

IMPLEMENTATION OF UMMP USING THE LOCALIZATION OF WEB OBJECTS IN USER INTERFACE DESIGN

Aslina Baharum^{a*}, Azizah Jaafar^b

^aFaculty of Computing and Informatics, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia

^bInstitute of Visual Informatics, Universiti Kebangsaan Malaysia, Bangi, Selangor, Malaysia

Article history

Received

15 May 2015

Received in revised form

1 July 2015

Accepted

11 August 2015

*Corresponding author
aslina@ums.edu.my

Graphical abstract

Web object	Result 1:	Result 2:	Result 3:
1. Logo	Top-left	Top-left	Top-left
2. Title of webpage	Top-center	Top-center	Top-center
3. Internal links	Top	Left	Left
4. External links	Left	Lower	Right
5. Login	Top-right	Top-right	Top-right
6. Language selection	Top-right	Top-right	Top-right
7. Search engine	Top-right	Top-right	Top-left
8. Content (area)	Lower-left to center	Lower-left to center	Lower-left to center
9. Calendar	Left	Right	Right
10. Advertisement (banner)	Right	Lower-right	Lower
	* Lao PDR, Brunei, Singapore, the Philippines, Myanmar & Vietnam	* Malaysia & Indonesia	* Thailand & Cambodia

Abstract

Websites play an important role as a communication tool between people around the world. This phenomenon introduces the medium of communication, the user interface (UI), between humans and machines as a key player. The existing web development process recognizes this importance but does not follow any precise guidelines for the construction of UI as an activity within the system development life cycle. This paper describes a method for constructing UI based on users' Mental Model patterns (UMMp) from the localization of web objects. This method can be incorporated into the development process in order to better fulfill users' expectations. The uMMp describe interface design solutions favouring the development of a UI.

Keywords: Mental model, pattern, localization, user interface, web objects, guidelines, users' expectations

© 2015 Penerbit UTM Press. All rights reserved

1.0 INTRODUCTION

There is a multitude of websites available for public access. According to the Internet's live statistics (<http://www.internetlivestats.com/>) as at January 30, 2015, there were over 1 billion websites (1,190,995,000 websites) and over 3 billion Internet users (3,056,797,000 users). The number of users and websites is increasing each year. The increased number of users around the world urges developers to design websites that can meet all users' expectations or meet the expectations of targeted groups of diverse users from different cultures and regions. However, developers do not have standard guidelines and may have only limited knowledge about the needs and expectations of this standardized multi-cultural online community. For this reason, there are many 'dead' websites that receive

little or no traffic. Visitors to these websites become confused and leave the website after browsing for a short time. Typically, visitors to these sites find it difficult to access information and need to spend too much time navigating the interface to figure out the site's orientation. This happens due to poor user interface (UI) on the website.

The previous basic guidelines [1] are no longer suitable for the current technology, and there is a need to have new guidelines or tools to accommodate the diversity of Internet users across countries for the systematic development of UI design. This study explores the development of such guidelines and proposes a solution using the users' mental model patterns (uMMp). The proposed solution offers the advantages of decreased development costs, better usability, and personalization of the UI design (UID). The mental

model theory is a cross-cultural adaption theory, which supports multiple community access. For this purpose, the localization of web objects makes use of the mental model for adaptive UI. The objective of this paper is to explore the application of the uMMP technique from mental model theory in practice and the way in which web objects are localized. The rest of the paper is as follows: Section II briefly presents the concept of the mental model in UID; Section III discusses the localization of web objects method; Section IV outlines the methodology adopted in the present study and the results of the experiments; and Section V presents the conclusions

2.0 CONCEPT OF MENTAL MODEL IN UI DESIGN

Lim and Klein [2] explain that the mental model concept was originally proposed by [3]; the mental model was developed from theory and research in cognitive psychology on individual mental models. Rouse and Morris [4] define mental models as the mechanism by which humans generate descriptions and design systems. Mental models provide a description of the functions of the system and the projected area of the system in the future [2]. Mental models are the framework of organized knowledge that enables individuals to describe, explain and predict behavior [5], [4]. Mental models determine the relevant content knowledge and also the relationship between knowledge components [6]. Individual mental models, for example, of cars, illness, or processes such as child development, reflect the individual's perception of reality. Therefore, mental models vary in terms of their accuracy and coherence. Lim and Klein [2] add that the mental model illustrates the accuracy of prediction of individual performance.

