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SmartG: Spontaneous Malaysian Augmented Reality Tourist Guide

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Abstract. In effort to attract higher tourist expenditure along with higher tourist arrivals, this paper proposes a travel application called the SmartG, acronym for Spontaneous Malaysian Augmented Reality Tourist Guide, which operates by making recommendations to user based on the travel objective and individual budget constraints. The applications relies on augmented reality technology, whereby a three dimensional model is presented to the user based on input from real world environment. User testing returned a favorable feedback on the concept of using augmented reality in promoting Malaysian tourism.

1. Introduction

According to the Economic Transformation Programme (ETP), Malaysia occupies a strong position in global tourism after being ranked as the top 10 in arrivals and top 15 in global receipts [1]. The tourism industry generated a gross national income (GNI) of RM36.9 billion in the year 2009, thus making the tourism as the fifth largest industry in the Malaysian economy. Malaysia is also the 9th most visited country in the world with RM1 billion receipts per week from foreign visitors. It is no surprise that the tourism sector will continue to be in the forefront of Malaysia's economic development, hence the need to innovate the tourism industry in promoting various fascinating tourist destinations. Recognizing the potential of the tourism industry, Malaysia has set sight on the target of year 2020, which is to receive an estimated of 36 million tourist arrivals and RM168 billion tourist receipts. This means the industry will grow by three times, therefore is capable to contribute RM3 billion receipts per week to the country by the year 2020.

From the Economic Transformation Programme Handbook [1], Malaysia's growth in tourism is predominantly reliant on growth of arrivals rather than yield as shown in Figure 1. Tourist arrival in Malaysia is high but the yield per tourist arrivals is lower as compared to the neighbouring countries such as Singapore and Thailand. From the figure, 75 percent of Malaysia's growth has been due to the increase of tourist arrivals compared to only 25 percent growth from tourist expenditure. Meanwhile, figure 2 visualizes the expenditure of marketing and the return on tourist arrivals by comparing top competitor to Malaysian tourism industry.

As shown in the figure, Australia has the highest marketing as well as highest return on marketing spending. Benchmarking Australian tourism in marketing, the Australian tourism is concerned about megatrends of customers. One of the main mega trends that Australian tourism

