

Heuristic Usability Evaluation of Microsleep Mobile Website

Nuramyra Natasha Binti Ismalludin (B19EC0035)

Nur Fazana Alia Binti Mohd Sanori (B19EC0045)

Nurul Syafiqah Binti Yusry (B19EC0036)

Nik Nur Fatini Binti Nik Ahmad Azhar (B19EC0027)

Department of Computer Science, Universiti Teknologi Malaysia.



ABSTRACT

As mobile technology grows rapidly, according to statistic, there is 3.3 billion smartphone users in the world and 35.13% of people have smartphones worldwide[1]. Under this circumstance micro sleep application used to expand the services and design application to meet users' needs. Usability evaluation of smartphone for detect micro sleep through devices is a new issue for study. As such, the paper evaluates the usability of micro sleep using devices and application. The evaluation result shows that the application contains some usability issues in 5 heuristics, such as unable to inform users the waiting time, some information not provided in a logical way, some consistency problems in displaying contents, lack of advanced searching for expert users, and inadequate helpful error message. The weakness found in this way provides useful hints in making improvement to application.

INTRODUCTION

Mobile technology has spread rapidly around the globe. Today, it is estimated that more than 5 billion people own mobile devices in 2019 and 35.13% of people have smartphones worldwide[1]. Most of people use their smartphone every day to surf the internet and social media platforms, listen to music, take photos and also every now and then they use them for their original purpose to make phone calls. For a driver, they use their smartphone to navigate their journey through application as an example Waze and Google Maps.

On the contrary, it is worth noting that the number of most driver owning smartphone is also increasing quickly. Besides using the smartphone as navigation, a driver who experiences micro sleep can monitor their sleep activities through Beddit (BD) application required iOS 12.0 and watchOS 4.2 or later. Compatible with iPhone, iPad and iPod touch[2].

As well as, Drivelert (DE) is an android application that get rating about 4.3, requires android version 4.1 and up. It is drowsiness detector that help you to stay alert and drive safe[3]. Along with, Stay Awake Pro (SA) an iOS version 7.0 and later. It can interact and respond with your voice to stay alert and active[4].

Under these circumstances, micro sleep website that especially used by an adult have attempted to expand their services and design mobile website to meet users' needs. As mentioned in reviews, one of the user said the BD app useful but needs update because they travel a lot but they cannot bring the Beddit with them. It's required a space for their suitcase. Besides

that, other reviews said the app doesn't drain his phone overnight. On the other hand, Drivelert user comment that the alarm sound for drowsiness is good, the driver response immediately. However, some of them asked for

an update like to use GPS at the same time. Moreover, Stay Awake Pro had a gorgeous gesture and tap driven interface. It also had great built in annoying alerts to keep you awake.

Regarded as all these application that main function to prevent driver experiences micro sleep. To probe into the cause of this, we develop this study to evaluate the usability of the prevent micro sleep mobile website by benchmarking against three other applications Beddit, Drivelert and Stay Awake, according to the 10 usability heuristics developed by Nielsen (1994). Based on that, we further provide some recommendations for the all three applications to improve their mobile website.

In brief, the objectives of this study are: (i) to evaluate the user interface design of the micro sleep mobile website; (ii) to find out the usability of the micro sleep mobile website; (iii) to identify the advantages and limitations of the micro sleep mobile website when compared to other mobile micro sleep website; and (iv) to give recommendations for the improvement of the micro sleep mobile website.

This paper is develop as followed. After the introduction, we review the literature related to the micro sleep mobile website and usability of mobile websites and identify the research gap in this field of research. Next, we discuss the methodologies used in this study. Also, we present our findings on the comparative studies between the design of HKUL with another two websites. To wrap it all up, we discuss our finding and conclusion for micro sleep website.

LITERATURE REVIEW

MOBILE WEBSITES AND MICRO SLEEP MOBILE WEBSITES

A mobile website features most of the contents of a desktop full site and allows users to view it through handheld devices, such as mobile phone, tablets, netbooks, and many more. Researchers point out that mobile websites have several advantages. For example, Kroski (2008) indicates that mobile websites were able to

provide constant connectivity, location-aware, limitless access, and interactive capability. Moreover, mobile websites comply with Web standards, such as the Text Markup Language (HTML) and JavaScript as well as Bootstrap, so that users can access the mobile websites easily with standard browsers.