A mental model may be an image, script, set of related mental model, controlled vocabulary or some assumptions [7]. In most cases, the mental model contains one or more aspects of the model, such as the appearance of the image interface, scripting process to be followed when completing tasks, vocabulary knowledge and assumptions about the behavior of the system [7]. Smith [8] defines mental models as structural or organizational data, functions, tasks and roles such as those in group work or play. Mental model accuracy will affect how users interact with a website. A more accurate model is reflected in more successful user interactions [8].

Various theories have been introduced to help researchers figure out the concept model in the context of human behavior. Without realizing it, humans develop mental models in order to interact with the world in which they live. By studying the mental model-like arrangement of object [9], researchers are able to better understand how a person interacts with the environment. Johnson-Laird [9] introduced this idea and used it to compile such things as the order of objects. Norman and Payne (in

[10]) developed this idea into the theory of human-computer interaction (HCI). HCI can be used to create the interface and interaction methods that help developers create a more accurate model of the users' mental system. In most studies, the mental model is interpreted based on the localization of web objects [11], [12], [13], [14], [15], [16], [17], [18], which is also referred to as the concept of translation.

3.0 LOCALIZATION OF WEB OBJECTS METHOD

Localization is the process of adapting a product or a service to a particular language or culture so that it reflects the 'look-and-feel' expected by local users (country-specific) [19]. According to [19], the main goal of the concept of localization in UI design is to improve the website by providing a natural platform in terms of culture, technology and linguistics, while at the same time creating a framework that combines content and functionality for users with various cultural targets. This enables developers to gain a better understanding of user preferences for the elements of the website experience. From this process, element-based guidelines can be developed for web designers.

According to [12], the key requirement in the construction of website content is to understand the ordinary user's mental model or schema for the localization of objects on the web interface. The layout of the interface used by various regional and international sites may influence users' expectations [15]. In the layout of e-commerce websites, [15] found that the layout of the UI must be in accordance with the users' expectations of where they will find common web objects. This finding is consistent with previous studies on the localization of web objects for typical websites (e.g. [13], [12], [11]). In a study by [13], 76% of the respondents had the same expectations regarding the localization of e-commerce web objects.

Adkisson [14] notes that research related to the localization of web objects often refers to e-commerce websites (such as amazon.com) and argues that the research by [13] is not a systematic analysis through which to determine whether the actual practice is in line with users' expectations. To determine these practices, Adkisson researched the localization of objects in a particular e-commerce website. The results supported the findings of [13]. A similar study was carried out in Portugal by [17]; the results were not significantly different from the results in the study by [15]. These shown that there is a significant pattern can be apply as a guideline for web-based UID.

According to [19], few studies have systematically examined the users' priorities in relation to the various web design features. With the increasing diversity of the multicultural online community, there is a need for future research in the field of design and object localization.

4.0 METHODOLOGY AND RESULTS

The present study was conducted in three phases. The first phase took place from May 2012 until September 2012, and involved a total of 50 participants [20], [21]. The second phase continued until the end of 2012, in which time the total number of participants increased to 94 [22], [23]. The next stage of the study was a period of additional data collection from August 2013 to September 2013, during which time the number of participants reached 110. The three stages of data collection were conducted due to the perceived needs of the population necessary for the study. In the first phase, the participants comprised case study representatives, the director of personnel management and sharing of data harmonization at the ASEAN Center for Biodiversity (ACB), and representatives from each ASEAN country including web designers, data managers and directors of the national biodiversity project. The second phase involved users of ASEAN countries from two different groups: the first group consisted of the users of the website or experts of the ACB region in the fields of biodiversity and databases, such as scientists, researchers, rangers, forestry workers and botanists, and the second group consisted of normal users of websites randomly selected in each country in various fields such as education, banking, tourism, business, mathematics, geography, engineering and telecommunications. The third phase involved additional ASEAN users from a training workshop of Southeast Asian countries held in Japan. This group consisted of experts and researchers in the biodiversity information systems field. Data collection was done in two ways, namely, an online survey via email and in person (offline) through workshop sessions, conferences and seminars.