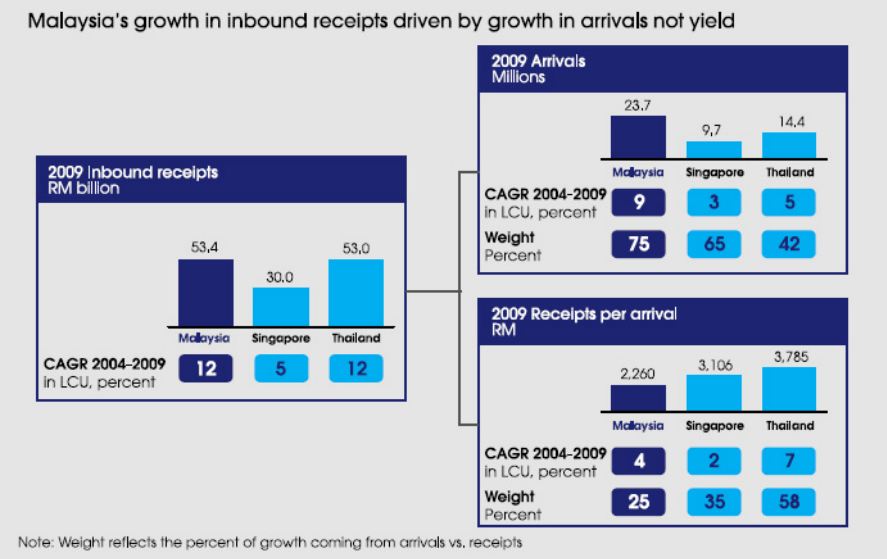

Figure 1. Malaysia today: High arrivals, low yield

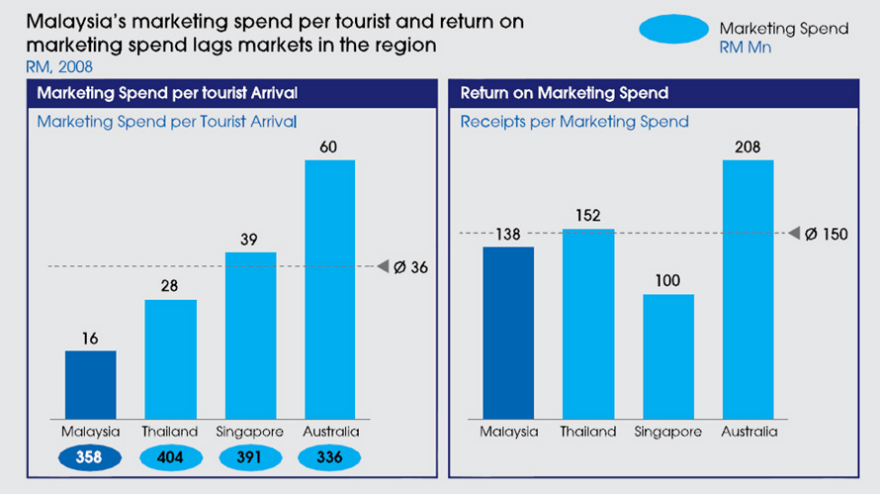

Figure 2. Malaysia tourists: Receipts vs. arrival

is increased information technology intensity in tourism marketing. Australian tourism focuses on online marketing where resources are provided online to assist in supplying integrated service to customers. The key to Australia's success in their tourism industry is by identifying the type of technologies that provide the marketing edge in boosting the tourism productivity. Hence, the Malaysian government must strategize to attract higher tourist expenditure by improving tourist offerings and services, as well as enhancing connectivity to key priority markets.

In order to supplement the growth of this industry in terms of marketing Malaysian tourism to the world, an intelligent travel planning application is necessary. To date, most of the holiday planning applications asks for the dates, location, theme and accommodation budget range but much of the decisions should be recommended rather than chosen by the users. This paper proposes a travel application called the SmartG, acronym for Spontaneous Malaysian Augmented Reality Tourist Guide, which is able to suggest users via automated decision making by determining the average budget covering accommodation, food and beverages, activities,

transport, shopping item and the key purposes of the visit to satisfy the end users.

SmartG is expected to solve the problem of high arrivals and low yield by promoting the tourist with the best-suited destination by considering their budget and preferred destination location of the tourist. For example, how to maximize yield from a foreign tourist who plans to purchase handcraft souvenirs when he or she is already travelling in a small budget. One possible solution is to promote handcrafts outside Kuala Lumpur such as Terengganu and Kelantan to compensate the costs but at the same time still achieving the objective. In this example, the SMART-G application learns the user's budget and his objective, and then makes recommendations to Kelantan state as the best destination to achieve the stated objective within the spending limit specified. This also will also increase the satisfaction among the uses as the recommendations allow them to spend more rather than dropping their idea to purchase handcrafts in KL due to expensive price tags.

The remainder of this paper proceeds as follows. Section 2 reviews current scenario on travel applications. Section 3 presents the proposed SmartG 3D augmented reality application. Section 4 presents the evaluations and finally Section 5 concludes the project with some indications for future plans.

2. Related work

The Internet technology does not only offer dynamic options for travellers, but also leads the tourism industry to build "homes" on the Internet in order to market their services [2]. In the current world scenario, tourism websites play the main role in people's traveling decision-making before they plan for holiday. However, while the depth and scope of tourism website services have expanded, the usability of these websites remains a problem. [2] indicated poor usability, weak functions, inaccessibility, hard-to-use content and few cross-cultural considerations that needs to be improved. Such problems lead to frustrating experience in planning a trip on the web [3, 4].

