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Adaptation of Web Services Based on User Preferences & User Evaluation

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learning society*
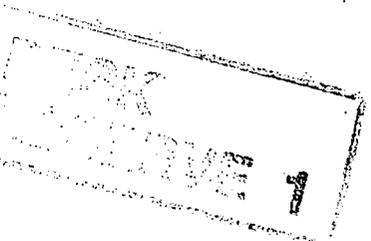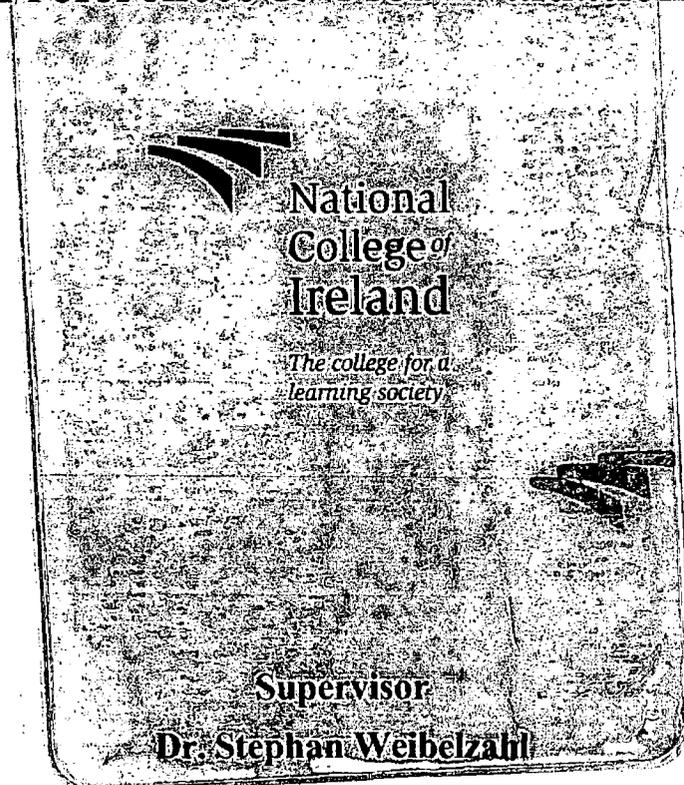
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Technologies, September, 2011

I hereby certify that this material, which I now submit for assessment of the programme of study leading to the award of Master of Science in Learning Technologies is entirely my own work and has not been taken from the work of others save and to the extent that such work has been citied and acknowledged within the text of my work.

Signed: Chennupati Gopinath

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Abstract

Adaptive web-based systems aim to adapt the services to the needs of the individual user. Each and every user will have their own preferences and the applications must fit the adaptive environment of those applications. Adaptive systems are attempting to bring personalization to the web, to ensure that both media (content) and services are tailored to the user's personal preferences, goals and context thus enhancing the user's experience of the web.

In general the adaptive systems are responsible to offer the service, which fits the environment. Here, the focus is given to the user of different kind. The massive web of data can be accessed through the APIs offered by the service providers in this research idea of building an open model. The adaptation is majorly focusing on proposing a simple model as an initiative and then building an application which satisfies the requirements. Mash-ups are prepared as part of accessing the services from different providers. In the application one can find the unique search hub like structure in the implementation.

Usability of the system or the final product is also a very important and impressive thing to be remembered for the entire design and development of the application. Evaluation the user based on the feedback gathered from the users through usability testing is an asset for the perfect assessment of the proposed web system.

This thesis is trying to design the architecture and define an algorithm to develop adaptation of web services based on the preferences of the users. And also, this is trying to propose new adaptive search functionality to a set of users. This paper also provides an investigation into the design of the application using different possible new web technologies. And also evaluates the user experience with the help of the usability engineering methods. This research allows and opens the gate for the construction of an open model approach for the adaptive web systems.

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I would like to thank Paul Stynes who had take care about the dissertation. I can't stop conveying my sincere gratitude to Pramod Pathak the Dean of computing for the support offered as a Lab Assistant.

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Acronyms Used

Short Form	Abbreviation
WWW	World Wide Web
AHA	Adaptive Hypermedia Architecture
UM	User Model
DM	Domain Model
AM	Adaptation model
HTML	Hyper Text Mark-up Language
XML	Extensible Mark-up Language
SMI	Senso Motoric Instruments
WS	Web Service
API	Application Program Interface
OWL	Web Ontology Language
LOD	Linked Open Data
RDF	Resource Description Framework

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1. Introduction

1.1. Background

Recently, there is huge and enormous increase of content on the WWW. This is because of the emergence of a new generation of social platforms, and this has transformed user interaction and content production on the WWW. The increase of usage of social networking and different blogs, photo sharing's offered by massive providers like Face book, Google, Yahoo, etc opened the gates to publish on web by the user. Social networking has become a massively popular means of communication and interaction online. With sites such as Face book, Twitter, YouTube, Google, Flicker, LinkedIn and Word Press there are over a billion socially active people online today, and that number continues to grow at an astounding rate. This change in emphasis and utilization of the WWW has come to be known as the new generation web. And this social Web will be treated as the new Web (www.kdeg.scss.tcd.ie, 10th -June-2011).

With the ever increasing volume of content on the web, authored for different needs and in different contexts - the user is left with the daunting task of searching, navigating and repurposing these resources for his/her own needs and requirements. Adaptive systems are attempting to bring personalization to the web, to ensure that both media (content) and services are tailored to the user's personal preferences, goals and context thus enhancing the user's experience of the web.

There are already some systems existed like "HeyStakes" invented by Dr.Barry Smyth (2008) on personalization and adaptation. This will produce the search results combined from Google, Yahoo, and MSN. This is community based search approach, where the results o the previous search will be stored and will be used in the next run (Maurice Coyle and Barry Smyth, 2008). And the proposed research is to try and bring that kind of personalization with an aim to achieve the possible ways for creation of an open model for adaptive web systems. But, this project will not involve the concept of search history to be used any more, which is a big differentiating point from the existing systems.

Making use of this content in web and satisfy the user with their needs will result in the creation of the adaptive web systems with personalization, making the user as the centre of attraction. In this research project the goal is to find the pitfalls of the open model approach and the technologies used to achieve this open model along the lines of brining user experience as the focal point.

The importance and benefits of involving users in the design and evaluation of adaptive systems has been advocated for a long time (Chin, 2001; Weiblezahl, 2001, 2005; Masthoff, 2002; Gena 2005; Gena & Weiblezahl, 2007). Designing and developing a user centered adaptive web system can be of great use and satisfies the user's preferences and the needs. The problem of inconsistency can be resolved just by following the user centered evaluation process especially for this kind of personalized adaptive systems.

Evaluation of the adaptive web systems can be done by decomposing and evaluating it in a piece wise manner. Separating the evaluation of different aspects can help to identify problems in the adaptation process (Paramythis, Weiblezahl & Masthoff, 2010).

With all these issues and the back ground knowledge this research work will try to find out various internet technologies and the evaluation strategies either in the formative or in the summative manner to best derive the user experience.

1.2. Adaptive Web Systems & User Evaluation

The area of the proposed contribution for this dissertation is involved in two different areas in computer science. There is significant focus on the adaptive system and then the second focus is given to the field of usability. By performing user tests, analyzing the data and evaluation the collected data.

The adaptive web systems are undergoing a different level of adaptation and considering the user needs to create the new dimension in the adaptive research area. The rise of latest and the new technologies is also allowing the implementation easy, also the task of developing and designing adaptive web systems is made flexible. Recently, the huge increase of the information in the World Wide Web, it has become very difficult for the

users to find the exact information required. Even the massive search engine giants like Google, Yahoo and MSN, etc. are unable to serve the exact needs of the user and are trying to search for the alternative solutions like concentrating on the effectiveness of the search engines.

The adaptive web systems are treated as the next big thing in the area of adaptive hyper-text and hyper media. Nielsen (1990) has proposed two predictions for the future

- The coming out of massive usage of hypermedia and hypertext;

- The combination of hypertext and other computer components;

1.3. Project Aim

Adaptive systems are attempting to bring personalization to the web, to ensure that both media (content) and services are tailored to the user's personal preferences, goals and context thus enhancing the user's experience of the web.

The main goal of this research will be to tailor the web services based on the personal preferences and goals of the user to build an adaptive web system with an easy to use, effective and efficient user interface by bringing the usability techniques throughout the development life cycle.

This is to have investigation through different approaches for the creation of an open model and the technologies that support to achieve this open model. Tailoring the web services based on the personal references of the users and brining the personalization for any specific user. And is also to evaluate the application for the usability of the application and build the rich user interface.

Typically the user evaluation will cover range of important evaluation techniques and also the user feedback from the user. Prototype adaptive web system will be built using the modern platform independent web technologies like python.

1.4. Objectives

The main objectives of the research proposal in brief can be listed as follows.

- **Adaptation of web services based on user preferences and needs with an initiative to achieve the open model.**

  These adaptive web systems are going to offer the personalized search results depending on the user. The user preference will be explicitly specified during the entire process of querying the web. Web services will be tailored to the needs of the user.

- **Investigate the possible web technologies to achieve the open model for adaptive web systems.**

  There are different modern new web technologies emerged in recent years. And the research would also be likely to perform on all the different possible new technologies to make the open model achievable. Along these lines researchers are saying that there are different theoretical and practical approaches to share, connect and expose content via the WWW. A proper investigation is for the possible approaches for sharing and connecting data in WWW the ways to access.

- **Importance of the open model and the possible pros and cons of the open model approach for adaptive web systems.**

  The open model approach will utilize the vast volume of data available on the WWW to dynamically generate models and source content. The next goal will be on pros and cons of creating an open model approach for these adaptive web systems. An investigation should be on the benefits and drawbacks of linking the data and generating the model.

- **Evaluate the effectiveness, efficiency and usability of the adaptation model.**

  In these days user experience is playing major role and got more priority in developing the applications. The evaluation of the web systems which will result in the design of a rich user interface with an easy to use, effectiveness and efficiency throughout the development of the research work.

1.5. What's New with Me?

As it is very clear from the previous section background, which describes the evolution of the research in a chronological order. There are some systems existed already in history which offer certain functionality. But, what the current thesis is going to offer or concentrated is to provide a system which offers an adaptive environment curtailing the web services to the user needs. From the previous section background, "HeyStakes" is the similar kind of functionality as we do in here. But, the way that they use to offer the search functionality is by using community search approach. They offer it with the help of the history from the friends and the favourites of a particular user.

The personalisation in this thesis is not obtained with the history as HeyStakes does. The personalisation is achieved by creating a user model, which can be modified further with the changing needs of the user. We also offer a range of web services by accessing the data present in the WWW. We treat the whole web as the data base and will be used for achieving the adaptation. The data present in the social networks like FaceBook, Twitter and Orkut profiles of the user are used and the search functionality is offered in relation to that information.

In determining the evaluation criteria it is planning to follow during the whole process of the implementation throughout the process which will evolve in the formative evaluation by separating into different phases. This way all the issues can be clarified for the user as the evaluation progresses. An investigation is made into the existing and the latest emerging web technologies to make the adaptive open model possible. The pros and cons of all the different techniques that are used and a proper evaluation of all the area of research carried.

1.6. Thesis Road Map

Chapter 2 Adaptive Web Systems

This chapter is focused on the on research in the area adaptive web systems and the adaptive hypermedia. This discuss with the architecture of the adaptive systems and the history of the hypermedia.

Chapter 3 Evaluation of Usability

This chapter proposes the concepts of usability and the reasons why and where we use usability. The importance and how one can improve the usability of any web application. This also concentrates on the user evaluation with an evaluation of different adaptive system.

Chapter 4 Possible Technologies to Achieve Open model

This chapter is containing the possible web technologies to make the open model achievable. This also discusses the pros and cons of all the technologies. This also helps to implement the application in increasing the developer ability.

Chapter 5 Architecture of Adaptive Web System

This chapter contains the discussion of the architecture and the different components of the proposed architecture. This outlines a new architecture for the creation of the open model for the adaptive web systems using the data present in the web. This is a simple model description.

Chapter 6 Implementing the Adaptive Web Prototype

This chapter plays a major role in the whole application. This illustrates how the application is working and focuses on the ways how the application is developed. Different steps taken to implement the adaptive web system are discussed. The development life cycle followed to complete the application. The process of adaptation is explained clearly in a simple algorithm.

Chapter 7 Testing

This chapter is focussed on user testing. The usability of the proposed web system is tested on five different users in order to find the usability issues involved in it. This describes the user experience and the usability procedure followed in conducting the user tests.

Chapter 8 Evaluation

This chapter is a real evaluation of the whole research work carried out in this dissertation and the contribution towards the proposed research field. This also describes the

evaluation analysis of the application with the adaptation policy followed and the adaptation criteria.

Chapter 9 Summery

This chapter is final summary of the thesis pointing the findings in the thesis and in the research work. This gives an overview of how the problem is addressed with clear problem solving approaches followed.

Chapter 10 Conclusion

This chapter is the conclusion which describes about the conclusions. The contribution towards the research area is discussed. And also this section describes how the proposed system is different from that of the existing ones.

Chapter 11 Future Perspectives

This section is the listing the future endeavours that can be made and how the system can be implemented further more. This solely concentrated on the future improvements that can be added to the implemented system.

2. Adaptive Web Systems

2.1. Introduction

This chapter concentrates on research in the area adaptive web systems and the adaptive hypermedia. This chapter begins with the basics of the adaptive systems and then moves into the discussion of adaptive hypermedia architecture. The adaptation process and the open model of the adaptive web systems and the functioning is discussed.

2.2. Adaptive Hypermedia

Typically, an adaptive hypermedia system is a system, which (Eklund and Brusilovsky, 1998) is based on hypermedia, includes a domain model composed of a set of elementary pieces of knowledge and their relationships in information space, maintains an explicit user model that records individual user properties, and is able to adapt some visual or functional parts of the system according to the user model. Adaptive hypermedia helps to bring the personalization to the user and eases the job of finding necessary and relevant information by the user.

Web has been the vast and the mostly using thing for the last decade with its ever increasing voluminous information base. With this success, it has also made very difficult to find appropriate information out of this huge volume of knowledge repository (De Bra, Aroyo & Chepegin, 2005). This is something like asking a person to learn swimming in an ocean, which he doesn't know where to start and what to do.

De Bra, Aroyo and Chepegin (2005), says hypertext, and the Web in particular, offers three ways to find information:

i. When one knows the precise location of the information we want, type a URL in the browser's address bar, to have an immediate access to the knowledge. Bookmarking the URL to remember for ever to access again and again.

ii.   When one has a great description of what is needed to wish to find, the modern search engines are mastering in configuring the location of those search terms.

iii.   When we want to explore the Web hoping to find interesting information, for instance hoping to find the conference papers on "Adaptive Web Systems" has been published on the Web, the real problem starts. You can browse and search all you want, but may not find that we are interested in at that time. When you start searching for the information we will have problems in finding the necessary information.

The major problem in finding the required information is describing what exactly the user wants. Most of the times the search terms are very ambiguous and sometimes they are irrelevant, etc. The best solution for this is to collect the information about user, when the user is browsing. The whole process of user modelling allows the user to query for the information combining the user's preferences and his profile.

Personalisation or adaptation will extend the features of the existing adaptive hypermedia architectures. Incorporation of the adaptive systems in collaboration between different sites in the architectures will allow more adaptation than in the current systems.

2.3. AHA! The Adaptive Hypermedia Architecture

2.3.1. Architecture of AHA

The whole architecture looks as shown in the below Figure 1. As it is evident from the diagram, that the overall architecture of AHA in Java. All the requests will be served from the local file systems and the external http requests using the Java Servlets. The communication of the Servlets with the *domain/adaptation model* DM/AM and also with the *user model* UM yields the triggering of adaptation rules, which will perform the updates to the UM. Storage of the DM and UM in AHA is in two forms. They may be stored either in an XML format or in the data base, there is a tomcat server installation required to run this architecture. Authoring tools are used to create this domain and user models. There a few number of authoring tools available to accomplish this task. From

the diagram we can say that the Concept Editor Graph authoring tool is used to perform the required adaptation. Recently this AHA architecture is being used in preparation and construction of different open source concepts (De Bra, Aerts & Berden, 2003).

