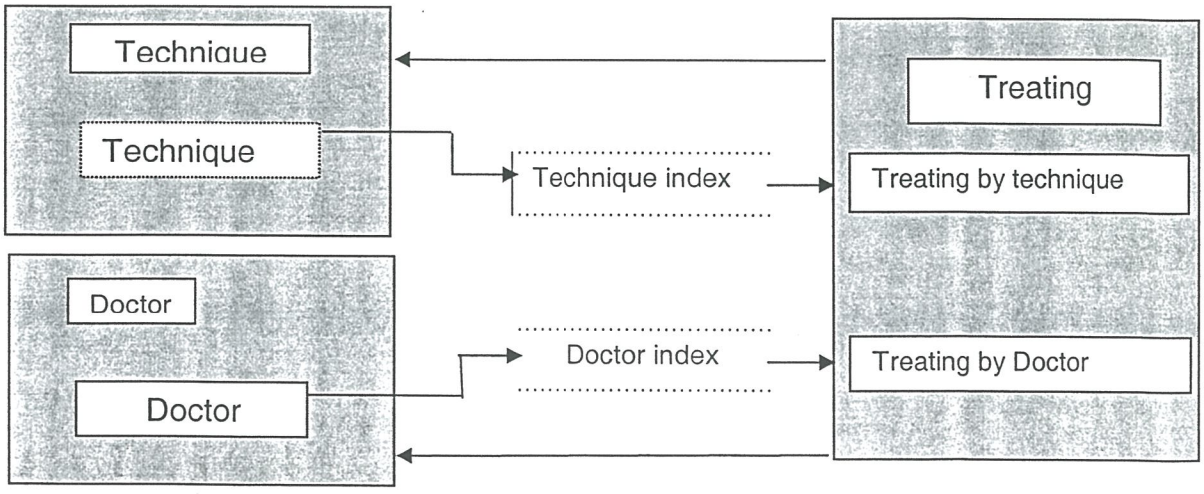


Figure 2.5: OOHDM Example Navigation Schema

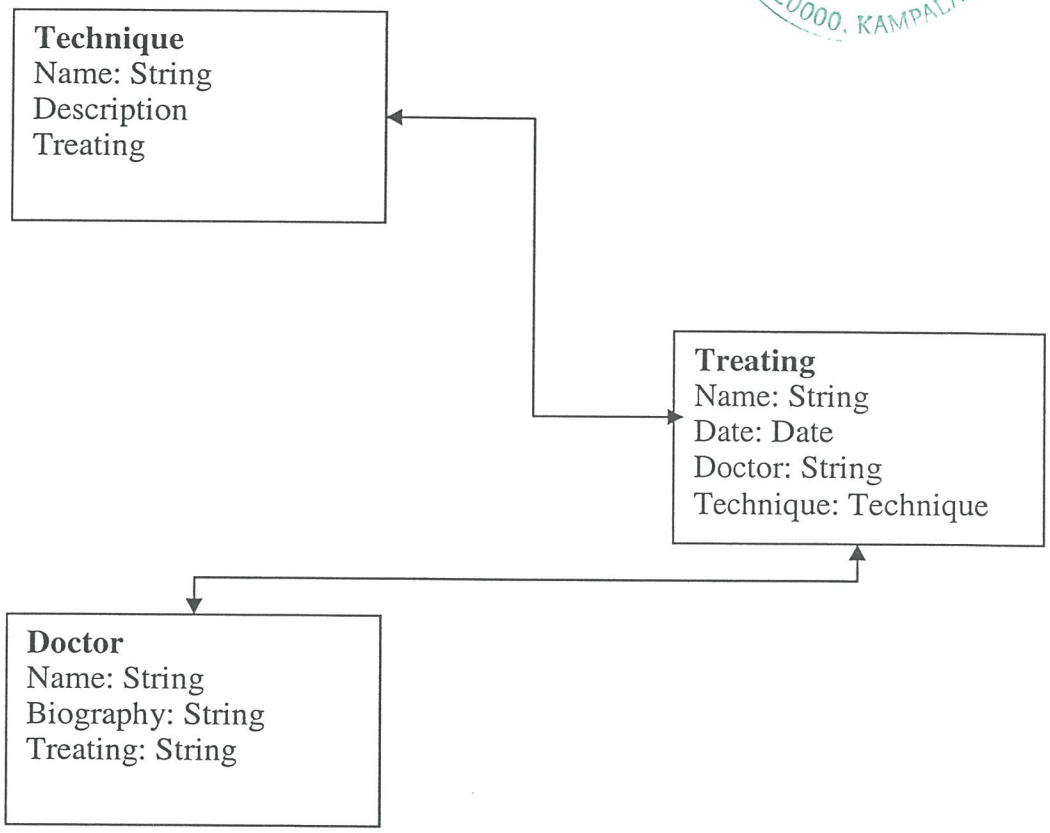


Figure 2.6: Navigation Class Structure of the Example

Although a designer can achieve adaptation by realizing multiple NMs (e.g. for different users or user groups) from one CM, there is no specific support for building adaptation in OOHDM. However, there are some proposals for extending OOHDM with adaptation. The approach described in and proposed by the authors of OOHDM) includes only a set of recommendations (and examples) how to achieve different kinds of personalization. The different advised techniques use the OOHDM notation. They are based on the application of object-oriented techniques, on widely used design patterns, and use parameterized navigation context specifications. OOHDM appears to follow the main lines of the object oriented design approach and adds specifically the navigation (and presentation) design to the development

process. Some modeling aspects are formally specified (e.g. temporal logic is used in the definition of contexts) in OOHDM. The conceptual model and the navigation model are clearly separated.

2.3.3: UWE - UML based Web Engineering Methodology

UWE represents another object-oriented approach to Web-based Information System design. UWE is based on the Unified Software Development Process and uses UML notation. The NM consists of the Navigation *Space Model* and the *Navigation Structure Model*. The Navigation Space model consists of navigation classes and navigation relationships between them. The navigation classes are derived from the conceptual classes by selecting and combining attributes from the related conceptual classes (similarly as in OOHDM). The *Navigation Structure Model* enriches the Navigation Space Model by adding access structures (indexes, guided tours, queries, and menus). Figure 2.7 gives the Navigation Space Model and Figure 2.8 gives the Navigation Structure Model for the above Paint Concept.

