Touch User Interface Evaluation for E-book Systems:

A Usability Experiment on Zinio and MagV

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Abstract—**In this paper, we conduct a usability experiment to evaluate two popular e-book systems (Zinio and MagV) using a touchscreen device (iPad). In the experiment, we ask 24 experienced Internet users to perform 10 tasks conducted by five interface design experts. We then collect the quantitative and qualitative data, including the operation time, error frequency, and subjective satisfaction, to explore the usability problems of the touch interface design for e-book readers. The experimental results show that the interface design of Zinio is more user-friendly and efficient as perceived by the participants. In addition, although the touch interface is effective for the participants, the operational performance could be compromised by the poor interface design of the e-book system. The research outcomes provide useful references for interface designers in designing user-friendly interfaces of e-books.**

Keywords-touch interface; e-book; usability; iPad.

I. INTRODUCTION

As both 'ambient intelligence' and 'ubiquitous computing' grow and mature, mobile devices or handy devices have become some of the most desired and popular commercial products, including smart phones, e-book readers, ultrabooks (laptops), and tablets [1]. According to various marketing reports [2][3], the number of mobile device users is with 10%-30% annual growth. This is a fantastic outcome for manufacturers and product designers. Additionally, a trend has been noted that the development of e-books is gradually changing the reading habits of mobile users and the manner in which they retrieve information [4]. For example, in the United States, around one in four of all book-buyers purchase at least one e-book each month. Moreover, 31% of new books purchased are e-books, and 15% of the dollars spent on these books are for e-books [5]. However, can e-books meet users' demands for reading? Is reading an e-book the same as reading a physical book [6]? Can the readers adapt themselves to the differences in the touch interface of e-books?

To address these issues, we conduct a usability experiment [7] on e-books in this study. For our experiment, we choose the iPad with a touchscreen as the input device. In order to collect additional data for further analysis, we choose two popular e-book systems (apps): Zinio and MagV, due to their popularity and cross-platform attributes [1], which will be described in the subsequent sections.

In subsequent sections, we first present the usability experiment for touch interfaces, including the 10 experimental tasks. We then collect the quantitative and qualitative data based on the usability experiment, including the operation time, error frequency, and subjective satisfaction. Finally, the participants' recommendations and conclusions are given about the e-book systems.

II. USABILITY EXPERIMENT FOR TOUCH INTERFACES

The tablet is suitable and portable to read the text without zooming in and navigating around to have it perfectly positioned for reading [8]. In addition, the top tablet market share is iPad (26.9% in 2014 according to the International Data Corporation (IDC) report) [3]. As such, we choose the iPad as the experimental device, with two e-book systems. The Zinio system captures over 60% market share in digital magazine circulation, and it is a polished platform for digital magazine reading, which has apps for iOS, Android, Windows, and a desktop reader for Mac and PC. However, MagV is one of the biggest online Chinese bookstores in Asia, particularly in Taiwan, Hong Kong, and China. The Zinio and MagV e-book systems have different interface designs and different ways of navigating and reading e-books (as shown in Figure 1). Therefore, we can examine the usability of the interface design of these e-book systems and their different learning performances in reading e-books.

There are 29 participants, including five design experts and 24 experienced Internet users, involved in the experimental study. The 5 experts, with at least 10 years of interface design experience and the relevant analytical experiences of human-computer interface, form a focus group [7][9] to conduct 10 experimental tasks (as shown in Table I). The other 24 participants (with the average age of 22.8) are asked to test two e-book systems (Zinio and MagV) by using a touchscreen to perform 10 experimental tasks, whose results are used as a basis to conduct quantitative and qualitative analyses.

We record the entire experimental sessions on video while the participants are engaging in the experimental tasks. After the usability assessment, a semistructured questionnaire is used to collect information pertaining to the

'subjective satisfaction' of reading e-books. The procedure of this experiment involves the following steps:

(a) Zinio   (b) MagV

Figure 1.   Two e-book systems (apps): Zinio and MagV.