Due to the benefits of mobile websites, more and more developers are doing this. For example, application such as Drivelert, Stay Awake, Beddit and more apps that are maintaining. As a result, they were able to provide information effectively to users. There are many other reports indicating the usefulness of micro sleep mobile website and suggesting various mobile Web services for micro sleep, such as mobile databases, mobile collections, SMS reference and so on. Some studies further explored the development of mobile library websites and their future.

USABILITY EVALUATION AND MOBILE USABILITY EVALUATION

There are many definitions of usability, and the most widely accepted definitions of usability are introduced by Nielsen (1993) and ISO (1997). According to Nielsen (1993), usability can be identified as five attributes: efficiency, satisfaction, learnability, memorability, and errors. ISO further defined usability as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context use” (p. 10). Usability is considered one of the major elements for Web applications. Hence, different usability evaluation methods have been proposed and can be divided into three categories which is usability inspection, usability testing, and usability inquiry.

However, some research found that not all usability evaluation methods were suitable for the mobile domain, and only a few methods are useful. Ketola and R ykkee (2001) stated that traditional usability methods did not work well in evaluating the mobile context. Zhang and Adipat (2005) further explained that these methods might not be applicable to mobile due to

changing of environment and individual needs. Some researchers suggest to adapt heuristic evaluation, which is one of the usability inspection methods, to mobile context. Other researchers applied heuristic evaluation to test the usability of mobile websites. For example, Diaz, Harari, and Paola (2008) used heuristic evaluation to test the mobile interface of an educational website. e. Monkman and Kushniruk (2013) and Neto and Campos (2014) applied heuristic evaluation method to evaluate a mobile health application, and tablet applications, respectively.

USABILITY EVALUATION OF MOBILE MICRO SLEEP WEBSITES

Although numerous research can be found in studying mobile usability evaluation, there have been very few studies on evaluating the usability of mobile micro sleep websites. Most of them used usability testing methods to evaluate the micro sleep mobile websites. For example, Pendell and Bowman (2012) used usability testing to evaluate the Portland State University Library's mobile site. Yeh and Fontenelle (2012) conducted an evaluation of a science university library's mobile website. Plus, Rosario, Ascher, and Cunningham (2012) applied usability testing method to evaluate the mobile website of a university health sciences library in order to help redesign the mobile website.

RESEARCH GAP

To sum up, there are only a few research studies conducted for evaluating the usability of mobile –micro sleep websites – particularly, there are almost none in Asia. This is because the history of mobile websites is relatively short, and mobile websites are not commonly implemented in micro sleep. Therefore, the usability evaluation of mobile micro sleep website is a new issue for study. Further, the recent advancement in mobile devices with larger screens and equipped with computing power close to desktop ones, coupled with the rapid diffusion of low-cost and high-speed mobile Internet in the Asia Pacific makes it worth to examine the usability issues of mobile websites. Therefore, this research

attempts to bridge the gap between the usability evaluation and mobile micro sleep websites under contemporary mobile technologies, as well as to make contribution for present and future research.

METHODOLOGY

This paper evaluates the mobile website of the Beddit as a case study, and it provides recommendation for improvement based on our evaluation. As motivated by the literature above, we employ heuristics evaluation and benchmarking for the evaluation.

HEURISTICS EVALUATION

Heuristic evaluation is a method of usability engineering to find usability issues in user interface design, making it easy to handle and solve as part of a repeated design process. It involves a small set of expert assessors who examine the interface and evaluate its compliance with a "heuristic," or recognized use principle [5]. heuristics evaluation method and proposed the 10 usability heuristics, i.e., (i) visibility of system status; (ii) match between system and the real world; (iii) user control and freedom; (iv) consistency and standards; (v) error prevention; (vi) recognition rather than recall; (vii) flexibility and efficiency of use; (viii) aesthetic and minimalist design; (ix) help users recognize, diagnose, and recover from errors; and (x) help and documentation.

Heuristics evaluation has many advantages, such as cost-effectiveness, speed, and conciseness pointed out that usability heuristics provided pragmatic guidelines for evaluating systems, which helped designers improve systems. Because of these benefits, we apply the heuristic evaluation method as guidelines to evaluate the usability of HKUL mobile website.

