Faculty of Information and Communication Technology

USER ACCEPTANCE OF MOBILE AUGMENTED REALITY FOR TOURISM BY ADOPTING THE UTAUT MODEL

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DECLARATION

I declare that this thesis entitled “User Acceptance of Mobile Augmented Reality for Tourism by Adopting the UTAUT Model” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……...…….

Name : Low Wei Shang

Date : ……...…….

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Science in Information and Communication Technology.

Signature	:	……..……..
Supervisor Name	:	Dr. Mohd Hafiz Bin Zakaria
Date	:	……..……..

DEDICATION

To my beloved mother and father who has always pushed me to complete my Master's Degree. My Supervisor Dr. Hafiz who have been overwhelmingly supportive throughout my current circumstances. My Wife for always showing off her own Master’s Degree completion to pressure me to finish my studies. Juanna, Stephy, Chin Tatt, and Siew Yun who aided me in this thesis. And lastly, everyone who still believes in me obtaining and finishing my Master’s Degree.

ABSTRACT

Of recent times, Augmented Reality (AR) applications have been seen to be able to execute through numerous seamless channels through our smartphones. However, the problem statement identified in the research shows that Malaysia therefore being a country flooded with mobile devices, still have many users who are unaware of the possibilities of AR and making the technology being limited among the mobile users here. That is why the objectives of this research will be to investigate a user's acceptance of AR technology using the Unified Theory of Acceptance and Use of Technology (UTAUT) model in Malaysia. From here, the research can identify relevant acceptance rate of AR technology, which can then be used to gather and analyse data for this research. The final objective will then be targeted to validate the analysed acceptance rate based on UTAUT. The research is targeted to develop and construct an AR application through a mobile phone which is able to merge 3D AR models of historical monuments. These historical monuments are then identified to be within UNESCO World Heritage Site of Malacca. Such mobile application will enable fellow tourists to be able to get multiple data and information via the monuments from the 3D object models which will be constructed and displayed via AR. The AR models are believed to be able to give tourists an alternative method to visit or view the actual monuments which can enable the prevention of overcrowding effect while at the mean time enforces heritage preservation. Using fellow tourists in Melaka as respondents, the researcher can determine user's acceptance of the mobile applications in AR based on the methodologies of UTAUT. The main UTAUT methodology used here for the research contains constructs which has been finalized. These includes Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC), and Perceived Playfulness (PP) which are then used as determinants of a user's Behavioral Intention (BI). Through numerous testing and analysis, user's acceptance for the AR application was tested and affirmed. Finally, it was found that the coefficient table confirms PE, FC and PP to have a positive significant effect to the model while EE was insignificant. This is due to the high ownership of smartphone device adoption of late therefore allowing users to have minimal effort to use the AR application.

ABSTRAK

Sejak kebelakangan ini, aplikasi realiti berperantara (Augmented Reality -AR) didapati mampu dilaksanakan secara lancar melalui telefon pintar. Namun demikian, permasalahan kajian yang dikenal pasti dalam kajian ini menunjukkan bahawa, penggunaan waktu sebenar AR memerlukan keperluan teknologi khas, khususnya untuk AR digunakan dalam telefon pintar. Walaupun Malaysia ialah negara yang banyak menggunakan alat peranti mudah alih, namun masih terdapat banyak pengguna yang tidak menyedari kemungkinan dalam AR, lalu menyebabkan penggunaan teknologi yang terhad dalam kalangan pengguna telefon pintar. Oleh itu, kajian ini memberikan tumpuan terhadap penerimaan teknologi AR dalam kalangan pengguna berdasarkan model Unified Theory of Acceptance and Use of Technology (UTAUT) di Malaysia. Daripadanya, pengkaji dapat mengenal pasti kadar penerimaan teknologi AR berkaitan, yang dijadikan data untuk dianalisis dalam kajian ini. Objektif terakhir kajian ini ialah untuk mengesahkan kadar penerimaan berdasarkan UTAUT. Kajian ini disasarkan untuk mengembang dan membina aplikasi AR melalui telefon bimbit, yang dapat menggabungkan 3D (tiga dimensi) AR terhadap monumen bersejarah. Monumen bersejarah yang dikenal pasti ialah di Melaka, iaitu Tapak Warisan Sedunia UNESCO. Aplikasi telefon bimbit sedemikian akan membolehkan pelancong mencapai pelbagai data dan maklumat melalui monumen dalam bentuk model objek 3D, yang dibina dan dipaparkan melalui AR. Model AR ini membekalkan kaedah alternatif untuk pelancong melawat atau melihat monumen sebenarnya, justeru mengelakkan kesan kesesakan, dan pada masa yang sama menguatkuasakan pemeliharaan warisan. Dengan menggunakan pelancong di Melaka sebagai responden, pengkaji dapat menentukan penerimaan pengguna terhadap aplikasi AR dalam telefon bimbit mereka. Antara kontruks muktamad yang dimasukkan dalam kajian ini ialah Performance Expectancy (PE), Effort Expectancy (EE), Facilitating Conditions (FC) dan Perceived Playfulness (PP), yang akan digunakan sebagai penentu Behavioral Intention (BI) untuk pengguna. Melalui beberapa uji kaji dan analisis, penerimaan pengguna terhadap aplikasi AR telah diuji dan disahkan. Akhir sekali, jadual pekali (coefficient table) mengesahkan bahawa PE, FC and PP mempunyai kesan positif yang signifikan terhadap model yang digunakan, namun EE tidak mempunyai signifikan. Hal ini disebabkan pemilikan yang tinggi terhadap penggunaan telefon pintar baru-baru ini, yang menyebabkan pengguna memiliki usaha yang minimum untuk menggunakan peranti ini.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

