Pattern Based Design Can Improve Usability of Sheffield Hallam University Student Timetable

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ABSTRACT

We present a comparative study of the use of patterns to build a new and effective time tabling system with the help of user responses and liking. We used the students and the people related to the time tabling system to collect information regarding the system. The subjects were given a set of questionnaires and interviews. The answers collected from these questionnaires and interviews were used to construct the time tabling system.

Initial survey of existing SHU student timetabling system encouraged author to carry out research to improve usability of student timetable by identifying current problems and scope of new features in timetable by using pattern design and language.

Around 25 users were given the questionnaires and the feedback provided by the users was used to incorporate the changes in the redesigned the timetable. This research is aiming to just begin the use of patterns in timetabling system and help in future research to create a user friendly interface that can shape itself according to user needs.

The author attempted to use architectural patterns to improve the existing SHU student timetabling system for making it more users friendly by adding features like quick view for viewing immediate lectures, SMS and printer friendly format.

The author concludes that the use of patterns makes it more user friendly and customer centered.

General terms

Design, Experimentation, Human Factors, Prototypes.

Keywords

Web design, web pattern and web guidelines, site usability principles, empirical studies, experiment and interview.

1. Introduction

Timetabling is an important mechanism used worldwide for smooth functioning of events. Nowadays timetables are used in our day to day life that helps us to save time and manage events. It is not only used for management of events but also for the smooth functioning of every individual event. Timetables are utilized in places like educational institutes, departments, companies and various other work places. Different tasks and schedules can be managed with the help of academic timetables. Timetable should be interactive so that it helps the user to perform the desired task with ease.

To make the SHU student timetable web-based system more easy and user friendly, author has introduced pattern language or pattern based design. Pattern is used for crafting customer centered design on web.

Patterns of various types are used according to the problem. The scenario of this author's research topic is to improve usability of SHU student timetable with the help of pattern language and pattern based user interface. SHU student timetable web pages should be designed according to the customers' requirements so that there should be no problems in the future. If the page is not designed according to the requirements of customer, then in near future the problems that will be created will cost much more than the software itself. The time and the money that will be spent in redesigning the product will result in loss to the university.

Project background

Timetabling is an important mechanism used in day to day activities to manage events and for also smooth functioning of every individual event. Timetable should be interactive as it helps to perform the desired task with ease. Author has introduced pattern language or pattern based design. Pattern is used for crafting customer centered design on web. If the page is not designed according to the requirements of customer, then in near future the problems that will be created will cost much more than the software itself. The time and the money that will be spent in redesigning the product will result in loss to the university.

The aim of this research is to improve the usability of SHU student timetable, identifying current problems and scope of new features in timetable by using appropriate pattern design. In order to satisfy these aim for the research the author the project into objectives.

2. Literature review

Patterns used in 'software architecture' or patterns used for 'design sites' are inspired from the original pattern concept used in Architecture. Purpose of using patterns for design sites or for software architecture is nothing but to improve their usability and make them more customer centered so everyone can use that application successfully. Patterns provide answers for nearly every kind of design problems. Pattern language contains more than 250 patterns. The concept of patterns was introduced by Christopher Alexander and his colleagues in the year 1977.

2.1. Investigation of the broader context

The author's main aim is to improve the usability of SHU student timetable with the help of patterns. For that the author observed the current SHU's current timetable and even the other available sources of timetables so as to get a better view of the time tabling system. The author used patterns to make the site more user friendly and customer centered.

2.2. Reusability

Reusability is an important concept in design patterns and it ensures the prevention of future problems related to web-based development. Reusability helps us in better understanding the code. Reusability can be called as the usage of greater parts of the same solution in different application. According to Van Duyne (2003, p19), "Patterns communicate insights into design problems, capturing the essence of the problem and their solutions in a compact form. They describe the problem in depth, the rational for the solution, how to apply the solution, and some of the trade-off in applying the solution."

3. What is pattern?

Patterns are basically an architectural concept Christopher Alexander and his collogue discovered the idea of pattern language. The book consists of design patterns. Christopher's patterns language is nothing but to describe construction and environment and this concept is adapted by software field. In software patterns are used for several things

Patterns are nothing but solution to the problems. Pattern deeply define problem as well as find solutions on that. For understanding of patterns used in timetable of SHU author can give an example as follows: Many users have very little computer background no basic concepts like action button and physical button with the help of their existing knowledge author can used HTML action buttons and graphical buttons. HTML button are little bit controlled buttons they can control the commands of that function. The developer can change their control according to usage. Web design pattern language is entirely customer centered language. It is based on customer requirements and customer satisfaction. It is human computer interaction while interacting with web pages.

