The Development of Augmented Reality Mobile Information System (ARMIS) influences the Psychological Factors in Consumers’ Preferences

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Abstract. Nowadays, the technologies had experienced massive changes. With the enhancement of technologies, enable devices, software as well as application to be synergised together and creating a new system. The synergised new system enables humankind to have more productive live ahead in the future. Augmented Reality Mobile Information System (ARMIS) is a system developed using smart phone devices, web studio, mobile application and Quick Response (QR) Code; used to create an overlay image that able to portray the information of products. This system was developed due to the price checker in hypermarket giving out several problems towards the hypermarket customer & retailers, such as giving out a few information regarding towards the product, consuming more electric current, it hidden somewhere in the store and the linear barcode which holding less information. The crucial concept of ARMIS is development of QR Code, development of AR, development of mobile application and the implementation of ARMIS into smart phone devices. Using the model of Alessi Trollip, the product had undergone a few procedures in its development. The main objectives are to develop and introduce ARMIS and to test the ARMIS reliability whether it meets the need of the consumer. ARMIS system also had undergone the Alpha Test where the survey was done towards the The Store hypermarket’s customer in Kangar, Perlis, multimedia expert possesses Master or Ph.D and as well as the KPDNKK’s officer.

Keywords: Augmented Reality, Mobile Information, Quick Response (QR) Code, Consumer Preferences

1. Introduction
In the new era of globalization, we are loaded and crammed with various information no matter in what kind of sector, there will be tons of information that we had to see, listen and notice about it. Therefore, lots of advance technologies that had been develop and created in order to enable peoples gain information effectively. Day by day, the technology keeps having enhancement in term of their system, and human’s computer interface. Augmented Reality (AR) is one of the integrated digital information that had been superimposed by computer generated with the real environment of the user in the real time [1]. It is had been started to be developed on the year of 1968 by Ivan Sutherland. On that moment, it was the first Augmented Reality (AR) system [2] that had been developed by him using 3D’s mechanically tracked via head-worn display which the wearer could see computer-generated information overlay with physical object [3]. Stated by Mehdi Mekni and Andre Lemieux,
Augmented Reality (AR) was stated as integration of technologies that enable the real time overlay interrelated to a computer generated content with live video display [4].

Nowadays, as the computer size is emerging from big to small and from thick to thin, Augmented Reality (AR) as for now able to be projected on the size of the mobile phone’s screen. In other words, digital or virtual information from a computer generated able to be seen on the mobile’s screen thus, creating the system using mobile hardware in collaborated with augmented reality (AR) called as Mobile Augmented Reality that enable digital and virtual information’s data to be portray.

There are tons of product that had been in the hypermarkets, most of the product still using the bar code as to scan the price and its providing minimum information about the product. QR code, is the code that can hold more information compare to bar code. It is 2 dimension code and an ISO standard which can encode all the things that need to be know such as text, or URL and it is very responsive as it is called as Quick Response (QR) with large data capacity [5].

According to Lanner, price checker is described as the electronic kiosk that enable the user (customer) in the hypermarket to scan the barcode of any merchandise, products or items in the hypermarket or stores to view the prices [6]. Unfortunately, the price checker only gives out a little information regarding towards the product. Stated by Lanner, the user of the price checker could access the exact same information from a price tag which are the information provided does not give any added value [6]. Besides that, the price checker is not energy efficient when the device still needs a power supply to be functioning. According to Champtek, it stated that the price checker named as Champtek SG-15 [7].

Plus needed a power voltage at 100 to 240 Vac and it power consumption is 3 to 5 Watt (5.2 Vdc, 580 to 1050mA). Therefore, the electrical power consumption of a hypermarket would have an increment. Other than that, there is another issue faced when a hypermarket using a price checker machine. The issue that a hypermarket will faced is, the customer of a hypermarket unable to find the price checker as it is hidden somewhere in the store. In other words, the customer having difficulty to find the price checker machine when they need it at the moment. Stated by Utusan Malaysia, according to Datuk Jainab Ahmad Ayida Minister of Community Development and Consumer Affairs of Sabah said that a hypermarket all around Malaysia should place the price checker at the right place where consumers could use the device to check the price of products they goes to buy [8]. Besides focusing on the issue of price checker, a barcode issue also needs to take into account as the barcode holding an information about the product. Linear barcode holding less information compared to (Quick Response) QR code which holding small amount of data [9].

