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Evaluating Gender's Mental Model Patterns for User Interface Design: Mobile Shopping Apps

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Abstract: Mobile applications (apps) development has experienced unprecedented growth, particularly in smartphone platforms. However, some mobile App. have been seen declining in popularity due to the unattractive user interface and bad user interaction with the users. This study adopted user's mental model pattern is crucial in human computer interaction. A guideline has been proposed for user interface design of mobile shopping App. based on female and male mental model patterns. The proposed guideline has been used in this research to redesign an existing popular mobile shopping App., Lazada and user interaction with the adapted user interface has been evaluated through simulation tool, namely AZ Screen Recorder. This research demonstrates an adapted interface design with guideline of user's mental model pattern is more efficient compared to interface design without adapted guideline.

Key words: Mental model patterns, user interface design, mobile shopping App., guideline, efficient, Malaysia

INTRODUCTION

Smartphones now a days are becoming integral part of society and thus, expedite the mobile applications development in particularly smartphone platforms. One of the most important part of mobile application is user interface as user interacts with the application through it. User Interface (UI) design is vital in most of development of computer systems including mobile applications (Punitha *et al*., 2017). A poor user interface design may result in stress and unhappiness among the users. Whereas a good user interface design leads to greater satisfaction in using mobile App. by promising a good, easy and positive interaction between a user and computer system. A good human computer interaction increases the popularity of a mobile application. The main purpose of user interface design is to ensure that the users understand and expedite their research with a mobile application (Georgiev and Georgieva, 2009). Therefore, mobile App. designers have to give first priority in the user interface designing process while developing a mobile application.

Mental model is widely acknowledged as one of the most essential approaches in human computer interaction (Vala *et al*., 2014). Mental model is an illustration of something that a user has in his mind he interacts with. When a user communicates with a system he compares his/her mental model with the system image. The low difference confirms the system design is easy and understandable by the users and helps the users to accomplish their task and goal. In contrast, the system design is considered confusing and the users may not be able to accomplish their tasks if the difference is considerably high (Vala *et al*., 2014). Thus, the use of mental model concept facilitates the mobile App. developers in creating a good user interface (Punitha *et al*., 2017). Moreover, the mental model theory between gender is different and (Punitha *et al*., 2017) has proposed guidelines for user interface design based on female and male mental model pattern.

This research is the continuation of Punitha *et al*. (2017) as the proposed guidelines is adopted to redesign an existing popular mobile shopping App. The adapted interface has been evaluated in order to justify whether

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the proposed guidelines can be embraced in the process of designing user interface for a mobile shopping App.

Literature review: User Interface (UI) design is the most essential component in understanding how a user interacts with a computer system, referred to as human computer interaction, to determine that the user is satisfied and able to accomplish his/her task in an efficient way (Galitz, 2007). Similarly, this UI design is crucial for mobile applications. The unique features of mobile devicessuch as small screen size, low resolution and inefficient data entry methods have reported as the major challenges in the interface design of mobile applications (Adipat and Zhang, 2005). As a result, Adipat and Zhang (2005) proposed a novel framework or guidelines in designing efficient and user-friendly interface for mobile applications. This framework consists of four major components, namely information presentation, data entry methods, mobile users and context and the researchers (Adipat and Zhang, 2005) have suggested the interface designers to take these four important perspectives into consideration while designing an interface for a mobile application. In addition, Barkhuus and Dey (2003) and Tarasewich (2003) advised that context, content and customization are the most important elements for designing successful mobile interfaces. Most of the mobile application developers have been facing proper graphical user interface design recently (Tarasewich, 2003). Meanwhile, Veldhuis (2012) classified the user interface design guidelines as high-level and low-level guidelines. The high-level guidelines do not define exact design details but specify what should or should not do in terms of designing the user interface and application (Veldhuis, 2012). Whereas low-level guidelines specify in more details on how an interface should be designed (Veldhuis, 2012).