Patterns have the ability to make effective and efficient websites. Patterns contain qualities like trust, reliability and value.

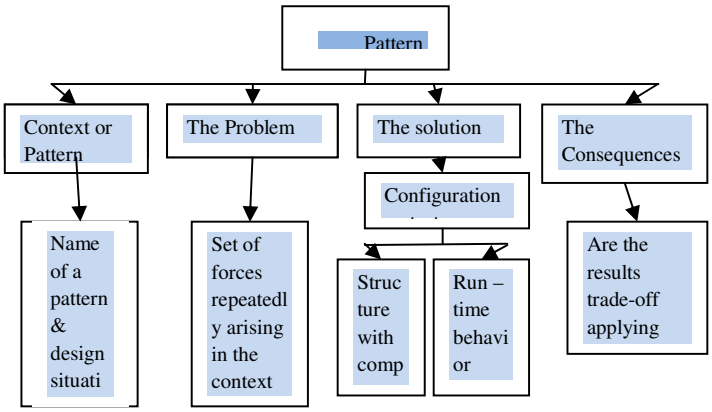


Figure 2: Diagram of pattern adapted from the research of Source: Frank Buschmann et. al.(1996, p11)

3.1. Design patterns

Christopher Alexander et. al. (1977) explains that, "Each pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice." A design pattern is a solution to the problems that occur in software designing. It is just a partial representation of the end product. Design patterns particularly deal with the problems related to software designing. A design pattern represents different problems and solutions in different situations. Algorithms are not useful for designing patterns, but are useful for computational problems. A relationship between objects and classes is seen in design patterns. The speed of the web development is increased due to the design patterns.

3.2. Customer oriented design

Design pattern has to be customer-oriented. Customer centered design is another main topic under design pattern for SHU timetable, because we always develop web-based applications according to customer requirements. Due to the customer centred design author can understand the customer's needs, tools and technologies. This helps author to design a web-based application that may contain the required social and organizational context.

In SHU timetabling main target customers are students, and the people who mostly used student timetabling. So they can students or tutors or pervious batch students. In customer centered design author always takes care that the needs of the customer and the product that we have designed should be the same. With customer centered design it is ensured that all the important features are incorporated that the customer requires and making certain that those features are built in a way that the customer will understand. So author take in account requirements and needs of her target audience and try to fulfill their all needs.

The concept of user centred design can also be denoted as customer centred design. Van Duyne et. al (2003, p6) states "Customer centred design increases the value of website through better design and evaluation."

In this part author try to gather information about pros and cons of a website at initial stage (without patterns). We are trying to find the best guesses from which we can find out the reasons why the users leave a particular site. From this author can come to know about the user requirements and expectations.

According to that customer centred design is divided into 3 aspects:

Principle:

This is an advanced process which guides author to focus on whole design process.

Process:

Process is an actual implementation of principle in practice. Process deals with website development process which gives information about main step and guidelines about development of SHU student timetabling.

Patterns:

Design patterns are the solution for many problems that occurs in design of student timetable. Set of patterns denotes a language which is useful for developing site. Patterns are providing a constructive energy to make sites effective. Patterns also provide creative ideas to make site customer centred. Patterns are useful for fulfilling your business needs.

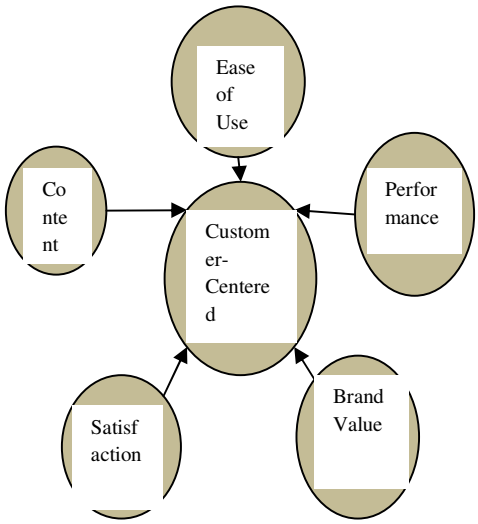


Figure 1: Key issues for customer-centred web design, source: Van Duyne et. al. (2003, p5)

4. Patterns limitations

The patterns are dependent on the design problem and design problems are dependent on the user requirements. It is very difficult to match one user requirements with other user. Each user thinks differently. To take in to consideration views of all the users for redesigning or designing site is very difficult. This results into a site which is different than actual conceptualized with lot of changes and compare to original solution it may be less successful because of modification done at various stages.