2.3.2. Domain/ Adaptation Model

AHA consists of a set of concepts, and fragments or pages with which they are linked to. These concepts are used to render the domain of the application (De Bra, Aerts & Berden, 2003). For example modules in MSc Web Technologies, paintings of some great painter, images of famous sports person, etc. Attributes are having some special meaning for their existence; some have meaning for the user, like knowledge or interests. So, AHA provides an overlay of the user model. All attributes of the DM/AM will appear in the UM.
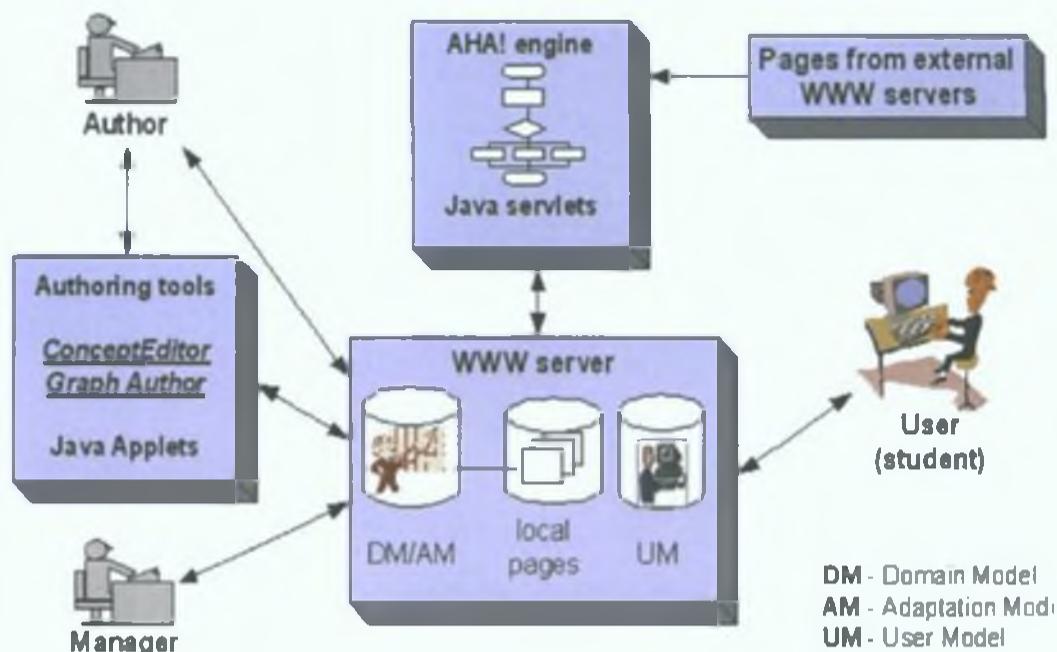
Figure 1 : Adaptive Hypermedia Architecture (De Bra *et al*, 2003)

AHA! The Adaptive Hypermedia Architecture
http://journals.tdl.org/jodi/article/viewArticle/124/122#, Accessed 07/06/2011.

2.3.3. Authoring Tools

All the pages were authored in HTML and the DM/AM are authored in XML in the first version of AHA. In the next versions i.e.: in version 2.0 and 3.0 the DM/AM the structure has become a bit more complicated compared to the previous version 1.0. In the new releases for each concept many attributes have to be updated based on the condition-action rules. Even in the latest release it has some features like *case group, stability* parameters, etc. It is a better approach to create any application in AHA using the authoring tool, or else the solution is going to be no longer a feasible solution. AHA can be authored in three different ways (De Bra, Aerts & Berden, 2003).

The *Concept Editor* is a *low-level* graphical, Java applet based tool to define concepts and adaptation rules for newly defined concepts. It uses an author defined template to associate a predefined set of attributes and adaptation rule.

The *Graph Author* is a *high level* graphical, Java applet based tool, uses concept relationships. Here, a set of attributes and adaptation rules are generated basing on the creation of the new concepts. Since, it is a graph authoring constructs from high level to low level will be propagated automatically.

Another authoring approach would be developing applications for other adaptive systems and translating them for AHA. The low-level implementation constructs will allow the author to construct this kind of applications.

2.3.4. User Model

A perfect user model has its effect on the performance and the effectiveness of the system basing on the user information and the knowledge of the user also (Kavcic, 2000). Regarding the user model the major aspects to be considered are

- o Where the information about the user is coming from and what is that information?
- o How that information is going to be rendered or represented in the system?
- o Then, the process that's been undertaking in forming and updating the model.

The information that is stored in the user model can be divided into domain dependant and domain independent user modeling systems (Shehryar Durrani, 1997). The behavioral properties like age, gender, the capabilities of the user like background knowledge and the preferences. There are various requirement gathering techniques and ways that we can gather this information regarding any user. The dynamic parts like user knowledge can be gathered by monitoring the browsing styles of the user and the user activities. Quite a few numbers of methods are used in constructing a user model. Some of them can be listed as follows (Jameson, 1999).

- Bayesian methods,

- Machine learning methods (rule learning, learning of probabilities, instance-based learning),

- Logic-based methods (first order predicate calculus),

- Overlay methods,

- Stereo type methods,

- Other general methods (plan recognition),

- Specifically developed computational procedures

  (User's expertise is calculated from their navigational

- actions or time spent on documents), and

- Specifically developed qualitative rules and procedures

  (These are special rules regarding user's properties or behavior).

  (Jameson, 1999)

Usually, combination of any two approaches will gives rise to better construction and maintenance of the user model with a good exploitation of collected information regarding the user.

2.3.5. User Profiling

In the web environments while processing the information there are certain parameters have to be accounted based on the differences between the individuals. Parameters like cognitive and emotional characteristics have to be considered. The web environment offers flexibility to the user based on the contextual parameters of the individual user.

The user will be given preference to the personalization based on adaptation in certain web systems. Different adaptive hypermedia systems have been identified based on the area of the adaptation like educational sector, information processing, etc. All these different sections of specific areas will have different adaptation constructs based on the user priority and vary from one system to the other (Tsianos, Lekkas, and Samaras, 2008).

In building the applications leading to personalization there are some key issues have to be addressed. The problem is how to construct accurate and comprehensive profiles of individual users and how these can be used to identify a user and describe the user behavior (Adomavicious, & Tuzhilin, 1999). As per Merriam-Webster dictionary the term profile means "a representation of something in outline" (Tsianos, Lekkas, and Samaras, 2008). User profiling is a set of data representing the significant features of the user. The objective of the user profiling is to create a repository that contains the preferences, characteristics and the activities of the user. A user profile can be built from a set of keywords that describe the user preferred interest areas compared against information items.

Tsianos, Lekkas, and Samaras, (2008) prepared a model for the user profiling, which considers the cognitive and emotional processes that could be described as user "perceptual preferences", aiming to enhance information learning efficacy. These perceptual preferences of the user would be described as continuous mental process, which starts with the perception of an object in the users' attention of visual field. And this involves a number of cognitive, learning and emotional processes that lead to the actual response to that stimulus (Germanakos, Samaras, & Mourlas, 2007). The primary parameters in this model approach formulates a three dimensional approach to the problem. The first dimension investigates the visual and cognitive processing of the users, the second their cognitive style, while the third captures their emotional processing mechanism during the interaction with the information space (Tsianos, Lekkas, and Samaras, 2008).

The *cognitive processing* parameters that are used in the user profile model proposed by Tsianos are control of processing which refers to the processes that identify and register goal-relevant information and block out dominant or appealing but actually irrelevant information, speed of processing refers to the maximum speed at which a given mental act may be efficiently executed, visual working memory span leading to the reference of the processes that enable a person to hold visual information in an active state while integrating it with other information until the current problem is solved, and the visual attention which specifies the empirical validation of the task (Demetriou, & Kazi, 2001).

The *cognitive styles* represent the individuals' typical or habitual mode of problem solving, thinking, remembering and are considered as relatively stable characteristics of the individuals. There are considerable number of cognitive styles are existed, out of all this model followed Ridings Cognitive Style analysis (Riding, 2001). The reason to do this is its implications can be mapped on to the information space more precisely (Tsianos, Lekkas, and Samaras, 2008).

The way how individuals will respond to their information-processing systems and their emotions will also be given priority to prepare the user profiles. *Emotional processing* is a pluralistic construct which is comprised of two mechanisms: emotional arousal, which is the capacity of a human being to sense and experience specific emotional situations, and emotion regulation, which is the way in which an individual perceiving and controlling his emotions (Tsianos, Lekkas, and Samaras, 2008). The emotional factors like anxiety boredom effects, anger, feelings of self efficacy, user satisfaction, etc are considered in the preparation of the profiling. This research is concentrated only on anxiety which includes fear, worry, and uneasiness. An empirical evaluation had done in relation to the user intrinsic characteristics. The results are proving that users are performing in a better way once the individual preferences and the intrinsic characteristics are collected using the individual differences approach. This research was done in the area of the educational sector (Tsianos, Lekkas, and Samaras, 2008).

2.3.6. Context Awareness

Different research areas are now focusing their interests on the concept of context. Since, each of these areas will come up with one or more number of definitions for the word context. In this research area the main goal is to personalize the services and providing the necessary and relevant information to the user (Jameson, 2001). The problem here is not only the content adaptation or personalization to the user but also, the elements of context for the user's preferences and the behavior have to be considered. And priority would be given in order to provide the best service and the information to user (Cappiello, Comuzzi, & Mussi, 2006).

Initially, all the work that's done is in defining the context, through a particularly limited vision. For example, consider only the localization of the user, the objects which encounter him, the people who accompany him, and the changes in these objects. This work remains rather vague on the definition of the context (Schilit, and Theimer, 1994).

Recent work in this area starts to define the context in a more general and clear way. For example, Chaari defines the context as "the set of the external parameters that can influence the behavior of the application by defining new views on its data and its available services (Chaari, Laforest, and Flory, 2005)". A one-fit-for-all notation for the context awareness proposed by Dey (2001), means as follows: "context is any information that can be used to characterize the situation of entities (i.e. whether a person, place or object) that are considered relevant to the interaction between a user and an application, including the user and the application themselves. Context is typically the location, identity and state of people, groups, computational and physical objects (Dey, Salber, and Abowd, 2001)."

In this project proposal the context of the user can be collected explicitly as an initial step to prepare the user model from a set of users. And the preferences can be modified by the user on the fly once they enter into the system.

2.3.7. Web Services

A web service is an application available on internet by a provider of service allowing interoperability between the users of applications through the Web. The architecture of the WS is composed of three components. They are Service provider, Service Requestor, Service Registry. And these three are served with three other standards called as WSDL (Web Service Description Language), UDDI (Universal Description, Discovery and integration), and SOAP (Simple Object Access Protocol).
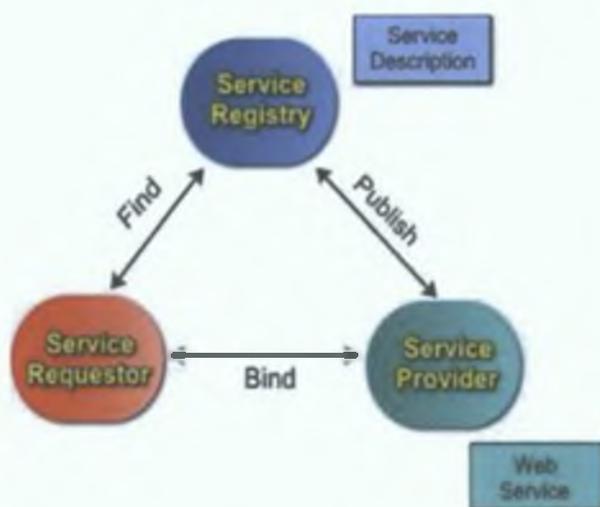
Figure 2: Architecture of Web Services (WSDL, 2006)

An Adaptive Web Information System based on Web Services

http://www.w3.org/TR/wsdl#, Accessed 20/06/2011.

The service provider builds the service and then publishes the description in the service registry. The user needs are translated into requests and the user will request the provider for the service that is being carried on by the service registry. Once the user finds the service then he will obtain the direct interaction with the web service. This is how the communication sequences are present in the web services architecture (WSDL, 2006). The context is the main important criteria in adaptive systems. But, the classical WS doesn't support the context adaptation individually. To provide a list of adapted services to the user the integration of the AHA and WS is the possible solution. In this integrated architecture user can have the requests and then those requests will be served with the adaptation model that the system provides. To restore the most adapted services to the context of the user the model follows a step by step process. The first step is *user context management* which will capture the user context using the sensors and then the context

will be interpreted. That means, transforming the raw data into meaning full data easily understood by the application, and then stores the context into the data base. The second step is to find the context services that meets the user preferences and stores them into the data base (DM) (Bouchra, & Florence, 2008).

2.3.8. Adaptation Process

The adaptation process proposed by Bouchra & Florence (2008) says that the system restores the most adapted web services to the user. To get to this adaptation the AM performs the matching between the user and the services. This compares the content and the contexts of the user and then, this will calculate the degree of similarity between the content and the context. To perform the adaptation process, a tree model is used and that will lead to the adaptation. Importance is given to the information with the nodes of the tree and the values are assigned directly by the user itself when there is a request from him. The context is taking more importance in mobile and the desktop applications in order to increase the usability of the web information systems (Bouchra, & Florence, 2008).

2.4. An Open Model for Adaptive Learning Systems

The creation of an adaptive open model for the educational systems, learning styles, knowledge fields and the teachers are given a level of adaptive rules of their own. Adaptive hypermedia systems were evolved from a long time upon the previous generations called pre-web generation, the web generation and the new adaptive web. The present web is trying to bring the original capabilities of the web like this open web and the semantic web concepts into brightness (Berlanga, & Garcia, 2004). The learning systems are supposed to achieve the five abilities said by eLearning Consortium, (2002). The five abilities are interoperability, reusability, manageability, accessibility, and durability (eLearning Consortium, 2002). It is not given preference the knowledge field, interaction styles, information, and the model will provide a flexibility for the teachers to prepare their own rule set for the adaptive approach (Adriana, & Francisco, 2004).

2.4.1. The Open Model

The initial architecture of the adaptive education hypermedia model is having four main important components, namely, the Learning Domain Model, the Student Model, the Adaptation Model, and the Interaction Model (as shown in the figure X.X). The metadata of the elements are defined by different learning technology specifications available and provided by IMS to create this open model (Adriana, & Francisco, 2004). The whole model was developed using the IMS LD (www.imsglobal.org, 2003) technology specification, and offers an open ended environment to the learning technologies.

The *learning domain model* gives definition to various elements such as learning style, learning design, the testing and the adaptive rule by the teacher. Learning styles establishes the indicators on the cognitive styles such as how learners perceive, interpret, process and interact with the system. The main idea of the model is just not to state any learning style, but it is to come up with a structure which fits for the authors and to characterize the learning styles to the user. The definition of the learning style contains the name, description, and the dimensions, which will be useful for the creation of the next things like design, test, etc. The learning domain defines the knowledge structure and the instructional design of any domain in learning. The major elements of the learning design are learner, staff, learning-activity, environment, play, act, etc using IMS LD specifications. These elements are the basic building blocks of the learning design to be defined and to carry on with the activities. Test definitions are used to assess the student's knowledge and the learning style. This includes our different types of tests, learning style, initial knowledge, current knowledge, and final knowledge. The learning style test is used to measure the learning style of the student. This contains its name, description, linked learning style definition, and a set of questions to test the student initial knowledge. The remaining three tests are to test the student's knowledge in the field. These test results will be stored in the student model to define the adaptive rules for the students. The adaptive rules will be defined by the teachers itself to give that freedom to bring the personalization suitable for the students. The goal is to provide that formalism to specify the rules that provide the navigation paths and the content to the students. The adaptation is based on the conditions and the knowledge and the interaction

style of the user. The actions involved in this definition are sorting, hiding or showing, or a menu with certain items (Adriana, & Francisco, 2004).