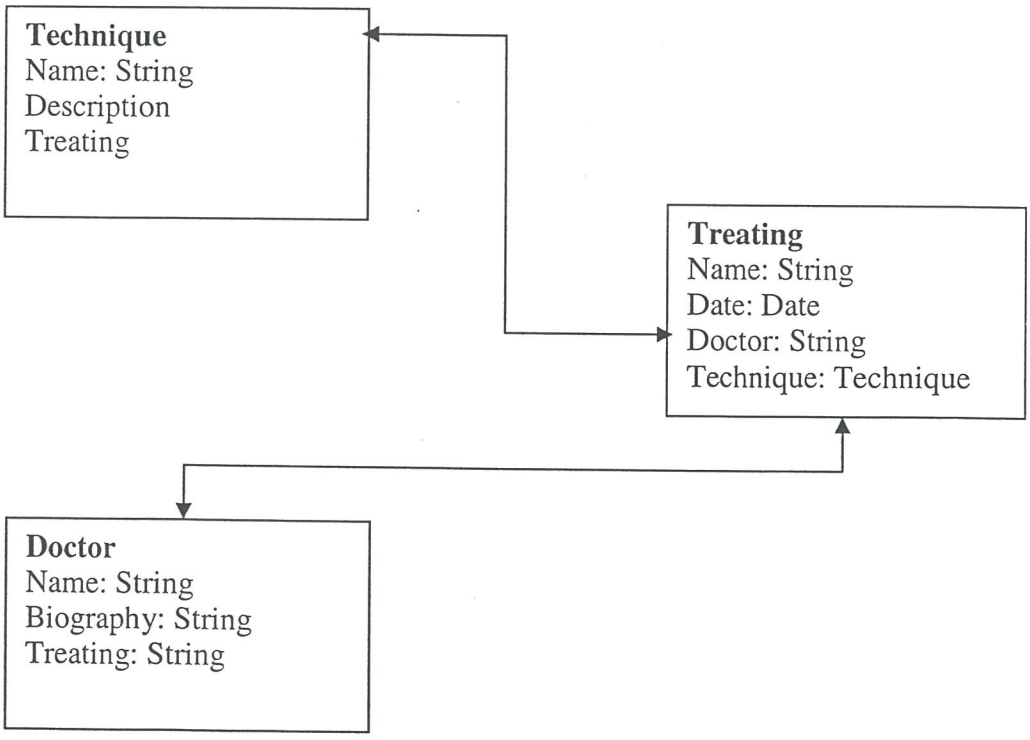


Figure 2.7: UWE Example Navigation Space Model

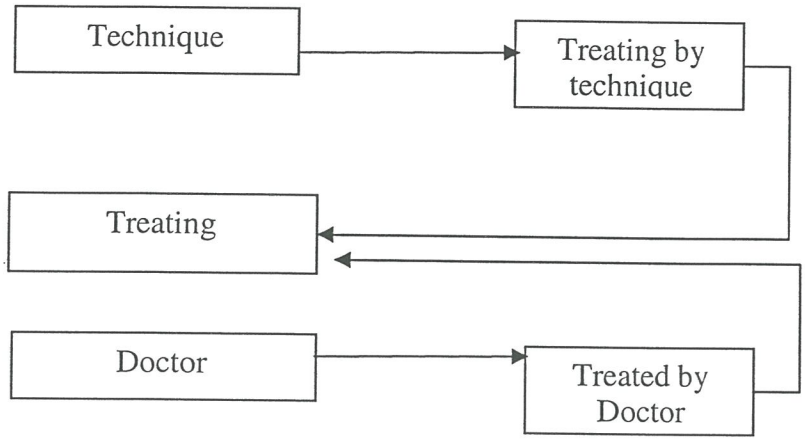


Figure 2.8: UWE Example Navigation Structure Model

2.3.4: Hera

Hera is a design methodology aiming at automated generation of adaptive hypermedia presentations. Hera provides a specification framework supporting the design of a Web-based Information System that generates presentations based on the data retrieved from the data repository in response to a user query. The architecture of a Web-based Information System accordingly to Hera is illustrated by the software suite depicted in Figure 6 and is divided into the three layers as explained below.

- **The Semantic Layer** defines the semantics of the data repository in terms of the CM. Since the data repository is virtual, the data instances are retrieved from external (and possibly heterogeneous) data sources on demand. The Integration Model links the semantics of the external sources to the semantics of CM.
- **The Application Layer** defines the abstract hypermedia structure of the data in terms of the AM. In addition, the Application Layer defines the adaptation in the generated presentation based on the User Model (capturing dynamic features of

the user including browsing history) and the User Profile (capturing static features of the user and his platform).

• **The Presentation Layer** defines the presentation details in terms of the PM that is needed together with the AM for the generation of presentations (possibly for different presentation platforms as for instance HTML or WML). All models in Hera are represented using RDF(S) [1, 13], and queries are in RQL [10]. The CM is built from concepts and concept properties, and both are organized in hierarchies based on specialization. The AM specifies the navigation structure on top of the CM and is based on the Application Model defined in RMM

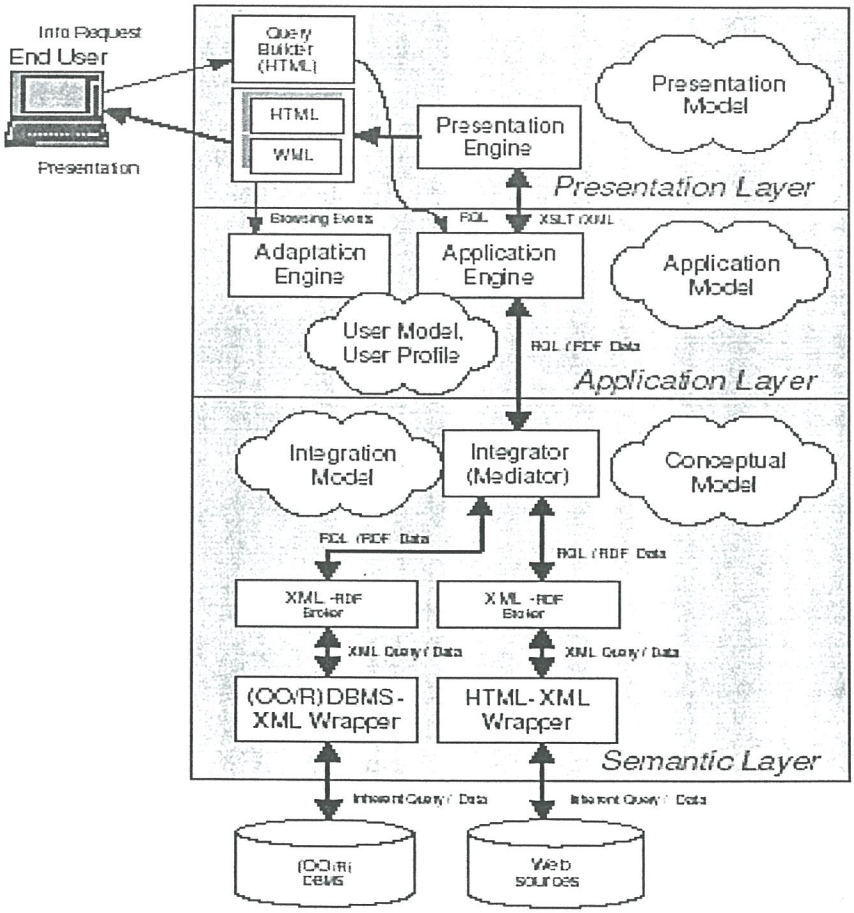


Figure 2.9: The layers of Hera suite

Source: National Technical University of Athens, Greece, Panos Vassiliadis, Yannis Stavrakas

2.4 Website Usability Evaluation Methods

2.4.0 Introduction

"Websites in libraries are now as common as books" (Norlin, 2002). Almost every Library now has its virtual counterpart located on the unlimited Internet. Because of information systems, HIV Information services are as close as a "click of the mouse" (Norlin, 2002). If 10 years ago, having a website was a new trend in providing HIV Information services, today to have a website is the norm for NGO's dealing in HIV. The HIV Information System's website becomes a gateway to its collections and services. This creates new challenges for HIV NGO's. HIV NGO's are challenged with the responsibility of developing a website that will be informative, user-friendly and at the same time efficient and easy-to-use. A good website is a usable and useful website. If these NGO's have a website that is not usable, web users will not return to it. HIV Information System users will excuse the bad looks of a website, but will not tolerate its inefficiency and low level of usability because they become obstacles in meeting the users' needs.

System design and development is often driven by technology objectives, rather than by user needs, which should not be the case with HIV Information System Fortunately, Organizations dealing with HIV, have acknowledged and have been addressing the issue of information system usability. Today, the major question is how these Organizations will determine if their Information Systems are useful and usable. And if they are not, how to make them as such? How to improve their usability? To assess Information Systems' usability, HIV Partners refer to various evaluation methods that help in assessing it.

There are several evaluation methods to estimate a Web-based Information System usability, from simple Questionnaires to user testing. This report will discuss three of the most popular methods:

- Focus groups
- User testing
- Heuristic evaluation.

Additionally, the report will look into what is usability and why it is so important for a Web-based Information System for disseminating HIV information

2.4.1 Definition and Importance of Usability

Before moving to the discussion of the website usability evaluation methods themselves, it is necessary to clearly understand what is meant by the term "usability", how website usability is defined and why website usability is so important.

The International Standards Organization defines usability as a feature that establishes "effectiveness and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment" (std. in Norlin, 2002). According to the Online Guide to Usability Resources, "usability addresses the relationship between tools and their users. In order for a tool to be effective, it must allow intended users to accomplish their tasks in the best way possible.

The U.S. Department of Health and Human Services has defined website usability as the measure of the quality of a user's experience when interacting with a website" (Usability Basics). Nielsen describes website usability as a "quality attribute that assesses how easy user interfaces are to use" (Nielsen, 2002). Website usability is commonly defined by five quality components:

1. Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the website design?