Usability

Usability can be decided with the help of number of users that interact with the SHU student timetabling. According to (Preece,2002) there are 10 rules which helps user to use system easily. Preece et. al. (2002,p286) thinks that these goals can be changed according to a new era so that the output can come out with new technologies. Tasks and goals are the dynamic forces for an interactive design process. In user friendly design author balanced forces in a way so they come with new solution that can be reused for similar problems.

5. HCI

Human computer interaction changes from person to person. It depends on every human beings cognitive capacity. Patterns are mainly dependent on customer understandings and their experiences working with web-based design like web pages and websites.

E.g. Three Dimensional Buttons, Lists etc.

According to the research done by (preece,1994), "The discipline concerned with the design, evaluation and implementation of interactive system for human use and the study of major phenomena surrounding them."

In this research author did comparison between two stages of one website. First stage is initial stage in that author have not used any patterns or principles of patterns. Next stage is refine stage in this stage author use guidelines of patterns to refine initial stage and make website more user-friendly.

Some problems that author faced in this research work are as follows:

Novice designers do not have experience and technical knowledge to work in collaboration with HCI. Because HCI is nothing but human and computer interaction, so designer or developer needs to have idea about novice user's requirements and mind set, so that they can create easy artifact of concern website.

Second problem is existing pattern and guidelines are not that reliable so this can be credited to an active gap between patterns and guidelines and their view to design.

Patterns are mainly used as mechanism to construct web sites but guidelines are used as tiny bits of perspective recommendation.So because of all this difficulties author decided to use appropriate pattern scheme for targeted site.

In order to avoid complicated procedures of transforming patterns into guidelines or developing new patterns, with all the drawbacks that such a procedure would imply, we decided to form a body of usable guidelines complying with our criteria and then transform them into patterns, since it was easier to find guidelines that were addressing low level problems. = 0

An additional complication in this experiment was that the users of the SHU were used to using the old timetable system. When the new and improved time tabling system was introduced, some of the users accepted it but some of the users were having trouble using it because of the habit of the old system.

6. Research methodology

The aim of the research is to analyze the existing student timetabling system in Sheffield Hallam University with modified one. Author will redesign existing timetabling system with the help of patterns guidelines and pattern language. As per the research, old student timetabling system is less interactive and user friendly. To make it more interactive, there is need to redesign with the help of patterns. According to Morris (2007, p7), "Research at masters level is intended to demonstrate the researcher's grasp of the subject or discipline and to provide a basic level of training and practice in systematic investigation." Even Zikmund discusses the fundamental basics about the research. Zikmund (2003, p7) defines, "Research that intended to expand the boundaries of knowledge itself on to verify the acceptability of a given theory."

6.1. Deductive and inductive research approach

Gill and Johnson(2002) gives an explanation for inductive research conducting approach, "this approach gives an outcome." Deductive research works from the more general to the more specific. Inductive approach begins with a fact that author has a theory which need not be tested. In inductive approach there is no to test information, it's directly an outcome. By comparing both the research approaches, the author came to know that she will use inductive research approach because it will be the most appropriate for her research.

7. Research strategy

Research can be done by two approaches: Qualitative and Quantitative. Research strategy explains how the research will be carried out and the main purpose is to identify the appropriate approach according to research topic. The author decided to choose the qualitative research approach because qualitative research is conducted from the user point of view and is used to identify the user perspective about the research topic.

Qualitative research strategy

The author decided to choose the qualitative research approach because qualitative research is conducted from the user point of view and is used to identify the user perspective about the research topic. Qualitative research approach is not counting but it includes description and finding information.