2. QR Code Data Representation for Mobile Augmented Reality

This project development was conducted by [5] which used the QR (Quick Response) code, Augmented Reality, and as well as the mobile device as their conceptual of the research. According to [5] due to high capacity of data storage of QR code, the three characteristics of augmented reality which is combining real and virtual, interactive in real time and as well as may portray 3D visual, and the existence of smartphone device enable the MAR or mobile augmented reality to be developed. In additional, the researcher stated that, QR code for MAR is considered as holding so much potential in many application domains.
2.1 QR Code and Augmented Reality-Supported Mobile English Learning System

This project development is conducted by [10]. They are creating the mobile learning system that was developed using the QR code, Augmented Reality and as well as Mobile Device. The concept of this research is the system functioned as the learning platform or task based learning for English learner. The system worked by process by at first, the QR code is detected by the PDA’s camera and it is giving the information through it and then, the QR code software will then read the QR context and portray the information in the form of Augmented Reality which is supported by the mobile learning system (m-learning). Therefore, it’s providing the interactive learning in between the English learner and the mobile learning system. In this research also, the proposed the system consisting of two subsystems: a HELLO server and m-Tools (application software) that already designed as in Figure 2.

2.2 Interactive Tourist Guide: Connecting Web 2.0, Augmented Reality and QR Codes

Project conducted by [11] proposed the developed a system by combining the three technologies which are Augmented Reality, Web 2.0 and QR Code. This system is developed as to guide the tourist to the two important routes in a World Heritage City. The system work by displaying the tourist with the 3D animation picture of the building with the route. The building of the historical was created and modelled as 3D so that the tourist will having the sense of interest about to visit the historical building. As for the printed map, the QR code was printed on it. The QR is functioned holding the information of the images and URL. Every QR code is given with some textual and multimedia information that
will directing the user to their web. It will then help in guiding the tourist as this system is handheld system as it can be access through smartphone devices.

Figure 3. Map of the Historic ensemble’s buildings with inserted code. Adapted from “Interactive Tourist Guide: Connecting Web 2.0, Augmented Reality and QR Codes” [11]

3 Chronology of Product Development of Augmented Reality Mobile Information System (ARMIS)

Based on the model of Allessi Trollip, after planning and design phase was carried out, the development will undergoes the procedure as in Figure 4.

Figure 4. Development phase of ARMIS

Figure 4 shows the work flow of the ARMIS development. At first step in the development, the QR Code will be created using the open source software which is QR Code Generator. Secondly, it will undergo the development of overlay image and trigger image by using Photoshop CS6. Lastly, after the images already create, it will be installed in HP Reveal Mobile Application. Figure 5 shows how the ARMIS is functioning to display information of a product.
Figure 5 shows the flow of how ARMIS work when the three developments of ARMIS is done from downloading the HP Reveal App, scanning the QR Code on a product and lastly retrieve the information in term on overlay image. This section elaborates the analysis result gained from the Alpha Test. Alpha Test was identified as the most suitable as the researcher is developing the prototype of the Augmented Reality Mobile Information System (ARMIS) system for products in the hypermarkets. In this product development, Alpha Test was conducted for multimedia expert, content expert and a few consumers of The Store hypermarket in North Malaysia which is located in Perlis. The Alpha test is divided into two sets of question which is Set 1, the Alpha test is towards the consumer which contains 2 sections. The two sections for Set 1 of Alpha Test are Section A: Demography section and Section B: USE Questionnaire: Usefulness, Satisfaction, and Ease of use. Whereas as for the Set 2, the question is given towards the multimedia expert and content expert. Therefore, the Alpha test was conducted through quantitative and qualitative method.

According to [12] Alpha Test is described as the form of internal acceptance testing for the product software developed. It is the test which will undergoes simulation or real operational testing by multimedia expert, content expert and potential user. In this project, the potential user is the hypermarket consumer. Most of the potential user is selected from 30 years old till 60 years old and above. The Alpha test is getting done before the product developed is ready for beta testing. Moreover stated by [13], the Alpha test is the pre acceptance test that get done to make sure that the user (consumer) able to get familiar and understand on the functionality of the product developed. Besides enable the user to get familiar on the interface and its functionality, the Alpha test also enable the researcher to get the feedback for further enhancement of the product.

