

User Centered Design Approach for Elderly People in using Website

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Abstract – With the introduction of World Wide Web, users are able to connect and interact with each other anywhere in this world easily. However, elderly users may not be familiar with these technologies, some are even unable to cope with the rapid changes of World Wide Web. In fact, they are slow and unfamiliar with the latest trends and technology. This paper aims at addressing the problem of the gap between elderly users and the rapid changes of Internet Technologies. We use different techniques of user centred design in order to abstract design requirement for elderly users. These techniques help to gather the necessary user requirements from the elderly users. We apply these techniques to a simple case study – Web Site Design. We develop a combination of low-fidelity prototype and high-fidelity prototype to get the different perspectives of the elderly users for establishing usability requirement.

Keywords – User Centred Design, Human Computer Interaction

I. INTRODUCTION

Due to the increased shift of the elderly population around the world, there is a need to address the needs of the elderly in using Internet Technologies. According to the official demographics report, it clearly shows that the population of elderly in Malaysia is increasing yearly. Studies for (Malaysia broad age 1963-2010) by the department of Statistics Malaysia shows that the elderly population in Malaysia has increased by 70% in 2010 compared to the statistics taken for the year 1970.

One of the most important and beneficial developments that need added attention is the website development catered for the elderly age group. These age groups are slow in adapting to the rapid changes of World Wide Web, unfamiliar with the latest trends and technologies used, and may have functional impairments in using the technologies. Currently, there are no websites in Malaysia that takes into consideration for the elderly age group. Therefore there is a great demand to overcome the virtual barrier of these age groups in using the e-services that are so essential for their daily needs. Noticeably, studies show that many elderly people in current day prefer to have their own activities and be socially independent[1]. There are also a number of retired senior citizens who enjoy travelling overseas. To travel oversea, they need to book their air ticket and hotel through the airlines and travel agency websites. Therefore, they need log on to the Internet, browse their travel destinations of choice, and purchase their tickets using the E-Services provided. However, current designs of these websites do not cater to their functional impairments. Therefore, there is a need for users to develop web sites which caters for the elderly group requirements.

In this paper, we present a User Centered Design (UCD) [6] process and the technique which could address the elderly age groups needs in using Internet Technologies and propose a solution to overcome these shortages. We choose UCD as our approach as it is well connected to specific audiences and have a high acceptability rate among the users. The process of UCD begins with establishing user interface requirement and functional requirements. Then, we apply techniques such as contextual inquiry, task analysis and task scenarios to evaluate existing travel websites. After that we develop an interactive version of a prototype. The stages of designing and building an interactive version of a system are strongly interrelated. During these stages, three other techniques are applied to our system to find usability requirements, they are card sorting, low-fidelity (paper prototype) and high-fidelity (software prototype). An evaluation is carried out by conducting a user testing in every versions of the prototype design. All these techniques are carried out on the elderly age groups at different stages. Finally, user testing is conducted on the Blue Air Travels website. The result of the final user testing on Blue Air Travel website prototype gives a satisfactory result. This shows that the approach of using user centred design methodologies enables the identification of the elderly group requirement problems and it can also be used to resolve the problems they are facing in using the websites.

This paper is divided into several sections. Section 2 describes the user survey for the development of the prototype system while Section 3 describes the development of the prototype system using UCD approach. Finally Section 4 summarizes our work.

II. A USER SURVEY FOR SYSTEM DESIGN

A. Overview

This section describes in detail the techniques of contextual inquiry, task analysis and task scenarios for evaluating existing websites so that we can gather requirements for Blue Air Travel Website. The contextual inquiry and the evaluation of existing website gather a list of user interface requirements and functional requirements.

B. Criteria for Selecting the Participant

In order to conduct the survey, we formulate a few criteria such that a proper survey could be carried out without any bias. Participants' age will be the primary focus for the selection criteria. The participant has to be 65 years old or above and this criteria will assist to evaluate the prominent cognitive issues. The second criterion requires the participant to be someone who is not Information Technology (IT) illiterate and not an expert in Internet Technologies as well. Once the participants are selected from the pools using the mentioned criteria, we will use the same participants throughout the whole survey to avoid bias in our results.