2. Efficiency of Use: Once users have learned the website design, how fast can he or she accomplish tasks?

3. Memorability: If a user has used the website before, can he or she remember enough to use it effectively the next time or does the user have to start over again learning everything?

4. Errors: How many errors do users make, how serious are these errors, and how easily can they recover from the errors?

5. Satisfaction: How much does the user like using the website? (Nielsen, 2002; Murray and Costanzo,1999) point to additional components of website usability: accessibility, appeal, consistence, clarity, simplicity, easy navigation and forgiveness of user blunders (Murray and Costanzo, 2006). The website usability components are usually assessed during evaluation of website usability. Why is website usability considered such an important quality attribute for a website? A good answer to this question is provided by the Online Guide to Usability Resources: From the user's perspective [website] usability is important because it can make the difference between performing a task accurately and completely or not, and enjoying the process or being frustrated.

From the developer's perspective [website] usability is important because it can mean the difference between the success or failure of a website. In both cases, lack of usability can cost time and effort, and can greatly determine the [efficiency of a website]. (Introduction to Usability) "On the Web, usability is a necessary condition for survival. If a website is difficult to use, people leave. If the homepage fails to clearly state what a HIV Information System offers and what users can do on the site, people leave. If users get lost on a website, they leave. If a website's information is hard to read or doesn't answer users' key questions, they leave" (Nielsen, 2006).

"Research by User Interface Engineering, Inc., shows that people cannot find the information they seek on Web sites about 60% of the time. Studies by Forrester Research estimate several costs of bad site design. One of the most striking is the loss of repeat visits from 40% of the users who do not return to a site when their first visit resulted in a negative experience" (Usability Basics). Realizing the importance of website usability, website developers strive to improve this quality attribute by evaluating it with the help of various evaluation methods that aid in determining and eliminating the existing flaws of a website. Some of these evaluation methods were discussed further in the report.

2.4.2 Website Usability Evaluation Methods

Website usability evaluation is "a process of technical investigation, of imagining and hunting down the potential problems or risks that website visitors face" (Kaner and Fiedler, 2005). Health information System and information science literature reveals that there are several different evaluation methods of website usability. All methods can be divided into two categories:

1 Those that collect data from actual website users
2 Those that can be applied without actual users present

The choice of method depended on the cost of evaluation, appropriateness to the project, time constraints, cost of implementation, and cost of training new users (Methods). There were three website usability evaluation methods that were among the most popular. They were focus groups, users testing and heuristic evaluation.

2.4.2.1 Focus Groups

Focus groups are a website usability evaluation method that involves face-to-face discussion between website developers and website users and leads to more qualitative data about a website. Focus groups are one of the best techniques in determining user's wants, expectations or perceived needs (Murray and Costanzo, 2006).

During a focus group session, a small group of users ("the ideal size for a focus group is usually between 5 and 10 participants" (Norlin, 2002) was asked to discuss their reactions and use of the website (Kochtanek and Matthews, 2002). The discussion was recorded, and then analyzed. Focus groups were also conducted electronically, via groupware or informally through e-mail or pre-existing newsgroups (Murray and Costanzo, 2006).

The major goal of a focus group session was to gather the following information: demographics of the participants, general impressions of the website (likes, dislikes, comparisons or contrasts with other sites, etc), new ideas and creative

concepts for the websites, diagnosis of potential problems (i.e., terminology, icons, placement of instructions) (Norlin, 2002). Elaine Norlin has developed sample questions that can be asked during focus group sessions:

1. How often do you access the HIV Information System websites?
2. When you access the HIV Information System website, what are you usually looking for?
3. How often are you successful in obtaining what you want?
4. Which areas of the HIV Information System website are the easiest to use?
5. Which areas are the hardest or most confusing for you?
6. Name two things that you like about our overall HIV Information System website and two things that need improvement. (Norlin, 2002)

This evaluation method has, no doubt, many positive characteristics. However, it has some drawbacks. George Murray and Tania Costanzo believe that while focus groups are a good method for assessing website usability because they are a forum for opinions, they don't show how the user would actually interact with the site (Murray and Costanzo). There is also an opinion that conducting a focus group can be misleading, because some groups can be affected by "group-think" or may simply have irregular views and, as a result, the data collected from the session will not be objective. For this reason, at least two groups should be evaluated for any one project (Methods: Focus Groups). It is often not enough to use only the focus groups method for a thorough website usability evaluation. For this reason, this method is often used in conjunction with some other evaluation method. Usually, focus groups are used as a preliminary technique to user testing (Genius). Norlin (2002) also comments that the problems discovered during focus groups sessions can be additionally examined in depth during user testing evaluations (Norlin, 2002).

2.4.2.2 User Testing

A well-known guru of website usability, Jacob Nielsen, believes that of all existing

methods for studying usability, the most basic and useful is user testing (Nielsen). "User testing is the mainstay method when it comes to finding usability problems. Nothing is more convincing than watching person after person encounters difficulties with the same part of [a website]. The difficult areas that repeat themselves between multiple test participants reveal areas that should be studied and changed by the website developers. User testing can often uncover very specific areas needing improvement" (Methods: User Testing).

According to Nielsen, user testing has three major parts: finding and recruiting representative users of the website audience.

- Performance of representative tasks with the website by users;
- Observance of what the users do, where they succeed, and where they have difficulties with the user interface (Nielsen, Introduction to Usability).

A typical range of website users to participate in the testing is from 5 to 12 representatives (Usability Basics). In user testing, website users complete a set of representative tasks while test observers collect information on behavior, expectations, and other empirical data in order to assess learnability, efficiency of use, memorability, errors and users' satisfaction. "It's important to test users individually and let them solve any problems on their own" (Nielsen, 2006). "The purpose of testing is always to see what is working well and what is not working well - with the goal of improving the site. Usability specialists manage the test, work directly with the users, and take notes; designers, developers, and others also observe - usually from an adjacent room or from a live video and audio stream - and take notes" (Usability Basics). After the notes are collected, they are to be analyzed, and conclusions with recommendations are to be written down. The report with conclusions and recommendations will serve as a result of user testing method. An important factor is to develop an efficient scenario for the testing. The scenario should contain the tasks that directly reflect objectives and goals of the test itself. Norlin's sample tasks described in her work *Usability Testing for HIV Information System Websites* are good examples of representative tasks for HIV Information System website users' testing.

The following are the sample tasks that can be used while conducting user testing in order to assess HIV Information System website usability:

1. Find info about CD4 Count
2. Find out if ARV's have side effects
3. Find articles on the History of HIV In Uganda.
4. What two things helped you the most when using the website?
5. What two things need improvement to help you more easily search the website? (Norlin, 2002)

2.4.2.3 Heuristic Evaluation

While testing with real users is the best way to evaluate website usability, sometimes it can be problematic to find and recruit enough real users for a test. Usability inspection methods and walk-through techniques can serve as excellent additions to user testing. Examples of such techniques are heuristic evaluation, cognitive walk-throughs, pluralistic walk-throughs, feature inspection, consistency inspection, and standards inspection. Fichter believes that heuristic evaluations are worth adding to the toolkit of website usability evaluation (Fichter, 2004). Murray and Costanzo go further to state that heuristic evaluation is most popular usability inspection method in the world of website design (Murray and Costanzo, 2002).

Heuristic evaluation is an examination of the HIV Information System website, based on a set of guidelines for webpage usability. "The goal of heuristic evaluation is to find the usability problems in the [website] design so that they can be attended to as part of an iterative design process" (Nielsen, Heuristic Evaluation). A group of evaluators (usually three to five) who are experts in the concepts of website usability assess whether a webpage complies with recognized usability principles called heuristics (Genius; Fichter; Murray and Costanzo, 2002). "They are called "heuristics" because they are more in the nature of rules of thumb than specific usability guidelines" (Nielsen, Ten Usability Heuristics). Usability principles are usually derived from studies in human-computer interaction, ergonomics, graphic

design, information design, and cognitive psychology (Methods: Usability Inspection).