BENCHMARKING

In order to have a comprehensive analysis of Beddit mobile website, benchmarking is also used for evaluation. Benchmarking is the process of measuring the performance of a

company's product, service, or process against another business that is considered best in the industry. The benchmark is to identify internal opportunities for improvement. By studying the companies that perform best, breaking down what makes them possible, and then comparing those processes to how your business operates, you can implement changes that will lead to significant improvements. [6]

Stresses on the importance of learning by borrowing from the best and adapting their approaches to fit your own needs is the essence of benchmarking. Therefore, benchmarking is a managerial approach for improving an organization's performance by comparing with similar organizations in the same field as to adopt best practices. There are 4 types of benchmarking: (i) internal benchmarking, (ii) competitive benchmarking, (iii) functional/industry benchmarking, and (iv) process/generic benchmarking. Competitive benchmarking is utilized in this project as it is typically used with competitors in the same field. Owing to high reputation and more functions provided, the and Beddit mobile website is selected as the best practice reference for the micro sleep mobile website. In addition, Drivelert and Stay Awake application were chosen to determine the performance of the Beddit application when comparing with other application.

ANALYSIS – EVALUATION OF THE BEDDIT MOBILE WEBSITE

The Beddit (BD) mobile website is evaluated by benchmarking against the Drivelert (DE) and Stay Awake (SA) ones, according to the 10 usability heuristics developed by Nielsen (1994). The findings are as follows:

VISIBILITY OF SYSTEM STATUS

Nielsen (1994) suggests that users should always be informed by the system and receive proper feedback from the system within reasonable time. The BD mobile website keeps users informed. For example, in the mobile website, “Days”, “Results”, “Sleep Analysis”, “Heart Rate”, “Trends”, “Learn” and “Settings” are available for users to select (see Fig.1(a)). Therefore, users can know what functions the application provided. Like the BD mobile website, both DE and SA display the main page in mobile website (see Fig. 2(a) and Fig.3(a)).

However, the DE and SA mobile websites provide less function than BD one. For instance, the mobile website for DE only shows the “Time Sensitivity”, “Menu”, “Select Sound” and “Start” to be heard during micro sleep (see Fig. 2(a)). The SA mobile websites provide “Menu” and “Tap Screen” function, which cannot be found in the mobile website BD.

Moreover, these three mobile websites do not inform the user of the waiting time. When loading the website, they do not display the loading icon. However, users may want to know how long they have to wait for the response, but the three mobile websites do not provide much information to users.

MATCH BETWEEN SYSTEM AND THE REAL WORLD

Rather than applying system-oriented terms, Nielsen (1994) suggested that a system should use the language and concepts of its users as well as follow real-world rules and logical order. The mobile website of BD does quite well in applying users’ language in the system. It uses simple words “Days” that show seven days in a week, “Results” which will show the section for user results of the activity, “Sleep Analysis” refers to analysis during micro sleep, “Heart Rate” refers to heart rate during the activity, “Trends” section will display the result that had been collected, “Learn” section to learn about the application, and “Settings” means to set the function of the app. The information of DE and SA mobile websites are not quite as clear as the BD one. For example, the mobile website of the DE shows “Time Sensitivity” (see Fig.2 (a)), which may not be clear enough to the user. The SA shows “Tap Screen” which may cause the user to be confused.