C. Contextual inquiry

We use contextual inquiry for our survey evaluation. Contextual inquiry is a technique devised to collect appropriate field data from the participants through a combination of interviews and observations. The enquiry was carried out informally with the participants. The technique contributes to the initial design concept by providing an understanding of the nature of user's work [3]. Based on the findings, lists of user interface coupled with the recommendations are derived. The following steps are taken into account to conduct the contextual inquiry:

Preparing a set of open ended interview questions and observation checklist.

Gathering information through interview question and observation checklist.

Summary of Contextual Inquiry Finding

D. Gathering Information through Contextual Inquiry

As stated in Section A, contextual inquiry technique involves two main activities: interviews and observations. The interview is carried out first, followed by the observation. Three interviews for three participants are carried out based on the questionnaires prepared. The researcher will scribe anecdotal notes while the interview is carried out. A tape recorder is used to record the interview. This step is carried out to prevent any missed data. Then, observation is carried out by observing the participants behaviour when working online at the computer centre. The researcher records the participants actions and aspects of their environment based on the prepared checklist.

We conduct an interview with three participants, all of them are elders are from different backgrounds and culture. Their favorite activities, physical constraints, commitment to Internet Technologies, and their concerns when browsing the web are taken and noted. Our user survey shows that these participants have good proficiency in English, have functional impairment, and use reasonably old computing devices. We summed up from our survey that these participants love outdoor and simple activities, are not adaptable to small fonts, not comfortable with glaring and bright colours, slow in their daily task, and used very old computing devices.

E. Evaluation of Existing Website

We focused on task analysis and task scenarios for our evaluation on existing websites. Task analysis identifies the elderly goals, tasks, and actions of accessing the Blue Air Travel website. The goals are defined as the elderly expectation of the website. The tasks are defined as the requirements for the elderly in order to achieve their goals while actions are the steps taken as part of the task. This finding will then establish the functional requirements while tasks are used to create task scenarios to derive user interface requirements which are specifically related to the procedure of accomplishing the tasks for the Blue Air Travel Website.

F. Task Analysis-Gathering the Goals from the Participant

The session is carried out through observation and analyzing the participants while they are accessing 'Air Asia', which is a travelling website. Air Asia website is a very popular airline website in Malaysia. The Airasia website is considered to be in the travelling website category because its website has services for travelling information in addition to flight bookings. It has other functionalities such as hotel bookings, package booking (hotel +flight), destination information, car rental and many other elements which can be very useful for the reviewers.

While the participants are browsing the website, they are also encouraged to verbalize and give running commentary for every steps they are taking (think-aloud technique). The observer monitors participants on what task the participants carry out and how they carry out the task. For further clarification, the researcher can request informally the task they are doing and actions they carry out to achieve certain goals.

G. The Established Functional Requirement

The functional requirements of the Blue Air Travel website should consist of six main modules:

Booking a Flight Module– The website allows elderly to book a flight.

Booking a Hotel Module – The website allows elderly to book a hotel to stay.

Booking a Package Module – The website provides elderly packages to book.

Travel Tips Module– The website provides elderly with information's on travel preparations and tips.

Looking for Travel destination Information Module- The website provides elderly with information's on travel destinations.

Register as a member Module – The website allows elderly to register as a member of the Blue Air Travels.

H. Task Scenario

We further evaluate our survey by carrying out task scenarios on the Air Asia Website (2006), based on the derived functional requirements from task analysis. Task scenarios are conducted to identify the user interface requirement specifically related to the procedure of accomplishing the tasks. The task scenario is given to participants to follow through and answer them. The participants are required to write down their findings on the task sheet given to them. While the task scenarios are conducted, they are encouraged to explain what they are doing (known as think aloud technique). The participants are encouraged to explain their expectation and their discovery from the activity. The researcher observes and records every user interface problems the participants encountered and obtains feedback from the participants. The time taken to complete each of the tasks is also recorded.