In order to counter the shortcomings in web-based travel planning, one important aspect of tourism must be explored and promoted, which is the "experience-oriented tourism marketing" [5]. Experience-oriented tourism marketing emphasizes on activity, events, and fantastic or exotic experiences as well as functions such as virtual tour, gallery, or interactive map. Such experiences help potential tourists to develop expectations about what they can experience at the destination. If the tourist organizations would like to reach wider audiences, they would have to build attractive multimedia content that attracts tourists. In order to provide a virtual experience, interactivity and multimedia would be the key factors, which include the richness of sensory information and the interactivity between human and virtual environment [6]. A virtual tour can enhance the memory of destination and further help users to form more vivid and clear destination image. This means, the tourists will experience a more realistic approach in choosing their destination due to more experiential information acquired when choosing a place for a holiday.

One innovative approach to provide experience-oriented tourism is by using Augmented Reality (AR). Adopting augmented reality is one way to provide more natural and intuitive interfaces for the interaction with computational systems [7]. In research by [8], the AR technology is selected for the reason of providing an opportunity for tourist to have high sense of reality by augmenting virtual data on the real environment. Unlike virtual reality, augmented reality only manipulates a part from the entire environment. Thus, implementation of augmented reality is very feasible in terms of cost and content creation. As the result of implementing augmented reality, Madsen and Lal [9] justified that AR has the potential to become truly widespread customer attraction, which is very important in marketing Malaysian tourism to target wider market scale and increasing productivity through the proposed application of SmartG.

At the Institute of Architecture and Media at Graz Technical University, Augmented Tourism [11] explored the ad-hoc possibilities offered by new media and state-of-the-art technology, as well as offers potential tourists an interactive method to fiddle with a range of parameters for selecting their future travel destination. The information provided by augmented reality application is completely multimedia, including texts, 2D pictures (maps, old photographs), movie clips and even 3D models of existing and non-existing tourist attractions [12]. In augmented tourism, the purpose is to explore the ad hoc possibilities extracted by new media and state of art technology and provide potential tourists and interactive way to select their future travel destination. Three dimensional of Austrian region of Styria is predefined on marker which will be virtually being augmented by layers of data. The Vicon tracking system, two projectors and a standard camera enable the interactivity with the tourist to select the regions and get to know the available activities and facilities in the particular destination as shown in Figure 3.

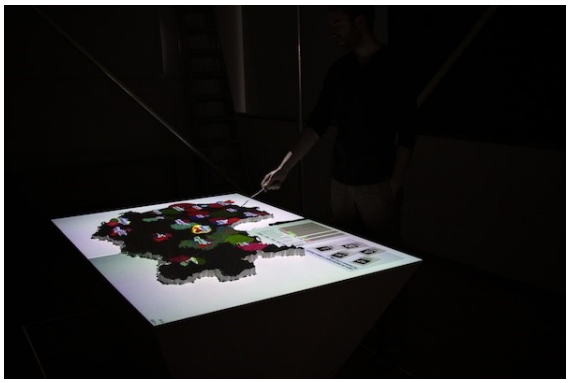

Figure 3. Ready to Roll! (`http://nielswouters.be/ready-to-roll/`)

However, augmented tourism is expensive to develop due to equipment needed and system set up, which is shown in Figure 4. Realizing the current customer expectation to be cost effective with the concept of minimalism, this research reduce the complexity of AR application by proposing SmartG, which is developed using a standard PC with a standard webcam.

Figure 4. Table Update: Vicon (`http://nielswouters.be/tafel-update-vicon/`)

Another AR-based application in tourism is the Valencia tourism, which promotes attractive destinations in Valencia City as shown in Figure 5. Their AR application works when the user

download and print the predefined pattern on the webpage and view to webcam to visualize 3D on the particular code. There are four main specific patterns available to download and to output four different three dimensional augmentations such as major events, natural area, and Mediterranean lifestyle, monumental and architectural in Valencia City. However although this application provides the chance to the user in viewing three dimensional element of the city, the website is lacking in recommendation capabilities to replace a tourism counsellor in suggesting the best place that suits a tourist according to their expectation.