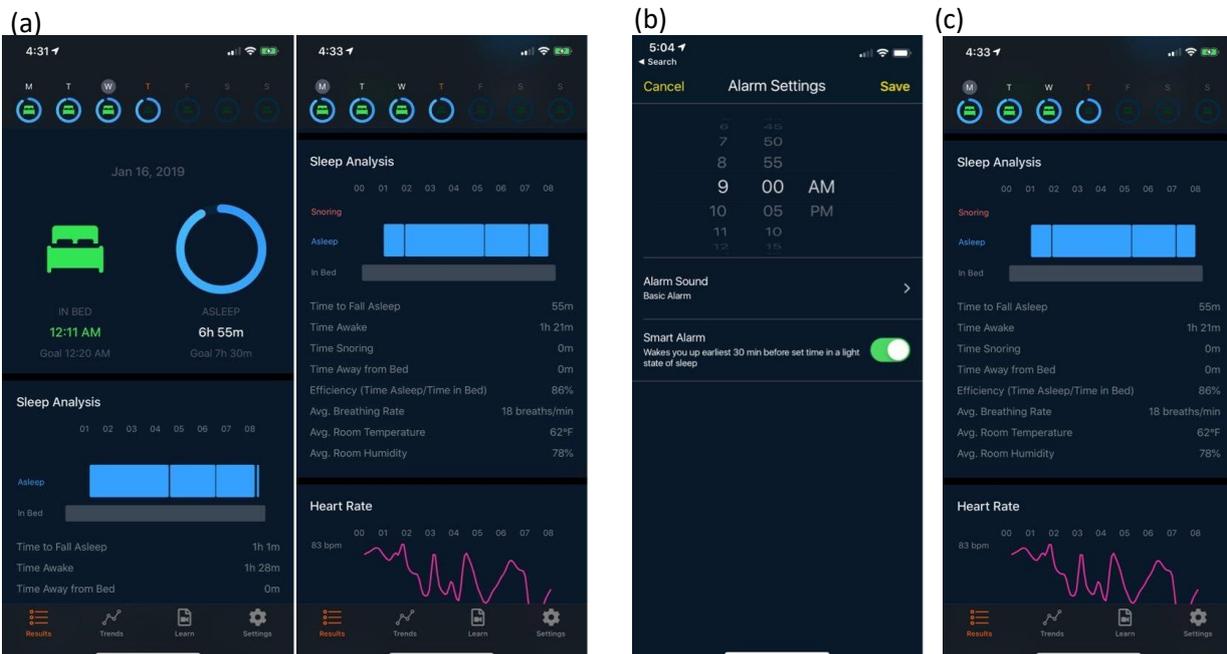


Figure 1. Beddit Mobile Website

However, the BD mobile website shows too much features in one page while DE and SA system shows minimize number of features in one page.

USER CONTROL AND FREEDOM

Users may select system functions by accident. Nielsen (1994) recommended that systems should provide an “emergency exit” for users to leave, as well as support users to undo and redo commands. BD mobile websites provide a “Cancel” button for the user cancel the wrong input (see Fig 1(b)). As for SA mobile websites, they do not have the buttons or options which allow users to go back to the previous page or the BD homepage if they want to leave an unwanted webpage. Since nowadays devices already had inbuilt “Back” button or “Main Screen” button. However, for DE mobile websites, it provided “End” button for the user to go back to the main page (see Fig 2(b)).

CONSISTENCY AND STANDARDS

Nielsen (1994) proposed the contents of the system should be presented in the same in the same manner. To a certain extent, the mobile website of the BD is able to produce consistent

content layout. For example, the “Results” tab displays the result of that day activity in the same layout, including “Sleep amount”, “Time of Sleep”, “Time of Wake” and “Heart Rate” (see Fig 1(c)).

The situation of DE and SA is the absence of an “emergency exit” in some pages, as mentioned in the previous subsection, can also be classified as inconsistency problem.

Compared BD to DE and SA, DE and SA have a simple yet minimize layout in the mobile website as they just prevent the micro sleep from happened. BD on the other hand has more complicated layout and more result to be displayed as it also analyses the user and create the report.

ERROR PREVENTION

According to Nielsen (1994), systems should have a careful design in order to prevent problems. The BD mobile websites make considerable effort to prevent input error. For example, it shows “Cancel” button to cancel or undo the changes of there are wrong the inputs (which has been explained in “User control and freedom”). Besides, in the “Contact Us” mobile webpage, the BD provides direct links to the email.