4 Results and Discussion
For the quantitative data analysis that had done for Alpha Test, it contains two sections which are Section A: Demography and Section B: Usability, Satisfaction and Ease of use (USE) questionnaire. The USE questionnaire is a standardised instrument that been used by the researchers as to test and measure the aspect of the user experience that are related towards to user behavior and purchase.
decision [14]. This survey was given towards six people. Three persons are male and another 3 persons are female that was 30 years old and above.

4.1 Recode

The USE questionnaire is the question from that had been used in this survey towards the consumer. Most of the questions that are inserted are in positive aspect. Therefore, the researcher does not do any data cleaning throughout the SPSS system as all the question in the USE questionnaire does not contain any negative items.

4.2 Frequencies

**Table 1. Gender frequency**

| Gender | Frequency | Percent | Valid Percent | Percent |
|--------|-----------|---------|---------------|---------|
| Valid  | Female    | 3       | 50.0          | 50.0    |
|        | Male      | 3       | 50.0          | 100.0   |
| Total  |           | 6       | 100.0         | 100.0   |

**Table 2: Age frequency**

| Age | Frequency | Percent | Valid Percent | Percent |
|-----|-----------|---------|---------------|---------|
| Valid | >30       | 2       | 33.3          | 33.3    |
|      | >40       | 1       | 16.7          | 50.0    |
|      | >50       | 1       | 16.7          | 66.7    |
|      | >60       | 2       | 33.3          | 100.0   |
| Total|           | 6       | 100.0         | 100.0   |

In this section containing items regarding to the demography which is age, gender, religion, level of education and experience on Augmented Reality (AR). Respondent need to answer the question that had been ask by tick (/) on the space provided. This method is being conducted as to ensure the respondent able to give specific and right answer when answering the question. The tables above showed that the total of the respondent of males is three persons meanwhile as for the female respondent is three persons as well. Making the total of the respondent is equal to six persons.
Table 3. Education Frequency

| Education  | Frequency | Percent | Valid Percent | Percent  |
|------------|-----------|---------|---------------|----------|
| Valid      | High school | 3       | 50.0          | 50.0     |
|            | Diploma    | 2       | 33.3          | 83.3     |
|            | Degree     | 1       | 16.7          | 100.0    |
| Total      |            | 6       | 100.0         | 100.0    |

Table 4. AR Experience frequency

| AR Experience | Frequency | Percent | Valid Percent | Percent |
|---------------|-----------|---------|---------------|---------|
| Valid         | Yes       | 2       | 33.3          | 33.3    |
|               | No        | 4       | 66.7          | 100.0   |
| Total         |           | 6       | 100.0         | 100.0   |

According to the Table 3, from the six respondents, half of the respondent had the high school level of education. Meanwhile, three out of six of the respondent are from the diploma and followed by 1 respondent from degree level. It’s also showed in the Table 4 above, that most of the respondent does not experience the Augmented Reality (AR) which is 4 out of 6 respondent tick No and the rest of 2 person tick Yes.