4.1 Participants

A total of 110 participants with different backgrounds and professions were involved in this research on the expected location of web objects for informational websites. The participants represented the following ASEAN countries: Brunei, Myanmar, the Philippines, Indonesia, Cambodia, Lao People's Democratic Republic (PDR), Malaysia, Singapore, Thailand and Vietnam. Figure 1 shows the distribution of the participants from different countries. In terms of age, 71% of the participants were aged over 30 years with an average age of 33 years (ranging from 18 to 58 years). In terms of gender, 70% of the participants were male and 40% of the participants were female. The vast majority of the participants (94%) reported that they used computers on a daily basis. Almost all the participants reported using English as a first or second language. This indicated that the majority of the skilled and semi-skilled users understood the English-language website. The participants were required to meet two criteria: first, the participants

must be a permanent resident or citizen of an ASEAN country and use their native language; and second, the participants must have computer literacy with web experience of more than five years.

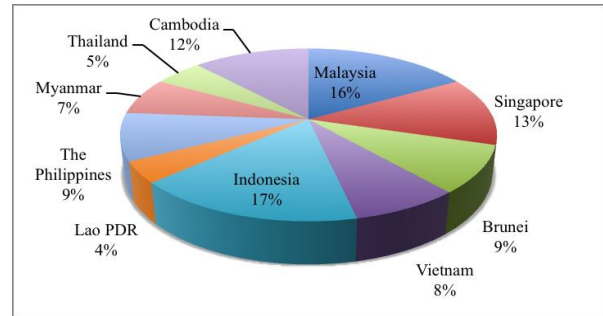


Figure 1 Distribution of participants from different countries

4.2 Design

In order to study users' expectations regarding the localization of web object information, a description of the web browser window that consists of 42 grids (7 x 6 grid squares vertically and horizontally, respectively) on a page with a white background and a geometric grid adapted from a modified method of the design by [14] was used (Figure 2). This experiment involved the localization of 10 selected web objects, namely, logo, title of webpage, internal links, external links, login, language selection, search engine, content (area), calendar, and advertisement (banner). In addition, each participant was asked to complete a questionnaire regarding their demographic background, profession, education, web experience, computer literacy and purpose of web surfing.

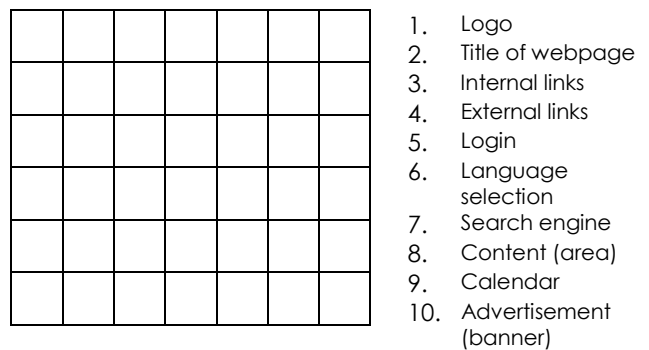


Figure 2 Geometric 42 grid method

4.3 Procedure

The participants completed the questionnaire either through email (online) or in person (offline). After answering the questions on demographics, the participants were required to put a number representing each object in the expected location on the web browser window illustrated with 42 grids describing the interface of an informational website.

The participants were free to arrange horizontally or vertically or overlap those numbers as appropriate and as they deemed relevant to their web experience. The operational definition of each web object was attached in order to facilitate the participants' understanding of each web object (Table 1).

Table 1 Operational definition of web objects

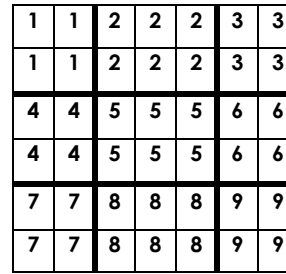
Code number	Web object	Operational definition
1	Logo	Introduction of organization, company or brand.
2	Title of webpage	Banner title of the website. It is used to identify and provide information on this website.
3	Internal links	The main menu or the links that go from one page to another page on the same site (for example, "Home").
4	External links	Useful links or links to another web page, that point to a page on a different site.
5	Login	It is used as part of the website (including user profile and others) to track users and security features, data and information.
6	Language selection	Feature to enable the user to choose another language.
7	Search engine	Helps users locate information within and/or outside the site.
8	Content (area)	Contains the information, products and/or content links.
9	Calendar	List of news/events in calendar form or links.
10	Advertisement (banner)	A graphic image used on websites to promote products or services.

