Evaluation of UUM Mobile Augmented Reality Based i-Brochure Application

Ahmed Jamah Ahmed Alnagrat, Abdul Nasir Zulkifli, and Mohd Fitri Yusoff

Abstract—Paper brochure is one of the typical approaches that have been used by most higher learning institutions (HLIs) to disseminate information to their prospective students. However, some drawbacks of paper brochure include information consisting of only text and picture that is static non-interactive and if updated, the brochure will be obsolete. With the advent of mobile technology, new technologies including Mobile Augmented Reality (MAR) have been introduced to facilitate human life. This paper discusses the design and evaluation of an MAR based interactive brochure (i-brochure) for promoting the Universiti Utara Malaysia (UUM) amongst the international students. User evaluation was conducted amongst the international students and the results indicated that the respondents highly agreed on all the measures that include; Usefulness, Ease of Use, Effects on Motivation, Out-come/Future Use, and Satisfaction of the i-brochure. The introduction of the i-brochure coincides with the needs of the students to acquire comprehensive information about UUM.

Keywords— Interactive Brochure, Mobile Augmented Reality, Higher Learning Institution, Marketing and Promotion.

I. INTRODUCTION

In higher learning education, Malaysia has attracted nearly 80,000 international students coming from about 100 countries in 2010. This is due to several factors which include; high quality of education, low fees, peaceful multicultural society, English as a medium of instruction and political stability. Malaysia has then set another target that is to attract 150,000 international students [1].

In promoting a Higher Learning Institution, the typical media that are normally being utilized include websites and paper brochures. These media are utilized to disseminate as much information as possible to the prospective students. In the case of paper brochure, it is the most widely used approach. However, some drawbacks of paper brochure include information consisting of only text and picture that is static, non-interactive and if updated, the brochure will be obsolete. According to [2], a very limited research has been conducted to involve modern technologies to the existing paper

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brochures. Commercial technologies that have been introduced into this area have had limited success. Since mobile phones are getting more powerful in terms of hardware and capabilities, they can be used to benefit human through the introduction of new mobile applications.

One of the missions of Universiti Utara Malaysia is to provide the international students with complete information about the university by using brochure as one of the promotional media. However, based on the authors' observation, the information provided by the existing paper brochure is limited to the programs that are being offered by the respective colleges. In order to further understand the situation, a preliminary study has been conducted amongst the international students of UUM pertaining to the information that is of upmost important to them prior to coming to UUM. The study was conducted amongst 50 international students who were selected based on the convenient sampling technique. The results indicated that the respondents were not able to get complete information related to the academic programs, academic facilities, student accommodation and places at the university from the existing UUM paper brochures. The study also indicated that only 22% of the students were satisfied with the information that they acquired through the using the paper brochure and 94% believed that the paper brochure can be further enhanced.

In the following sections, we describe the technology involved, previous related studies, the UUM Mobile Augmented Reality Based i-Brochure, user evaluation and the findings.

II. TECHNOLOGY INVOLVED

A. Augmented Reality

The augmented reality technology is not new and is concerned mainly with connecting the virtual objects in the actual world. Several fields have adopted the AR applications, including advertising [3], education, training and entertainment [3].Mobile devices, particularly smart phones, which are equipped with cameras, can present a collection of video clips of the actual world. However, virtual objects, such as texts, images, videos and three dimensional objects, can be attached to markers in the actual world through using the AR application and displayed either by smartphones or by computers, enabling the users to touch the device screen or interact with the virtual objects. This kind of integration, together with the magical effects of AR, is highly appreciated and appealing to the intelligent technology users. Smartphones, particularly the developed ones which are equipped with new application, are available at markets at a very reasonable price. Thus, more users are using these kinds

of mobile devices, leading to adopting the MAR technology in advertising. As a consequence, the market for AR may rise in multi-folds in the next few years. For example, ABI research foresees that it can eventually increase to US$350 million in 2014 within the USA while the Juniper Research forecasts up to US$714 million [3].

B. Mobile Augmented Reality (MAR)

MAR is a combination of both interactive real and virtual world that relies on dynamic 3D and classified as one of the fastest growing research clusters in AR [4], [5] . In order to make the virtual or natural unseen information visible by digital means, Augmented Reality is considered a system which constitutes and facilitates the main senses, represented by vision, audio, and tactile [6] . Consequently, media devices, such as camera, GPS navigation location, screen, accelerometer, image recognition capability and compass will operate the MAR. Generally, what connects between the user and the system and allows for more interaction as a medium is the internet [5] . Thus, using the MAR is effective in displaying the information and data through adopting the whole system directly with the real world environment [7] , and allows people to cooperate, interact and introduce information for the purpose of constituting and resolving uncertainty. This will enable the people to become user screen (US) all over the world. However, in order to get modern and effective MAR applications, the adoption of many technologies is necessary, including display technology, interaction technology, wireless communication technology and tracking global technology [8].