AR	-	Augmented Reality
SDK	-	Software Development Kit
SVM	-	Support Vector Machine
VR	-	Virtual Reality

LIST OF PUBLICATIONS

1) Shang, L. W., Siang, T. G., Zakaria, M. H. B., and Emran, M. H. 2017. Mobile Augmented Reality Applications for Heritage Preservation in UNESCO World Heritage Sites through Adopting the UTAUT Model. *AIP Conference Proceedings,* 1830, pp. 1-5.

2) Shang, L. W., Siang, T. G., and Zakaria M. H. B., 2017. Gauging User's Acceptance of AR Mobile Application with AR Postcards for Heritage Education in the UNESCO World Heritage City of Melaka: Adapting the UTAUT Model. *Proceedings of Innovative Research and Industrial Dialogue,* 1, pp. 43-44.

3) Shang, L. W., Zakaria, M. H., and Ahmad, I., 2016. Mobile Phone Augmented Reality Postcard. *Journal of Telecommunication, Electronic and Computer Engineering*, 8(2), pp. 135–139.

CHAPTER 1

INTRODUCTION

1.1 Background of study

On much recent times, alternatives of obtaining information have grown to multiple platforms. Due to the advancement of computer graphics and also interactive techniques has greatly increased the capability and visual quality of Augmented Reality (AR) applications. AR has been implemented in many fields across the world, namely in various forms of the education sector, geographical information systems, and also in the tourism sector. There are various developments conducted using AR in the field of education, however it is still relatively new in the Tourism Sector (Yu D et al., 2010).

Even till this date, information is barely being used by electronic guides, which makes it unreachable for tourists and visitors alike. Existing multimedia presentations are also far away from the real environment which means that tourists needs to leave the tourist site to actually gain additional information regarding the places that they visit (F.Fritz, 2005). If the tourism body wants to reach a wider range of audiences, they would need to construct attractive multimedia content which can actually gain the attention of tourists. That is why it is believed with AR, this means of conveying information in an attractive way can be done.

A couple of studies involving tourism and AR have been conducted in countries like Spain, Taiwan, Japan and etc. However, the usage of AR technology in Malaysia is still relatively new having no relatable research or data for support. Therefore, the adoption

of the Unified Theory of Acceptance and Use of Technology (UTAUT) model is being used to conduct the effectiveness of adopting AR technology in Tourism.

UTAUT is a technological acceptance model formulated by Venkatesh and others in “User acceptance of information technology: Towards a unified view” (Venkatesh et al, 2003). The UTAUT is a model which aims to describe and explain a user’s intention in using an information system and its subsequent usage behaviour. UTAUT also gained subsequent validation where in a longitudinal study, it was proven that an impressive 70% of the variance in Behavioural intention to use (BI) and about 50% in actual use (Holden et al, 2010). Apart from that, UTAUT was also used in various notable research like the one conducted by Koivumaki et al.’s study in northern Finland towards mobile services and technology, Kroenung et.al.’s study in Germany towards IT adoption in companies, Curtis et al.’s study in social media in public relations, and Verhoeven et al’s study of computer usage for university freshmen’s in Belgium.

Therefore, a research will be conducted through the adoption of the UTAUT model in order to identify collect data regarding the impacts and effects of AR technology in Malaysia by focusing on the tourism sector as a case study. The choice of choosing the tourism sector will be explained in detail at section 1.4.

1.2 Problem statement

AR as a concept has existed even way back in the 1960’s, and it is only over the last two decades that technological advances around the world actually made it possible for the formulation of proper research in the field of AR (Kounavis et al, 2012). Therefore, AR is slowly gaining momentum with recent developments of the technology’s usage around the world.

However, real time usage of AR requires specific technological requirements, especially for AR to be used in mobile applications. All AR mobile platforms now require the usage of web servers for the hosting of data, databases and also the usage of AR tags for points of interests in the case of tag recognition in the tourism industry (Kounavis et al, 2012). Apart from all this, the main issue faced is for users to actually have a capable mobile device that is able to process the AR technology found within the mobile application. AR applications that utilize a user's location would actually require the mobile phone to be powered by a GPS system and also an accurate gyroscope instrument. That is why without a capable mobile device, the usage of AR is extremely limited to the public.