4.4 Measurement

The frequency of the participants' selections was obtained by adding the number of each selected object on a grid and representing the selection frequency in different colours as shown in Figure 3. The frequency represents the number of times each square was chosen as the expected location of a particular web object. Figure 4 shows the nine divisions of the 42 locations on the distributed grid to facilitate the location of each object in this study.



Figure 3 The darker the colour, the more frequent the selection



1. Top-left
2. Top-center
3. Top-right
4. Left side
5. Center
6. Right side
7. Lower-left
8. Lower-center
9. Lower-right

Figure 4 Overview browser window (showing 42 grids with nine parts)

4.5 Results

In the results obtained from the localization of web objects (Figures 5(a) to 5(j) and Table 2), leading to the uMMp, Layout 1 represented the layout expectations shared by the participants from six countries, namely, Lao PDR, Brunei, Singapore, the Philippines, Myanmar and Vietnam (see Figure 6(a)). Meanwhile, the layout preferences of the participants from Malaysia and Indonesia were represented in Layout 2 (see Figure 6(b)), and the preferences of the participants from Thailand and Cambodia were represented in Layout 3 (see Figure 6(c)).

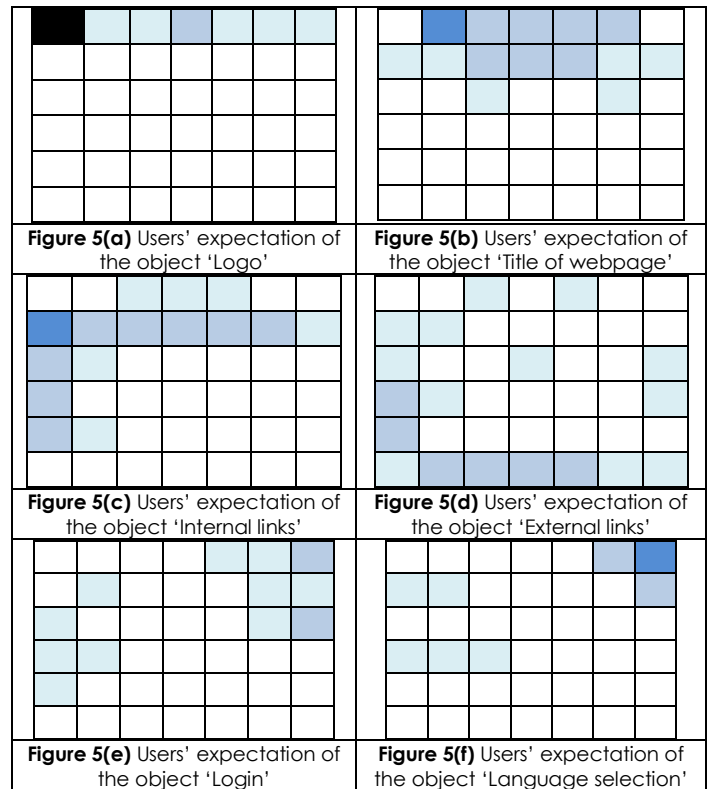


Figure 5(a) Users' expectation of the object 'Logo'

Figure 5(b) Users' expectation of the object 'Title of webpage'

Figure 5(c) Users' expectation of the object 'Internal links'

Figure 5(d) Users' expectation of the object 'External links'

Figure 5(e) Users' expectation of the object 'Login'

Figure 5(f) Users' expectation of the object 'Language selection'