There are 10 recognized website usability principles that have been identified by Jacob;

1. Visibility of system status;
2. Match between system and the real world;
3. User control and freedom;
4. Consistency and standards;
5. Error prevention;
6. Recognition rather than recall;
7. Flexibility and efficiency of use;
8. Aesthetic and minimalist design;
9. Error recovery;
10. Help and documentation (Nielsen, Ten Usability Heuristic)

The profession of health has recognized Nielsen's website usability heuristics. A proof to this statement is the fact that the set of website usability principles that is used by Online Computer HIV Information System Center.

During a heuristic evaluation the evaluators should work independently. They should identify usability problems and match each problem to the usability principle that it violates. Sometimes, scenarios (list of steps the user would take) are used to assist evaluators to understand realistic tasks. Found problems are rated according to severity (Murray and Costanzo, 2002). The evaluators should also make recommendations for resolving these problems. According to Shelagh Genius, heuristic evaluation method of website usability should be referred to on early website development stages (Genius, 2004).

Murray and Costanzo (2002) note that there are some drawbacks to heuristic evaluation. This type of website usability evaluation does not provide solutions; it simply identifies usability problems. Also, it does not address the positive aspects of

the design (Murray and Costanzo,2002). Despite these drawbacks, heuristic evaluation remains one of the popular website usability evaluation methods.

2.5 Conclusion

Given the unique nature and amazing rate of growth of the Web, it is clear that website usability is an issue that is becoming increasingly important for Health Information System website developers to address. HIV NGO's are now concerned about how their virtual counterparts respond to remote HIV Information System user's demands, how efficient they are for users to use. Today HIV NGO's realize that their web pages can be successful only when they meet the usability criteria of being clear, appealing and easy to use (Murray and Costanzo, 2002). To make sure whether the HIV Information System webpage is useful and usable, HIV NGO's evaluate their web pages in terms of usability. There exist many website usability evaluation methods from simple questionnaires and interviews to users testing. Some of the most useful and popular methods are focus groups, user testing and heuristic evaluation. These methods have their advantages as well disadvantages. The HIV NGO's can use any of them, but for best results, as website usability experts Nielsen, Murray and Costanzo suggest, it is recommended that all three methods are used as a set in order to get an objective and thorough evaluation.

Kaner and Fiedler note that usability evaluation cannot replace good usability design, but it can reveal errors in implementation. Usability evaluation process sometimes might take a lot of time and a large budget. However, if HIV NGO's are interested in developing and maintaining a useful and usable webpage that will certainly contribute to HIV NGO's' credibility and prestige, HIV NGO's should dedicate as much time as needed and find necessary funds for conducting a website usability evaluation (Kaner and Fiedler, 2004).

2.5 Interface Design for Health Web-based Systems

User interface design or user interface engineering is the design of computers, gadgets, appliances, machines, mobile communication devices, software

applications, and websites with the focus on the user's experience and interaction. Unlike traditional design where the goal is to make the object or application physically attractive, the goal of user interface design for health web-based systems is to make the users interaction experience as simple and intuitive as possible-that is often called user-centered design. Where good graphic/industrial design is bold and eye catching, good user interface design is often subtle and invisible.

User Interface design is involved in a wide range of projects from mall kiosks to software applications to car navigation systems to e-commerce sites; all of these projects have some things in common yet also require some unique skills and knowledges. As a result, user interface designers tend to specialize in certain types of projects and have skills centered on their expertise, whether that be software design, web design, or industrial design. What all these projects have in common is, of course, the focus on how the user interacts with the device/system/application.

2.5.1 Processes

There are several phases and processes in the user interface design some of which are more demanded upon than others depending on the project. (for the remainder of this section the word *system* is used to denote any a web-based system website)

- Functionality requirements gathering - assembling a list of the functionality required of the system to accomplish the goals of the system and the potential needs of the users.
- User analysis - analyzation of the potential users of the system either through discussion with people who work with the users and/or the potential users themselves.

Typical questions involve:

- What would the user want the system to do?
- How would the system fit in with the user's normal workflow or daily activities?
- How technically savvy is the user and what similar systems does the user already use?

    - What interface look & feel styles appeal to the user?
- Information architecture - development of the process and/or information flow of the system (i.e. for web-based system, this would be a site flow that shows the hierarchy of the pages).
- Prototyping - development of a wire frames, either in the form of paper prototypes or simple interactive screens. These prototypes are stripped of all look and feel elements and most content in order to concentrate on the interface.
- Usability testing - testing of the prototypes on an actual user—often using a technique called talk aloud protocol where you ask the user to talk about their thoughts during the experience.
- Graphic Interface design - actual look and feel design of the final graphical user interface (GUI) based on the findings developed during the usability testing. This last phase is often handled separately by a graphic designer who also has knowledge in user interface design. However, some user interface designers are also proficient graphic designers.

Chapter Three
Requirement and Analysis

3.0 Introduction

This chapter specifies the requirements for building a web-based system for providing HIV Information in Developing Countries. To be effective, an iterative and incremental process, adopted from Unified Process, is to be used throughout this phase. Two iterations were planed at the start stage of this project. Throughout each meeting with different partners in fighting HIV/AIDs, who double as potential user of this Information. Requirements of the system and uncovered issues, which would be incorporated into the system. Based on this comments, changes of functional and non-functional requirements will be carried out as iteration.

3.1 Requirements Gathering

The potential users of the system are employees in HIV/AID Non-governmental Organizations and the public. Table 3.1 shows the activities that each type of user will use the system for.

3.1.1 Stakeholders Analysis

Table 3.1 User Activities

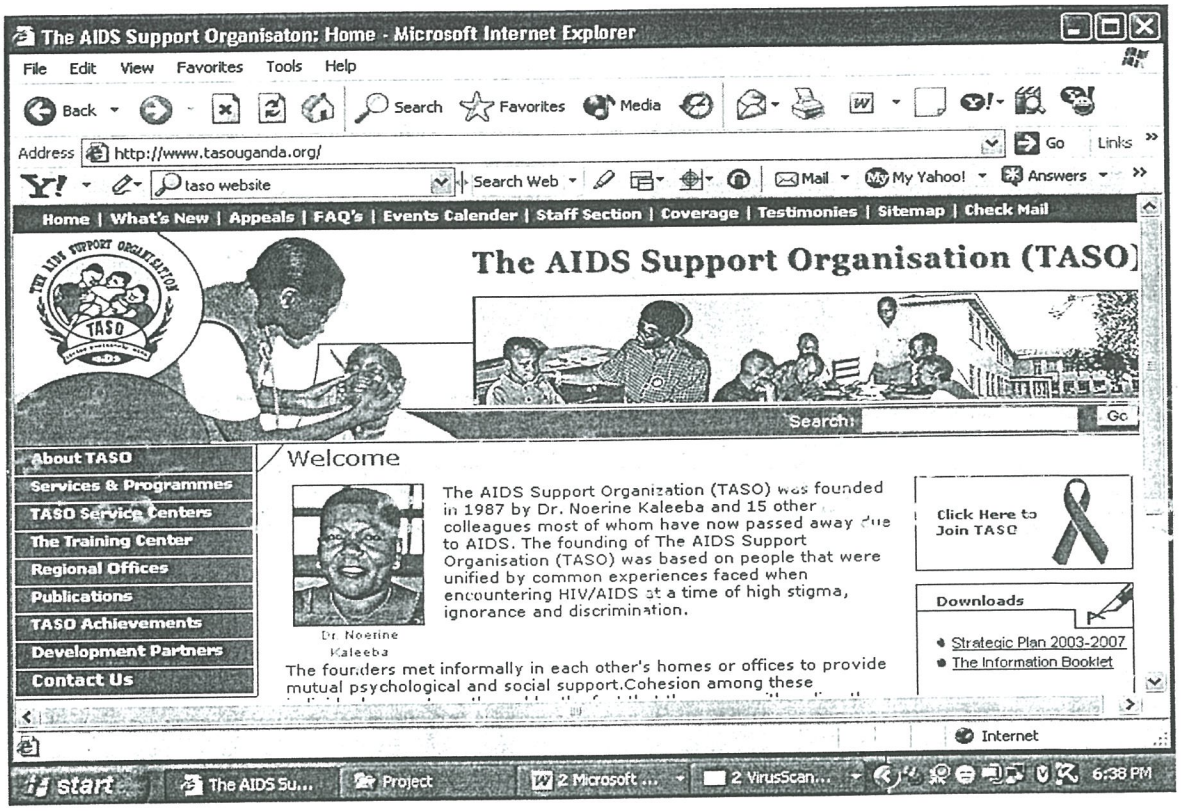
Potential User	Activities performed
NGO's in HIV/AIDS	Disseminate HIV information to the Public
Doctors	Place /upload their findings or update during , their administered drugs

Counselors	Gets HIV information from the system, then transplant, this information to those seeking counseling?
General Public	View HIV information and acknowledge how behavioral patterns impact on the prevalence of the Disease
Uganda AIDS Commission	Responsible for accessing privileged information or tools (Population statistical data)

From the above requirement capture section; users can use the systems to perform activities that provide values to him or her to enhance the provision of such values. These are the requirements of the project.