TABLE I.   DESCRIPTION OF 10 EXPERIMENTAL TASKS

Task No.	Task Description	Corresponding Functions
T1	Please find the *AA* article on the Content Page of the *BB* book, and point out the exact position.	Scale Drag Page
T2	Please find the first page of the *AA* article, and point out the exact position.	Content Page Drag and Scroll Up/Down Page
T3	Please find the *CC* title in the *AA* article, and point out the exact position.	Drag and Scroll Up/Down Page
T4	Please read the *DD* point of suggestions aloud in the *CC* paragraph, and answer the *EE* question.	Scale Drag Page
T5	Please return to the initial model, and choose another *FF* book.	Content Page Choose Book
T6	Please browse the Content Page of the *FF* book, find the *GG* title, and point out the exact position.	Scale Drag Page
T7	Please find the first page of the *HH* article, which contains the *GG* title.	Content Page Drag and Scroll Up/Down Page
T8	Please answer the *II* question aloud in the *JJ* paragraph of the *HH* article.	Scale Drag Page Drag and Scroll Up/Down Page
T9	Please return to the *BB* book from the *FF* book, and find the first page of the *AA* article.	Content Page Choose Book Memory Retrieval
T10	Please find the *KK* paragraph in the *AA* article, and answer the *LL* question.	Scale Up/Down Page

* Each symbol *AA, BB,…, LL* represents a specific text individually.

Step 1: Conduct 10 experimental tasks by the five interface design experts.

Step 2: Perform the 10 experimental tasks by the 24 participants who test the two e-book systems by using the touchscreen. These participants are randomly assigned to test the Zinio or MagV e-book system. After the test, they take a short break (about 10 to 15 minutes), and then test the other system (MagV or Zinio), depending on which is taken first, until the experimental tasks are completed.

Step 3: Record the entire experimental sessions on video, including the operation time and errors occurred during the 10 experimental tasks.

Step 4: Distribute the semistructured questionnaire to collect quantitative (i.e., the subjective satisfaction of the participants) and qualitative data (i.e., the participants' suggestions regarding the e-book systems).

Step 5: Analyze the numerical data, including the operation time, error frequency, and subjective satisfaction.

III.   ANALYSIS AND RESULT

In this section, we present the result of the quantitative and qualitative analysis, including the operation time, error frequency, and subjective satisfaction.

A.   Operation Time

Table II shows the average operation time and error frequency of the 24 participants when they perform the 10 experimental tasks. In Table II, T1 toT10 in the first column represent Task 1 to Task 10, respectively. Table II shows that the operation time of the Zinio e-book system (229.02 seconds) is faster than the MagV system (261.21 seconds). The result suggests that the Zinio e-book system is easier to operate compared with MagV.

TABLE II.   RESULT OF OPERATION TIME AND ERROR FREQUENCY

	Operation Time		Error Frequency	
	Zinio	MagV	Zinio	MagV
T1	12.42	24.65	0.17	0.33
T2	21.22	28.42	0.13	0.33
T3	16.22	5.88	0.04	0.00
T4	8.17	3.33	0.00	0.00
T5	22.64	22.78	0.33	0.25
T6	8.63	8.16	0.00	0.04
T7	43.98	104.94	0.79	0.92
T8	28.83	37.44	0.08	0.13
T9	37.70	19.63	0.29	0.13
T10	29.21	5.98	0.04	0.04
Total	229.02	261.21	1.87	2.17

For a further discussion, there is a significant difference when the participants perform T7 on the Zinio system (43.98 seconds) and the MagV system (104.94 seconds). The description of T7 is '*Please find the first page of the HH article, which contains the GG title*', and their corresponding operating functions are 'Content Page', 'Drag and Scroll', and/or 'Up/Down Page' (please refer to Table I). It indicates that when the participants perform T7 by using 'Content Page', 'Drag and Scroll', and/or 'Up/Down Page' functions, the operation performance on the Zinio system is significantly different as compared to the MagV system. In

other words, the operation performance of an e-book system could depend largely on its user interface design.

B. Error Frequency

An error is defined as any action that does not reach the desired goal [7]. In this study, we count the number of such actions made by the participants while performing some specific tasks. The error frequency is the average of errors made by the participants in a specific task. From Table II, the error frequency of the Zinio e-book system (1.87 times) is less than the MagV system (2.17 times) for completing all the tasks. The result indicates that the Zinio e-book system results in fewer errors, thus having a faster operation time.

To further compare the two systems, we perform the correlation analysis to examine the relationship of operation time and error frequency. The result shows that there is a high positive correlation on the Zinio e-book system (Pearson's $r=0.736$, $p=0.015$), while the MagV e-book system has a very strong positive correlation (Pearson's $r=0.951$, $p=0.001$). The result reveals that the participants may make few errors while using a system, but the critical issue is how fast the users can recover from the errors [10].