The adaptation in the *student model* is achieved by storing the learner (student) information. This contains the all different kinds of knowledge stated from the learning design definition and the student's interaction model with the data available, something like visited learning activities. The student model is solely based on the learning style of the model and is defined in the mathematical notation (vector notation). This is producing a multi-layered student model, which represents a learning style approach (Adriana, & Francisco, 2004).

The *adaptation model* is the integration of all the definitions that are defined in the learning domain model. This then generates a file containing the learning design which is useful in the students learning process (Adriana, & Francisco, 2004).

The *Interaction model* supports majorly two functions. One among them is, generation of an adaptive unit for each student. A unit of learning is nothing but a manifest, resources like URI or URL and physical files. And the next function is tracking the behavior of the student, while he/she are interacting with the material. The data about the student visits, the results of the tests that were taken in the early stages will be observed (Adriana, & Francisco, 2004). This model best serves the teachers and helps the students prepare their student models and improve the knowledge of the individuals.

2.5. Conclusion

In this chapter the adaption process is clearly described with keeping al in relevance to the traditional adaptive hyper media architecture. This also explained the move towards creation and the adaption policies in the open model. Adaptive hypermedia which describes the link texts is explained. The incorporation of the user evaluation can be made by following the discussion in the next section.

3. Evaluation of Usability

This chapter introduces the concepts of usability and the reasons why and where we use usability. This also describes about the user evaluation in the design of the web applications with a focus on some interesting web systems.

3.1. Usability

In the recent world of web 2.0, there is an increased importance for the concept of user experience. It hardly involves the simple concept of making the things in an easy to use, effective, efficient, and easily memorable way. The general definition of the term usability can be described as follows.

"Usability is all about making sure that something works well: That a person of average and even below average ability and experience can use the thing- that can be a web site, electric lift or even a coffee cup without getting frustrated of using it (Steve Krug, 2006)."

As part of user testing we has to measure the user reactions, recording, analyzing and also the performance are to be observed. A user centered approach, means an early focus on the user tasks and directly studying or observing the cognitive, behavioral and attitudinal characteristics is considered as the best approach to produce better user satisfactory products. An iterative interaction design by Sharp (2006) is a best practice to achieve this goal.

3.2. Why, Where, When & How About of Usability

For the web applications usability is the necessary condition and then, finally user evaluation is the sufficient condition. Usability is a necessary action to bring the concentration of the users. We run usability tests to identify key issues and problems involved in any application or its interface. For intranets usability is to increase the employee productivity. We run usability tests where ever that we can provided there are no external distractions. Anyone having knowledge on this field can run user tests to bring the user satisfaction.

Usability plays a significant role in each stage of any application.

- ✓ Testing the old designs before going to the new ones.

- ✓ Testing the design of the competitors to get cost effective designs.

- ✓ Creating paper based prototypes.

- ✓ Conducting filed studies.

- ✓ Designing the interfaces following the usability guidelines in an iterative passion.

This is when we start working on achieving the usability of any product. Now, how can we improve the usability of a web application? This can be achieved by getting hold of the representative users. Asking the users to perform the representative tasks with the design of the application is again an important improvement. Observing the users success and difficulties through the whole process of interaction design is the best analysis (Jakob, N., 2010).

3.3. User Evaluation of Search Engines

Search engines are providing an alternative to browse the hypertext in the internet environment from the last two decades. The information present in the internet is increasing exponentially and the content-based searching is increasing and the amount of information retrieval is becoming more and more important factor (Chen, Houston, Sewell, and Schatz, 1998). Since, an increasing craze for the search engines to improve their performance and the information retrieval group to enhance their strategies, it has become the most discussing criteria with the evaluation of the search engines effectiveness and the usability (Chuang, & Wu, 2007).

Search engines effectiveness is measured using two different categories. They are system-based approach and the user-based approach. System based approach is to measure the objective evaluation of the systems and the user based one is to measure the user satisfaction and some cognitive features of the user. User based evaluation of the search engines is a vantage in the end user perspective. Lot of researches proved and stated how the user will be given satisfaction with the search engines and no priority

given to the attracting factors and brings back the user to the search engines. And the research is to attract the users and to retain the users by the search engine providers (Chuang, & Wu, 2007).

Zhang and Dran (2000) said that the hygiene factors are the responsible factors for the web application functional and serviceable and at the same time, the absence of those functions is the responsible factor for the user dissatisfaction. User based evaluation of the search engines in the research by Su's (2003), which gives freedom the end-users to do their own research evaluation on different factors like response time, online documentation, search engine interface and the display of the result. The research by Chuang and Wu (2007) summarizes that hygiene factors and the motivational factors are the two considerably responsible for the evaluation of the search engine end-user experience.

The search engine characteristics that will affect the performance of the search engines can be listed as response time, number of ads in the page, consistency of the results, number of results, search by language (Support to multiple languages), font size, colour, and tips for improving the search. These are the some of the factors that affect the intention of the search engine usage (Chuang, & Wu, 2007). Hygiene factors are the mostly developed by all of the modern search engines and the competition is also of the same comparison because of the hygiene factors of common use. Similarly, motivation factors are given less attention and preference by the search engines. They might also become the factors for the competition in the market of the search engines (Chuang, & Wu, 2007).

3.4. Evaluation of the Adaptive Web Systems

This section describes the evaluation on a couple of adaptive systems including AHA. AHA! Is a framework generally that is used in academic industry quite often. In this system the domain modeling is done with the help of the concepts and relationships among them. User model plays a major role in the process of adaptation that any systems using the tradition AHA model architecture. It has two tools and Graph editor is used to

define the key components called the concepts and relationships. It generates XML files which can be edited manually by the user. It has content adaptation and link adaptation. AHA uses java language and Servlets to offer the communication between different components. This is platform independent and is an open source project (Sadat, H., & Ali, A., 2005).

SETA is a toolkit used to implement the adaptive web stores. It is built on a three tier architecture designed to build web stores based on authoring, and domain knowledge about users and context. This dynamically generates the web pages for the web store. It monitors the user product selection and recommends the product based on the selection made. All the product recommendations are based on the user preferences (Sadat, H., & Ali, A., 2005).

SeAN is a web system used for personalized access to the news. This is offering advantages by selecting new topics relevant to the user. The next function is to give an appropriate level of news and then to offer the advertisements relevant to the user and the news. News is represented by following the hierarchical domain model. It has been implemented using Java (Sadat, H., & Ali, A., 2005).

SETA and SeAN are treated as close, because they both are having the same software architecture. This is a typical evaluation of different web systems to date.

3.5. Conclusion

This chapter provides an over view with an evaluation comparison of the existing web systems. The differences between all the systems with their evaluations can be better understood with the documentation and the references available. User testing and the feedback from the user provides the best results with an in-depth analysis o the user data collected from the user testing.

4. Possible Technologies to Achieve Open model

4.1. Introduction

This section is concentrated majorly on the discussion of the possible new technologies to make the open model possible. There are a handful number of web technologies emerging in these days; they are discussed in the following sections with their advantages and disadvantages respectively. These technologies are all made in one document makes the task easy to decide to go with a particular language or a technology.

4.2. HTML (Hyper Text Mark-up Language)

HTML and HTTP both were implemented by the profound researcher Tim Berners-Lee in 1999. The mark-up scripting language has undergone five major releases up to now. The latest version of HTML is Html 5, with an intention to improve the performance and the development of multimedia application support. In HTML 1.0, each and every page is of the same colour and that to it are gray colored back ground and the font is Times New Roman. The links are in Gray colour until it is visited by any one and will change the colour into red once it has been visited. The next version HTML 2.0 then comes up with improved features over the previous HTML version with the features like selecting the back ground colors, images, and the forms can be set and prepared. Likewise the version HTML 4.0 is the one responsible for the reduction of the maintenance costs and then eased the difficulties. With the rise of the client side languages the new concept of web 2.0 is also got great popularity. Many organizations and persons are developing applications using these languages. And the latest release of the HTML 5.0 is the best supportive and the offer of the support for the APIs and the display of the multimedia content are the best supportive features (Brian, Chung and Bill, 2004).

```
<html>
<head>
<title>Home of Hector Chavez - Jan Smith</title>
</head>
<body>
<h1>Home page of Hector Chavez</h1>
<h2>My house is your house!</h2>
<p>Here are my hobbies.</p>
<ul>
<li>Travel</li>
<li>Fishing</li>
<li>Soccer</li>
<li>Cooking</li>
</ul>
</body>
</html>
```

Figure 3 : Sample HTML code

http://www.google.com/images/htmlcode/, Accessed 04/07/2011.

A sample code written in HTML can be used in the development of the user interface of any of the applications that will enable the user satisfaction too.

4.3. Java Script

HTML has the disadvantage of the fixed stage and that has been overcome by the java script. The information from the user forms will be sent from the client machine to the server which is a dynamic technology. Java script was started early with the name Live Script and then that is renamed as Java Script. This was introduced by the Netscape in the year 1996 along with the Netscape Navigator (NN) 2.0 browser with an interpreter to support the html functionality (Christian, 2006).

4.4. Publishing Web of Data

To publish the web of data present in the WWW in the form of web documents into the web data there are three different approaches available. This technique is used to consider the whole World Wide Web as the singe data base and then the data will be accessed

through different techniques. They are stated s follows Web APIs, Micro formats and the Linked Open Data (Olaf, 2008).

4.4.1. Web APIs

Web APIs is the one best approach for publishing the web of data into the web pages and the most of the service providers are having their own APIs to serve the application and development needs. APIs to access the services like Gmail, Flicker, Google Search, Google Maps, Face Book API, Picasa, Sales Force, etc. All these are the services which can be accessible through the web of APIs. The best and the most useful resource containing all these APIs is *programmable web* which is a great repository of all the APIs and the documentation available for the use in future. The web APIs provided by the different vendors of the service providers can be used and this whole concept of publishing the web data using APIs is contributing both pros and cons for the approach (Olaf, 2008).
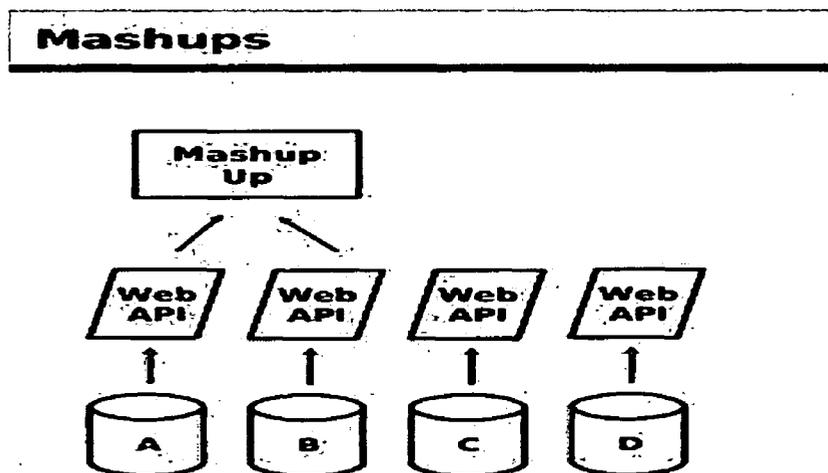
Figure 4 : Diagram Showing a Mash-Up (Olaf, 2008)

How to publish Linked Data on the Web

http://videolectures.net/iswc08_heath_hpldw/, Accessed 12/06/2011.

The mash-ups are prepared with the existing web services through their APIs. The above diagram shows the formation of a simple mash-up. "A Mash-up is a forming a new service by combining two or more services, web pages or applications together (Wikipedia.org, accessed 04/07/2011)." For example the mash-up formed by combining

the Google Ajax Search and the Google Maps would result in the service from two different sources. There positive side and the negative side of publishing data using web APIs based on the current research is as follows (Tom, Michael, Chris, Richard, & Olaf, 2008).

Advantages of APIs:

✓ APIs expose the structured data meaning that the data is accessed in the format defined and specified by the service provider.

✓ APIs will result and enable in the formation of the new applications through the concept of mash-ups.

Disadvantages of APIs:

❖ The negative side of the APIs is one cannot set the communication between different sets of data of different formats.

❖ Offers a proprietary interface, means that as an application developer one has to decide which APIs have to be used and bring that into the context.

❖ Mash-ups are fixed only on the fixed set of data sources, but not the whole web.

4.4.2. Micro Format

Micro formats are the embedded structured data into web pages written in html. These micro formats also work with the html pages and there will be some security issues to be considered with the embedding of the script and the tag elements. A sample code representing the micro formats included in the traditional html tags is as shown below.

```
<div class="vevent">
  <span class="summary">bdigital</span>
  <abbr class="dtstart" title="2008-05-20">May 20</abbr> -

  <abbr class="dtend" title="2007-05-22">22</abbr>
</div>
```

Figure 5 : Sample Code in embedded Micro formats (Olaf, 2008)

How to publish Linked Data on the Web

http://videolectures.net/iswc08_heath_hpldw/, Accessed 12/06/2011.

And the concept of the micro formats is compatible with the concept of web as single data base. The setbacks for this approach are the existence of a fixed set of micro formats and they can be used for that purpose only. The second one is that there is no other way to connect between the data sources and different data items.

4.4.3. Linked Open Data

Linked open data is the concept of using the URIs as the names for all the things. These URIs are the responsible for the people to look up things and get the information on the web. Linked open data model uses the semantic web technologies to publish the data onto web and it also figures things to the user's needs using the URIs. This linked data will set up the links between different sets of data so that they can be given access to the data within the other data sources. RDF (Resource Description Framework) statements will be included to discover the other things on the data items. This approach over comes all the short comings present in the above two approaches.

4.5. Python & Java

Python and Java both are treated as the platform independent and object oriented languages. Basically there is more compatibility offered by Google app engine and the AHA model. Since both of them are built on the same servlet technology. The loosely typed nature of python and the support to build the web applications with all the built in functionalities enables the developers to actively choose the language python. Either of these two languages is a plus, as the Google App Engine supports both of them. Python has a great compatibility of offering a solution to access and preparing mock-ups using the APIs by different service providers. Accessing the APIs through Java Script with an incorporation of python is again a big advantage over the other languages.

4.6. Silver light

Silver light is a latest language which is proposed by the Microsoft in the .Net family with visual studio. Silver light is used to build rich internet applications. It is a heavy weighted tool. Most of the applications are only implemented using windows platform. There are some third party software's which can be used on other operating systems.

Using silver light we can build the rich user oriented applications. It is also a developer friendly language, but will have the impact caused by the Microsoft's problems.

4.7. OWL (Web Ontology Language)

This web ontology language is designed not only for presenting the information on the web but also to process the information. Ontology is about the description of the things and the relationships between the objects. OWL offers the machine interoperability of the web information in a more effective and easy way compared to the languages like XML, RDF, RDF-S (Schema) by providing the semantics to the vocabulary. OWL is designed to achieve the semantic web. This has been divided into three parts *OWL Lite, OWL DL, OWL Full (www.w3.org, accessed 04.07.2012)*. OWL is written in XML and is having the same syntax provided by the scripting language XML. This ontology based language is based and built on top of the frame work RDF, which helps in the processing of the web of information. OWL is a W3C standard leading to the semantic web. And this language is not designed for the people to read and understand by them.

Sample code for ontology can be written as follows (Grigoris and Frank, 2009).

```
<owl: Ontology rdf: about="">
    <rdfs: comment>example OWL ontology</rdfs: comment>
    <Owl: priorVersion rdf: resource="http://www.mydomain.org/uni-ns-old"/>
    <Owl: imports rdf: resource="http://www.mydomain.org/persons"/>
    <rdfs: label>University Ontology</rdfs: label>
</owl: Ontology>
```

OWL is also a possibility to design an application which offers a functionality of the proposed project.