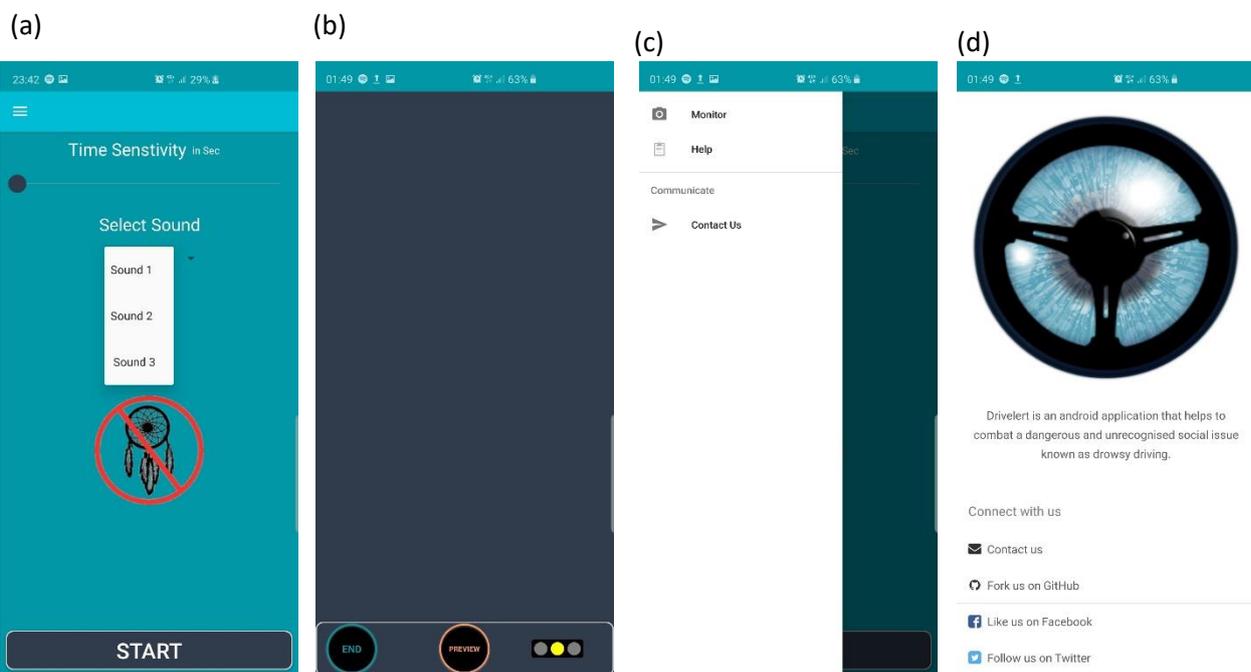


Figure 2. Drivelert Mobile Website

Much like BD, the mobile websites of DE also strive to prevent errors. For instance, in the “Menu” slide-out navigation bar, user can see “Contact Us” under “Communicate” section. Users can write an email or submit the complains or feedbacks on Facebook or Twitter (see Fig 2(d)). Same goes to the SA mobile websites.