C. Subjective Satisfaction

After the 24 participants complete the 10 experimental tasks, we distribute the semistructured questionnaire to collect quantitative and qualitative data. The participants are asked to assess two questions about the interface design (of the e-book system): 'S1: how do you feel regarding the visual and aesthetical style of the interface design?' and 'S2: how do you feel regarding the operation (operating efficiency) of the interface design?' A 5-point scale is adopted in the semistructured questionnaire, ranging from 1 (the lowest satisfaction) to 5 (the highest satisfaction). Figure 2 shows the result of the participants' subjective satisfaction (S1 and S2).
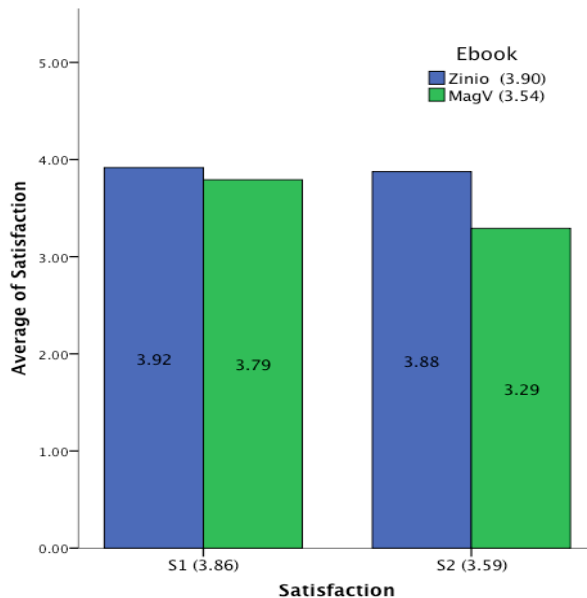

Figure 2.   Result of the subjective satisfaction.

The result of S1 (i.e., aesthetics) shows that there is a slight difference between the Zinio system (3.92) and the MagV system (3.79), while S2 (i.e., operation) has a significant difference between them (the Zinio system being 3.88 and the MagV system being 3.29). We further perform the t-test to examine whether a statistical significant difference exists or not between these two e-book systems on S1 and S2, respectively. The result shows that the t value of S1 is 0.54 ($p= 0.59> 0.05$) and the t value of S2 is 2.30 ($p= 0.03< 0.05$). The result indicates that the Zinio interface design is more user-friendly and efficient (S2) as perceived by the participants, although the visual and aesthetical style (S1) of Zinio is identical to that of MagV. This is also reflected by the operation time and the error frequency.

Furthermore, the semistructured questionnaire is also used to collect the qualitative data. The participants are asked to write down their opinions and suggestions regarding the two different e-book systems, as given in Table III.

TABLE III.   PARTICIPANTS' RECOMMENDATIONS

Zinio E-book System	MagV E-book System
• It is easy to read e-books with iPad, but lack of the feeling about real turning pages. • The page number should be consistent with the 'Scroll' page. • It is difficult to find the 'Content Page', and should be improved with hints/tips. • How to turn to the next page is inconsistent and confusing (e.g. some to the right-hand side, and others to the left). • The book should be marked if users have read it, and the label of books should be more visible and larger. • The 'Scroll' function is unclear, and easy to make an error to turn to the next page.	• The page number should be consistent with the 'Scroll' page. • Users cannot jump onto a specific page, but scroll page-by-page. • The duration of scroll page is slower than the reality. • For the convenience, books should be categorized into proper sections. • The whole operation is not very smooth, and not easy to find the specific content. • How to turn to the next page is inconsistent and confusing (e.g. some to the right-hand side, and others to the left). • Resolution of display is too low/fuzzy, particularly when the page is scaled up.

According to Table III, there are some common problems with respect to the two different e-book systems, such as 'the page number should be consistent with the 'Scroll' page'. In addition, although the iPad with the touchscreen is intuitive for the participants reading e-books, most of the participants feel confused and make errors on 'how to turn to the next page' (because some e-books are to the right-hand side, and others are to the left). For further analysis, most of the participants prefer combining two or three options (e.g., 'Up/Down Page' with 'Drag and Scroll') to read an e-book. In addition, the participants also like to navigate the article (i.e., page by page) in a similar manner to when reading a real book. This result could be provided as a guideline for the designers to design an effective user interface that can best meet user requirements and satisfaction.

IV.   CONCLUSION

In this paper, we have presented a usability experimental study on two e-book systems (i.e., Zinio and MagV) to

address whether the touchscreen device is user-friendly with high subjective satisfaction for e-book readers. The experimental study has been conducted to examine if the different e-book systems have significant difference in terms of the operation time, error frequency, and subjective satisfaction. The result has demonstrated that the Zinio e-book system is easier to operate with few errors compared with the MagV system. Moreover, even though the touchscreen device is intuitive for the participants reading e-books, the participants still feel confused and make errors due to the poor interface design. Although two e-book systems are chosen as an illustration, the user-centered approach presented in this study is applicable to other kinds of e-book systems (e.g., FlipViewer) for addressing the usability issue.

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