III. USER CENTERED BASED SYSTEM DESIGN

A. Design Process Overview

The stages for designing and building an interactive version are highly interrelated, therefore it is hard to distinguish each of these stages. For the first stage, the card sorting activity is carried out by the elderly to organize the information of the Blue Air Travel website. The results of these findings help to initiate the design of the Blue Air Travel website using paper prototype (low-fidelity prototype) together with requirements gathered from Section II (Functional Requirements and User Interface Requirement). This paper prototype will be tested by the user using task scenarios to identify usability problem where a list of usability requirements are derived. This finding is then applied to the high-fidelity prototype 1 along with the most recommended guidelines obtained from Section II. The interactive version of high-fidelity prototype 1 is tested by the users to find usability problems which helps to derive a list of usability requirements. These requirements are then incorporated to the design and implementation of Blue Air Travel website (high-fidelity prototype 2).

B. Preparing for the Card Sort Session

Preparation for the card sort begins with getting the titles of the cards ready. Several relevant and important titles are selected from existing traveling websites based on task analysis presented in Section II. The titles of each card consist of objects (nouns) and actions (verbs), which represent information presented in the website. Three travel websites are selected and the titles from these websites are compared with the three websites. Every similar title from these websites is ticked. Those titles with 2 or 3 ticks (✓) are selected. These selected titles are then printed out using a white paper. Each title is cut separately and pasted on a bright yellow manila card with

a size of 15cm x 10cm. A total of 63 cards with their relevant titles are prepared such that it appears big and clear for ease of use during the session with the elderly. Other preparations for the session are the place, stationeries and a wide table.

C. Arranging and Conducting the Card Sort Session

We conducted three sessions of card sorting at three different locations. The first participant chose to be tested in his house, while the second participant at the computer class and the last one chose the Science Faculty at University of Malaya. Convenient location was selected in order to provide comfortable settings and achieve the best result. An acknowledgement letter and a consent form were also given to the participants to inform them of the requirement of the test. During the card sorting session, a set of instructions was read out to the participant. These set of instructions are taken from ZDNet Developer[8].

The piles may not contain the same number of cards as some piles may be very big and others may have only one or two cards. Participants can change his choice and move cards around, merge or split piles as he wants. After the instructions were given, the participants were given some grace period to clarify any doubts they have. Then the cards were given to them. They were also provided with marker pen and extra empty cards with the same size in case they wanted to rename the titles or add a new title. Rubber bands were also given to tie the group of related cards together.

All participants were told to think aloud during their session. For each session no time limits were imposed. However, while the observations were carried out, the researcher will stand by to answer queries from the participants. Jacob Nielsen stressed that the card sorting results are only part of the findings in the session but the other half that needs the same attention is the qualitative insights that was gained in the testing sessions, which is to listen to the participants comments as they sort their cards [5].

D. Observation of the Participant

Mr. Paul

The first session was with Mr. Paul, held in his house. He was really looking forward to this session. He was not given any clue what was going to be done till the last minute. He took almost one hour categorizing them in different categories. Finally he managed to get them into 10 categories. This included a few new titles and change of card names which he preferred. This session was taped with a digital video camera.

Mr. Chong

Mr. Chong's card sort session was done in University of Malaya. It was conducted at the Science faculty canteen on a semester break to make sure there were no

distractions and noise for him. Figure 5.2 refers to a photo of Mr. Chong during his card sorting session. He finished in 25 minutes. He also managed to categorize them in only four categories which were very different from the first participant.

Mr. Balakrishnan

The third participant was Mr. Bala. This session was done in the researcher's house. It took Mr. Bala almost one hour to get the cards sorted. He managed to come up with eight categories.

E. Card Sorting Analysis and Discussion

Throughout the sessions the think aloud method did not work out as the participants were busy trying to concentrate on their card sort rather than talk out loud on their opinion. This is due to their inability to do multi tasking among the elderly people [7].