In 2012, according to Juniper Research, US$ 2 million has been the earnings of the AR technology. However, in 2014, this amount of earnings can reach US$ 14 million a year [9] . This illustrates the huge usage of the smart devices, such as Smartphone and tablets, by people in all sectors, particularly with the invention of new technologies among Android and Apple Smartphone and tablets which can be used as platforms for AR [10] . The first MAR application, which is a touring machine to investigate the urban environment was developed for the first time by Steve Feiner in 1997 [11] . However, at that time, bulky hardware carried inside a backpack was used for the MAR systems [8] . On the other hand, smaller laptops, Ultra-Mobile personal Computer (UMPCs) and Personal Digital Assistant (PDAs) were also exploited as AR hardware platform [12], [13]. However, nowadays, the Smartphone which are equipped with capable processing power and due to the development of their functions have increasingly become more popular as MAR platform [14], [15], [16].

Both features, the mobility and lightweight, enabled the users in checking the screen and interacting with the virtual objects. Moreover, since the Smartphone are already supported with new applications and devices, there is no need for the users to carry additional devices to experience MAR. Table 1 shows some components of Mobile Augmented Reality.

Due to employing it in mobile advertising, AR has become the focus of daily discussions among people nowadays. This technology has been exploited increasingly in practical advertisement to include several industries such as automobile, food, game and engineering [3] . Companies

TABLE I
COMPONENTS OF MAR

Components	Descriptions
Computational platform	Generating virtual objects in the physical settings.
Display Type	Presenting the virtual object in the context of the physical world. Often used to convey contained information either matching or completely alternate for visual elements [16].
Registration and Tracking	For the purpose of annotating, aligning the physical objects with the virtual elements.
Discussion Technologies.	Choose what people do, and have access to conceive the related materials.
Networking Wireless	It is important to be involved with others while on the move.
Data Storage and Access Technology	To present the information to the user about the current environment/scenario.

III. PREVIOUS RELATED STUDY

A. AR In Advertising and Marketing

with high reputation, such as McDonald, Coca-Cola, Nike and Kellogg, have adopted this technology as a tool in their marketing.   AR technology, as a modern way of advertisement, is believed to be a perfect option to support achieving the aims of advertising. Meanwhile, many researchers have been conducted to study the effectiveness of AR in marketing [3].

A centric was one of the researches conducted to explore the effectiveness of AR in advertising and has been reviewed by [17] . By using advertisement in CAR magazine [18] , a new Mercedes Benz model was formed adopting AR technology. This followed by an evaluation among 79 respondents who were instructed to use the AR advertising in the website. As a result, the findings revealed that 63% of the respondents checked out the AR advertisement on the website to view the advertisement animation. Further findings revealed that 86% of the respondents were interested to view online content advertisement about Mercedes-Benz.

Another study to explore the effectiveness of AR in advertising was conducted by [19] . They studied information retention related to advertising among people by using standard 2D printed media and AR. The findings of the study demonstrated that both methods are to provide optical components or products and generate interest in the product. Additionally, the results implied that the 2D printed media is much effective in offering the required factual information. However, a possible explanation for this result, regarding the augmented reality advertisement, participants viewed only video recordings.

A further study conducted by advertising and marketing consultants [18] investigated parents' validation of AR advertisement which involve children's gadget. The sample of the study included two groups of 100 parents to compare between two types of advertising media. These are 2D printed and AR to know the best places to buy toys for their kids. Having watched the 2D printed advertisement, 45% of the sample considered buying toys, while 74% considered buying toys after viewing the AR advertisement. As a consequence, the highest price for the purchased games after viewing the AR advertisement was £7.99, whereas the highest price related to those who viewed the 2D printed advertisement was

only £5.99. However, in terms of time spent on each type of advertisement, AR advertisement viewers spent more time, 1 minute and 23 seconds, viewing the products. In contrast, the 2D printed advertisement viewers spent only 12 seconds. It was concluded that the more interesting the advertising media are, the more engagement on the part of the viewers and a higher possibility of the willingness to purchase a product even at a higher price will be. These findings indicate that the AR advertisement is effective in influencing the customer's decision in buying products. The findings of the several studies explored the effectiveness of the AR advertisement; therefore, a lot of marketers dash to venture directly into this new method of promotion. This justifies the need of this kind of study in order to explore the potential of AR in advertising [3].