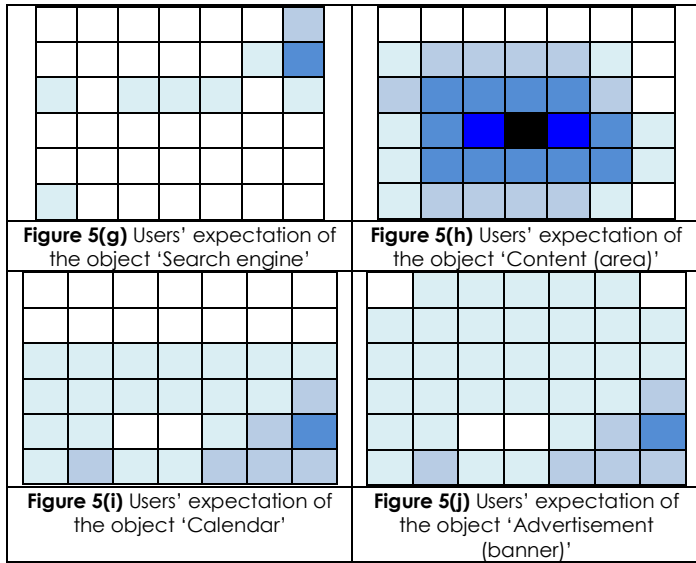


Table 2 Conclusions from the results of users' expectations regarding the location of web objects

Web object	Result 1:	Result 2:	Result 3:
1. Logo	Top-left	Top-left	Top-left
2. Title of webpage	Top-center	Top-center	Top-center
3. Internal links	Top	Left	Left
4. External links	Left	Lower	Right
5. Login	Top-right	Top-right	Top-right
6. Language selection	Top-right	Top-right	Top-right
7. Search engine	Top-right	Top-right	Top-left
8. Content (area)	Lower-left to center	Lower-left to center	Lower-left to center
9. Calendar	Left	Right	Right
10. Advertisement (banner)	Right	Lower-right	Lower
	* Lao PDR, Brunei, Singapore, the Philippines, Myanmar & Vietnam	* Malaysia & Indonesia	* Thailand & Cambodia

Layout 1, shown in Figure 6(a), was the most preferred layout for the ASEAN countries. This layout was preferred by the participants from six out of 10 countries, namely, Lao PDR, Brunei, Singapore, the Philippines, Myanmar and Vietnam.

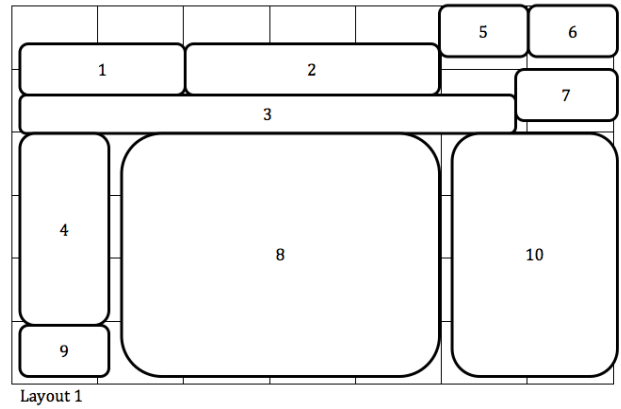


Figure 6(a) Results for Layout 1

Malaysia and Indonesia shared the preferences for a similar layout. This may reflect that these countries have bilateral relations, and are neighboring countries that share similarities in many aspects. Both have many traits and common features, including history, culture and religion. Although both countries are separate and independent states, there are similarities in their national language as the Indonesian and Malay languages are closely related. The majority of the population in both countries is Malay, with a significant Malay culture shared among them. Both countries have a Muslim majority, so they have their own Islamic culture. The populations of both countries also include followers of the Hindu and Buddhist religions. In addition, there is a large number of Indonesian migrants in Malaysia. Thus, patterns of thought and mental models also influence the cultural characteristics of these countries and produced the same pattern in the present study, that is, Layout 2 as shown in Figure 6(b).