Method	Relationship With theory	Approach to research / Type of research
Interviews Focus groups	Inductive	Qualitative Research
Questionnaires Observations	Deductive and Inductive	Quantitative Research and Qualitative Research
Feedback sheets,Online or email forms the above can be: Check lists multiple choice ranking 1-5 etc Attitude scale of 1 to 10 etc	Deductive	Quantitative Research

Table 2: An Overview of Research Source: adapted by the author from 'Research Design' (a handout from the course materials provided) (2008) and project lecture slides for data collection and analysis of (week 9).

7.1. Why author selected this approach

Qualitative research is a realistic research. This research model needs an understanding and flexible modifications as per search development. In qualitative approach, interview is the most useful way to gather information but these results in to large quantity of notes and data. This data again needs to be analyzed according to usability and try to arrive at perfect data. As author mentioned above, author decided to choose qualitative research approach since my topic is about to improve usability of student timetable in SHU. For this I need to know my target users, difficulties faced while accessing timetable and the design problems in SHU timetable. Accordingly the author needs to redesign the timetable and carry out a survey to know the results of users. For author's research topic about timetabling, most important thing is collection of data.

Secondary data this data collection technique is useful for author research topic because it provides her external information than primary data. Author researched for patterns for her data. This data will help author to structuralize extra ideas about her project topic. It will give her the guidelines about how to carry out author's tasks and even it will support her for writing a report and presentation. Secondary data was collected from paper based and electronic secondary sources, e.g. mainly from books, journals, research papers and online sites etc. with this sampling pilot study, survey this techniques also author use for her resesrch.

Questionnaires

Questionnaires are one of the popular strategies of survey. According to preece et.al. (2002), "Questionnaire is a technique used for collecting demographic data and users opinion." Wilson and Macclean (1994) says that, "the questionnaire is highly structured data collection instrument which allows the investigator to assemble a set of data for each respondent, against a consistent suite of questions." Questionnaire is the most important and popular tool for data collection. Questionnaire is divided as follows:

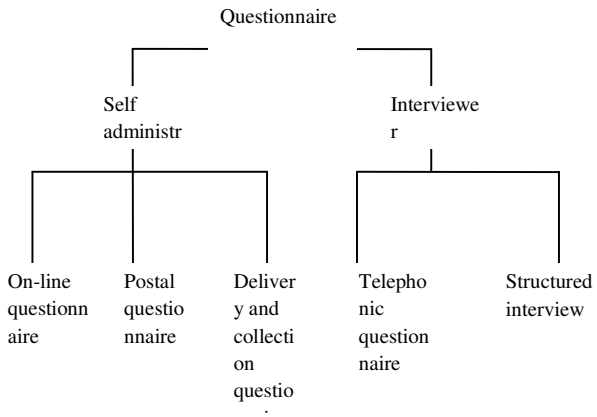


Figure10 : Types of questionnaire diagram taken from Source: Saunders (2003,p282)

There are another two types of questionnaires called open-ended or closed-ended questionnaire. Author adopted both of these types of questionnaire for our research. The research is about student timetable. In that there are some open-ended questions and few closed ended questions also.

Think aloud method and interviews are also effective tools of data collection. Interviews have the following types

- Structure interview
- Unstructured interview
- Semi structure interview

By comparing all types, author adopted structured interview for her research. With the help of this kind of interview method, author will cover design problems, difficulties which user has while using time table, user requirements, and patterns used in the time table

8. Design implementation

User interface

Nielson(1999, p18) says, “white space can guide the eye and help users to understand the grouping of information”. Usage of white space in a webpage helps users to understand the information quickly. Author’s aim with developing the student timetable of SHU is to make the webpage customer centred and easy. According to Nielson, to complete the process author used sufficient white space in author’s main webpage. Nielson (1999) gives explanation about webpage development that people have a ten second ability to keep their attention focused while waiting. Van Duyne (2003, p68) provide evidence of Ben Shneiderman’s eight golden rules of interface design: these are the few golden rules author used for her interface design

- Be consistent throughout.
- Offer informative feedback
- Relay on recognition over recall
- Help customers prevent and recover from errors
- Support customer control and freedom
- Help frequent customers use accelerators
- Strive for aesthetic and minimalist design

Each golden rule contains number of user interface development patterns e.g PREVENTING ERRORS (K12), NAVIGATION BARS (K2), MULTIPLE WAYS TO NAVIGATE (B1), and ACCOUNT MANAGEMENT (H4).