Figure 5. Extra Valencia: Augmented reality in tourism (`http://extravalencia.com/2010/04/13/augmented-reality-in-tourism/`)

3. SmartG 3D augmented reality

The main objective of the SmartG 3D augmented reality application is to develop an intelligent system that is able to help users or travellers to make advanced decisions on their holiday. In SmartG, the user needs to answer a few questions which are based on the criteria that they expected for their holiday. Once the information needed by the application has been fulfilled, SmartG will propose the best destination for the user to visit by taking account their travel objectives (i.e. shopping or dining) as well as their travelling budget. SmartG then provides a two-dimensional image as output of the destination as suggested by the application.

However, a 2D visual representation is common to existing applications, whereby images of the destination will be presented to users along with textual descriptions. SmartG adds the concept of augmented reality to the application in order to improve the entire interactivity by adding three dimensional models. After the users answers the questions, the application prompts to print the marker and opens the webcam. When the users shows the printed marker towards the camera, the system will detect the specified marker and the three dimensional model will appear on the marker in real world environment. The three dimensional model is basically a simplified model of destination as suggested by the application. A customized marker relevant to the Malaysian Tourism is shown in Figure 6.

This research decided to use only one pattern or marker for the entire application for one time marker printing. This also helps users because printing is only required once and the marker is reusable. In order to create a marker, the application used a proper measurement of 80x80mm for optimum detection. The software used was the marker builder API that converts from bitmap format to .PATT format, and later converts to the .PAT format that reads pattern in 16bit format. This marker can also be detected if the image is saved in any colour screen phone without printing it in paper. Once the application recognizes the pattern as well as the movement track with the transformation matrix, the application will then apply the final transformation and project the mesh which is the 3D model in the real world environment based

on real-time calculation of matrix transformation from user actions. The application also added augmented reality video functionality for tour video but only limited to specific locations.

Figure 6. SmartG augmented reality marker (national flower the Hibiscus)

The 3D augmented reality has two major tasks, 3D modelling and implementation of the 3D model into augmented reality functions. A 3D modelling software called 3DS max was used. The software needs high capacity of graphics and memory hardware to develop. Figure 7 shows the 3D model view of the Kuala Lumpur City Center area in Malaysia while Figure 8 shows the 3d model view of the Langkawi island in Kedah, Malaysia.