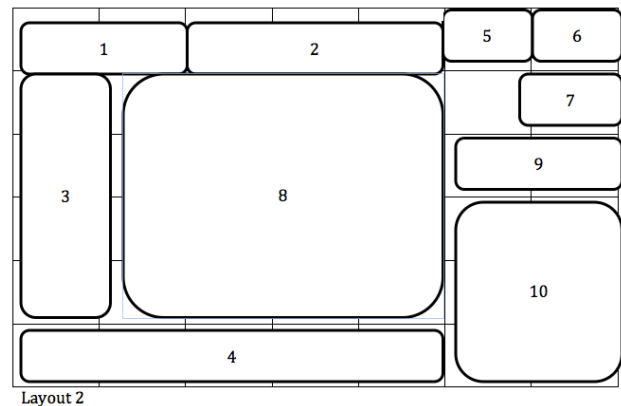
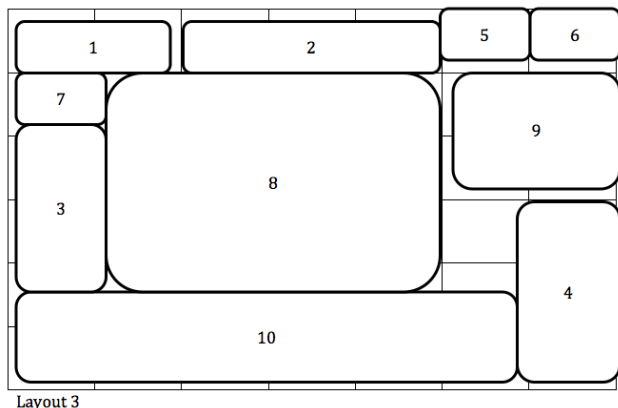


Figure 6(b) Results for Layout 2

Thailand and Cambodia have some cultural similarities regarding beliefs and traditions. In particular, Buddhism is a major shared tradition. Among the neighboring countries of ASEAN, Thailand and Cambodia are the most similar [24]. Both

countries share the same customs, traditions, beliefs and way of life. This is true for royal ceremonies, languages, writing systems, vocabulary, literature and the dramatic arts. In the present study, the participants from Thailand and Cambodia shared an almost identical pattern or mental model, that is, Layout 3 as shown in Figure 6(c).



Layout 3

Figure 6(c) Results for Layout 3

5.0 CONCLUSION

uMMP with national cultural adaptation can serve as useful guidelines for the standard development and web UID proposed for the new interface of ACB websites. This is to ensure that UID meets the recommendations of previous researchers regarding good UID [25], [26], [16]. UID is necessary to ensure a good user interface is developed that is applicable to a variety of users with different demographics, rather than a mono-cultural interface [16].

These uMMP can be integrated into website development through the planning process of web UID. Based on the results of the case studies, an interface can be developed and applied to the front page of websites such as the ACB and national biodiversity websites. The interface can incorporate UID ideas to enhance process visualization and facilitate communication with the target users generally and ASEAN users in particular.

Further research will carry out a study of the usability test by implementing the uMMP into the development of an interface prototype. In addition, the results are expected to generate a data collection and analysis methods that are more specific to the research and development of effective UID evaluation [27].