9. Process model

The main aim to use the process models is to develop a system or application systematically which helps to develop the system successfully. Process model actually shows the steps and activities in the process. This increases the actual quality of the process and work done according to plans to achieve goals.

Author compared 4 related process models for her research waterfall model, Spiral model, Rapid application development (RAD) model, the iterative design process or incremental development model

The iterative design process or incremental development model

The iterative design is concerned with existing SHU student timetable design. It will change the existing design till it does not cover user needs. It is a most important designing technique for interface design. When problems are really expensive for fixing, this model is tried to solve problems at early stage. It is really expensive to fix the problems in future phases than the earlier phases. This design model contains three steps:

- Design
- Prototype
- Evaluate

This model is used by author, for redesigning the student timetable in SHU with the help of pattern and takes care of all the features that research needs. This model works smoothly with designing patterns. In first level, collection and analysis of user requirements is done. It helps to generate patterns and then last level pattern makes a rough sketch about fundamental future site needs. Lower level pattern will see only the story board, prototype and scenarios that site needs. This model finds design problem and tries to solve it rather than fixing later on because it is more expensive. This gives assurance that site features are matched with customer needs. This features are also kept in a way that user can use them effectively.

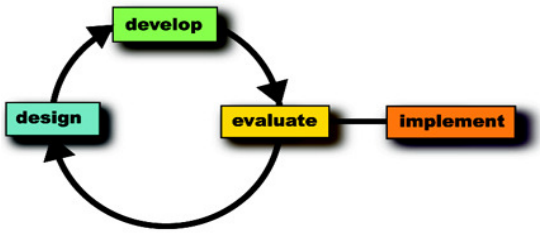


Figure 11: Iterative model Source: bmu.unimelb.edu

To develop an interactive user interface according to suggestions and needs of users, author used following software's:

HTML

This style sheet knows how to manage html data. Without doing lot of efforts author can easily change webpage's appearance from basic to dynamic. This really saves work and time. CSS is controllable so author can change it accordingly as per requirements. By using just single sheet author can design a number of html pages together because author just need to change the style in one and the others will be automatically updated. It specifies inside <head> tag.

JavaScript and CSS

Java script always reacts on every event which is done by user. When web page is fully loaded and when user interacts with it by html pages it works. By using java script author can make a basic program in html to improve the level of her time table web pages. It is really easy to write it. "document. write ("<h6>" + surname +"</h6>")" It just amends the html code and data submitted to the server.

Why author used the dream weaver in her time tabling system:

It is very easy to develop webpage's in dream weaver. There is no requirement to have deep knowledge about web development. Author used this because it supports nearly all web developing technologies like CSS, java script, ASP.net, code fusion, java server pages and PHP.

The main aim of using software is to modify the existing student time table in SHU according to regulations of patterns. Author modified it in such a way that everyone can easily access it.

10. Ethical issues

(2001, p43) explains that "Ethics is the philosophical study of the moral value of human conduct and the rules that govern it". Some ethical issues popped- up during the research. Author's research can be coincided with British Computer Society (BCS), Computer Professional for Social Responsibilities (CPSR), Institute of Analyst and Programmers (IAP). Author even used IEEE standards and BCS professional conduct for author's research.

- Informed consent
- Confidentiality
- Data Storage
- Anonymity

Data collection and analysis

Prototype is main concept in software development. In software development there are number of prototypes. The main aim of prototyping is to solve number of problems as early as possible. The author redesigned the student time table using the responses of the questionnaires and interviews which helped the author to solve their problems. The author used methodology for collecting responses. Out of the various numbers of methods to tackle problems the author selected the iterative design because it easily adopts changes found during the process. With the help of that author can reduce the problems in author's web-based design and the prototype guides to improve with the help of user perspective. According to the suggestions the author put a new feature regarding the lectures and the venue of the lectures in the past half hour. To apply this concept, author first developed a prototype of the website and with the help of that website she took opinion of students. Subsequently, author made changes in timetable user interface to make it more user friendly. Author used a paper based storyboard prototype for redesigning SHU student timetable. Story board prototyping is low fidelity and non computational. For redesign of SHU student timetable, author made blueprint of new design using storyboard and prototyping. Author used 'throwaway prototyping'. This prototyping moves constantly and goes from one level to another level to complete user requirements.

Forming the set

Author followed a step wise approach for modifying and refining the web site.