B. MAR In Marketing

AR technology affects the appearance of the market. AR enables the consumers to enjoy shopping with much fun and make the appropriate selection. In their marketing strategies, some famous companies, such as IKEA, have adopted AR technology [9] . Further, advertising through mobile phone has become more popular. Gartner expects that 1 billion Smartphone will be sold in 2014; this, of course, will promote MAR [20] . According to Juniper, portable AR promoting revenue will certainly be affected by subscription-based products and services, advertising as well as AR-based application data [21] . MAR is considered an effective instrument in assisting users to achieve many tasks. [22] mentioned some issues related to the adoption of this technology. He reported that mobile devices will not be always connected, and when they are connected, there is absolutely no way to guarantee or even predict reliability as well as bandwidth, or even delays in connection. Determining the precise position and orientation of the installation of images or content is another important issue related to this aspect [23] . In addition, the hand move while using the portable devices can cause overlay images to be distorted or flickered without the consumer's awareness of the matter especially in the MAR [10].

IV. UUM MOBILE AUGMENTED REALITY BASED I-BROCHURE

The UUM MAR based i-brochure is an application running on Android Smartphone. This application will be used with the brochure that has been specially designed for the purpose of promoting UUM to the prospective international students. Through the use of the application and the brochure, the prospective students will be able to view more detailed information about UUM in the form of interactive displays.

In developing this application, Metaio Creator software was used to develop the logical body of the application. The interfaces and video of the application were created by using Adobe premiere Pro CS6 , Format Factory V2.60, Adobe Sound Booth and Audacity. The Metaio Creator Integrated Development Environment enhanced with Android development tools was used as a plug-in tool to develop the MAR based i-brochure application. Fig. 1 illustrates the stages of the work within the Metaio Creator software.

Fig. 1 Metaio Creator

Adobe Photoshop was used to design the interface of the i-brochure as shown in Fig. 2. Photoshop and Format Factory V2.60 were used to create and modify the required images, photos, and icons. Finally, the application has been uploaded on the Metaio cloud hosting to allow users to access from their Android Smartphone.

Fig. 2 The UUM MAR based i-brochure

V. EVALUATION

The evaluation of the UUM MAR based i-brochure application comprised of expert and user evaluations.

A. Expert Evaluation

The expert evaluation was conducted to determine the robustness of the UUM MAR based i-brochure application interfaces and application functionalities. The rationale was to detect fault in the application before presenting it to the end users. Evaluation by experts was employed to validate in terms of usability before being introduced to the end users. The experts were categorized into two groups. The first group consists of content experts who are two officers from the Center of Academic Affairs, Universiti Utara Malaysia. They were selected based on their knowledge and experience in matters related to the promotion of UUM among prospective international students. They were required to check and validate the contents of the application. The second group consists of User Interface experts who are two lecturers from the School of Computing and School of Multimedia Technology and Communication, Universiti Utara Malaysia. They were selected based on their knowledge and experience related to the user interface design and layout for mobile application. They were required to check and validate the user interfaces of the application. Feedbacks and recommendations from the experts were documented and earlier version of the application was modified accordingly.

B. User Evaluation

User evaluation was conducted to determine users' perception in terms of Usefulness, Ease of Use, Effects on Motivation, Out-come/Future Use, and Satisfaction on the UUM MAR based i-brochure application. The evaluation was conducted among 50 international students (users). User evaluation process was carried out by using a set of questionnaires. The questionnaires were adapted from [24], [25], [26], [27]. Usefulness measures the level that a person believes about using a specific application that would raise up the user's performance level [28] . Ease of Use can be described as the degree of easiness for a particular application by being free of heavy effort [24] . Effect and motivation are representing the way that can be followed to motivate the users to use a specific application and how this application can influence the on results. Satisfaction measures the level of satisfaction for the user with the whole application and contents [29] . Finally, Outcome and Future Work represent the degree for a person expected to use this application [30] . A 5-point Likert scale anchored by "Strongly Disagree" (1) and Strongly Agree (5) was used as shown in Table II [28].

TABLE II
FIVE-POINT LIKERT SCALE FORMAT

	Strongly	Disagree	Neutral	Agree	Strongly
Score	1	2	3	4	5
Category	Disagree		Neutral	Agree	

VI. RESULTS

A. Demographic Data

The respondents consist of 26 male (53.3%) and 24 female (46.7%) international students of Universiti Utara Malaysia. In terms of education background, 27 (56.7%) of them have a master degree and 23 (43.3%) have PhD. In terms of age, 3.3% of the respondents were between the age of 21-25 years, 33.3% were between the age of 26-30 years, 33.3% were between the age of 31-36 years, 13.3% were between the age of 36-40 and 16.7% were over 40 years.