4.8. Ruby on Rails

Ruby is a new and the latest scripting language. It is treated as an open source language with an initiative to offer open ended approach to the applications. It is very easy develop the web applications using the ruby scripting language. It supports all the object oriented features like encapsulation, inheritance, polymorphism, platform independence, etc as they are supported by the other object oriented programming languages like java, python, etc. Here, in this language the syntax is slightly different compared to the other

languages. In ruby everything is considered as an object whether it may be a variable, or it may be a constant, or it can be either a data object.

```
Class Person
        'def initialize (name, age)
                @name = name
                @age = age
        end
        def name
                return @name
        end
        def age
                return @name
        end
end
```

Sample class written ruby to mention the syntax of the newly designed language and the development of the applications using the language (Peter, 2007). Amy (2007) said that Ruby makes him to smile. So, ruby is a fun tool and like a funny toy in the hands of a small kid.

4.9. Conclusion

This chapter describes about various technologies used in the design and in the construction of the adaptive web system. Similarly, the advantages and disadvantages both are discussed in this chapter. All the possible approaches were discussed which will enable the combination of adaptation and user evaluation. The design of the system will be based on the discussion and with one or more of the languages mentioned in this chapter.

5. Architecture of Adaptive Web System

5.1. Introduction

This chapter contains the discussion of the architecture and the different components of the proposed architecture. This outlines a new architecture for the creation of the open model for the adaptive web systems using the data present in the web. This also discusses how different components communicate each other and the process of the adaptation.

5.2. A New Model Architecture

The proposed architecture for the new model is composed of some elements of the classical AHA [1] and the some elements from web services [6] along with the architecture of the Google app engine for python. The reason for using the Google app engine architecture in this project is, it has a great support for the number of web services. This is decreasing the extra cost spent on the data bases by offering its own data store service. Google App engine also offers a huge support to a lot of services for the user to access. The usage of these features along with the cloud hosting of the final implementation resulted in the integration of app engine into the current architecture. The adaptive engine [12] acts in the same way that performs its tasks in the classical AHA. The registration of web services will also be in the same way that happens. Here, we considered the user as the *service requestor,* the registry is treated as *service registry,* and the web services are treated as the *service provider.* The app engine is the service provider of all the service.

JDO is the connecting media between the data base called data store and the user model. User model is prepared with the aim to store the different aspects of the user. User contextual characteristics are taken due care like the static and the dynamic characters are going to be give an effect. In order to avoid the overlay redundancies the domain model is kept along with the user model itself. The user model variable will be stored in the data store. The whole user model will reside in the data base itself which can be used further in future by the user in order to update his profile and the preferences. The updating and the user modeling with the contextual analysis based on the user preferences and affect

them back into the data base; all this will be taken care in the user model itself. Data store is a special kind of web service offered by Google to store the information in it. There is limit for storage of the amount of data on a free account. If it exceeds then, pay per use kicks into action. For, these research projects we are taking due care not to exceed the limit. Data store contains the user model. This is a different kind of data base which can be used on fly.

The application interface is the whole front through which the user will communicate with the system. The emerging web applications are allowing developing the application interface, and can be developed using any of the latest technologies. We are planning to develop the application and construct this model using the python web frameworks with some advanced client side technologies like JQuery, Java Script and CSS, HTML.
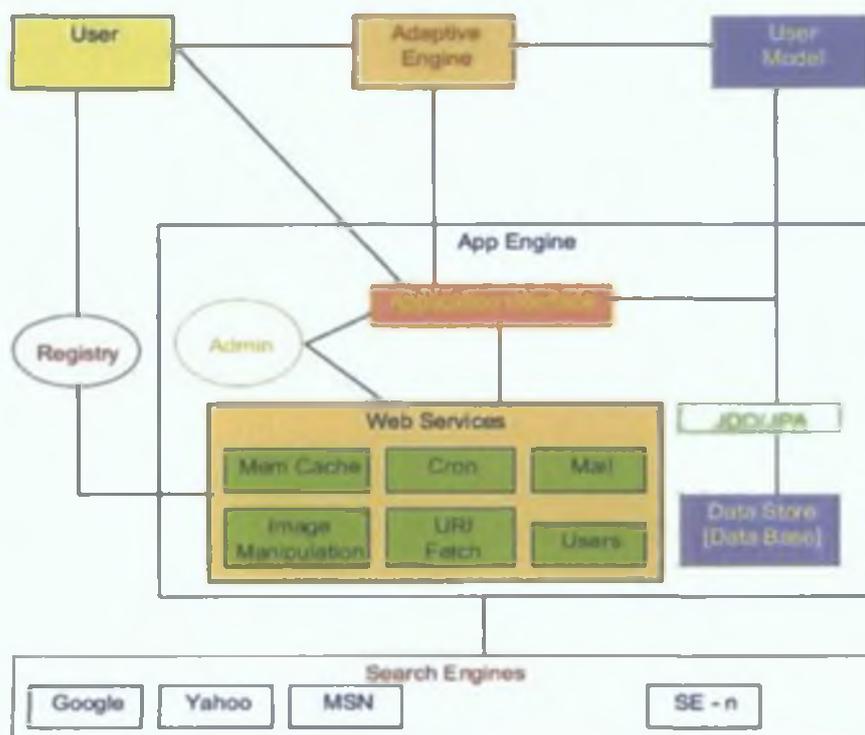
Figure 6 : Proposed New Model Architecture

Web services component is containing various services offered by Google cloud like to cache the memory a service named *Mem Cache* is used and in the same way, Users service is used to fetch the Gmail users contact and the other information. So, the Web

Services is a container of all the services. The *Admin* is the controller of the access to the web services based on their preferences and will control the flow to some extent. This is only for security purpose not of that much importance in the application.

And finally the last bottom component and the bed rock of the whole architecture are the search engines. In order to access the services offered by different search giants and to offer that combined and the optimized search we are researching with the search engine vendors like Google, Yahoo, MSN, etc. Search engines can be accessed by the APIs offered by those respective service providers. These services can be registered with the *service provider* web services container. This is the whole new architecture serving the multipurpose adaptation application with the adaptation as major concern.

5.3. Conclusion

This section covers the architecture of the new model for the adaptive web system. This new model is allowing the users to access the web o data with the creation of the simple profile to register their preferences and also holding the profile information from the existing applications like Twitter and Gmail. The next chapter will have a deep discussion about how the adaptive web interface can be implemented.

6. Implementing the Adaptive Web Prototype

6.1. Introduction

The scientific proofs in bringing the personalization of the web services and consideration of the user preferences on the fly are given in the implementation of the research project. These research findings are implemented using an efficient tool provided by the large search engine in the present days (Google). The tool used is "Google App Engine" and the development language is Python. This chapter lists the implementation of the prototype of the proposed research project in a nice and easy way with the inclusion of user centric design.

6.2. Developing the Design

As mentioned in the previous chapters (literature review and research background), developing an adaptive and the personalized version of the web services and bring the open model will be achieved with some of the software development languages and the frameworks available. As it is confirmed that the research is in the web development field with an eye on human computer interaction and usability, due care should be taken to design the development of the design of the application. By the integration of the usability interaction development life cycle in the software development phases of the application is leading to get the best user feedback and evaluation. Client side web technologies like Java Script, JQuery, and CSS are the richer form of developing the rich web application and the software development methodologies following are closely related to the development and resolution of the problem space.

6.3. Software Development Process Models

Software development process models are the best useful principles and guidelines to make the software development in an important and more precise way. "Process models define a different set of activities, actions, tasks, milestones, and work products that are required to engineer high-quality software (Pressman, R. 2005)." There are different process models a software developer can use to build a software component or a web

application or a software artifact. Some of the process models for example are Water fall model, Incremental model, Spiral model, Formal methods model, and Unified Process model (Pressman, R. 2005). These models are offering the best possible ways to build an application. In the same way, each one is offering some advantages along with the disadvantages. Unified process model is one among the best process models that can be used in the development of a software artifact.

6.3.1. Unified Process Model

The process model that is followed to develop the application is Unified Process model. The iterative analysis and flow of the model through different phases helps the developer to build the small components quickly and release in different versions. The generic process framework activities planning, communication, modeling (Analysis and Design), construction, and deployment are actively divided into four phases offered by the process model.

The project is divided into four phases provided by the process model. The phases are namely Inception, Elaboration, Construction, and Transition.

Inception:

This phase consists of the requirements gathering from the user along with some planning for development of the software application. The major business requirements are described through use cases and actors are identified.

Elaboration:

Elaboration combines the customer communication with the modeling of the application. This expands or elaborates the use cases from the previous phase, and predicts the five different views of the software application. This phase allows modifications to the plan and avoids risks involved in the plan.

Construction:

The construction phase of the model contains and involves construction of the software artifact. This accepts the architectural model as input, and makes each use-case

operational. This phase consists of writing source code for the software. This also contains some acceptance tests initiation, which are used for the next phase.

Transition:

The software is transferred to the users for the user testing in the form of beta release. User feedback is taken from this phases which contains both defects and the necessary changes identified by the user. The success of the project depends on this phase. The analysis and the design of the product will depend on the feedback from the user. If something went wrong in the previous communication phases and in the design this will lead to an overhead of implementation.

6.3.2. Functional requirements

The functional requirements are derived from the user needs, user and the task analysis of the current existing system. This also describes which action the design must take to reach user benefits.

"How can you get the drink without opening the door?"

Requirement 1 <Login>

Description & Priority

For any user o enter into the system they need to enter the user name and password which they had created it early. Then the system will show the account details to the particular customer. The account by default is a Gmail account authentication.

Requirement Activation

The user name and the password are to be entered to fully use all the features offered by the web system. Gmail account is enough for the application to work properly.

Technical issues

If the user don't have the Gmail account then the best way is to Sign-Up for a new Gmail account. This allows using all the web services offered by the application to a maximum extent.

Risks

If the user entered either the account number or the password as wrong then it fires the error of mismatch. The only thing that he needs to do is just keep the account details safe and remember them.

Dependencies with other requirements

Personalized search feature will be activated once the user login into the application.

Requirement 2 <search & web services>

Description & Priority

The application offers a combined search results and also the web services to ensure the personalization.

Requirement Activation

Once the user prepares a profile with the application through an interface offered by the web application, then it allows accessing all the web services.

Risks

The information will be shared in the web. So, need to care about that.

Requirement Activation

The main thing that each and every user needs to do is to have the account activated and logged into their accounts.

Functional Requirements

Use Case 1 ....<Each requirement should be uniquely identified with a sequence number or a meaningful tag of some kind.>
<Create a separate use case and place it in the appendix. As an example see Appendix 7.1.>

6.3.3. Non-Functional Requirements

Specifies any other particular non-functional attributes required by the system.

Non-functional requirements are those which are not directly concerned with the system. Here we concentrated on performance, security and reliability requirements.

Performance/Response time requirement

The response time of the application is considerably up to the expectations of the user. The usage of different web services through APIs is a bit cumbersome process, though it yields appropriate results.

Security requirement

The system client side scripting security is given a concern in dealing with the security. The information provided by the user in the form of preferences will also be given priority with a concern.

Reliability requirement

The information from the user or from WWW is from trusted bodies. The information is reliable and can provide a high end of service.

Maintainability requirement

The major maintenance issues that we may come across are effort and support by the API providers. Administrator will anyway keep track of the service vendors and their updates on the API releases.

6.4. Interaction Design Life Cycle

In order to avoid the difficulties stated in the transition phase of the unified process model, a combination of this interaction design with the unified process model are evolving the best possible solution to the users. Interaction design is an iterative process involving user at each and every stage in order to avoid the mess and the difficulties that may be encountered that are stated in the above unified process model.

The main characteristics of the interaction design are focus on user, usability and user experience goals, and iteration. So, the interaction design involves developing the projects intended use, target user group, and practical issues involved in it. Alternative designs will be generated and evaluated successfully with the inclusion of the user. More over to have a successful evaluation the design must be in a form that suits the users to interact with the application.

The diagram of the interaction design life cycle is as shown below. It acts like a road map to the development of the usable web and product based or embedded applications also.

Finding Needs & Establish Requirements:

The first step of the interaction design model is all about identifying the target users. To design any product for any user has to be used by the user to the possible best extent. In order to know, what user wants from the product identification of needs helps largely. These needs will be used to establish the requirements and then will help the developer in the design and in the development phases.
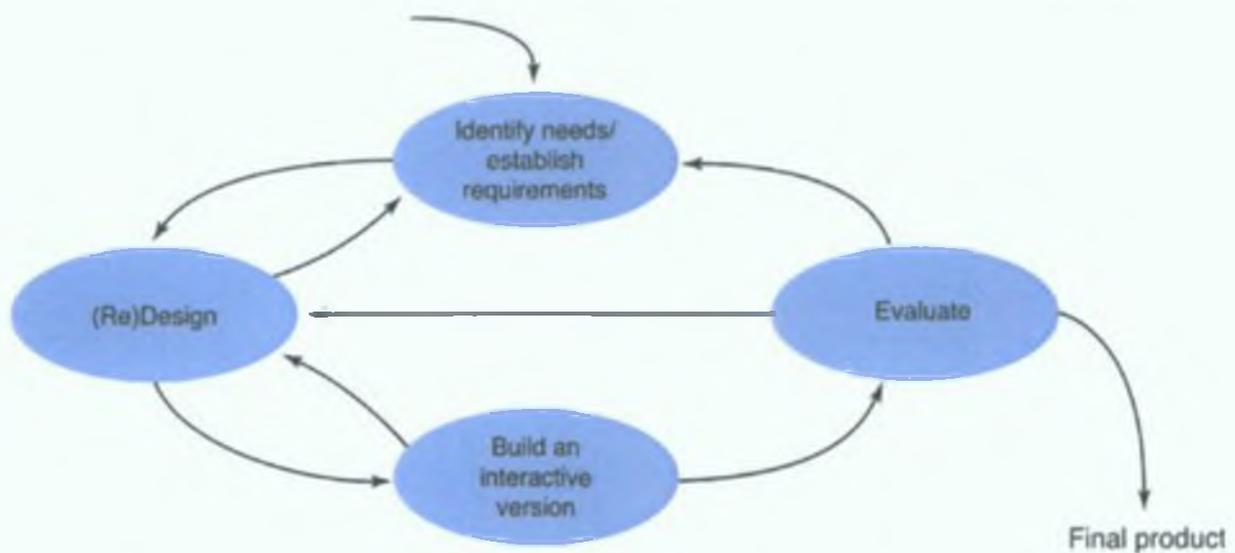
Figure 7: Interaction Design Life Cycle Diagram (Sharpe, Rogers, & Preece, 2008).
http://moodle.ncirl.ie/file.php/2183/L01/MScWebTech_L01_slides.pdf accessed
26/07/2011

This act of identification of user requirements forms the base of the user centric design approach. There are some data gathering techniques available to collect the user needs and to establish the requirements. The data gathering techniques are like forming a focus group in order to collect the information from users and analyze the data from the users and configuring the requirements. This consists of 4 to 8 members per a group. The next one is to have questionnaires, and the other one is to conducting interviews.

Interviews are conducted on five different users as part of collecting the user requirements. The interview questions were listed in the Appendix with the name

Interview Questions, which helps to gather the needs from the users. These interviews are resulted and used to prepare personas. "Personas are the descriptive models of the users which will inform the interaction design (Cooper, 1999)." The great advantage with preparing personas is to determine the behavior of the product and to decide what the product should do. Three different persons on different users were prepared. These are documented in the Appendix with the name Personas.

Develop a Design:

This action looks like the blood and heart of the whole interaction design process. This suggests us how to reach the requirements that were set in the previous stage. This phase is having two sub-activities. They can be as listed below.

      i.   Conceptual Design
     ii.   Physical Design

Conceptual design tries to yield the conceptual model, which describes the functioning of the product and how does this behave, look like. The physical design is concentrated more on the design of the front end of the application. The details like menus, icons, layout, sounds, and colors, etc to use in the design.

Build an Interactive Design:

Building an interactive design involves design of a usable and feel good interface serving the needs of the user. This is through building an interactive version of the design for the software product. This can be achieved through different ways. One of the best possible and hands on experience one is "paper-based prototypes". These are the cheapest and the easiest designs at the initial stages of the design, and role playing. Design of the prototypes will be done in different ways in order to bring the user satisfaction. The different prototyping techniques like low-fidelity prototyping and high-fidelity prototyping.