Step1: author first asked the users what they found easy and what was difficult for them in the SHU time table. She also asked about the changes they felt should be there in the time tabling system.

Step2: the author came to know about the changes and the difficulties that the users had through a simple informal interview. Based on the changes the author made the basic changes to the SHU time tabling system.

Step3: the author presented the prototypes according to the changes and then took suggestions from the users about the prototype.

Step4: accepting the changes as provided by the users the author made changes to the prototype.

Step5: based on the prototype the author made the application.

Step6: the author then showed the users the application.

Refining the set

Step1: the initial application was shown to the users by the author that did not contain any patterns.

Step2: the users came up with some problems and some suggestions. After this the author included patterns in the system.

Step3: the author then showed the users the application consisting of patterns.

Stpe4: the author took a feedback from more than 25 users and then concluded the research.

11. How author used patterns

According to research of Van Duyne et. al. (2003, p25) there are some main pattern groups as well as subgroups of these groups. These groups are arranged with the help of alphabetical order. This scheme is sequential scheme. When designer designs website this scheme patterns are used from beginning of the scheme. In any website the pattern scheme follows top- down approach. E.g. with the help of group(A) in pattern scheme, designer starts with his website the (B) and (C), creates a effective framework and powerful browsable homepage to the site. Benefits of Pattern Scheme are user can easily collect the patterns as per site requirements. Patterns are easily browsable under this scheme. This is because of special arrangement of patterns. Some of the patterns names and guidelines titles were changed to improve the users' understanding. author also added some patterns/guidelines, and modified the focus of others in ways that author believed would help SHU site improve its usability. The format that guidelines were presented was adapted from Van Duyne guidline format.

As author mentioned above the pattern scheme is very useful for timetable design problems. This scheme can solve all kinds of problems and make timetable more interactive. Following patterns were selected by author according to her redesign timetable. Author listed out following patterns with help of Van Dyune et. al. (2003) research:

11.1. Some helpful pattern points used in SHU timetable to address accessibility issue:

Author has taken effort to follow the guidelines and has successfully used these in her application:

- by People with auditory disabilities:
- People suffering with visual disabilities:

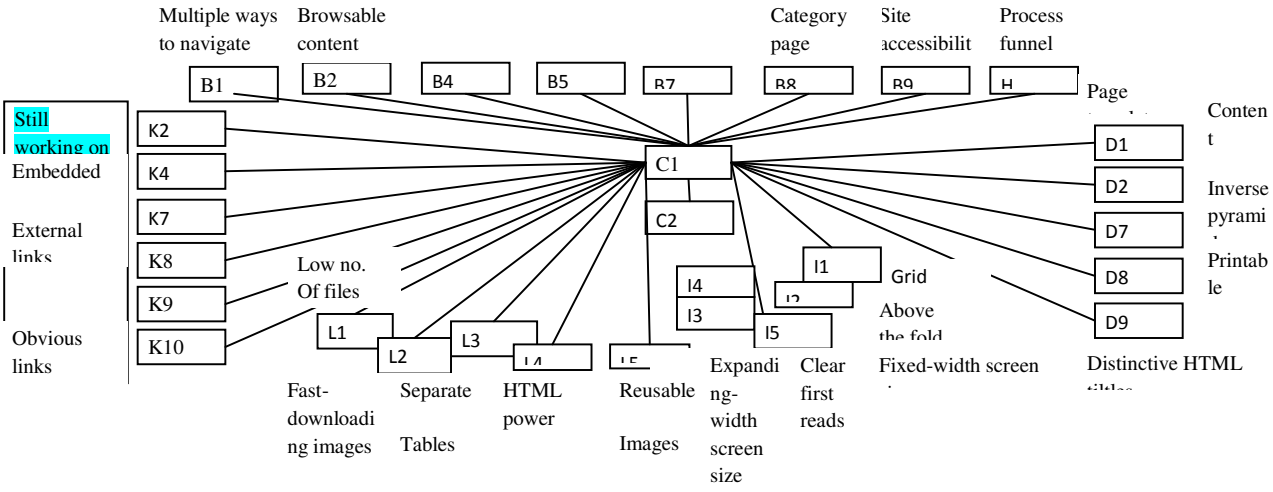
- So she followed some guidelines like
- Website can be navigated without mouse.
- Reduce the typing work for users.