This problem however can be solved through the recent rise of product purchasing power of Malaysians. Through the article "Nation of Smartphone Addicts", According to various statistics located from MCMC and other industry surveys, there are at least 10 million smart phone users in this country of Malaysia alone. (themalaymail.com, 2014)

Another survey from the TNS/Google Global Connected Consumer Survey 2014 showed to us that 1 in 2 Malaysian owns a smartphone. The survey was seen to include 150,000 interviewees across 56 countries around the world including Malaysia. (http://www.skmm.gov.my, 2014)

However, being a country flooded with mobile devices, the existence of alternative technologies like AR is still very limited among the mobile users here. Through a pilot questionnaire conducted with 50 people, it was found that the term AR is still relatively new and unknown among the locals of the country.

Therefore, the main research problem which has been identified would be "With AR Technology still being relatively new in Malaysia, would tourists accept the technology to enhance their tourist experience"? This will then lead to an investigation through adopting the UTAUT model.

1.3 Research question

Even though AR has been around for quite some time, Malaysians are still very vague or do not even know the existence of this technology. During a simple verbal survey of 30 respondents without a background in IT, all 30 of them said they do not know what is AR. Therefore, the proposed research question would be: “With AR Technology still being relatively new in Malaysia, would tourists accept the technology to enhance their tourist experience”?

This will therefore bring out questions on how do we identify the relevant questions for data tabulation at the end of the thesis where it is believed we can understand the psychological behaviour of our users and also the necessary models needed to achieve the desired results by testing user acceptance with AR technology.

1.4 Objective

The objectives of this research are as follows:

a) To investigate a user’s acceptance of AR technology using the UTAUT model in Malaysia.

b) To validate the acceptance rate and analyze the shortcomings of AR technology in Malaysia.

1.5 Hypothesis

Based on the understanding and information gathered from the current findings, the theorized hypothesis will be shown as below. A total of 4 hypotheses was formed for this research.

H1: Perceived usefulness significantly affects the behavioural intention to use an AR application for tourism.

H2: Perceived ease of use significantly affects the behavioural intention to use the AR technological application.

H3: Facilitating conditions significantly affects the behavioural intention to use a mobile AR technological application for tourism.

H4: Playfulness expectancy significantly affects the behavioural intention to use the AR technological combo application.

1.6 Scope

This research focuses on identifying the acceptance of AR technology in Malaysia. To determine the viability of the technology's usage, a field will be chosen for the implementation of AR technology.

The chosen field for this research is the tourism sector where the main focus group would be tourists. The tourism sector was chosen as the scope of research due to several advantages factors.

The first would be due to the ease of obtaining diversified respondents in the field of tourism. By conducting this research, various respondents from all corners of Malaysia is needed, and the best way to reach out to these people of different states would be through visiting tourist sites at peak hours. This not only allows data to be obtained from people of various states, but also people of various races, genders, and ages.

Secondly, the field of tourism has also been actively researched by researches from overseas. A few of the research contains implementing AR into tourism. This is because AR has a vast potential in the tourism sector by allowing historical monuments or landmarks to have an interesting multimedia twist for information display.

Therefore, the chosen location in conducting this research would be at the famous Jonker Street located in the heart of Melaka where thousands of tourist swarm into the area during weekends and public holidays.

1.7 Thesis organization

This thesis is organized into five chapters. Chapter one introduction, chapter two reviews the literature related to Augmented Reality and also the Unified Theory of Acceptance and Use of Technology, chapter three describes the methodological aspects used for this research, chapter four presents the results obtained through the usage of UTAUT, and will focus on the discussion and data analysis of this research while the final chapter provides conclusions, and recommendations for future research. Breakdowns of these chapters can be seen at the end with Figure 1.1.

Chapter 1 contains a compilation of various findings relating to the potential growth of the tourism sector has been compiled and proven within this chapter. A gap of requiring technology to enhance tourism experience has been identified.

Chapter 2 heavily and critically evaluates the extensive reviews on the literatures, covering subtopics that involve the usage of Augmented Reality, applications of AR educationally, applications of AR in the tourism sector, the evolution and also theories of

user's acceptance of IT products primarily focusing on the UTAUT model. This chapter therefore then discusses the proposed determinants of user's Behavioural Intention through the AR technological application and also the formulation of hypotheses.

Chapter 3 provides explanation on two different phases which will be done in this research project with each phase focusing on numerous aspects of this research. The 1st phase will provide a discussion on how UTAUT will be used to implement the data gathering session while the 2nd phase will break down the process of constructing an

application which will be tested for the pilot study and also the main study for this research.

Chapter 4 will be having discussions regarding the development and implementation process of the research. The application will have discussions on whether it's development was able to garner the targeted objective as proclaimed in the introduction which states the usage of a 3D Historical monument with educational information was successfully implemented via the Android Platform. The application will also then be proven on whether it works efficiently through several processes of application validation which has been done to assure suitable algorithms are selected. Methods used to determine the analytical data through UTAUT constructs will be used effectively in an appropriate manner. The findings in this chapter will be used for implications for the developers and managers of the application, the managerial implications for heritage properties and also makers of the policy for tourism activities.

Chapter 5 will then finally wrap things up with the combination of all development methods and analytical analysis that can therefore prove the objective of the research proposed in Chapter 1. User's acceptance for the AR application will be tested and re-affirmed through this chapter that will conclude the research in a whole. A summarized Figure 1.1 is formed for a brief overview of the 5 chapters in total.