Low fidelity prototypes creation techniques like Mock-up objects, sketching, story boarding, wire-framing, and wizard-of-oz, etc. These all are used to roughly draw the initial ideas of any application design. These are to draw the rough graphical representation of the final application/product. The prepared prototypes will be used to

communicate with the users and with the customers also. The high fidelity prototypes result almost a final product. These generally lack the functionality and are prepared using the high level languages like HTML.
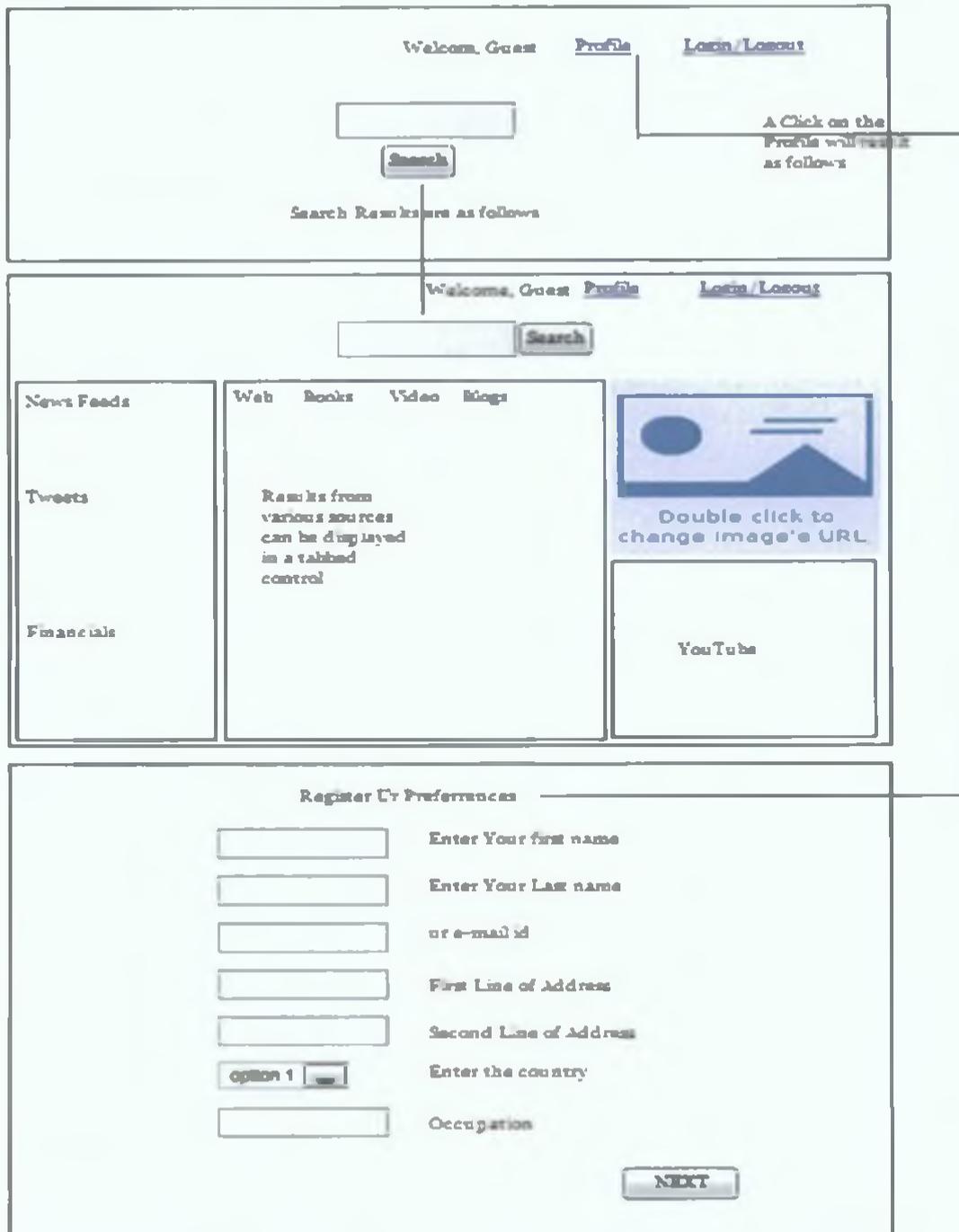
Figure 8: A mock-up describing the initial design of the web system

The above mentioned prototype is prepared using a wire-framing technology, which is a low fidelity prototype. It is represented the flow and the navigation with straight lines.

Evaluate:

Evaluation is considered as the process of deciding the usability and acceptance of the design of the final product. This is going to consider the mistakes by all different sorts of users in using the product. This also concentrates on the match of the design with the requirements, and appealing feature of the interface. The whole process of interaction design involves the user throughout the development and this increases the delivery of the acceptable product. Usually we do tests and quality assurance to confirm the final version is "fit-for-purpose" as is mentioned in the software process models above. Evaluation is also the same but it enhances the same functions.

6.5. Developing Environment and Tools

This section outlines the implementation environment and the tools that are used to develop the adaptive web application. Brining personalization is the core idea behind the development by curtailing the web services to the user preferences. For this the development environment used and the APIs accessed are having great impact and ease in the implementation.

6.5.1. Programming Language

The programming language used for the development of the application is Python, which is an object oriented language. The version of the development language is 2.5. Though there are still latest versions are available, the current version offers the best possible support with the other tools like Google App Engine. The main advantage in developing with python is because of the support for the web development and the support to develop the mash-ups integrating the APIs. This is very helpful and an easy language to deploy the final version onto Google cloud. It supports the platform independence that creates the development of loosely typed applications and finally deploys it onto cloud environment. This also offers the possibility to access on any operating system environment.

6.5.2. Client Side Development Languages

As it is shown in the research back ground section for various development languages that can be used. The user interface is designed with the help of HTML and CSS. JQuery is also used to bring the richness onto the front end design. Java script is helping throughout the application. Major development is done with the help of the Java Script. The application is developed and the APIs that are used to bring the services onto the user screen are implemented solely using Java Script. Classical HTML is used to develop the front end with a bit of help from the external CSS files. JQuery is also used to register the user preferences into data store. This also brings some scripting and security into existence. With a proper alignment of the script tags and the use of the YSlow techniques are allowing the user to operate in a secure environment. The performance rules offered by YSlow like minimizing the HTTP requests, keeping style sheets at the top and scripts at the bottom, Avoiding CSS expressions, and avoiding the filters, etc. YSlow version 2.0 allows the developers to create their own custom rule sets build upon the minimal requirements specified by the performance measures. This is offered by the yahoo developer's network, which is again a mash-up of the whole adaptive web application with Yahoo developer performance rule set.

6.5.3. Web Services Used

"Web services are typically APIs that are accessed through HTTP protocols and hosted on a remote servers (Wikipedia, accessed 20/08/2011)." These services are offering the best possible interfaces to use the service offered by the provider. The web services in developing this application and finding solutions to the problems proposed are working with the protocols to call the service. REST services are also used to access some of the web services. Some of the web services that were pulled onto the adaptive web application are listed as follows.

Google Custom Search:

The largest search vendor allows the developers to access their search with the user preferences using the custom search service. This will perform the search operation on the whole web and offers the results to the user based on the criteria that is defined by the

user. This allows the use of the whole or part of the search functionality of the Google servers.

Google Ajax Search:

Google Ajax search is another shortest form of search services, which yields the quick results without refreshing the whole page and with the requests to the server for the particular information. This service offers the best search functionality and usually this comes along with the custom search.

YouTube:

YouTube is the sister service provided by the big vendor Google. This is offering the users to view the videos on different things, upload the videos, and contains download option as well with extensions. This service is again mashed with the Google search option.

Google Maps with Google Ajax Search:

A Google map is one of the best services offered in the world among all. This allows the users to search for the desired place in the world, provides some directions to reach the destination, and also gives a quick look at different locations. This is accessed with the Ajax search functionality by Google.

Wolfram/Alpha Widgets:

Wolfram/Alpha is a computational search engine. This is used to perform some computations and this service is working on their own data base. This knowledge base covers numerous ranges of areas starting from mathematical computation to the science and chemical fields. This service is holding their own range of data sets and not depending upon any other vendor like Google to perform and fetch the information.

Yahoo & Bing:

Yahoo, and Bing are the next largest search engines. These search services are also used to show the best results for the user. Here Yahoo is a bit more than searching alone. So, all those functionalities are offered through the application.

Yahoo Finance:

Yahoo Finance provides an up to data information and financial position regarding any item, firm and the stock market results, etc. This service also offers the user to create charts for the finance and stock of the year or for a quarter.

AccuWeather:

AccuWeather is the service provided by AccuWeather.com to show the weather report and forecast for the next two or three days. This is also a useful service for the users to have a look at one place.

Bid Vertiser Ads:

Bid Vertiser is the service with which we can have some ads from the service provider. This allows the site master to place ads on the web application.

Twitter:

This service is used to show an unlimited number of tweets from the twitter top most popular users. The tweet feeds will be from the public figures, famous persons, etc. They will change day by day.

Google Web Elements:

Google web elements is one more service which offers a better range of applications and displays the top news in the world in a region wise manner like Asia, Europe, America. This web elements service also offers the video results from the web.

Google Books, News, Image, Blog and Video Services:

Google services like Books, Images, Blog results, video services are also used in the web application. These services are accessed as a result of the custom search.

Sindice Search:

Sindice Search is the web service which is treated as semantic web index. Sindice is a platform that offers the users to build the applications on top of the RDF, and micro format data, semantic search technology. This service is used directly which serves the user based on the search terms meaning. Right now, this service is holding a set of data elements and offering results with that web of data.

Brainy History:

This is a web application which is using Google Custom Search as one of their search criteria and displaying the results for some historic quotes, dates, etc. This service is used to display the word of the day, to know the birthdays of any day, and to know the essence of any particular day in the history. Means, this will bring the awareness with some information explaining the importance of the day. Brainy history is used to show birthdays, word of the day, and the importance of every day in the history. Quite a nice and beautiful service, that brings enlightenment about the historic moments.

Special Service Used:

These are the services provided by the Google App Engine and the Google cloud environment with a support to the Python language. To store the user preferences the Data Store service offered by Google cloud is used which acts as a data base in the general programming world. Google users service is used to offer the authentication and authorization functionality. With this service the user will be directed to login through Gmail account credentials. If the doesn't have one, has to create a new Gmail account and can access the service provided by the web application. Google Web Templates service is used to create the web applications. This allows the developer to create the user interface in HTML and offers support to CSS content. This is responsible to load the HTML page on server.

6.5.4. Google App Engine for Python

Google App Engine enables the developer to build and host the web applications on the Google infrastructure. This offers us the infrastructure which will allow us easy building, easy to maintain, and simple administration capabilities. This also offers the solutions to the back-ups with high scalability. The version that is used to develop the adaptive web application is Google App Engine 1.5.1. There is another version released, but that doesn't make much difference to the existing tool. The support for python is highly viable. One has to install Python before installing the App Engine, if so; it automatically detects the environment path variables. Using App Engine it is very easy to deploy on to Google's infrastructure.

6.5.5. Google Cloud Strategies & Limitations

App Engine will always be free to get started, and we can purchase more computing resources, paying only for what we actually use. This is calculated using the quota system on daily basis. The app engine will keep track of the number of requests; the amount of data being stored in the data store, Calls made to the Mail API, etc will be recorded every day. If the application exceeds 50% of any particular quota halfway through the day, it may exceed the quota before the day is over. The following tables describe the limitations of the usage of the resources in Google cloud for the applications that were built/developed using the free account of the Google accounts and Gmail users.

The overall outlook of the limitations once again to get rid of any mess and for the better understanding of the developers, it can be stated as follows.

1.	Number of page views	-	~5M page views/month
2.	CPU time	-	6.5 CPU hrs/day
3.	Storage	-	1 GB storage
4.	URL Fetch Calls	-	650K calls/day
5.	Mail	-	2,000 recipients emailed
6.	Bandwidth	-	1GB/day
7.	Tasks Enqueued	-	100,000
8.	Chat Messages	-	650K XMPP messages/day

(Google.com, 2011)

These are all the overall limitations of the Google app engine. The services offered by the app engine are within the range of the service limits and if that exceeds that may be denied for the day and will be renewed for the next day. And if anyone wants to convert the app to convert into a business application then that can be done by paying some pricing strategies listed in the Google app engine's dash board.

6.6. Implementing Adaptation

The adaptive web implementation is supporting and implements a different environment offering personalization. The web application allows the user to register their preferences with the server which will be used to bring the adaption of web services. If the user is logged into the system he will have results matching the criteria specified in the preferences section. If the user is not logged in he will have a normal Google search results. The application is also offering a secure environment and great user experience.

The web services are accessed with through APIs and internet protocols like HTTP offered by the service providers. The implementation details are documented as follows.

6.6.1. Algorithm Explaining the Flow

An algorithm describing the flow of information and the way services are accessed through various different components of the architecture. A step by step procedure used to implement the algorithm, which describes the communication between each component. World Wide Web is considered as the data base for the development of the application.

Step 1: User will query for the information through the application interface.

$$x = \text{Query from the user.}$$

Step 2: Then, the adaptive engine will process the query on to the user model and then sends that to the web services (if the user wants to use any services then finds them.).

Step 3: If (preferences are not registered)

Register through the interface provided by the application.

Else

The user model contains the user preferences information and that will have the advantage to query the data base of the WWW.

Step 4: Before querying the data base the actual query will adds some conditions based on the user model. The user model preferences will be given priority and then the query result will be entirely different compared to the ordinary search.

If not current user:

Perform general search.

Else

New_query = (x, user model);

Search (New_query);

Step 5: The query is just the use of the search from the search engines and is the information from web is resulted back onto the application interface.

Step 6: The application user has to login sometimes if the search is the explicit option.

Step 7: The new services like MemCache can be used with the permission of the Admin and the users are directed to the Gmail login page to access those special services.

Step 8: The next thing is conditional where the user can request the services and find the service from the registry.

Step 9: The service provider will serve the requested web service by the user with a modified query.

Step 10: The user requests will be continued once the communication is set-up with the service provider and will have the access to the web services.

This is the simple explanation of the step by step procedure of what is happening in the whole architecture and with the implementation.

6.6.2. Attaining Client Side Security

Client-side security is all about the security of the client. The role of the client can be taken by anything. A client is our browser but also our machine as part of a Windows domain. A client is also our Skype and our Wi-Fi card that is associated with an access point. Every piece of software often is a client. Well, it is often related to JavaScript and Browser security, which is a hot topic today. Client-side vulnerabilities include both software weaknesses and end-user security awareness. Risks that affect both client and server are Eavesdropping, Fraud, Web jacking and the risks to the end user are Active content and Privacy infringement.

"Clients and servers are in symbiosis. The security of the server depends on the security of the client and vice versa (David, J., 2009)."

Client side security issues are not as deadly as the server side ones and are often used as a stepping stone towards larger and more sophisticated attacks.

As it is discussed in the above section client side development languages, there are certain measures that researchers are suggesting and YSlow performance rules that are

offered by Yahoo in the real world. Out of all the measures offered by YSlow some are implemented in the development of this application. The following measures are listed below.

Put the Style Sheets at the Top:

```
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en-GB">
<head>
    <title>Adaptive Web</title>
    <!--
    /* Index.html
     *
     * Version 1.0
     *
     * Date 29/07/2011
     *
     * @reference http://www.code.google.com
     * @author Chennupati Gopinath, x10202131
     *
     */-->
    <link rel="shortcut icon" href="/favicon.ico" type="image/x-icon" />
    <link rel="stylesheet" type="text/css" href="screen.css" media="screen" />
    <link href="http://themes.static.developer.org/themes/examples/base.css" type="text/css" rel="stylesheet" />
    <link href="static/css/modal-window.css" type="text/css" rel="stylesheet" />
    <!-- Siudice Search Scripts -->
    <link href="http://www.siudice.com/widgets/siudice_widget/themes/default.css" rel="stylesheet" type="text/css"/>
    <link href="http://www.siudice.com/widgets/siudice_widget/themes/mac_os_x_custom.css" rel="stylesheet" type="text/css"/>
    <link href="http://www.siudice.com/widgets/siudice_widget/siudice.css" rel="stylesheet" type="text/css"/>
```

Figure 9: CSS in the Head section Top of the Document

To bring the client side security one of the best measures is placing the content on top of the document that is in the header section. By practicing this, the practical results are proving that the pages are loading in a fast manner. Even the HTML also supports the best possible ways to load and to place the style sheets in the document.