Important information on links, tabs and other elements always in clear and big font size so that is easily noticeable to users.

11.2. For people using internet on other devices then desktop:

These are some guidelines to follow

- Even though the mobile phone user has a keyboard, the option of entering the text should be reduced.
- According to Van Duyne as author mentioned before use image with an alternative text is useful for SHU timetabling.
- Every tab and link has to provide self explanatory information.
- Try to use Distinctive Html Title pattern (D9).
- Always put information on top side of the page. Evidence of that concept



Experiment

Author gave her experiment in the form of sub tasks, so she included 5 subtasks. Each subtask has individual tasks that the user needs to complete. Due to this the user has to go through the whole site. The author gave the users the site containing all the patterns that were implemented. The author gave the users this task to get a proper feedback from them about the site. The author found that majority of people could complete the tasks. The author collected the results via questionnaires.

12. Data analysis and result:

12.1. Data analysis:

After subtasks, next step is analysis of questionnaire data. There were total of 25 people involved in the survey. And here the participants were classified according to concept sampling. Out of 25 people there were 19 SHU students and 6 others.

This survey was done with the 19 SHU students enrolled in different courses and others were non SHU (next pat please enter) students. Survey was done with 'others' because their participation gives a genuine result about user friendliness.

12.2. Number of participants:

There were 9 people from IT background and other people from non IT background. And there were six other participants who were non SHU students.

12.3. Age group:

Around 90% of respondents were in age group of 19-30 (years) and balance were in age group of 31-40. But no respondent was above 40.

12.4. How often user uses the time table:

42% respondents use timetable several times in a day, 32% use timetable once a day and 26% use once in a week.

Various devices are used by target audience. It is a multiple type of question and participants were to select one or more devices. It helps to understand participants used mostly laptops and university desktop for accessing student timetable. If some user is accessing timetable on device other than computer, did they face any difficultly in accessing timetable on their particular devices. Other than computer, 5 people used other devices. In that 3 users did not experience any problem with these devices.

12.5. Find which interface user feels easy and user friendly:

There are two UI, existing one and redesigned one. After finishing their sub tasks they got idea about friendliness of UI. According to the results, around 84% people like redesigned UI and 16% people like old SHU student timetabling UI.

Did the participants find any difficulty while performing tasks:

27% participants felt that sub-task 1 were easy 34% people felt sub-task 3 easy and sub-task 4 were easy according to 12 % users. The one question asked in questionnaire is to give suggestion on timetable if user thinks that they need changes in redesign one. Changes are of many types 16% people say they need changes and 85% people say they do not need. To know there response about changes I gave 3 questions in questionnaire.

13. Findings

According to all questionnaires and subtasks, from the number of responses that author has collected, she concluded that the user interface that the people liked was redesigned one.

User testing is an important concept. The main aim of this concept is that by testing the prototype it makes sure that the requirements were met to the design pattern solutions or not. Design patterns solutions are used in design to increase the usability standards and make the site efficient and satisfactory to the users.

- Type of users:
- General users:
- Novice user:
- Advanced users:
- Expert users:

14. Conclusion

Patterns are one of the best tool for designing websites which make the website user friendly and customer oriented. Design patterns open new opportunities to design user interface. Author conducted a research to improve the SHU student time table using patterns. Finally when the finished prototype was given to the users to test the feedback that the author got was good. More than 52% of the users liked the redesigned time tabling system prototype. Due to the patterns the usability of the time tabling system will increase which is the other hand of the author's research. The final conclusion that can be perceived is that the new time tabling system is better than the existing one. The statistical results were obtained from the data gathered from the questionnaires and all of them prove that the performance of the redesigned time table is all because of patterns. The author has even checked that the site is efficient to handle disabled users also which are specified under the site accessibility pattern. Future analysis of this research will be that the user interfaces that have been redesigned can be made into a real life application by introducing functionality and database. There is a benefit for doing this and it is that the patterns used in redesigning are functionality friendly and can be and there would be no problems while loading functionality and database. The results that were obtained will have to be validated by the researchers that would like to do some further work. Due to this the impact of the research that was conducted now will increase.

15. Critical evaluation

The aim of the research is to increase the usability of the Sheffield Hallam University's student time table with the help of different types of patterns and to also redesign the user interfaces and develop prototype to meet customer requirements. Given the limited time span author had, the research conducted on some sections or phrases could have been provided with much better proposition.