All the cards from each participant, collected from three different sessions were carefully separated into different bags and each time a participant grouped the card, it will be tied up with a band. This procedure is carried out so that results entry into the IBM's EZSort Beta Edition (IBM, EZSort) will be easier. EZSort (IBM, EZSort) is a free cluster analysis software tool produced by IBM to help interface designers in organizing information based on users' expectation. This tool includes two application, they are USort 1.8 Beta and EZCalc 1.3 Beta. USort helps in organizing card virtually by each individual participant but in this research the researcher does the sorting manually. All three participant's results were keyed into USort 1.8 (Beta edition) by the researcher. This procedure is carried out to avoid consumption of time for training the elderly users to use the system. The EZCalc 1.3 Beta then managed the sorted cards from multiple participants and gave clear dendrogram output which showed the categorization very well. The difference in the categories is determined and areas of similarities are assessed in the design process. The result shows the categorization, differentiated by different colors.

The horizontal axis describes all the titles in sorted order and the vertical axis represents the threshold lines measurements. The threshold lines are represented by green and pink lines. If the threshold is at 1.0, it indicates that none of the participants have put these verbs and nouns together with any group that was formed. These categories are labeled as title of each page or each category. Then the most chosen cards are all those vertical lines at 0.0 which mean that it is the strongest related card. Distance of 0 means that all participants placed the two cards together. For example, 'Hotel' and 'Hotel Information' are put together by all three participants. It also means that it must be put under the same category within that bracket. The Dendrogram's threshold or the criterion is set to 0.70 and there are four big groups and four small groups. The groups which have more than four labels in it are identified as big groups. Altogether there are eight groups formed. From the participant's feedback, the groups that was formed were

'Hotel', 'Promotions', 'Flights', 'Package', 'Fleet and Destination Informations', 'Help and Term and Condition', 'Travel Tips and Preparations' and 'Before, During and After'. Categorization of contents is still subject to changes in the next section, which is the paper prototyping.

F. Paper Prototyping

This section describes the initial design of Blue Air Travel Website. The initial design is based on the paper prototype. The designs initiated on the paper prototype are based on the participant's findings as presented in Section II (user interface requirement and functional requirements) and card sorting activity. The purpose of the Blue Air Travel paper prototype is to identify the usability problems. This technique is considered to be the cheapest way to make changes to the design as it can be made immediately to the paper prototype.

1) Preparation for the Paper Prototyping

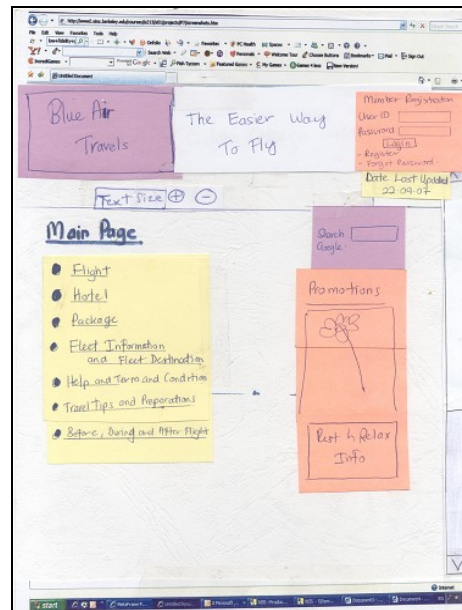


Figure 1 Main Page - Paper Prototyping

Computer-generated browser header is printed and pasted onto the A4 size papers to present the window mockup screens of the "computer". The post-it papers are used to stick some of the verb and nouns so that changes of labels could be made. Figure 1 shows design of the Main page for the Blue Air website. It shows the seven categories in a button form and the promotion as an icon with link. There are also labels for 'Increase' and 'Decrease' button. These buttons are used for increasing and decreasing the font size for the page. The Main page shows a simple design with very few items on the screen. The top most will be the banner which comprises the title on the left, the slogan in the middle and the logo on the right hand side. Every page has the same banner on top to indicate consistency.

Figure 2 shows the link for the 'flight's main page which is labeled as flight booking. This site will concentrate on the 'Flight Booking'. The other button will be the 'Schedule and Time table'. The search criteria are to be entered in the box provided. The box shows the search page for the preferred flight. There is a radio button in the site to select either 'return' or 'one way'. Then there is a drop down menu to view and select the 'departing' and 'destination' country or city. Another drop down menu is for the 'departure date' and the 'arrival date' of the trip. At the bottom of the screen there is two drop down menus for the number of passengers: one is for adults and another one is for infants. Then a 'book now' button is added for the convenience of the participants to know the next step of action.