Avoiding CSS Expressions:

The CSS expressions are being placed in-line with the "div" tags and also with the some other style elements. This kind of expressions enables the security risks. For example an expression is like this.

<div style="position: relative; float: right ;"> Blah Blah...</div>

This kind of expressions will enable a big trouble and allows the third person to access the web sites. Hence, the expressions are avoided to a maximum extent in the whole application and a sample is shown below.

```
<div id="ads">
    <a href="http://matthewjamestaylor.com">
                 src="mjt-125x125.gif" width="125" border="0" height="125" alt="image"
    </a>
</div>
```

Figure 10: Avoiding CSS Expressions

Placing Scripts at the bottom:

The problem with the scripts is their action of blocking parallel downloads. Te solution to this problem is using "differ" attribute but this is not supported by all the browsers. Hence, the best possible solution in our reach is implemented as follows.

```
<script type="text/javascript" language="javascript" src="static/js/jquery-1.3.2.min.js"></script>
<script type="text/javascript" language="javascript" src="static/js/modal-window.min.js"></script>
<script type="text/javascript" src="static/js/script.js"></script>
<script type="text/javascript" src="http://www.sindice.com/widgets/sindice_widget/lib/windows/prototype.js"> </script>
<script type="text/javascript" src="http://www.sindice.com/widgets/sindice_widget/lib/windows/effects.js"> </script>
<script type="text/javascript" src="http://www.sindice.com/widgets/sindice_widget/lib/windows/window.js"> </script>
<script type="text/javascript" src="http://www.sindice.com/widgets/sindice_widget/lib/windows/window_effects.js"> </script>
<script type="text/javascript" src="http://www.sindice.com/widgets/sindice_widget/lib/windows/debug.js"> </script>
<script type="text/javascript" src="http://www.sindice.com/widgets/sindice_widget/window.js"> </script>

<script type="text/javascript">
    function sindice(data)
    {
      if(data==null)
        alert('Connection problem. Please check your internet connection any retry.');
      else
      {
        set_search_win_content(data);
      }
    }
</script>
<!-- End of Sindice Search Tag -->

<script src="http://www.google.com/jsapi" type="text/javascript"></script>
<script type="text/javascript">
</body>
</html>
```

Figure 11: Places Scripts at the Bottom of the HTML page

Placing all the scripts at the bottom o the page allows the site to be loaded quickly. This increases the performance of the application as well. This is supported by all the browsers. The scripts lacing in this application is show in the above representation.

404s Disappeared:

Another client side performance measure would be to say no to 404s. The expense on HTTP requests can be controlled and to get better and increased user experience these no page found errors are avoided totally.

Minimized DOM Access:

The access to a DOM element through java script is a slow process. Hence, it is nice measure to take to get quick response from the service providers. The only DOM access that the adaptive web application using for the Sindice search results, which is a semantic search service.

These are some of the client side security performance measures that were practiced in developing the application. This offers the solution in a quick fashion and is increasing the performance of the application and resolves the reaction time problems in user experience.

6.6.3. Java Script Implementation

The major part of the implementation and coding is done in Java Script. All the applications are and the APIs are accessed with JS. Java Script implementations are documented as shown below. The JS implementation starts with "<script>" tag and ends with the same one. The variables that are placed in the script tag are accessed through out the program. There are three different ways of placing a script tag.

- Placing the script tag on top of the docent head section,
- Placing at the bottom and
- Within the body element

The following code demonstrates using the YouTube service in the application and its implementation in java script. We can define any number of variables depending on the need of the program. Those variables are global to the program and are accessed through a function in the script. This function allows the users to play a YouTube video without going to the official web site.

The example below clearly states how to declare a variable using java script, how to define a function, etc. There is a statement how to call the function from the script itself. We can call the same functions in the HTML body element also.

```
<script type="text/javascript">
    function LoadVideoSearchControl() {
      var options = {
        twoRowMode : true
      };
      var videoSearch = new GSvideoSearchControl(
                            document.getElementById("videoControl"),
                            [{ query : "entertainment"}, { query : "science"},
                            { query : "technology"}, { query : "tv ads"}],
                            null, null, options);
    }
    // arrange for this function to be called during body.onload
    // event processing
    GSearch.setOnLoadCallback(LoadVideoSearchControl);
</script>
<!-- --End Video Search Control Wizard Generated Code-- -->
```

Figure 12: YouTube Video Loading Written in Java Script

The script elements can be loaded in the div tag. The above example displays the results in where ever the developer wants to place it. Or the user wants to be placed.

```
<div id="videoControl">
  <span>Loading...</span>
</div>
```

Figure 13: Div Tag Loading

This will load the YouTube results where the above tag is placed in the whole HTML page. Means the placement of the div element may be in the middle of the document, right side or it may be at left. Depending on the placement of the tag, the results are going to be displayed. This takes advantage of the style sheets written and the alignment of the content on the page.

6.6.4. APIs Accessed and Usage

The APIs used in the development of this adaptive web application are listed in the above section. But, the question is how do we access these services? The web services are accessed with the help of the APIs in different development environments. Out of those supporting environments one of the possibilities is APIs in Java Script.

Simple task involved in accessing any of the APIs is get register with the service that we want to use and that registration will provide a unique key for the developers to use it in

building the application. The key is a large piece and is used to uniquely identify the application from the other apps.

The key that is used in the development of this application and accessing the Google services is as shown below. The implementation of this code is as it is given below.

```
<script src="http://www.google.com/uds/api?file=uds.js&v=1.0&source=uds-vsw&
  key=ABQIAAAAfMBHoUIqkwZVf_vZO_rdPBTwM0brOpm-All5BF6PoaKBxRWHERRcfCuZADLKhyF39a4szD_n_srmxQ" type="text/javascript">
</script>
```

Figure 14: Google API access with a Registered Key

This key uniquely identifies this application use all the services like Google Images, News, Searching the Whole Web, Local search, etc. The procedure and the rules are same in case of any other web service like Yahoo, Bing, etc. They are also offering access to their APIs with the help of a small concept of key to control formula. This is looking like a key to the door of a house; if we lost that key the only way to open the door is to break the lock. Here also, the error in the key or the wrong one gives a few warnings and the service will be terminated after a while.

Another big service that we used is YouTube for this also, the procedure is same, a key.

```
<!-- Video Search Control and Stylesheet  -->
<script type="text/javascript">
  window._uds_vsw_donotrepair = true;
</script>
<script src="http://www.google.com/uds/solutions/videosearch/gsvideosearch.js?mode=new"
  type="text/javascript"></script>
<style type="text/css">
  @import url("http://www.google.com/uds/solutions/videosearch/gsvideosearch.css");
</style>
```

Figure 15: YouTube API Access from the Provider

This service is accessed with the direct approval from the provider and in the Uri that requests the service may not contain the key some times. This kind of service is also allowed by some of the vendors, where YouTube is one of the best examples of that kind of implementation.

This is how the APIs are accessed in this application in order to serve the users with a diversified services brought together at one place named Adaptive Web system.

6.6.5. Adaptive Web Interface

The above discussed application is having a final look as shown in the figure below. The user tests and the evaluation all of the research work was carried on the designed interface shown in here.

Figure 16 : Screen shot of the Adaptive Web Interface

The adaptive web application is hosted in the Google clouds and is up and running perfectly. The application will be accessed by typing the following URL http://persanalise.appspot.com/ in the browser. The user needs to sign-in with the Gmail account and if not have one will have to sign-up for a new account. The application is authored using the Gmail user account access.

6.6.6. Google Cloud Hosting

Google cloud development in a box. Downloadable SDKs, Application Runtimes, Local development tools, Specialized application services, Cloud based dash board, Ready to use, Built in fault tolerance and load balancing. Google App Engine enables a developer to build and host web apps on the same systems that power Google applications. App Engine offers fast development and deployment; simple administration, with no need to

worry about hardware, patches or backups; and effortless scalability. An application can use Google Accounts for user authentication. Google Accounts handles user account creation and sign-in, and a user that already has a Google account (such as a Gmail account) can use that account with the app. An app can detect when the current user is signed in, and can access the user's email address.

Detailed pricing for usage that has exceeded the free quota of 500 MB of storage and around 5M page views per month cost for computing resources is as follows: (Google.com, 2011)

Resource	Unit	Unit cost
Outgoing Bandwidth	gigabytes	$0.12
Incoming Bandwidth	gigabytes	$0.10
CPU Time	CPU hours	$0.10
Stored Data	gigabytes per month	$0.15
High Replication Storage	gigabytes per month	$0.45
Recipients Emailed	recipients	$0.0001
Always On	N/A (daily)	$0.30

Figure 17: Google Cloud Infrastructure Usage Costs (Google, 2011)
http://code.google.com/appengine/docs/billing.html#Billable_Quota_Unit_Cost,
Accessed 01/08/2011

Google cloud hosting is one of the best options among all the remaining cloud hosting processes. It's easy and free initiative to host the application and the interface to do that are all in a user friendly environment. The billing strategy can also be activated by the user of the strategy. It offers our web site to earn money option by allowing us to publish the Ads posted by the Google Ad Sense. Moreover, this hosting offers the high level of

productivity, quick adaption by user to the new functions, security offered to the data is also having huge impact.

These are the some of the advantages offered by the Google cloud hosting and the free to use functionality. The only thing one as a developer has to remember is using the Google infrastructure and tools provided by Google to develop the applications.

6.7. Conclusion

This implementation was stated by following the software development life cycle to gather the requirements. The application is evaluated to measure the usability by following the usability engineering life cycle. And then the implementation is having the different APIs used, the Google cloud technologies usage and then the sample of the final product. The user testing is carried out with the following section to get the user feedback on the implemented system.

7. Testing

7.1. Introduction

This section describes the Usability Engineering approach taken in this project and document of the results. The user observation contains the feedback gathered from the users. The approach that was followed to perform user testing is described. Means report of all the contents and response from different users has been documented in this section.

Users were observed performing certain tasks in the usability lab in National College of Ireland. The users were observed and behavior was analyzed using the Observer XT technology which uses the SMI Begaze technology to record the user behavior.

7.2. Goals

The goal of the user testing is to provide a feasible and a best user interface to access the web services by the user through the account provided by the user. This is also designed to make the user feel free to access the web services related to his/her account details such as profile information, search the WWW for the need. The application developed will also makes the user feel more comfortable with the user interface of the application that they are using is the ultimate goal going to be achieved with this Adaptive Web application.

- Try to get the satisfaction from the user after using the application.
- To make the application more efficient to use: It takes less time to accomplish a particular task.
- To make the application easier to learn: Operation can be learned by observing the object.
- The usefulness of the interface: How better the application can be useful for the user.

7.3. Method

The method section best describes version tested, test design, sample recruitment, tasks, type of data collected, criteria, etc., which play a major role in the evaluation of the web applications in the perspective of usability testing.

Version Tested:

The screen shots of the tested version are placed in the Appendix. There is a mock-up which is the motivation and an initial design which was given a small amount of changes for ease of use.

Sample Recruitment:

"Five users are enough to know 80% of the usability problems involved (Jakob, N. 2010)".

The usability tests were conducted by recruiting five different users from different streams with different levels of understanding. All these five belongs to National College of Ireland, out of which one is a researcher, one is an associate professor, one librarian, another one is a post graduate student and the last one is bachelors' student from business background.

In the pre-test questionnaire the information regarding the user and the backgrounds were collected. The age limit of the users were in-between the range from 21-40. They were also asked to provide suggestions to improve the number of services offered by the application.

Test Design:

Tests can be designed based on the usability tools we have in use or else using some task analysis techniques such as interviews and questionnaires. The approach followed to perform user testing is video recording and before that a pre-test which gathers the information about the users. A questionnaire to get the feedback and then a small interview is conducted to get the user focus. These task data analysis techniques were used to analyze the data collected by performing the usability tests. This analysis will

draw a beautiful attention about the user and also can be used in future to evaluate the user experience.

Test Area:

The test area is at National E- Learning Laboratory (NELL), allows a researcher to improve the use of usability techniques and engineer the usage of the tools offered by the lab. NELL offers an environment to test the design and the usability of the web applications. The laboratory consists of nice piece of hardware and software offering four user tests at a time simultaneously. Means, at a time we can observe four users while we are testing.

User behavior and interactions are observed combining the technologies like eye-tracking technology, audio, video recording, and screen captures in order to measure the usability. This allows the researchers to evaluate the data and the interactions of the user and also brings the ease of use, effectiveness and usability of the applications and suggests the improvements based on the requirements of the user.

Task Data Analysis:

In user testing the evaluation technique that's followed is task data analysis. We have two different kinds of data analysis techniques. They are quantitative analysis and qualitative analysis techniques. This task data analysis is used for description, prediction and explanation of the data that is collected from the user testing. In this Adaptive Web application Qualitative task analysis is the one that was chosen for analysis.

The qualitative analysis technique provides different types of data. They are for example verbal, written and graphical, etc. The one followed in this application is verbal and written. The written approach contains the open answers and questionnaires. The verbal is having interviews and interactions.

The interviews and asking some questions to get the feedback from the user is the preferred action that has taken on the Internet Banking application. And the questionnaires also played their role in analysis.

Tasks:

The "**Adaptive Web**" was tested based on the user preferences and the users were asked to search for the content of their choice and the results were analyzed. These are the more specific tasks that were asked each user to perform.

Tasks taken on the application interface:

Task 1:

- Pre-Test questionnaire filling. Login using Gmail login credentials, if don't have these, please sign-up for a new account.

Task 2:

- Completing the user profile. This can be completed by clicking on the preferences link.

Task 3:

- Searching the WWW through the application with a given scenario and observing and comparing the results with Google search engine.

Task 4:

- Now, asking the user to join the application by clicking the link "**Join or Sign in**" with any of their Gmail or Twitter or Bebo or Yahoo account.

Task 5:

- As part of joining as a member the user is asked to complete a poll which takes care about their interests. And asking the user try to send a message to a member called "Nath".

Task 6:

- Once again conduct a search in the same way as done in Task 3. Repetition of the search with the same or different terms as done in the previous task 3.

Task 7:

- And the final task is to observe the various functionalities offered by the application along with Wolfram Alpha and YouTube, Maps functionality.

The user was asked to perform the above listed activities in order to gather the user experience and the results were documented.

Scenarios:

All the five users were given the same scenario with a minute variation.

Search with a keyword "**Ant**". Observe the results straight down at the middle and follow through all different tabs called Web, Images, Bing, Yahoo, etc. Then, search for the same keyword in Google. And compare both of them, after that please give us your feedback. Navigate through the results in each section focus on the labels in the first tab called "Adapt me." If the user is interested in experimenting with a keyword of their choice can work with that one. That will really test the applications performance. This kind of open ended testing scenario with an open ended option was provided.

Type of Data Collected:

The type of data collected is only the verbal data and also the written data which is based on the questionnaires. The data collected is going to provide a feedback from the user about what his/her feeling in using the application and the experience from the user.

Verbal data is the result of interviews and interactions with multiple users. The interview in the form of questionnaires provides us a view about their opinion on the web application. This way provides a fruitful interaction also. The interactions resulted in gathering more data for the project design.

Procedure:

The application is developed by the iterative usability engineering approach. The procedure followed to complete the test is by recording the user experience. A deep analysis of the user tests that were recorded gives full knowledge of how the user feels about the interface of the application. The questionnaire is prepared for the users to get their feedback and a small interview was conducted to gather the user experience straight away. The user experience was collected in all the possible different ways within the reach. An audio and video recording is used to grab he user test results.