Another important component of UI design is the user interaction evaluation which involved the observation of the end-user's engagement with the mobile applications via. the user interface as well as the measurement of their performance (Veldhuis, 2012). These evaluations consists of three main methods: laboratory studies, field studies and studies without user interaction (Veldhuis, 2012). Laboratory studies are usually implied for new product designs or during the conduct of usability tests and examples of laboratory studies include questionnaires which and semi-structured interviews (Veldhuis, 2012). However, the laboratory studies cannot justify the uncontrollable or external factors which may play a role for mobile applications (Veldhuis, 2012). Whereas in field studies display usability issues which may not be encountered during lab studies due to external factors related to the environment (Veldhuis, 2012). Field studies ensure the users perform tasks and then they are asked to fill out a questionnaire regarding feedbacks and experience. Comparison between lab studies and field studies by Duh *et al*. (2006) has shown that field studies exposed more usability issues as it included external factors. Field studies can also, be conducted by observing user while using the mobile device during performing tasks. Studies without users are conducted in the early stage of the interface design process by requesting consultants or research experts for their experience and opinions.

In addition, to the three methods of user interaction evaluation (Nielsen and Molich, 1990) has introduced a heuristic evaluation approach namely walkthroughs. Walkthroughs are substitute approach for estimating the user's problem without doing user testing. Analytics is an another method for evaluating user interaction through a system by logging user activity, counting and analyzing the data in order to understand what part of the system are being used and when (Preece *et al*., 2011). Recording or registering the amount of time or button clicks for a user to successfully complete a certain task is an example of an analytic approach (Veldhuis, 2012). Predictive models also can be as user interaction evaluation method where it evaluates a system without users being present by the use of formulas to derive various measures of user performance (Preece *et al*., 2011).

Lastly, eye tracking has become a popular approach in the context of the usability research. Aslina and Azizah (2014a, b) applied eye-tracking technology to evaluate localization of web objects in a web user-centered interface design based on ASEAN mental model pattern. Aslina and Azizah (2014a, b) provided support that eye-tracking technology is an accurate and useful evaluation approach for interpreting and understanding what a user looks at and the user's behavior.

MATERIALS AND METHODS

User interface design: In this research, the user interface of an existing mobile shopping App. has been redesigned based on a guideline of female and male mental model pattern proposed by Punitha *et al*. (2017). This proposed guideline (Fig. 1 and 2) was obtained from analysis of localization of standard features for a shopping App. which was collected from 49 female and 46 male participants as Punitha *et al*. (2017).

The user interface of Lazada has been chosen to be redesigned in this research Lazada is ranked as the most favorite mobile shopping App. by participants involved

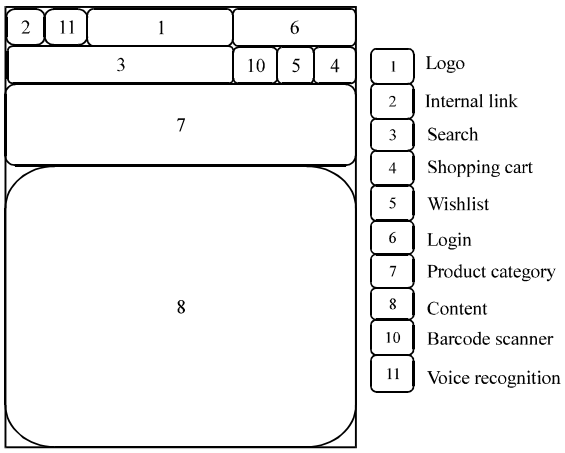

Fig. 1: Female mental model pattern

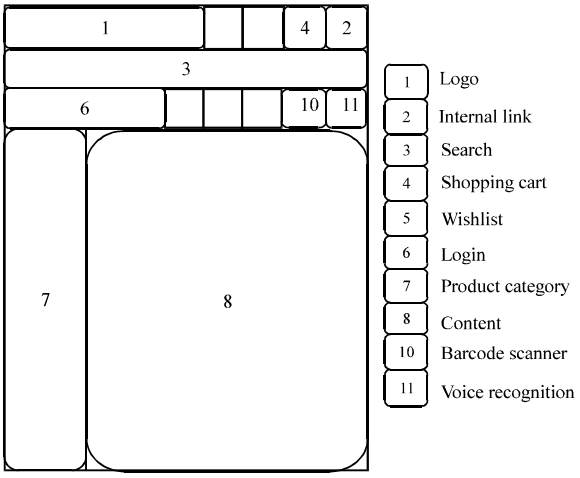

Fig. 2: Male mental model pattern

in research (Punitha *et al*., 2017). Figure 3 and 4 show the redesigned user interface of Lazada based on the guideline for the female and male mental model pattern, espectively. The user interaction with the adapted Lazada user interface is then evaluated using a controlled experiment.