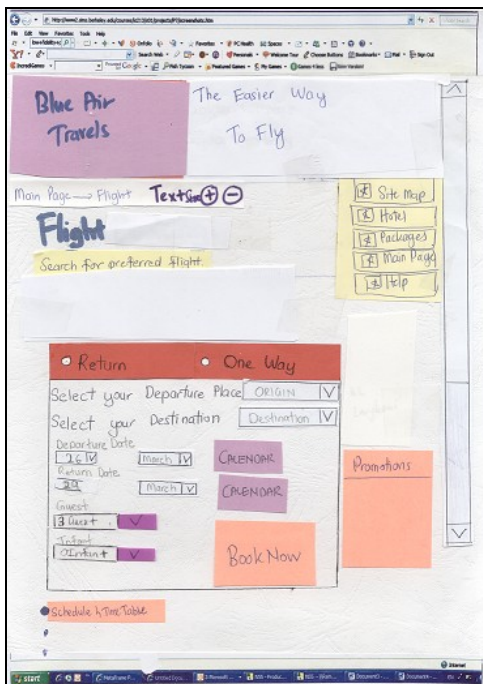


Figure 2 Flight Main Page - Paper Prototyping

G. Blue Air Travel Website Design and Implementation (High Fidelity Prototype 1)

This section introduces the development of high fidelity prototype 1. This prototype is designed according to the findings from Section II (user interface requirement, recommended guidelines) and usability requirements from Table 1. In this version, functions that are obvious and interactive to the participants are developed. Although the features are more distinguishable in this iteration, the less obvious and more complex functions are added in the high fidelity prototype 2.

Table 1 Usability Requirements from Paper Prototype

Category	Usability Recommendations/Requirements
Content	*To provide am and pm on the time of the flight for easier differentiation of

	timing of flight.
	*Hotel List to have other hotels viewable
	*At 'Hotel Room' the information selected earlier are changeable
	Light blue colour is provided on departure flights and pink on arrival flights. Colour contrasts to each for the departure flight and the arrival flights.
	Buttons are replaced to text 'Increase (+), Decrease (-)' in all the pages.
	'Flight and Fare' title is changed to 'Flight List' to describe the function of the page better.
	Main Menu is used to identify the first page. So the Main page is changed to 'First Page'
	The word 'Return trip' to be substituted for 'Return'.
	Hotels, Flight and Package are changed to Hotel Booking, Flight Booking and Package Booking.
	The fare breakdown has to be clear to users. The day is stated there.
	None of the Term and Condition can be eliminated as each one of it has its importance. To make it easier to read only main title is provide with the links.
Layout & Style	*Tour packages are created; the function is reduced to tour packages.
	The booking search will have calendar only.
	To provide 'Table of Content' on the first page.
	Member registration is included in all the pages.
	All buttons to move bottom left.
Navigation and Mechanism	Each step will be labelled with Step 1, Step 2 and so on.
	All the pages have tabs linking to important modules such as flight, hotel and package.

1) Software Used to Design

The designs are created using Microsoft Dreamweaver. The static designed pages are saved as html files but some of the dynamic pages are saved as aspx pages as these pages involve more complex programming techniques. Features which describe style and layout such as the background colour, text colour, page title, hyperlinks and position of the elements (graphics, tables,) are specified in the HTML files. An image file size is determined by the number of colours it has, therefore the number of colours used in a particular image is kept to the minimum possible without degrading the image quality.

The other softwares and images that contribute to the design features are Likno Web Button maker, Adobe Photoshop, Sothink Button creator and Microsoft Visual

Studio.NET 2003, which are used to design the buttons and icons. The images are then saved for web usage, most of them as gif files and a few more as jpeg files, which are used in the design. This procedure is carried out to ensure that the file size is small and the image downloads are fast when the website is viewed.