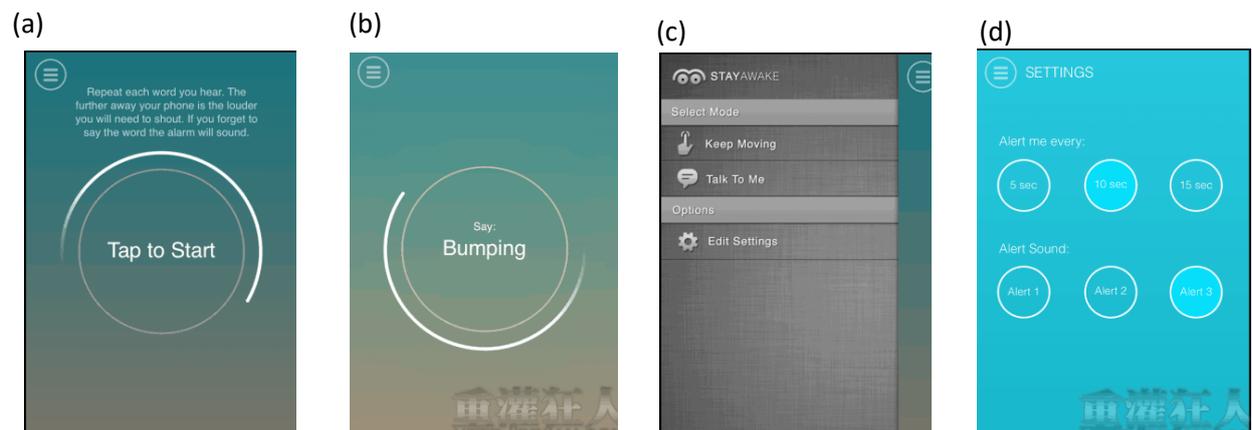


Figure 3. Stay Awake Mobile Website

RECOGNITION RATHER THAN RECALL

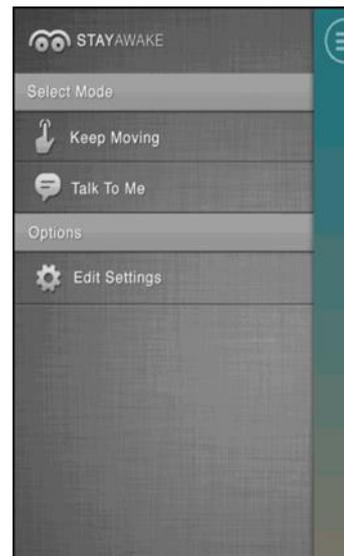
According to Nielsen (1994), systems should make objects, options, and instructions clear and visible so that users need not remember unnecessary information. The mobile website of the BD does quite well in this part. For example, on the bottom page of the BD, each icon is followed by its own name. The icon “Result”, “Learn”, “Trends” and “Setting” (see Fig. 4(a)) are visible at the bottom of each webpage. The instructions are also clearly available. Moreover, the data are very detailed and highlighted with bright colours to help with easy read.

Like the BD mobile website, both the SA and the DE mobile website have good design in this aspect. In the mobile website of the SA, the select mode and options are visible and easy to locate at the top left of the webpage. The instruction is also very clear for users. For example, the “Start” button are clearly visible as it is big and highlighted. As for the mobile website of the DE, it does not have a lot of option but it does display a simple list of options such as “Time sensitivity” and “Select sound” filter function depends on the user preference. The instruction is also very clear and simple.

(a)



(b)



(c)

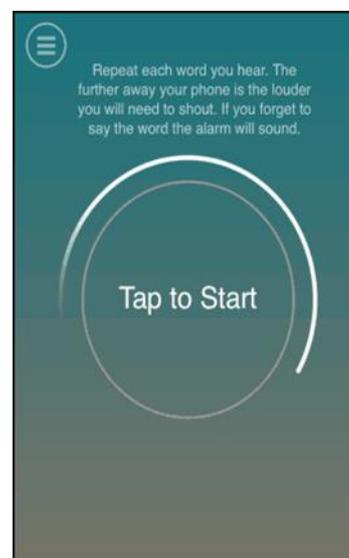


Figure 4. Recognition.

FLEXIBILITY AND EFFICIENCY OF USE

Nielsen (1995) suggested that systems should provide effective services for both experts and inexperienced users with tailored options. Compared with the SA and the DE mobile websites, the BD mobile website has a superior design in this part. The BD website does offer advanced search function for expert user. It allows users to limit a search to a specific collection (see Fig. 4(a)). For example, user can choose a specific data of user heart rate or sleep time. However, both the SA and the DE mobile

websites does not offer advanced options for expert users. It only provides a simple search options to choose and general user requirement (see Fig. 5(c)(b)).

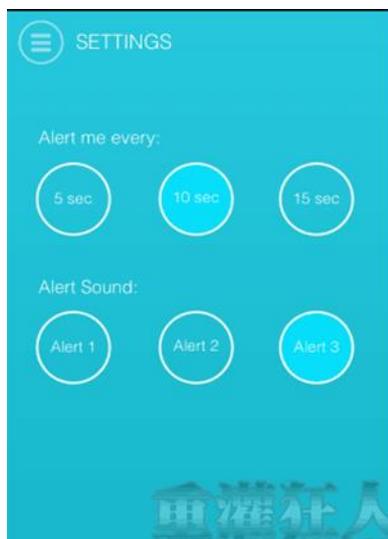
AESTHETIC AND MINIMALIST DESIGN

According to Nielsen (1994), systems should avoid showing excessive and irrelevant information because that will confuse users. The three mobile websites of the BD, the SA, and the DE produce an overall simple design with relevant information without the irrelevant materials. Simple wordings and classification of subjects are utilized in the design (see Fig. 5).

(a)



(b)



(c)



Figure 5. Minimalist Design.

HELP USER RECOGNIZE, DIAGNOSE AND RECOVER FROM ERRORS

In the system, the error messages need to disclose the problems and suggest solutions for users (Nielsen, 1994). However, three mobile websites of the BD, the SA, and the DE are unsatisfactory in this aspect. For instance, when user face is not detected by the camera, it does not inform user of the error which is camera unable to detect in DE mobile website. While the SA mobile website does not provide error message if the users voice is interrupted with other sound such as music in the car. The error messages are not supportive and cannot help users recover from errors.