4.3 Describing Respondents and Numbers

Table 5. Descriptive Statistic

| Descriptive Statistics | N | Minimum | Maximum | Mean | Std. Deviation |
|------------------------|---|---------|---------|------|----------------|
| B1                     | 6 | 3.00    | 5.00    | 4.500| .83666         |
| B2                     | 6 | 3.00    | 5.00    | 4.333| .81650         |
| B3                     | 6 | 3.00    | 5.00    | 4.500| .83666         |
| B4                     | 6 | 1.00    | 5.00    | 3.666| 1.50555        |
| B5                     | 6 | 3.00    | 5.00    | 4.000| .89443         |
| B6                     | 6 | 3.00    | 5.00    | 4.000| .89443         |
| B7                     | 6 | 4.00    | 5.00    | 4.500| .54772         |
| B8                     | 6 | 4.00    | 5.00    | 4.666| .51640         |
| B9                     | 6 | 4.00    | 5.00    | 4.500| .54772         |
| B10                    | 6 | 4.00    | 5.00    | 4.500| .54772         |
Based on Table 5, showed that, all the question in the USE (Usability, Satisfaction and Ease of use) questionnaire having the scale of Likert. The Likert scale is determined by values of, 1.00 = strongly do not agree, 2.00 = do not agree, 3.00 = agree, 4.00 = strongly agree, and 5.00 = very strongly agree. The Table 5 shows that the minimum value is 1.00 and the maximum value is 5.00. All the question that had been insert in the table above is the questions that only using the Likert scale. According to the table above, all of the respondent choose to answer the question in between the values of 1.00 till 5.00. None of the respondent where detect answering the question out of the value in between 1.00 till value of 5.00. The respondents answered in question B4 with the value of 1.00 meanwhile other question is in between value 3.00 and 4.00 for the minimum value. The value of 2.00 was not recorded in the minimum value as none of the 6 respondent choose to answer with value of 2.00 in any of the question from B1 to B30. Therefore, the above table recorded the items really well.

4.4 Reliability Statistics

| Valid N (listwise) | 6 |

Based on Table 5, showed that, all the question in the USE (Usability, Satisfaction and Ease of use) questionnaire having the scale of Likert. The Likert scale is determined by values of, 1.00 = strongly do not agree, 2.00 = do not agree, 3.00 = agree, 4.00 = strongly agree, and 5.00 = very strongly agree. The Table 5 shows that the minimum value is 1.00 and the maximum value is 5.00. All the question that had been insert in the table above is the questions that only using the Likert scale. According to the table above, all of the respondent choose to answer the question in between the values of 1.00 till 5.00. None of the respondent where detect answering the question out of the value in between 1.00 till value of 5.00. The respondents answered in question B4 with the value of 1.00 meanwhile other question is in between value 3.00 and 4.00 for the minimum value. The value of 2.00 was not recorded in the minimum value as none of the 6 respondent choose to answer with value of 2.00 in any of the question from B1 to B30. Therefore, the above table recorded the items really well.

4.4 Reliability Statistics

| B11 | 6 | 4.00 | 5.00 | 4.3333 | .51640 |
| B12 | 6 | 4.00 | 5.00 | 4.1667 | .40825 |
| B13 | 6 | 4.00 | 5.00 | 4.5000 | .54772 |
| B14 | 6 | 4.00 | 5.00 | 4.3333 | .51640 |
| B15 | 6 | 3.00 | 5.00 | 3.8333 | .75277 |
| B16 | 6 | 3.00 | 4.00 | 3.8333 | .40825 |
| B17 | 6 | 3.00 | 4.00 | 3.6667 | .51640 |
| B18 | 6 | 3.00 | 4.00 | 3.6667 | .51640 |
| B19 | 6 | 3.00 | 4.00 | 3.6667 | .51640 |
| B20 | 6 | 3.00 | 5.00 | 4.1667 | .75277 |
| B21 | 6 | 3.00 | 5.00 | 4.1667 | .75277 |
| B22 | 6 | 3.00 | 5.00 | 4.1667 | .75277 |
| B23 | 6 | 3.00 | 5.00 | 4.0000 | .63246 |
| B24 | 6 | 3.00 | 5.00 | 4.1667 | .75277 |
| B25 | 6 | 3.00 | 5.00 | 4.1667 | .75277 |
| B26 | 6 | 4.00 | 5.00 | 4.6667 | .51640 |
| B27 | 6 | 4.00 | 5.00 | 4.5000 | .54772 |
| B28 | 6 | 3.00 | 5.00 | 4.3333 | .81650 |
| B29 | 6 | 3.00 | 5.00 | 4.3333 | 1.03280 |
| B30 | 6 | 3.00 | 5.00 | 4.3333 | 1.03280 |

| Cronbach's Alpha Based on Standardized Cronbach's N of Items |
|---------------|-------------------|-----|
| Alpha         | .976              | .980| 30  |

Table 6. Reliability Statistic
Table 6 shows the reliability statistic for all items in USE questionnaire. Based on the above table, the Cronbach’s Alpha for 30 items in USE questionnaire are 0.976. Therefore, all the item in the USE questionnaire had good reliability as the coefficient of Cronbach’s Alpha exceeded 0.500. According to [15], the Cronbach’s Alpha is known as the internal consistency of a test or scale which had the value 0 and 1.