2) *Conducting User Testing on the High Fidelity Prototype 1*

The participant who participated in the paper prototype was invited to the testing session held in the NASCOM centre. Researcher conducted this session separately with each participant. Each of them was briefed on the way the prototype is evaluated. Since the High Fidelity Prototype 1 is similar to the paper prototype, no participant will find it hard to understand. Researcher then gave out the task scenarios to be carried out on the prototype. The tasks were similar to the once given out earlier which is divided into three types of task, which are easy, moderate, and difficult. The researcher then takes down the feedbacks of the participants while they were conducting the tasks.

3) *Results of User Testing On the High Fidelity Prototype 1*

The timing for each task scenario in the user testing is recorded for each of them and tabulated. The timing determines the time taken to finish each of the tasks on the website, whereas the user testing feedbacks containing comments and suggestions are recorded.

H. *Design and Implementation of Blue Air Travel Website (High Fidelity Prototype 2)*

This section describes the design and implementation of the Blue Air Travel Website (High Fidelity Prototype 2), which includes the hardware and software used for the implementation. The website does not support credit card and debit functions, although it do shows the process.

The Blue Air Travel Website is developed using ASP.NET 1.1. The Integrated development environment that the Blue Air Travel website uses is the Microsoft Visual Studio.NET 2003.

We use Ms Access as the database solution for the Blue Air Travel Website. Tables and queries are generated to store the data. All data are directly retrieved from the database tables using Ms Access. The connection to the database for updates and operations is carried out using OleDbConnection. OleDbConnection is an object that represents a connection string to a data source. So its role is to serve as an intermediate object sitting between the client and server. In other words, it is a connector for stringing the database to the requested site.

The execution was done using the support of IIS 5.1 or the Internet Information Services as it is a window component under Microsoft Windows XP Professional. It is also a component which supports Active Server Page and databases.

The Blue Air Travel website is developed on the Windows XP Professional Version 2002 Service Pack 2 platforms. Since it is using the .Net platform, it is portable to any type of operating system.

IV. CONCLUSION

In this paper, we aim to address the problem bridging the gap between elderly users and the rapid changes of Internet Technologies. We use different techniques of user centred design in order to abstract design requirement for elderly users. These techniques help to gather the necessary user requirements from the elderly users. We apply these techniques to a simple case study – Web Site Design. We use Contextual Inquiry, task analysis and task scenarios to establish user interface and functional requirements of the web site developed. Then, we use card sorting and combination of low-fidelity prototype and high-fidelity prototype to get the different perspectives of the elderly users for establishing usability requirement. Our final prototype system enables the elderly users to use Travel Websites conveniently without any problems.

V. REFERENCES

- [1] Adams, N., Stubbs, D., Woods, V., and Centre, R., 2005. 'Psychological barriers to Internet usage among older adults in the UK', *Medical Informatics and the Internet in Medicine, Health Informatics Journal* 10, Vol. 30, No. 1, March, pp.3-17.
- [2] Gaffney, G., 2004. Contextual Enquiry - A Primer, online, Retrieved April 16, 2006 from <http://www.sitepoint.com/article/contextual-enquiry-primer>.
- [3] Holtzblatt, K. and S. Jones (1993): Contextual Inquiry: A Participatory Technique for System Design. In D. Schuler and A. Namioka (eds.): *Participatory Design: Principles and Practices*, pp. 177-210.
- [4] McCracken, D., Wolfe, J., and Spool, J., 2004. *User-Centered Website Development: A Human-Computer Interaction Approach*, 1st edition, Prentice Hall.
- [5] Nielsen, J., 2004. Card Sorting: How many users to Test, Alertbox, July.
- [6] Preece, J., Rogers, Y., and Sharp, H., 2002. *Interaction Design: Beyond Human-Computer Interaction*, John Wiley and Sons, United States.
- [7] Schwender, Clemens, Kohler and Christoph., 2006. 'Introducing Seniors to New Media Technology: New Ways of Thinking For a New Target Group', *Technical Communication*, Nov, Vol 53, Number 4.
- [8] ZDNet Developer, 1999. Card Sorting, online, Retrieved November, 2005 from <http://www.zdnet.com/filters/printerfriendly/0,6061,2253113-84,00.html>.