Experimental setup: A survey has been conducted to evaluate user interaction with the adapted used interface of Lazada. In contrast with Punitha *et al*. (2017), the survey data was collected from different sample size in order to avoid bias of localization of standard features of shopping App. as discussed by Aslina and Azizah (2014a, b). The participants were randomly selected among individuals from Malaysia. A total of 10 participants, five males and females with different background involved in the survey. The sample size of the participants were chosen based on Aslina and Azizah (2014a, b) who has participated as user interaction evaluation using an eye

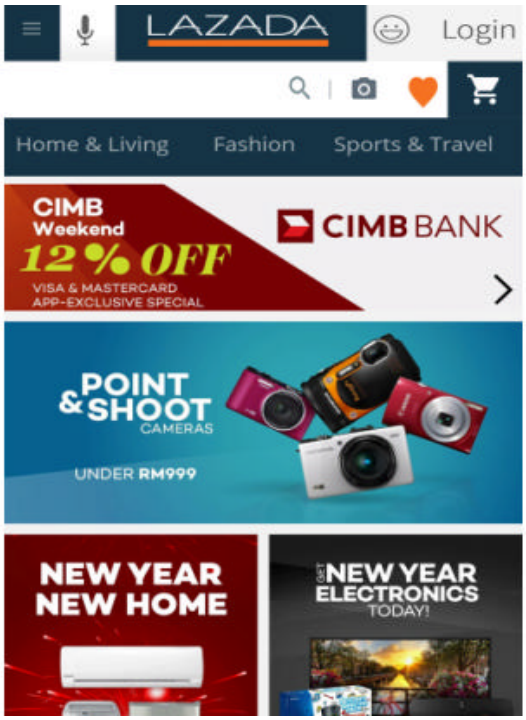

Fig. 3: Adapted Lazada user interface based on female mental model pattern

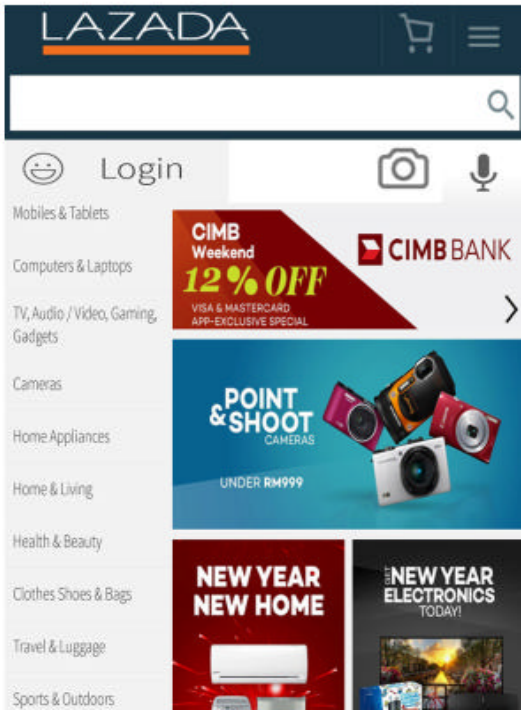

Fig. 4: Adapted Lazada user interface based on male mental model pattern

tracking method with six participants which was <10 participants. The disseminated questionnaire in the survey was adapted from Baharum and Jaafar (2015). Controlled experiment was conducted on the individuals who participated in the user interaction evaluation survey. The questionnaire consisted of two sections: section A and section B. Section A entitled user interaction evaluation was designed to capture the user interaction with the adapted user interface of Lazada shopping App. Whereas, section B entitled demographic was designed to collect participant's personal information such as age, gender, race and state they are living. This section is crucial as the gender plays an important role in evaluation of user interaction.

Section A consists of two parts. The first part involved four tasks to be completed on the female redesigned user interface and the second part involved four tasks to be completed on the male redesigned user interface. Before the participants begin they were informed on the purpose of the user interaction evaluation. They were given Sony Xperia Z2 Smartphone to enable them to interact with the redesigned Lazada shopping App. based on female and male mental model pattern. Each participant are required to complete all the tasks in the questionnaire on both female and male based redesigned Lazada interface. While they are completing the user interaction tasks in the section A of the questionnaire, the screen of the smartphone was recorded using screen recorder software, AZ Screen Recorder in order to record the time the participants took to finish the tasks.