7.4. The User's Experience

The results section contains the report of questionnaires information collected from different users. The interviews were performed on five users. A deep analysis of the video and audio recordings and an interview at the end, gives a brief overview of the observation of user tasks on Adaptive Web application. The following section is broken into two sections.

1. User Profile

2. An Overview of Observation

User profile

The user profile describes the user's personal data and prior experience with computers and some details about the background of each and every user. The observation describes what the user is thinking about the design and the interface of the application.

The test results on each user are listed as follows.

User FR001:

User 1	Female, Age: 25-45. She is currently working as a lecturer in NCI in Learning and Support.
Computer use	This participant uses a desktop computer regularly however laptop is her preferred choice. She works on the computer to prepare notes for her students and browse the internet for programs and working on the course related modules.
User data	The user is having good knowledge on computers and did not have any experience with web development using high level languages related to web applications.

Overview of Observation:

The Overview of observation contains a short narration describing the highlights of the user's experience.

User 1 had tried to access almost all parts of the screen and the services and she succeeded in accessing the relevant content. She correctly logged into the application and tried the preferences registration and then followed the task to search. She felt some difficulty with all the number of services having at one place, confused of which one to choose. She suggested the services are looking like scattered and wondering on the screen and wanted a proper navigate style of services differentiating among them. Felt inconvenient about scrolling till to the end of the application. On a whole she is excited with the functionality offered by the application.

User SA002:

User 2	Female, Age: 17-32. She is currently working in NCI as a junior research assistant.
Computer use	This participant regularly uses a desktop. He works on the computer for doing her research tasks and to search for the information in internet.
User data	The user is having some good knowledge on computers usage and is a technically sound person. She is quite passionate about learning new things and creating them. This user is very much interested in using the new technologies for her research work.

Overview of Observation:

User 2 had wasted most of the time in comparing the results between Google and the application. She was confused totally with the usage of the application. Even can't able find the join link as it is clearly mentioned with the position. She complained about too many things on the screen and can't select any particular one. It was a kind of weird behavior from the user in the very first look at the interface. She suggested making the application more usable and easy to use for all different sorts of users. She suggested limiting the number of services further down.

User WR003:

User 3	Male, Age: 28-40. He is currently studying for a postgraduate diploma.
Computer use	This participant frequently uses a desktop computer and the laptop with equal importance. He works on the computer for performing his study related activities, writing codes and doing projects in computer science. His preference is to settle down as a programmer.
User data	The user is having some knowledge on computers how to use it. He can work on some word documents, programming also. He is very passionate about learning the new technologies in the market.

Overview of Observation:

User 3 had tried to perform Task 2 filling the preference registration. He faced some difficulty in finding the link for the preferences. He updated his profile information and had a view on all the remaining tabs by searching for a given task. He tried to check the remaining services and felt happy with the functionality. There are some suggestions in the perspective of connecting people each other. On a whole he had some best experience with the interface and he wants the more results and the navigation should be on the same page.

User FR004:

User 4	Male, Age: 29-45. He is working as a librarian in NCI serving the students.
Computer use	This participant frequently uses a desktop computer. He works on the computer for performing book transfer and issue activities. His preference is to have a laptop in use daily.
User data	The user is having some knowledge on computers how to use it. He can work on MS Office and much familiar with the use of

library catalogues. He is interested in learning about the new book authors. He completed his diploma in library management.

Overview of Observation:

User 4 also faced some problem similar to user 2. He had a problem in joining in the application. He had a look at all the remaining parts of the application. He tried to check the services like YouTube and Maps and excited with the functionality offered by the application. On a whole he had some best experience with the interface and he wants the application to avoid the crowded nature of services on a single page.

User DR005:

User 5	Male, Age: 17-32. He is currently doing his bachelor's in business.
Computer use	This participant rarely uses a desktop computer. He works on the computer for performing his study related activities. His preference is to have a laptop in use often needed.
User data	The user is having very less knowledge on computers how and their use compared to the remaining four users. He can work on some word documents and spread sheets for business purpose. He completed his leaving certificate and expected to complete BA next year.

Overview of Observation:

User 5 had has skipped some steps and tasks treating them as unnecessary for him. He directly joined the application using the Gmail account. And then he had some search and a comparison of the results with the massive search engine Google. He agrees the results are great. But, he wants more usable version of the application. He expressed his frustration with the crowded services on one screen.

The user questionnaire is placed in Appendix A as Questionnaire.

These usability tests are performed to get the user feedback and experience. These tests will also draw the extent the application is usable and can meet the goals of the usability engineering.

7.5. Conclusion

Usability tests were performed on five different users with different levels of knowledge with computers and different backgrounds. The user tests resulted in with a fair amount of voluminous data and an over view of the observation provides a best analysis of the collected information. It is proved that usability test with a minimum of five users is solving 80% of the usability issues. All the users have expressed their opinion about the interface in a very nice environment for testing. The video recordings are used to evaluate the whole system and its performance. An evaluation about the system can be described later in the document.

8. Evaluation

8.1. Introduction

In this chapter an evaluation of all the research work done and various ways followed to solve the problem. The research evaluation will outline the areas worked on like adaptive web systems, the web services, and the user evaluation. As it is mentioned in research background chapter about different technologies that can be used are discussed. The evaluation is going to discuss about the technology used or the API approach used to access the web services. This research evaluation will also going to draw focus from user experience and the advantages and disadvantages offered by the broad area adaptive web systems.

8.2. Research Evaluation

The research work in this project is mainly focused on the adaptive web services and the usability engineering. Ideally, both these areas are waste in nature but when brought together will have a great impact on the development of new useful concepts and bringing things together. Each section will discuss various different aspects of the personalization with the incorporation of user preferences by providing some sand-box environment. Also, this section will focus on the advantages and disadvantages of building a unique adaptive web system by considering the WWW as the source of information.

8.3. Evaluation of Adaptation

This covers the adaptation of the services based on the user preferences and the evaluation of the adaptation criteria. The adaptive web is aiming to store the user preferences in advance and then offers the search results. There is no functionality implemented which stores the preferences on the fly. The Domain Model functionality offered by the adaptive systems is neglected in this application. But, if the user wants to perform a dynamic consideration of the preferences they can modify the preferences alternatively. Service adaptation is the biggest concern and the massive search engine

vendors like Google and Bing are doing research in bringing the personalized search functionality into existence. This personalization of web services can only access only a few numbers of web services, but not the whole bunch. Using APIs accessing a large volume of service is a great deal as they offer very slow service.

The User Model (UM) stores all the information provided by the user. And these preferences can be modified further by the user at any time that the user wants.UM communicates with the adaptive engine, and the interface of the application through which user can enter the preference value. Here, it stores all the information in Data Store, a special service offered by Google Cloud. And then depending on the criteria the search results will be displayed to the user.

Adaptation of web services are closely depending on the APIs used and the possibility and access offered by the service provider to make use o the service. This kind of barriers are always there acting as hurdle to the growth.

8.4. Evaluating Web Services

In this adaptive web application there are a handful number of web services used and the services can be accessed through the application interface. The user has to register to use these services. The whole process of registration is explained in the Architecture of this thesis. Registration is very simple and straight forward, if the user has a Gmail account then they can access the services easily or they has to sign-up for one. These web services are accessed through the APIs provided by the service providers stored in the service registry. Here, the problem lies in with the way that the services have to be accessed. These APIs won't offer that quick access to the services. Hence, the network issues are to be monitored and have to be taken into consideration. The speed of the broad band connection should be relatively high compared to the general broad band connections.

And coming to the storage of information for the application, the application only stores the user preferences in a single table. That table is also placed in Google cloud. There is no question of data bases in implementation of Adaptive Web. WWW is used as the data base and the service is offered for the user. In accessing the services provided by a third party and personalizing them is involving major concerns like security. HTTPS is used to

provide secure connection to operate in a secured environment. Security is one of the major concerns at any time. Since, there are a handful number of web services used in the application, it is necessary to offer a sand-box environment to get the user satisfaction and to win their confidence. Hence, client side security measures were followed in-order to serve the user in a better way.

With all these extra additions and constructions the application performance is a bit concern. It is loading the services with some delay for the first time access. And then, the application behavior is fantastic till the end of the usage. The web services Yahoo, Bing, Google search operations were given major focus and then the YouTube can be used to watch the videos. These web services can be extended further more by the user as they continue to use the application.

8.5. User Evaluation

The process of evaluating the interactive adaptive web systems is considered as a daunting task and it remains the same for a long period. User feedback from a series of user tests is holding a mark on the evaluation of the usability of any application. Similarly, this research project also concentrated on the user feedback. User testing is the measure of knowing the usability of the application.

The feedback from the users is evident that the application holds some draw backs in terms of the design of the front interface. Here, we have two different kinds of evaluation techniques available summative and formative. Summative is a final feedback and is taken only once at the end of the application. Formative evaluation is used at different stages, involving user to suggest modifications to the application. We may opt for a layer evaluation of the application, but needs more time than anything else.

The usability tests were performed on five different users. This is uncovering the maximum amount of pitfalls present in the design of the application. These users are all from different backgrounds. Say starting from a high end researcher to a low end unknown user about the computers. Users provided a valuable feedback from the tests. The data gathered from the tests can be further analyzed and evaluated in order to bring

and figure out more specific needs of the user in the design of the front interface. The five users are from different streams and they are all different by nature and by profession.

The only suggestion resembled from all the users is the cluttering nature of the screen. All the services at one stage are confusing and the user is taking more time to find the service. A navigation menu is the suggestive framework for the application. This is the valuable feedback that users provided. This testing gives a brief outlook weather the user has reached his requirements and goals not.

8.6. Evaluation of Technology

It is evident that the application is developed using the APIs, Python language and the Google App Engine. The application is finally hosted in the Google Cloud. There are so many other possibilities that one can choose to develop the application. The best one is using the Linked Open Data. This allows the developers more flexible environment compared to that of the present implementation. Linked Open Data overcomes many of the disadvantages present in the interfaces. This offers cross communication among the web services. The present implementation only allows the user to access the particular service and can't provide an effective solution to personalized service. Micro-formats are also a different alterative which acts in the middle of these two. But, this doesn't offer the feasible solution for any problem. This is having some disadvantages compared to both of the technologies.

There are other alternatives for the developing language as well. The OWL will provide a semantic linking to the web services. This will generate a more specific functionality like semantic search. Ontology based learning is used for the best results. In the implementation of the adaptive web application there is a fairly large amount of XML is used to provide semantics to the predefined search terms. In order to avoid this over head the best possibility is, to use the RDF advanced version of the XML. This contains the semantics of any element.

Client Side scripting language Java Script is used to provide most the communication with the web service provider. This is the positive approach which any developer can use to build interactive web applications. This offers the rich interface with the help of

JQuery, a dynamic client side scripting language. The infrastructure offered by Google Cloud is next big asset for the developers. The performance of the application is also highly reliable and secure in this environment. And the clod environment provides support for almost all type of requests with different protocols. The loosely typed Python is used to build the web applications. This offers a secure environment and also some kind of access to the mash-ups by the developer.

The technology is just a medium to produce the build the working application. Really, technology matters at certain cases where high level vicinity is required. In the application considering the time constraints, using APIs and JS is yielding more positive results in small period of time. It has never been a motivation to back any single technology, but the current status of the research work proves that the optimal solution can be achieved with the help of ontology based implementation with LOD.

8.7. Pros & Cons of Adaptive Web Systems

For anything in this nature there will be some advantages and disadvantages. In the same fashion, the adaptive web systems are holding more advantages and disadvantages as well. The concept of Adaptive Web Systems is relatively a new concept.

Here are the advantages and the disadvantages:

Advantages:

❖ Adaptive web systems are used to bring personalization in the web environment with a high end tailoring tasks of searching, navigating through different services and with the social networking.

❖ Construction of an open model for adaptive web systems is a very useful and a straight forward way to access the web services considering the whole WWW as a single database.

❖ The information can be provided to the user of their own choice at the right time in the right position by decreasing the level of difficulty to a maximum extent.

❖ High end adaption for the developer with a way to implement an adaptive system in the language of their choice.

Disadvantages:

There are some disadvantages that an adaptive system will have obviously.

❖ The user can be diverted if the prerequisites are wrong and the user preferences are not matching his needs. In this case the user will be directed to unknown results pages, which will yield the user a frustrating result.

❖ There will be some unstable appearances in the results of the pages. This will cause a great confusion to the user.

❖ There are some difficulties with authoring in accessing the interested information by the user in the WWW.

❖ Adaptive systems that were developed using the APIs and micro formats won't offer the flexibility to access the other services, acting as the gate ways.

❖ Even with LOD also, the performance of the resultant system is going to be the major concern.

8.8. Conclusion

This chapter is a whole evaluation of the proposed system. This is carrying and covering different approaches and the pros and cons of the system. The technology used, research evaluation in the area of the adaptive systems. The evaluation of the usability concepts is again a great advantage for the web systems like this in the thesis. The adaptive web systems are then further summarised with the potential findings then concluded with at the end.

9. Summery

This section summarises the whole research work done in the adaptive systems field with the findings the ways they are addressed. In implementing the adaptive web user interface using the APIs and python ended up with some important findings. The APIs are acting as the barriers to move from one service to the other. This can be resolved by using the solution linked open data. It is recommended an early start on the registration of the user preferences from the first phase requirements gathering brings more specific results to the user, though the application uses the existing data about the user by looking at the profiles in the social networks and the e-mail accounts. User preferences and needs should be fairly straight forward and pre-planned.

User Experience is also a major concern in developing any web application. The adaptive system will have a different importance compared to the other applications. This focused on the user reactions to the results generated from the system. There will be more issues that the user feedback and the testing will solve. All the usability factors are satisfied with an effective user testing with video recordings. There are different ways that we can collect data from user to have an evaluation like questionnaires, interviews, recordings and eye tracking. The user feedback with the user testing allowed finding the difficulties present in the application. A large amount of data collected is used to produce an evaluation in the next section. This testing enabled to further improve the performance and the design of the adaptive web interface. We do system tests to catch bugs. I dare to say with all my experience with this dissertation **"We do usability tests to catch user experience."**

The adaptive web applications can be built using any technology that the developer is familiar with. But, it is holding a mark on some performance issues depending on the technology used. An open model approach to construct an adaptive web system using the existing profile information in the WWW like social networks and generating the models dynamically is a best practice. And, running usability tests is again a great deal to get user feedback and to make modifications to the design of the front end. These are the potential findings in the research carried.

10. Conclusion

The significance and the demand for personalization and adaptation are increasing highly in different sectors like e-Learning, education and research, etc. To meet the user needs in these conditions, the applications must be developed curtailing the functionalities to the user preferences. However it's been a difficult and daunting task to get personalization satisfied in all the respects. It is a much better practice to use the information about the user that is present in the WWW. Or the other alternative is asking the user to register the preferences in advance. It is very difficult to grab the preferences on the fly.

The proposed adaptive system in this thesis is far better than the existing systems. For instance a comparison to that of the HeyStakes, which uses the community based search with the help of the history from the previous search. This really is a day by day process. To get the specific and exact results to the user needs, takes some time. But, our system the Adaptive Web is solving this kind of delay getting the user satisfaction with quick results. We are offering a completely new search environment which is best for the user needs. The system was developed using the social connect concept which will connect with the friends and the other members of the world. This offers the search functionality with the interests that are present in the user model and in the interests registered in the friend connect.

A major concern in our application is constructing a unique user model that satisfies the user model. The construction of the user model depends on the services that the user wants to get access rights and the area of research. The existing adaptive systems are offering traditionally a closed model. This will result in describing the metadata to a large extent in advance prior to the start of the business. In order to avoid these risks an open model approach proposed in the application by accessing the web services and tailoring them to the needs of the user is a gigantic task. To achieve this open model there are a number of emerging web technologies present now-a-days. We can make use of any of these technologies in order to better serve the user needs and in the construction of the models on the fly. The different technologies and the best ones with advantages and disadvantages are discussed in the construction of an open model approach. It is a hard

task to decide on which technology to choose as they are all having object oriented nature. Till today the best practice is to use LOD to access the web of data and then present it to the user using some ontology technique.