Based on the interview session that had been conducted imposed towards multimedia expert that had 5 years’ experience in the multimedia field and possesses a Master or Ph.D. level. Another respondent is a content expert who is the Ministry of Domestic Trade, Co-operatives and Consumerism (KPDNKK)’s officer. This interview session was focused on structured question and guided in which using the method of structured interview. There are five questions of open-ended question that had been imposed towards the 2 respondent.

Question 1 (Q1) regards towards to developed product which is Augmented Reality Mobile Information System (ARMIS) capability to provide the information needed by the consumer effectively. According to KPDNKK’s Officer, the ARMIS system is effective. The basic information in term of weight, expired date, where the product produced, nutrition fact, and price are provided in the virtual overlay image. Therefore, it’s fulfilled the act imposed by the government law. He justified that the information that have completed will not be able to make the consumer get confuse, hence, the manufacturer and retailers have no problem with the KPDNKK sector. Moreover, he said that, whenever using the ARMIS, it enables the consumer to scan and provided all the information needed effectively. Meanwhile, the multimedia expert testified that the product developed was possible to be used.

Question 2 (Q2) is about the ability to learn and understand the interface of Augmented Reality Mobile Information System (ARMIS) easily. According to KPDNKK’s officer, said that the ARMIS system it is quite easy to be learn and understand how to use it. This is because people nowadays had a smartphone and able to install the application. Besides that, the ARMIS system is saving our time consumption as the consumer able to scan and directly got the information of a product. The multimedia expert confirmed that the ARMIS system easy to be used as it is straight forward. Other than that, the ARMIS system also easy to be used as the message able to convey towards the consumer and at the same time able to fulfill the requirement of the act imposed.

Question 3 (Q3) regards towards the information that provided in ARMIS system able to meet the need the of the consumer. The KPDNKK’s officer said that the information provided of the overlay ARMIS had all the criteria that already specified, and the consumer does not need to turn the product upside down to gain the information. But just by scanning using the application, the consumer able to gain all the information needed in one page. Hence, the KPDNKK’s officer stated that; ARMIS’s information provided meet the need of the consumer. As for the multimedia expert stated that the basic information is exactly meet the need of the consumer. This is due to the most of the packaging had nutrition fact and best before or expired date that printed on the packaging already have in ARMIS’s information overlay.

The next question been asked regards to the positive impact that able to give by the ARMIS system to the consumer and retailer in the future in question 4 (Q4). KPDNKK’S officer said that the information provided could not make the consumer confused. This is due to ARMIS system always using the same Quick Response (QR) Code therefore the information would not get adjusted. He added more, that there is different in between using the system and manual method. Therefore, KPDNKK’s officer said that the ARMIS system able to give positive impact towards the retailers and consumer in the future. The multimedia expert also said that, this system able to give positive impact toward the retailers and consumer. This due to the price checker only had at certain points in the hypermarket to gain the information about the product.

Lastly, the question 5 (Q5) is about the recommendation that had been proposed by the respondent in order to improve the ARMIS system application. KPDNKK’s officer proposed that, the color, font, background, and layout makes it more attractive and designs creatively. Besides that, KPDNKK’s officer also suggested that to develop in term of 3D design and play with more color. This is in order
to make it more sophisticated and modern in look. Add a magnifier button as to enable the information could be zoom in. For multimedia experts suggest that, the information of the nutrition fact should be clearer to read. Furthermore, according to the multimedia expert, they suggested that the overlay image of information to be appear right away right after scanned the QR code and no need to double tapped on the overlay twice.

5. Conclusion
Based on the respond of the multimedia experts and content expert, the implication from this product development could be seen in positive ways. Based on the interview with the KPDNKK’s officer, he said that the ARMIS system able to give positive impact towards the retailers and consumer in the future. Multimedia expert also giving the same opinion that the ARMIS system able to give positive impact. Therefore based from both multimedia and content expert response, showed that ARMIS system has the great potential in the future to be market as the product that will substitute the usage of bar code and price checker in the hypermarkets.

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