3.3 Reviewing Existing Web-based Systems

Similar systems reviewed included:



(1) http://www.tasouganda.org

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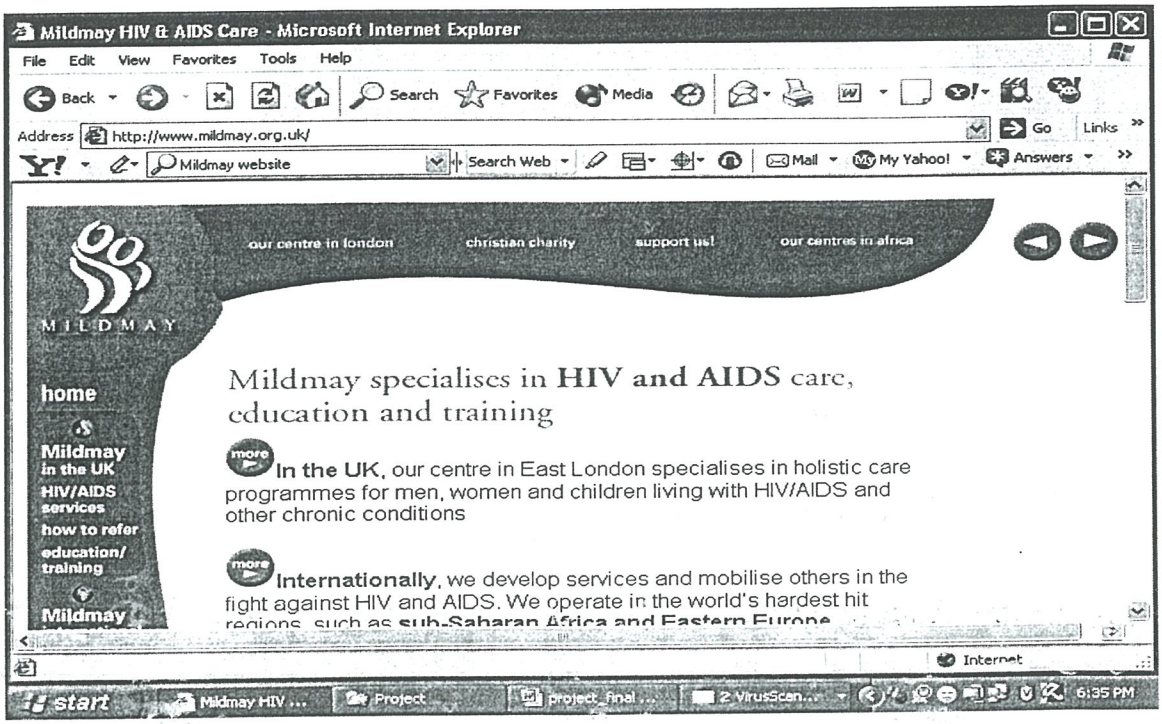
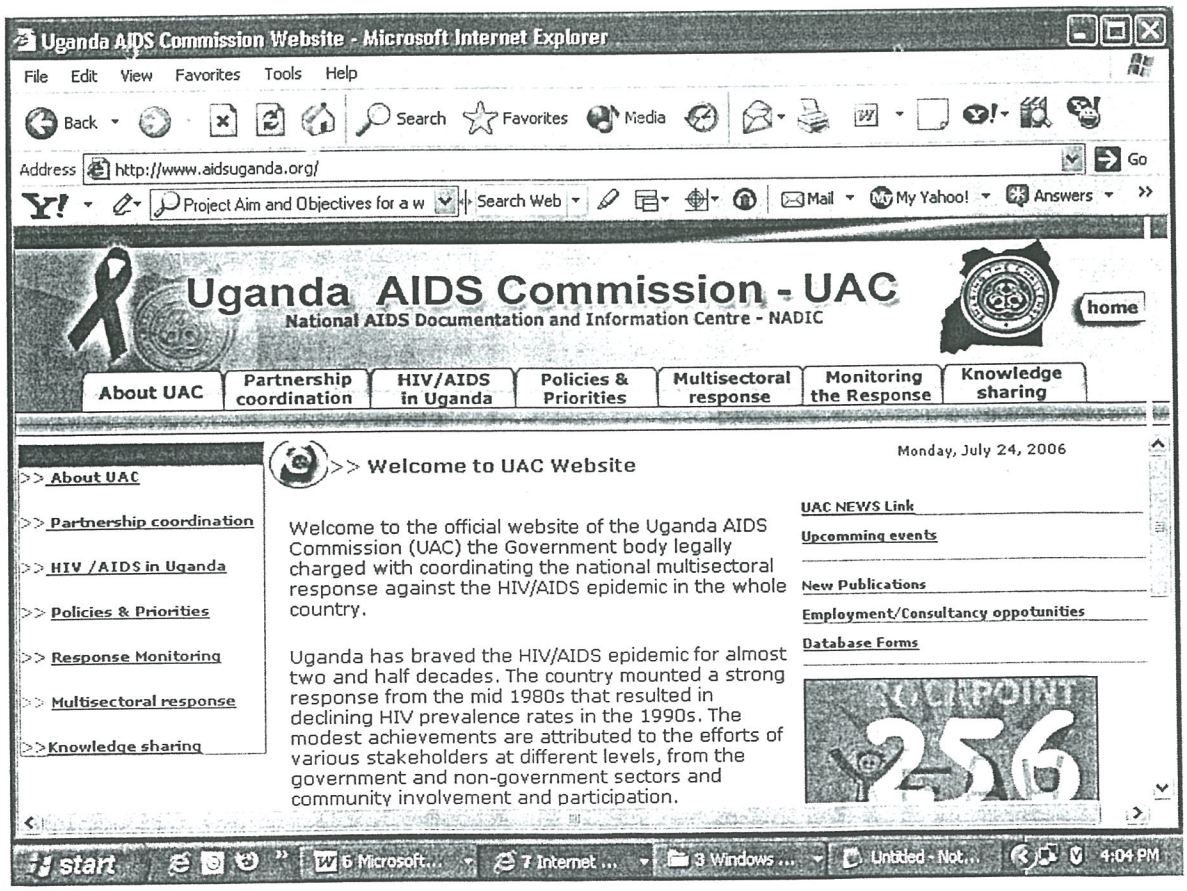


(2) http://www.mildmay.org.uk



(3) http://www.aidsuganda.org/

Considering the above web-portals, viewing the global navigation systems for the above systems (Appeals, Staff Section, Coverage, Testimonies, check mail, about taso, regional office: HIV in Uganda, Response Monitoring etc). The system is missing menus or the following utilities on treatment & care, Vaccines, Clinical Trials, Health Topics, Drugs, Prevention, Diet, Problems and Challenges and ABC Campaign, which are very important for HIV /AIDS information dissemination.