The completely new thing which is distinguishing this thesis is discussing about the new technologies that are used to achieve this open model. There are no other research works which has opened up the discussion for the argument for choosing a new technology out of the existing ones to construct this open model. This will definitely help the other future prospective researchers with a decision to go in a right direction with the right language for the adaptive open models.

The implementation of this adaptive web system with the help of the client side technologies is certainly a helpful move in bringing rich user experience. This is offering a secure environment by following some security measures for the user to enhance their faith on the application. This functionality in this application is achieved simply by following the YSlow techniques offered by Yahoo. Developing the application in Google cloud really increased the performance better than the other environments. It is the first move from the application side. The cloud provides the environment which serves every request through the server, which helped the APIs to load quickly. User preferences can be better served if the application is quick and loading-up all the details in a quick passion.

User evaluation is the final task which helps to modify and add changes to the user interface with all the consideration from the user. This increased the usability of the web system. A deep user testing was done with five users to completely get the usability issues resolved. Finally, this author is saying that there is a real significant contribution to the research area adaptive systems by constructing an open model for adaptive web systems and evaluating the usability of that system.

11. Future Perspectives

11.1. What's next?

This section outlines the future advances and recommendations, which can boost up the performance of the adaptive web application and in the construction of the open model. Layer evaluation is going to discuss about the user evaluation in a different and versatile way from the current evaluation technique.

11.1.1.   Technology Recommendations

The adaptive web application was developed using the emerging Python framework with the help of some advanced client side scripting languages like Java Script, JQuery and some APIs to access the web services. But, there are different latest web technologies which has the capability to build an open model for the adaptive web application.

Adaptation of web services is a bit tricky way in this application. There are some barriers with the technique followed in this application. The APIs are acting as gates to use the other service by sitting on one service. This kind of inflexibility can be handled in a best way by using the LOD concepts. This will integrate the whole web of data into one data base and allows the user to have their requests in the form of URIs. This kind of advanced implementations will resolve the semantics involved in the application. Also, there is a fairly large amount of discussion involved in the semantics of the search results. To get the semantics there is a lot of XML used in the application. In order to avoid this overhead, the best suggestive approach can be using RDF and ontology based programming constructs.

The construction of this adaptive system requires some knowledge about the Domain model which is integrated in the user model itself. A separated DM will work as efficient as the user preferences can be stored in a dynamic way. This is how some enhancements can be taken to improve the system performance and ability.

11.1.2.   Layered Evaluation

The user evaluation section of this research work has proved that the usability engineering followed is going to cover 80% of the usability concerns. One of the findings is that the evaluation strategies followed is in the form of summative. There are many reasons that forcing to use an alternative user evaluation strategy. One of them is the time and the other one is the cost factor. Unsuccessful user evaluation and analysis will lead to rework increasing the time, cost and manual effort. The best user evaluation practices can be by following the layered evaluation. This brings the user feedback at different stages early from the requirements and design stage. User perception can be evaluated by dividing the evaluation at different layers. A formative evaluation approach is the best practice for a perfect and a usable application.

On a whole constructing a fully open model adaptive system will meet the user requirements by building different models dynamically for the day-by-day changing needs of the user.

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Appendices

The appendices section is arranged in an alphabetical order.

Appendix A: Use Case
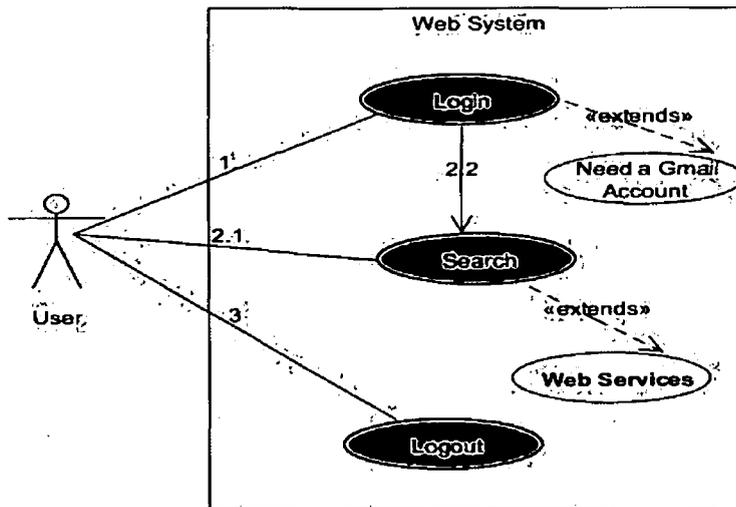
Figure 18: Use Case representing the flow

Appendix B: Interview Questions

1. What is your Name?

2. How old are you?

3. What is your occupation?

4. Do you Search for information quite often?

5. What is the mostly used search engine?

6. What type of information would you search for?

7. What are the improvements you suggest for the search engine you use every day?

8. What we-Services you think are to be at one place? (Like YouTube and Google maps together along with twitter feeds)

9. Then, how would you want the final interface?

10. What is your qualification?

11. Where are you from?

12. What are your likes?

Figure 19: Interview Questions as part Requirements Collection

Appendix C: Personas

Mr. Darren Mulvihill: Student

"Life is the process of endless compromises; Let us chill at least for some time of the day with what we want."

Studying In: National College of Ireland
Background: B.A.
Computer Skills: Moderate

Computer Type: Laptop
Age: 28
Job: Employee in NCI

Goal:

Darren loves to search the web for his friend and for the information regarding entertainment in the websites like YouTube to get relief from his academic work. Darren finds himself hanging out more on social networking and in entertainment. E love to see all the services offered in a single window, instead of going to different URLs separately. As, he is from a non-technical history, can use the existing things in a better way.

Motivation for Personalization:

Darren always wants to use search engines like Google (most often), Yahoo to get the results on things like the friends in his social networking community, and also spends most of his time on entertainment like watching to the digital media. The digital entertainment and things like watching for the videos in YouTube. He is also concerned with the news on finance and economic status of the country. He is using Yahoo financial news section. Whereas again coming back to the social media thing, interested in following the tweet feeds from his friends and on famous items. The intention of Darren to go and visit all this different sites at a time is making him to feel frustrated and irritating. For all this he is visualising a web application which can bring him the results based on the preferences stated by him under one roof. Like all the requirements and access to the services on single home page. This will be the best solution that we can produce on the needs of Darren. Some of his likes and interests are saying that a moderate usage of the services. He spends some part of his time in browsing through the net. These services can bring most of his time saving.

From all the given requirements, we can design the web application which can serve the needs of Darren and is taken into consideration with the front end layout. The final product designed using the wire frames is the layout of the application. This can be achieved in the form of having multiple sub windows in the same page of the web applications. This made him feel happy with the service being provided by the application with the final application interface.

Figure 20: Persona on Darren a Student
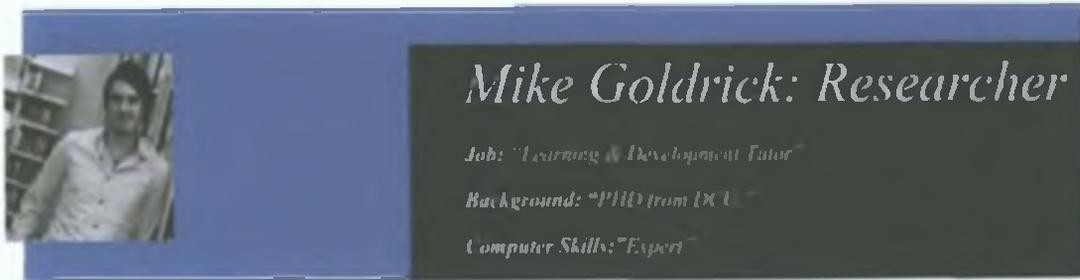
Mike Goldrick: Researcher

Job: "Learning & Development Tutor"

Background: "PHD from DCU"

Computer Skills: "Expert"

Short View Note on Mike:

Computer Skills: Expert user		**Computer type** : Laptop	
Job : Student Support Tutor		**Background** : Sports star	
Computer tools : email, Browsing, Developing, Research, etc.			
Employer : National College of Ireland.			
Age : 29			

Goal:

Michael Goldrick is a hard working and runs in a busy schedule all the time. He wants to have an adaptive system which supports with his responsibilities and also helpful for his students in teaching.

Journey with duties:

Mike is a young researcher working in National College of Ireland as a student support tutor, taking the responsibilities like guiding the students, helping the disabled persons in acquiring the skills. Mike had his doctorates from Dublin City University, Ireland. His research interests lie in adaptive social connectivity for learning and also in addressing the student disabilities in learning and in distance learning. He is the head of Learning and support in NCI. He had lot of leadership responsibilities on his back. His research interests also lie in Cloud computing. As a profound and young blooded researcher, he wants to work in an environment or likely to create one which adapts for his needs. AS a researcher he loves to spend his leisure time in reading books, listening to melodious music, surfing internet, etc. His interests are forcing to create an application which will support with the culmination of all the services together at one place.

Mike wants to see a platform which will allow is users to search for the web services like Google Maps and YouTube which are absolutely of his likes. He regularly uses the Maps to see the locations and his disabled students also prefer the same to travel. As a researcher he had some national and international research publications. He wants to search the web to find a good academic findings and also for the conferences in the world to enhance the research knowledge and to add more to the profile. He used to browse through internet for the conference and academic papers, journals and articles. For this the only findings he had is the current search engines are not having feasible solutions to his search queries.

He regularly searches through the web search engines like Google and Yahoo. And sometimes to have a look at the videos on conference meetings, uses the YouTube and TED web sites. He also wants to use a predictive search engine, like weather forecast predicts the headlines or the next week and so. He is also interested in the predictive web search. In relation to that the combined web application with the services like Google Maps and YouTube together will result a fruitful output to serve the user needs.

Coming to the design of the interface providing this application should be an easy to use and fast effective and efficient one. The design must attract the user attention and should not deviate him from the actual work which is the regular problem with the search engine right now. These goals can be achieved with the application that can bring the adaptation into the concept and also a bit of support for the predictive search and also offers a high end of user experience finally.

Figure 21: Persona on Mike a Researcher

Michael Bradford

Lecturer
MSc in Mathematics
Age: 37
Employee
Expert User of
Computer
Laptop

Frequently spends his time browsing for technical information and for the stock market macro economics.

Good logical thinker and also a dedicated person towards his work.

Privacy is the main concern and doesn't like the personal information to be shared and visited by others.

Key Goal:

Get everything done

In a secure and privacy driven environment:

Michael is a lecturer in National College of Ireland. He is a deserved person and doesn't like to share the information in the world wide web. Privacy driven mentality and loves to work with the needs in a secured way. He is interested in browsing the internet for the things like stock market to know the macro and macro economics of the country. He is also interested in turning off the javascript content, popups and all the disturbing events.

Life Achievement:

Michael is a person with a knowledge working in the diffeent environments as a developer in IT and turned into a lecturer with an initiative to guide the students in a better way.
Michael is very keen and interested about using a search engine. Some web sites that list his interests are "ixquick", "scroogle", "Yahoo", "Google", etc. His search interests lies in finding the information on stock news, technical information like latest releases of the softwares, news about the new things like phones and the software updates.

He is prefering to visit the sites directly. And there is a hope at a corner of his heart to support the application provided the app offers the security and a sandbox environment. The kind of information provided by the application is an upto date and offers a striaght day to day information and that is the interesting feature for him and uses already existing online information. So, a positive sign.

Figure 22: Persona on Bradford a Lecturer

Appendix D: Questionnaire

Search

Welcome to the National E-Learning Laboratory (NELL) and thank you for taking part in usability testing today.

There are 23 questions in this survey.

Privacy

1 [privacy]A Note On Privacy

The data collected through this questionnaire is anonymous. The record kept of your questionnaire responses does not contain any identifying information about you unless a specific question in the questionnaire has asked for this. In this study we may record additional data such as video footage, screen recordings or audio data. Publications or reports to clients may contain samples of this data (e.g., pictures, videos or audio sequences). However, we aim to keep data anonymous at all times, and while we will present summaries of data in publications, individual participants will not be identifiable at any time.
By participating in this study, you agree that such data may be published and reported.

Do you agree with this policy? *

Please choose only one of the following:

- ☐ Yes
- ☐ No

Introduction

2 [id]Participant ID

Please write your answer here:

Please enter tester number provided (e.g., user 001)

3 [sex]Are you ... *

Please choose only one of the following:

- ☐ male
- ☐ female

4 [age]What age are you?

Please write your answer here:

5 [occupation]What is current employment/area of study?

Please write your answer here:

6 [Location] Where are you from? (Ex.: Dublin, Galway, etc)

Please write your answer here:

Interests-Computers

7 [internet]Do you have internet at home?

Please choose only one of the following:

- ☐ Yes
- ☐ No

8 [usefor]What do you use your computer for?

Please choose the appropriate response for each item:

	Never	Sometimes	Always
Office packages such as word, excel etc	☐	☐	☐
Email	☐	☐	☐
Web surfing	☐	☐	☐

Study	☐	☐	☐
Chatting via facebook, bebo, twitter etc.	☐	☐	☐
Search for Content	☐	☐	☐
on-line banking	☐	☐	☐
Buying & listening music online	☐	☐	☐
Playing Games Online	☐	☐	☐
Skpe calls	☐	☐	☐
E-learning	☐	☐	☐

9 [broad]Do you have broad band connection? *

Please choose only one of the following:

- ☐ Yes
- ☐ No

10 [Broad Band]If yes, What kind of broad band connection do you use?

Please write your answer here:

11 [Speed]What is the speed of your broad band connection?

Please write your answer here:

Previous Experience

12 [Searching]How often do you usually use search engines? *

Please choose only one of the following:

- ☐ several times a day
- ☐ serveral times a week
- ☐ less often

13 [search2]

Which search engines do you use? (Ex.: Google, Yahoo, MSN, etc.)

Please write your answer here:

14 [social network]Do you use social networking? (Ex.: Facebook, Google+, Orkut, etc) *

Please choose only one of the following:

- ☐ Yes
- ☐ No

15 [social2]If yes, please tell us which social networks you use?

Please write your answer here:

Activity

16 [activity]Now please switch to Google Chrome browser and complete the tasks on separate sheet. *

Please choose only one of the following:

- ☐ Yes
- ☐ No

Usability

17 [Usefulness]How Useful is this website?

Please choose the appropriate response for each item:

	strongly disagree		strongly agree		
It meets my needs	☐		☐ ☐ ☐ ☐		
It does everything I would expect it to do	☐		☐ ☐ ☐ ☐		
It allows me to do the things I want to do	☐		☐ ☐ ☐ ☐		

18 [Ease of Use]How Easy to use is this website?

Please choose the appropriate response for each item:

	strongly disagree	strongly agree
It is easy to use	☐	☐ ☐ ☐ ☐
It is easy to find what I am looking for	☐	☐ ☐ ☐ ☐
The structure of this website is logical and easy to follow	☐	☐ ☐ ☐ ☐
If I make a mistake, I can find my way again easily	☐	☐ ☐ ☐ ☐

19 [learnability]Is this website easy to Learn?

Please choose the appropriate response for each item:

	strongly disagree	strongly agree
It is easy to learn how to use this	☐	☐ ☐ ☐ ☐
I learned how to use it quickly	☐	☐ ☐ ☐ ☐
I can easily remember how to use this website	☐	☐ ☐ ☐ ☐

20 [Satisfaction]How satisfied are you with this website?

Please choose the appropriate response for each item:

	strongly disagree	strongly agree
I like this website!	☐	☐ ☐ ☐ ☐
It works the way that I want it to work	☐	☐ ☐ ☐ ☐
This website annoys me	☐	☐ ☐ ☐ ☐
I like how this website looks	☐	☐ ☐ ☐ ☐
I would recommend this website to a friend/colleague	☐	☐ ☐ ☐ ☐

Feedback (Final Section)

21 [plus]What did you like most about this website?

Please write your answer here:

Figure 23: A Questionnaire used for the survey