References

- [1] Smith, S. & Mosier, J. 1986. *Guidelines for Designing User Interface Software*. Technical Report MTR-010090, EDS-TR-86-278, The Mitre Corporation.
- [2] Lim, B., & Klein, K. J. 2006. Team Mental Models and Team Performance: A Field Study of the Effects of Team Mental Model Similarity and Accuracy. *Journal of Organizational Behaviour*. 418(October 2004). 403-418. doi:10.1002/job.387.
- [3] Rouse, W. B., & Morris, N. M. 1986. On Looking Into the Black Box: Prospects and Limits in the Search for Mental Models. *Psychological Bulletin*. 100: 349-363.
- [4] Norman, D. A. 1983. Some Observations On Mental Models. In D. A. Gentner & A. L. Stevens (Eds.), *Mental Models* Hillsdale, NJ: Lawrence Erlbaum Associates. 7-14.
- [5] Webber, S. S., Chen, G., Payne, S. C., Marsh, S. M., & Zaccaro, S. J. 2000. Enhancing Team Mental Model Measurement With Performance Appraisal Practices. *Organizational Research Methods*. 3: 307-322.
- [6] McDaniel, S. 2003. *What's Your Idea of a Mental Model?*, Technical report. 1-15.
- [7] Smith W., Thomas R. and Apperley M. 2001. *Proceedings of OzCHI 2001 (Perth, Australia, November 2001)*. Churchlands, Edith Cowan University Press. 77-83.
- [8] Johnson-Laird, P. N. 2001. Mental Models and Deduction. *TRENDS in Cognitive Sciences*. 5(10): 434-442.
- [9] Kurtz, A. 2003. *Mental Models-A Theory Critique*.
- [10] Bernard, M. L. 2000. Examining User Expectations of the Location of Web Objects. *Internetworking* (3.3): Article-Conceptual User Interface. 1-6.
- [11] Bernard, M. 2001. User Expectations for the Location of Web Objects. *CHI '01 Extended Abstracts on Human Factors in Computer Systems-CHI '01*, 171. doi:10.1145/634164.634171.
- [12] Bernard, B. M. 2002. Examining User Expectations for the Location of Common E-Commerce Web Objects. *Usability News*. 4(1).
- [13] Adkisson, H. P. 2002. Identifying De-Facto Standards For E-Commerce Web Sites. *Proceedings, IEEE International Professional Communication Conference*. IEEE. Retrieved from <http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=1049085>.
- [14] Bernard, B. M., & Sheshadri, A. 2004. Preliminary Examination of Global Expectations of Users' Mental Models for E-Commerce Web Layouts. *Usability News*. 6(2): 1-9.
- [15] Shaikh, B. A. D., & Lenz, K. 2006. Where's the Search? Re-examining User Expectations of Web Objects. *Usability News*. 8(1): 2-6.
- [16] Costa, C. 2010. *Cultural Factors and Usability User Expectations for the Location of E-Commerce Web Objects*. 1-20.
- [17] Vasantha Raju N, Harinarayana, N. S. 2011. Identifying the Location of Web Objects: A Study of Library Web Sites. In *8th International CALIBER, Goa University, Goa, March 02-04, 2011*. 28-39.
- [18] Cyr, D., & Trevor-Smith, H. 2004. Localization of Web Design: An Empirical Comparison of German, Japanese, and U.S. Website Characteristics. *Journal of the American Society for Information Science and Technology*. 1-20.
- [19] Cannon-Bowers, J. A., Salas, E. & Converse, S. A. 1990. Cognitive Psychology And Team Training: Shared Mental Models In Complex Systems. *Human Factors Bulletin*. 33: 1-4.
- [20] Aslina, B. & Azizah, J. 2013. Users' Expectation of Web Objects Location: Case Study Of ASEAN Countries. *Advances In Visual Informatics-Third International Visual Informatics Conference, IVIC 2013, Selangor, Malaysia, Proceedings*. Springer 2013 Lecture Notes In Computer Science ISBN 978-3-319-02957-3, 2013. 383-395.
- [21] Aslina, B. & Azizah, J. 2014. Investigating Adaptive ASEAN Cultural Diversity Through Users' Mental Models for User Interface Design. *Journal of Theoretical and Applied Information Technology (JATIT)*. 61(3): 617-629.
- [22] Aslina, B. & Azizah, J. 2013. Investigating Adaptive Cultural Diversity Through Users' Mental Model For Sustainable User Interface. *Visual Informatics International Seminar (VIIS 2013)*.
- [23] Aslina, B. & Azizah, J. 2013. Cultural Adaptivity for Sustainable User Interface: Investigating User Expectation

- on ASEAN Countries. *Proceeding of The International Conference on Future Trends in Computing and Communication Engineering (FTCC)*, 45-49.
- [24] Kasetsiri, C. 2003. *Thailand and Cambodia: A Love-Hate Relationship*. Kyoto Review of Southeast Asia. Issue 3: Nations and Other Stories.
- [25] Marcus, A. & Gould, E. W. 2000. *Cultural Dimensions and Global Web User-Interface Design*.
- [26] Reinecke, K. 2007. Cultural Adaptivity for the Semantic Web. In *Doctoral Consortium at the International Semantic Web Conference*.
- [27] Aslina, B. & Azizah, J. 2004. Evaluation of ASEAN Mental Models Pattern of Web User-Centered Interface Design using Eye-Tracking Technology. *Journal of Computer Science*. 10(10): 2492-2506.