The participants, firstly need to login to the redesigned Lazada interface with a given username and password. Then, they were required to search for a product and add to the 'Wishlist' and shopping cart. They were also, required to share the particular products as well as to buy a particular product. The products were different for the different redesigned interface. After a participant has finished all the tasks on one interface, they were required to switch to another interface to complete the tasks in the questionnaire. Each participant's user interaction was evaluated on both female and male mental model patterns based redesigned interface. They were not informed which interface was female based interface and which was a male based interface in order to avoid biasness. The time taken to complete the tasks on different interfaces was stored using the recorded video and analyzed.

RESULTS AND DISCUSSION

The proposed guideline of female and male mental model pattern for user interface design of mobile shopping App. has been evaluated through a controlled experiment by distributing a questionnaire which contains a few tasks that should be completed on both female and male mental model guideline based redesigned Lazada interfaces. The record of the time taken to complete the tasks on female and male mental model pattern based interfaces for the all ten participants is filled in Table 1.

Table 1: Ttime taken to complete tasks

Participants	Time taken (Female mental model pattern (min: sec)	Time taken (Male mental model pattern (min: sec)
Female		
1	01 min 48 sec	03 min 00 sec
2	03 min 12 sec	03 min 16 sec
3	01 min 57 sec	03 min 15 sec
4	02 min 08 sec	02 min 49 sec
5	03 min 14 sec	02 min 20 sec
Male		
6	02 min 13 sec	01 min 46 sec
7	02 min 59 sec	03 min 25 sec
8	01 min 58 sec	01 min 28 sec
9	03 min 26 sec	02 min 30 sec
10	02 min 34 sec	02 min 05 sec

Table 1 displays the records of the time taken of each participant to complete the given task on the redesigned Lazada interface based on the female and male mental model pattern. The analysis of the records of the time support that all the female participants took shorter time to complete the tasks on the user interface that was redesigned based on the female mental model pattern guideline. Shorter time taken means a better user interaction with the redesigned interface. This confirms that the female mental model pattern guideline is acceptable for the females. On the other hand, 4 out of the 5 male participants, took a shorter time to complete the tasks on male mental model based interface. Only one male participant's time was shorter on the female mental model based interface (highlighted in Table 1). Since, majority of the male participants were having a better interaction with the interface designed based on the male mental model pattern, male mental model pattern guideline has been considered as acceptable for the males. The analysis showed that female more prefers female mental model pattern guideline and male prefers male mental model pattern guideline.

User interaction evaluation has proven that different gender has a different mental model pattern. As the result of the analysis, we can infer that the proposed guideline of female and male mental model pattern can be used as a guideline in designing of user interface of a mobile shopping App. Since, all female participants have better interaction with the interface that was redesigned based on the female mental model pattern guideline, this guideline is considered as applicable to be used as guideline in interface designing process for a mobile shopping App. While analyzing the recorded video, females were having difficulties finding the Wishlist on

the male mental model pattern based interface. All female participants were comfortable with the female mental model pattern based interface as most standard features are located on the home page. After completing their tasks on both interfaces, female participants informed that they prefer the female mental model based interface.

As for the male participants, majority of them preferred male mental model pattern based interface. This can be seen from the record time taken to complete the tasks on male mental model pattern based interface was shorter except for one participant who was having better user interaction with the female mental model pattern interface. The 4 male participants tend to have better user interaction with male mental model pattern based interface as that is more simple and less complicated compared to the female mental model pattern based interface. These user interaction evaluations have justified that the proposed guideline of female and male mental model pattern as in Fig. 1 and 2 can be referred in the process of designing a user interface for a mobile shopping App.

CONCLUSION

Punitha *et al*. (2017) has proposed guidelines for user interface design of mobile shopping App. based on female and male mental model pattern. The proposed guidelines was used in this research to redesign a current popular mobile shopping App. User interaction with the adapted interface has been evaluated through a controlled experiment in order to justify the guidelines. The experiment in this study has proven that the proposed guidelines can be referred in the user interface designing process of a mobile shopping App. as it could provide a better user interaction and would prevent failure in its popularity by providing fast and user friendly interface.

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