HELP AND DOCUMENTATION

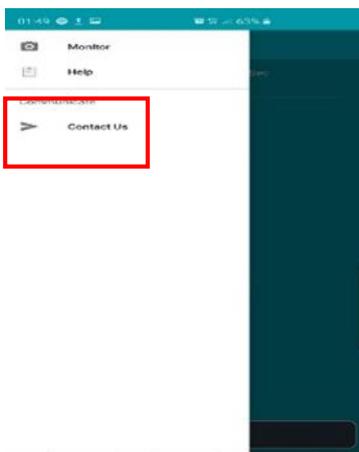
According to Nielsen (1994), it is necessary for systems to provide help and documents that should be easy to search. The mobile website of the BD makes effort to provide support for users who have problems. For instance, if users is new and innocent on how to use the application, they can click on the “Learn” icon (see Fig. 6(a)). The enquiry service provided by the BD mobile website is very supportive and

convenient. The DE provides enquiry service if users have any questions about the function of the DE, the contact information is available and notable in the homepage of the DE mobile website (see Fig. 6(b)). However, the SA mobile website does not provide the enquiry service or the guidelines to help the user.

(a)



(b)



DISCUSSION

SUGGESTION ON IMPROVING THE BD MOBILE WEBSITE

Based on the results of our comparative study, we discovered that the BD mobile website has good design features, two average features, and three features need further improvement as assessed based on the usability heuristics. Our assessment result is listed at Table 2.

First, the BD mobile website should provide an improvement on the context of visibility of system status, which has been assessed as overloaded. The BD should improve the mobile website by making it able to inform users about the waiting time of a search, such as providing an icon informing users about the estimated waiting time, instead of just showing a “loading icon”. Second, the BD mobile website should improve its design in the context of matching its design with the real world, i.e., to provide information in a logical way. Our assessment results show that the BD only achieves an average standing in this aspect as well. When showing the results of analysis, it shows in a really nice order. This can help provide clear information to users.

There are three more aspects of the BD mobile website which require more attention. The first issue is related to its consistency and standards. The BD mobile website should pay more attention in enforcing consistency of contents. The BD mobile webpage should be improved in its flexibility and efficiency of use, such as offering advanced functions for expert users. This can further improve the usability and flexibility of the website. Last, but not least, the BD mobile website should adopt a better approach to help users recognize, diagnose, and recover from errors. In other words, it should be designed for providing features that identify the problems faced by users and providing suggestion/solutions to the users. At the moment, the error messages of the BD mobile website can be improved to further help users recognize and recover from errors. Therefore, we suggest that new features should be included in the mobile website which should be able to indicate the problems and actively suggest solutions to fix the errors.

In addition to the above suggestions, which are developed based on the finding of the comparative study, we would also like to suggest BD to consider providing more sleep detection services and wake up features in its mobile website. During the evaluation, we discover that the BD mobile website offers more services than

DE and SA. Thus, BD may consider expanding their mobile services in the mobile website.

CONTRIBUTIONS AND LIMITATIONS

This study has significant contributions to both the academics and practitioners. For academics, this study provides, as far as we understand, a research studies on the usability evaluation of mobile website. In view of the relatively short history of mobile service, this study provides the insight for researchers on how to apply the usability heuristics framework (Nielsen, 1994) in the context of evaluating the usability of mobile websites. For practitioners, our findings also provide them with the insight on designing better websites for providing library and other similar type of services, such as search engines.

Similar to other research, this study also has its limitations. The main limitation is that it is just a case study on the BD mobile website. Although partially enhanced by comparing mobile websites of other universities, the results and the investigation method focused on the BD mobile website environment, which may have weakened its universality. However, we are of the view that the design of the BD mobile website is quite similar to other mobile (academic) websites, and thus, the results are still quite useful for many other applications. In addition, this study is exploratory in nature and subjective to our judgment, though we are experienced users and two of us have extensive IT experience.

For future research direction, we are planning to conduct next phase of this project through using a survey study focused on usability. We would like to collect feedback from users and subjects recruited on the usability of these mobile websites and further look into the usability issues from user perspectives. This arrangement can allow us to triangulate the users' perception on the usability of this mobile websites

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