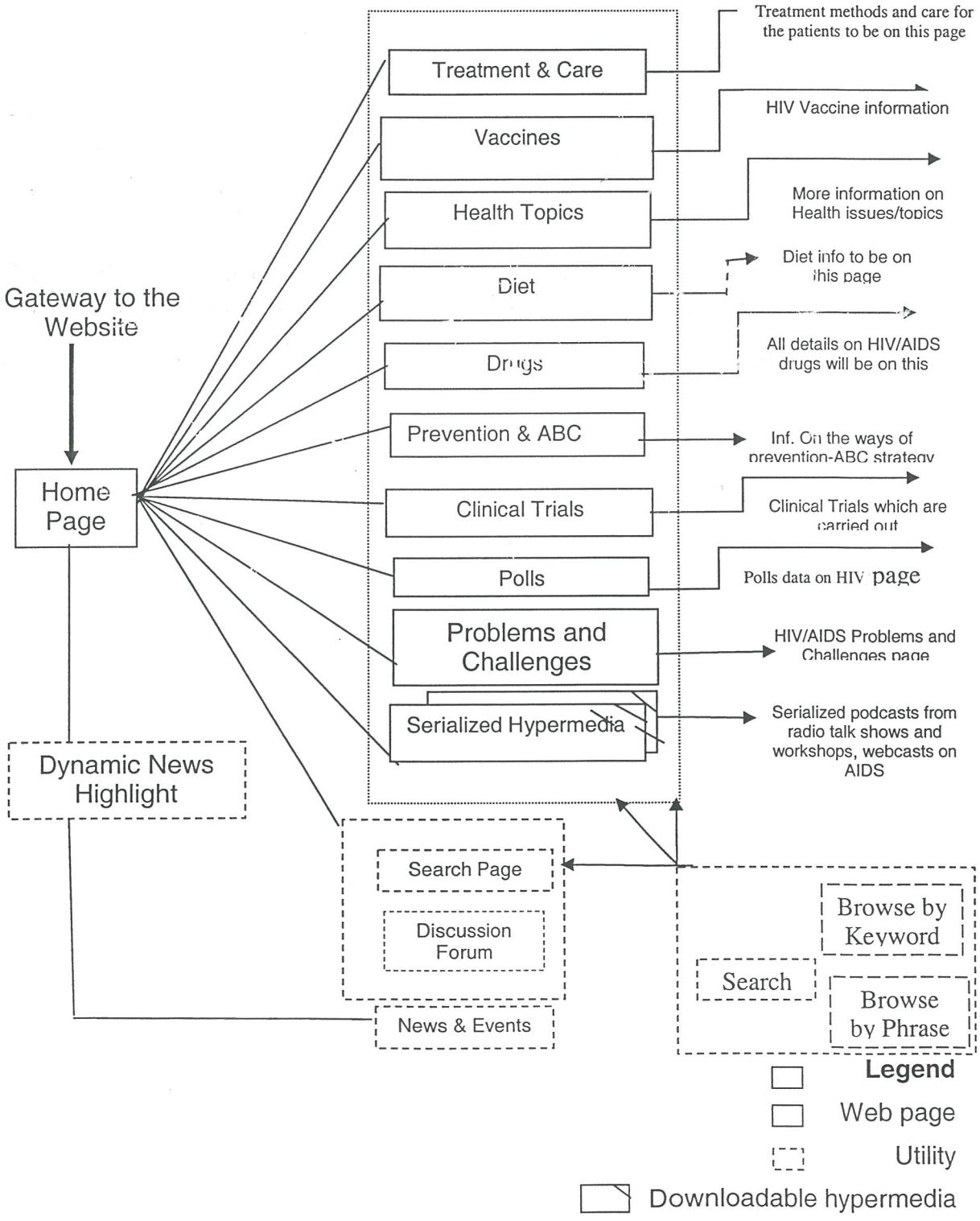
The systems are based on organization's static information page presentation. The information presented in these pages is presented by the NGO Website administrators in HTML format. No centralized data storage is used and data is not stored in a database. Users cannot query dynamic information in the system. Administrators need to generate new presentation page when information is added or updated. All news and announcements are presented in HTML pages. Therefore, no communication is carried out between NGO administrators and the system when they do not have Internet access. The potential users of the above systems are only administrator and web visitors.

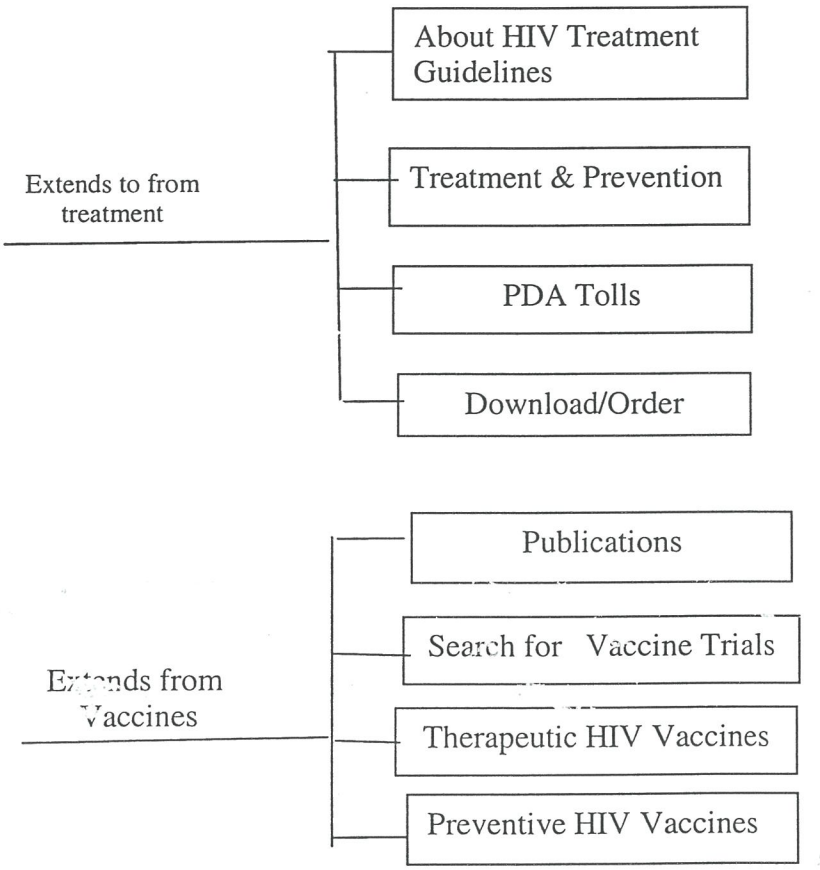
3.4 High Level Blue-Print of the Web-based System Website

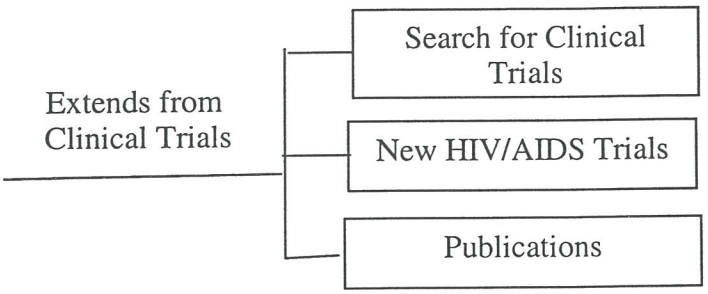
3.4.1 Level 1-Global Navigation System:

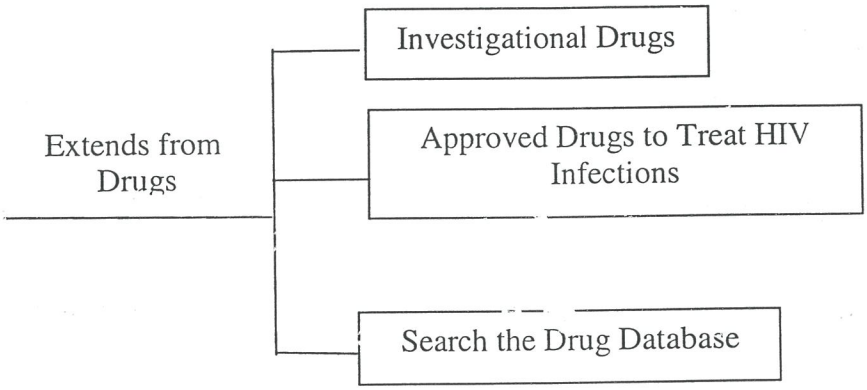
(Treatment, Vaccines, Health Topics, Clinical Trial, Drugs, Prevention & ABC, Problems and Challenges, Contact Us, Search, FAQ's, Administrator, Poll)