B. User Evaluation

In this study, descriptive statistics, reliability analysis and t-test were used .SPSS version 18 for Windows 7 was used for all the analyses. The results are discussed in the following sections.

The descriptive statistics for all the measurements and items are presented in Table IV. The reliability was addressed for the user evaluation questionnaires. The Cronbach alpha values were calculated as shown in Table III.

TABLE III
CRONBACH ALPHA VALUES FOR ALL MEASUREMENTS

Measure	Number of items Included	Cronbach Alpha
Usefulness	6	0 .782
Ease Of Use	6	0 .786
Functionality/effectiveness	6	0.794
Satisfaction	4	0 .865
Outcome/Future Use	5	0.787

The descriptive statistics for all the measurements are presented in Table IV.

TABLE IV
DESCRIPTIVE STATISTICS FOR ALL ITEMS

Items	Mean	Std. Deviation
USEFULNESS	4.48	
1. Using the i-Brochure would enable me to accomplish tasks more quickly.	4.52	.54361
2. Using the i-Brochure would improve my job performance.	4.44	.61146
3. Using the i-Brochure in my job would increase my productivity.	4.62	.49031
4. Using the i-Brochure would enhance my effectiveness on the job.	4.52	.54361
5. Using the i-Brochure would make it easier to do my tasks.	4.46	.76158
6. I enjoyed working with the i-Brochure.	4.36	.52528
EASE OF USE	4.29	
1. Learning to use the i-Brochure would be easy for me.	4.48	.64650
2. I would find it easy to get the i-Brochure to do what I want it to do.	4.36	.66271
3. It is easy for me to becomes skilful when I use the i-Brochure.	4.14	.80837
4. I would find the i-Brochure to be flexible to interact with.	4.14	.72871
5. I would find the i-Brochure is easy to use.	4.36	.77618
6. I found it easy to work in i-Brochure.	4.26	.80331
FUNCTIONALITY / EFFECTIVENESS	4.10	
1. Information was presented in a meaningful way.	4.12	.52060
2. I could achieve what I wanted in the i-Brochure	4.02	.62237
3. I found it easy to access all the functionality (control) of the i-Brochure	4.12	.59385
4. The i-Brochure is easy to use	4.20	.72843
5. The i-Brochure shows the information step by step	3.98	.71400
6. The i-Brochure presented in useful format	4.18	.59556
SATISFACTION	4.37	
1. I was satisfied with this type of i-Brochure	4.36	.77618
2. I was satisfied with the overall learning effectiveness.	4.26	.80331
3. I enjoyed using the i-Brochure	4.50	.61445
4. I found the i-Brochure contents meet my needs	4.38	.66670
OUTCOME/FUTURE WORK	4.53	
1. I was able to complete my job quickly using the i-Brochure	4.54	.70595
2. I could effectively complete my job using the i-Brochure	4.52	.54361
3. I was able to efficiently complete the job using the i-Brochure	4.44	.61146
4. Based on current experience with using this i-Brochure, I think I would use it regularly.	4.62	.49031
5. I believe I could become productive using the i-Brochure	4.52	.54361

VII. DISCUSSION

Table III indicated that all measures have cronbach alpha values greater 0.7. Thus, all of them satisfy the internal reliability criterion as recommended by [31] . The results of the user evaluation as shown in Table IV indicated that three items with means more than 4.5 are bolded which indicate that the users strongly agreed on these items and just agreed on the rest of the items that are related to the i-brochure. Only one item has a mean value of less than 4. Overall, the users

agreed on the Usefulness (4.48), Ease of Use (4.29), Effects on Motivation (4.10), Out-come/Future Use (4.37), and Satisfaction (4.53) of the UUM MAR based i-brochure. From the results, the following key strengths are apparent:

i. The users think that the i-brochure is useful.
ii. The users think that the information provided by the i-brochure is easy to learn and understand.
iii. The users will use and recommend the i-brochure.
iv. The users are satisfied with the use of the i-brochure.
v. Users can use the i-brochure at anytime and anywhere with internet connection.

VIII. Conclusion

In this paper we discussed the evaluation of i-brochure, a mobile application based on Augmented Reality running on Android Smartphone among UUM International students. This application is targeting the prospective international students who are interested to continue their studies at UUM. The i-brochure application is intended to be a supplement to the existing paper-based brochure that is commonly used by UUM in promoting the university and all the academic programs offered by the university.

It is hoped that the findings of this research will encourage more prospective international students to use the i-brochure application in order to understand more about Universiti Utara Malaysia prior to their arrival to the university. At the same time, this will help UUM to introduce a new promotional tool which is more creative and innovative among the international students. This will help UUM to be more recognized at the international level through the use of more interactive and trendy marketing and promotional strategy.

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