Time was the biggest drawback for the author. Author used all her time in efficient manner. It took her 2 months to complete the whole task. The literature review, methodology, design and development and questionnaire analysis were run parallel with the prototype development. If time would have not been the limitation, an in depth research would have been possible and more topics and concepts would have been discovered.

Research methodology is the methodology that describes all the types of methodologies that are used in research. Each and every methodology has its own criteria, benefits and disadvantages.

15.1. Summary and Future work:

In the result of this research I have attempted to reach the tip of the website designing patterns. Through my research I have minutely contributed to the field of patterns with the help of literature, researches and existing studies. My biggest advantage while doing this project is that I had a tutor who is excellent in this field. In this research I have made a customer centered user interface, for which appropriate functionality and with some finishing touch, a real world application system can be made for Sheffield Hallam University. The main advantage of patterns is that the web pages made using them are easy to add functionality and there is no need to amend them. For further works we can create a user interface that can shape itself according to the users needs and that is flexible to functionality. Finally pattern can have a strong impact on student time tabling system.

16. Reference

ALEXANDER, Christopher, ISHIKAWA, Sara, SLIVERSTEIN, Murray, JACOBSON,Max with SHLOMO ANGEL, Fiksadahl-King (1977) A Pattern Language: Town, Buldings, Construction. Oxford University Press.

BUDDE, R, KAUTZ, K, KUHLENKAMP with ZULLIGHOVEN, H (1992). Prototyping: An Approch to Evolutionary System Development. Springer-Verlag.

BUSCHMANN, Frank, MEUNIER, Regine, ROHNRET, Hans, SOMMERLAD, Peter with STAL,Michael (1996). Pattern-Oriented Software Architecture: A System of Patterns. Wiley Series, Vol 1.

CLOUGH, Peter and NUTBROWN, Cathy (2002). A student's guide to Methodology. Great Britain, Sage.

EASTERBY-SMITH, Mark and THORPE, Richard and LOWE, Andy (1991). Management Research: An Introduction. London, Sage.

FINK; Arlene (1995). How to Sample in Surveys, USA, Sage Publication, Inc.

FINK; Arlene (1995). How to Analyze Survey Data, USA, Sage Publication, Inc.

GAMMA, Erich,HELM, Richard, JOHNSON, Ralph with VIISSIDES, John (1995). Design Pattern: Elements of Reusable Object- Oriented Software. Addision-Wesley.

GABRIEL, Richard (1996). Patterns of Software: Tales from the Software Community. Oxford University Press.

Gill, J. and Johnson, P. (2002). Research Methods for Managers, 3 ed., London, California and New Delhi: Sage.

GRIMSHAW, Bob (2001). Ethical issues and agendas. [online]. Research paper from emerald. 19(1/2). Last accessed 25 May 2008 at: http://www.emeraldinsight.com.

HOLZNER, Steve, PhD (2006). Design Patterns For Dummies. Wiley.

LOWERY, Joseph (2001). Dreamweaver 4 Bible. Hungry Minds.

MORRIS, David (2007). Creating a Web Site With Flash CS3 Professional, Berkeley, Peachpit.

NIELSON, Jakob (1999). Desiging Web Usability. New Riders.

PREESCE, J, ROGERS, Y, SHARP, H, BENYON, D, HOLLAND, S and CAREY, T (1994). Human Computer Interaction. Addison-Wesley.

PREESCE, Jennifer, ROGERS, Yvonne, SHARP, Helen (2002). Interaction Design , beyond Human Computer Interaction. John Wiley & Sons.

SAUNDERS, Mark, LEWIS, Philip and THORNHILL, Adrain (2003). 3rd ed., Research Methods for Business Students, England, Pearson Education Limited.

SPANS, Karen M. and KOVACS, Gyongyi (2006). A content analysis of research approaches in logistics research. [online]. International journal of Physical Distribution & Logistics Management, 36(5), 374-390. Article from Emerald, last accessed on 22 August 2008 at:

http://www.emeraldinsight.com

VAN DUYNE, Douglas K, LANDY, James A and HONG, Jason I (2003). The Design OF Sites. Addision-Wesley.

WESSON, Janet and COWLEY, Lester (2006). Designing With Patterns: Possibilities and Pitfalls. 1-5