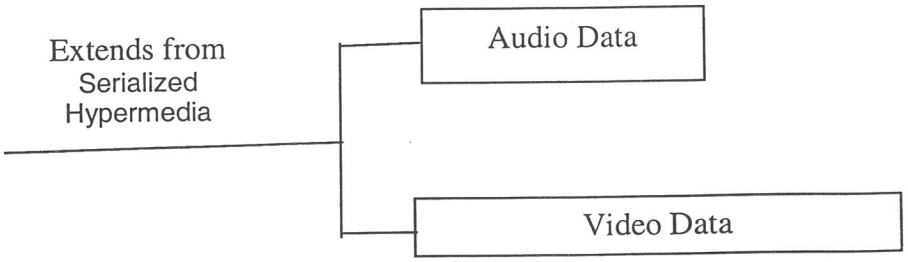
3.4.2 Level 2-Local Navigation System: (About HIV Treatment Guidelines, Treatment & Prevention, Investigational Drugs, Vaccine Trials, Magazines, PDA tolls, Publications)











Chapter Four

System Design and Implementation

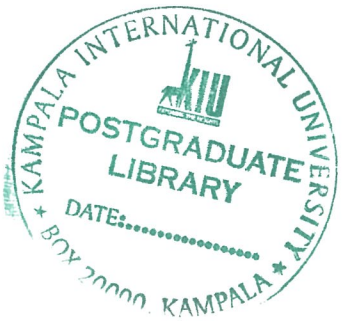
4.0 Website Design for Web-based System

The world has been changing rapidly in respect to technology and needs of its people. Globalization has also fastened the pace of peoples thinking. People currently are not limited to what is available in their neighborhood in terms of information gathering but they also look beyond the horizon. Information has been for a long the reserve of those with resources especially money and time, that is to say, to get information, one had to buy a book. The time resource becomes even more restricting when the book is oversees.

It's a web-based systems that avails everyone an opportunity to information any where, any time while they carry out their other activities.

4.1 Implementing prototype website

This is the first page of the website which acts as an introduction page. This gives the basic information about the site. This page contains hyperlink to other inner pages.
All the pages were designed using Joomla Content Management System



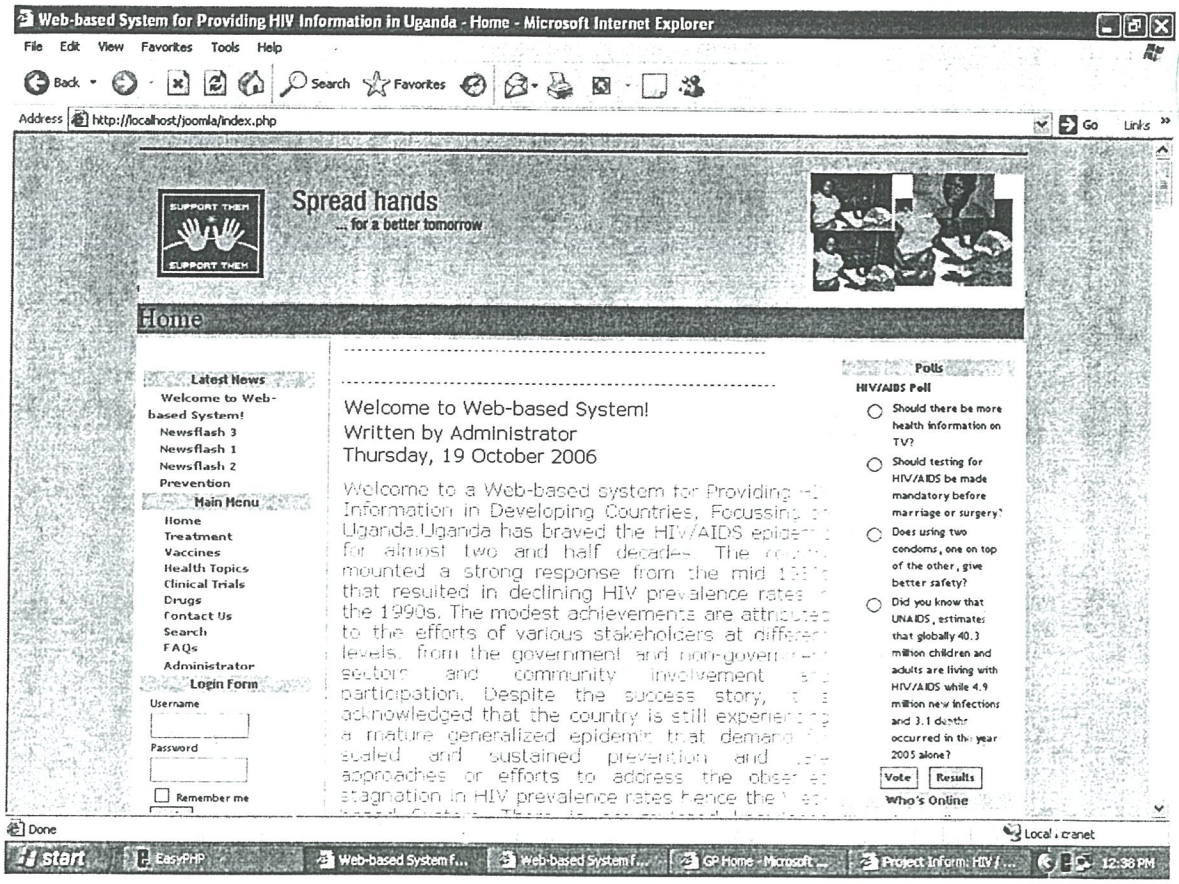


Fig: 4.1Website Prototypes

4.2 Implementing prototype administrator module

This is the default page of the administrator module, which asks for administrator username and password. The username and password obtained from the administrator are checked against the database. If successful the administrator will be allowed to login, otherwise not.

This can be done via, a global IP address as shown below:

http://217.113.72.17/joomla/index.php

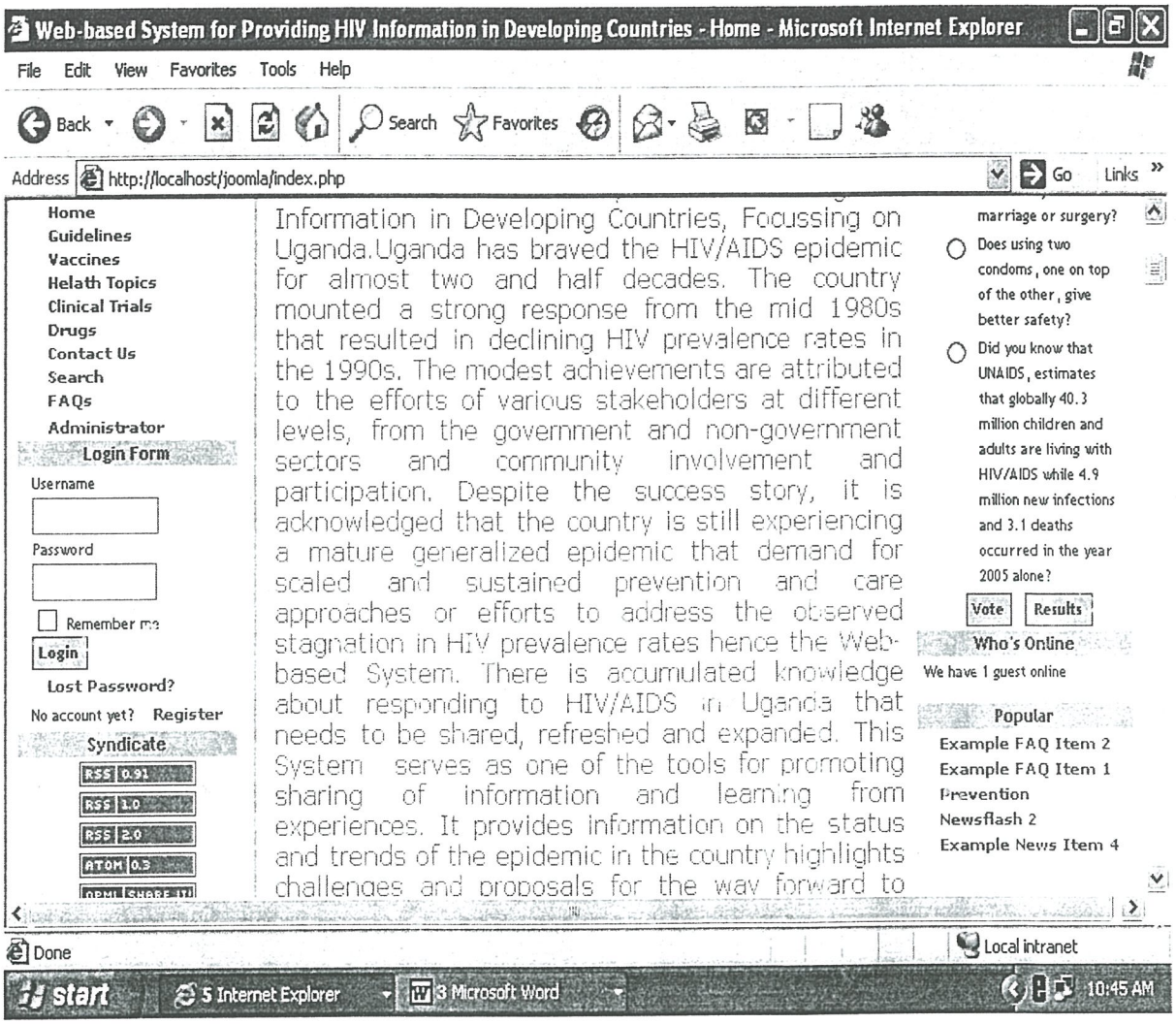


Fig 4.2 Website Prototypes

Chapter Five
Conclusions and Recommendations

5.0 Introduction

The aim of this project was to use component architecture to create a Web-based Information System for Providing HIV Information using Content Management Systems (Joomla and Mambo with the help of Apache, PHP and MySQL database). By using these technologies, reusability and extensibility issues could be achieved to evolve the system. User interfaces could adapt to the changes by modifying the modules or components of the website. Although time spent on designing and implementing components was longer than traditional design and implementation, the time spent on future changes would be saved. And this is one of the advantages of building a web-based Information System using component architecture

5.1 Summary of Objectives, Problems and Challenges

The objectives of the project were to:

1 To develop a web-based Information System to provide comprehensive HIV information
2 To access the impact of Open Source Software on the prevalence of HIV in developing countries –case study is Uganda
3 The system should collect data from partners involved in HIV, and different reports can be generating from the system
4 Affordability is another objective for this project, where, some one will just pay a small fee in the café, in order to get some HIV information.

Objective 1 and 4 were successfully achieved while the rest were partially completed in this project. Capturing requirements were achieved and presented in Use Case Diagram in Chapter 3.

The major challenges of this project were:

1 Designing a normalized MySQL database to support the system
2 Integrating components to make a database driven working system

4.2 Recommendations

1 To add high database functionalities
2 To add more content
3 Further research should be conducted into how health workers can adapt to the Web-based System for disseminating HIV Information and integrate the system with PDA's for easy access.

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APPENDIX A- QUESTIONNAIRE

KAMPALA INTERNATIONAL UNIVERSITY

THE SCHOOL OF POSTGRADUATE STUDIES

QUESTIONNAIRE FOR EMPLOYEES AT DIFFERENT ORGANIZATIONS DEALING WITH HIV AND THE GENERAL PUBLIC

Preamble

The purpose of this questionnaire is to find out information regarding benefits and availability of Web-based information systems. The findings from this research will be used for academic purpose.

Confidentiality

All information provided herein will be treated with strict confidentiality.

Instructions

Please kindly complete the questionnaire with as accurate information as possible. Tick the correct answer of your choice and fill in the blank spaces.

.

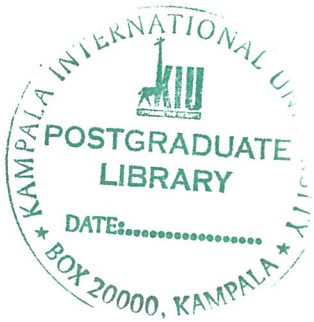
1. To help us evaluate your answers, please indicate by ticking

a) Your computer experience.

1 year or less
2 years
3 to 4 years
5 to 9 years
10 years or more

b) Your job experience.

1 year or less
2 years
3 to 4 years
5 to 9 years
10 years or more



2 Your primary activity.

Sales Engineer
Systems Engineer
Field Engineer
Professional Services
Customer Services
Manager
Other (please specify) _____

2. When you receive a new information system, what are your preferences for finding out initial information about it?
Rate the following from 1 = "most preferred" to 8 = "least preferred. Leave blank any information sources that you do not use at all.

__ Audio Cassette Tapes
__ Printed Documentation
__ Web-based Tutorials
__ Commercial Advertisements
__ Training Videos
__ On-line Documentation
__ Corporate Seminars
__ Other (please specify)

_____

_____

3. Using the following scale evaluates the usefulness of the above system, you have chosen:

a) Very Useful
b) Useful
c) Not Useful

5 4 3 2 1

4. Consider the information system you preferred. How accessible and available is the system?

5. Consider the information system that you do not prefer. What makes them not valuable for you?

6 Using the following scale evaluate the information system that you have had here.

Excellent.....Poor

5 4 3 2 1

Accuracy_____

Clarity_____

Completeness_____

Organization_____

Ease of Use_____

_____

_____

_____

_____

7. What are the best aspects of the information system offered here?

8. What are the worst aspects of the Information system offered here?

9 How would you improve the Information System offered here?

10 Have you ever accessed any web-based system, providing HIV information?

11 What are the best features of that web-based information system?

12 What were the worst features or aspects of that web-base information system?

10. What other feedback would you like to provide to system developers of such Systems?

APPENDIX B-Project Code

PHP Code for the Web-based System

index.php

```
<?php
/**
* template_name - Mambo 4.5.1 template
* @version 4.5.1
* @copyright (C) 2004 by yourname
* @license licensce info here
*/
defined( '_VALID_MOS' ) or die( 'Direct Access to this location is not allowed.'
);
$iso = split( '=', _ISO );
echo '<?xml version="1.0" encoding="'. $iso[1] .'"?' .'>';
?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
 <head>
  <?php if ( $my->id ) initEditor(); ?>
  <meta http-equiv="Content-Type" content="text/html; <?php echo _ISO;
?>" />
  <?php mosShowHead(); ?>
<?php echo "<meta name=\"author\" content=\"www.mambosolutions.com\"
/>" ?>

  <?php echo "<link rel=\"shortcut icon\"
href=\"$GLOBALS[mosConfig_live_site]/images/favicon.ico\" />" ; ?>
  <link href="templates/bereaved/style.css" rel="stylesheet" type="text/css"
/>
 </head>
```

```
</head>

<body>
<table width="784"  border="0">
 <tr>
  <td                background="templates/bereaved/images/header.jpg"><div
align="center"><br />
   <img   src="templates/bereaved/images/header-image.jpg"   width="778"
height="117" /></div></td>
 </tr>
 <tr>
  <td><div id="header"><?php mosPathWay(); ?>
  </div></td>
 </tr>
</table>
<table width="784"  border="0">
 <tr>
  <td width="20%" valign="top" bgcolor="#FFFFFF">      <div id="navlist">
</div>
   <div id="navlist">
    <?php mosLoadModules ( 'user1' ); ?>
  <?php mosLoadModules ( 'left' ); ?></p></div></td>
  <td valign="top" bgcolor="#FFFFFF"><div id="middle">

      <div id="line"></div>
   <div id="middleleft">
    <div id="forlinks">
         </div>
    <h6>
     <?php mosMainBody(); ?>
    </h6>
   </div>
```

```
    </div></td>
  <td width="15%" valign="top" bordercolor="#ECE9D8"
bgcolor="#FFFFFF"><div id="navlist">
    <?php mosLoadModules ( 'right' ); ?>
    <p>
     <?php mosLoadModules ( 'user2' ); ?>
    </p>
  </div></td>
 </tr>
</table>
<table width="784"  border="0">
 <tr>
  <td><div align="center"><div id="footer">
    <?php include_once('includes/footer.php'); ?>
  </div></div></td>
 </tr>
</table>
<p> </p>
</body>
</html>
```