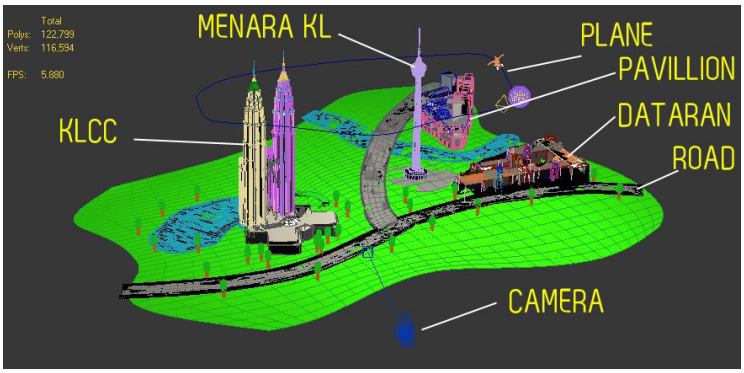

Figure 7. KL city 3D model view in 3DS max software

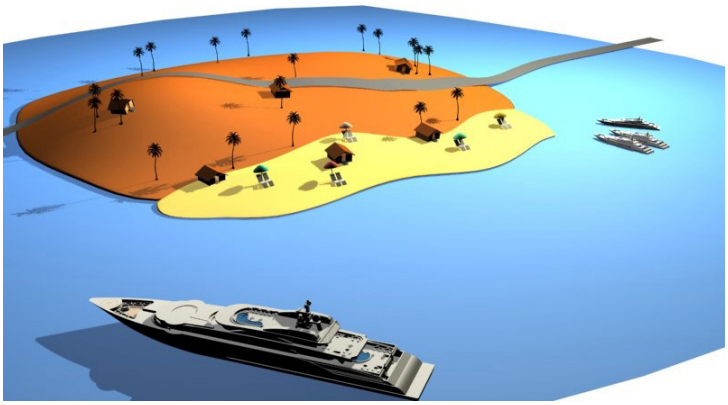

Figure 8. Langkawi Island 3D model after rendering in 3DS max software

Implementation of augmented reality also brought up a lot of challenge in terms of library compatibility across several platforms. There is sequential support transfer of compatibility library throughout the platform to process the 3D model appears on the real world environment through computer monitor as shown in Figure 9.

Figure 9. Support across libraries and platform in identifying 3D model

The main concept of augmented reality is pattern matching through the camera capture via webcam access. This functionality is achieved by developer using SLAR library for the purpose of scanning the pattern occurrence in every frame and calculates the transformation to projects back the 3D on the proper projection plane which is on the detected pattern. As shown in the figure, in order to achieve augmented reality functionality, C# language needs a Silverlight 4 platform that supports SLAR library that responsible for marker detection and also projection followed by BALDER a gaming engine that able to recognise 3D model and responsible for 3D rendering on real time.

4. Evaluation

User testing was carried out by distributing questionnaires to respondents with demographic information as shown in Figure 10 to cover different level of society groups.Testing or evaluation is one of the important phases in the methodology. The main reason of doing system evaluation is to measure user satisfactory in quality measure and also system functionality to measure system performance and response. In order to evaluate both user satisfactory and system functionality, researcher has done user testing. User testing to retrieve user feedback about the system from several perspective in meeting customer requirement retrieved in primary research and also meeting the objective of this research. User testing to five different categories to make sure this system is accepted by all group or level of society. The purpose of questions is to identify the group of society the participants belongs to. The main the reason is to know the profile of the participant is to identify the acceptance of the user in different level of society. To measure of SMART-G in satisfying any user in any level of society group.

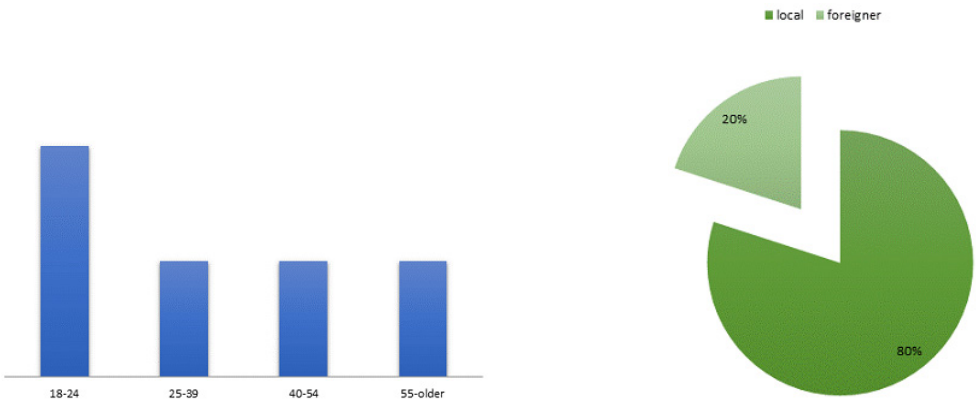

Figure 10. Age distribution of respondents and their nationalities.

The responses from respondents showed that the design and consistency of SmartG achieved 100% satisfaction from users across various groups. As shown in Figure 11, 90% of the

respondents have given the highest rating of 5 for easy navigation while the remaining 10% respondents rated 4. In terms of interactivity, 90% of the respondents rated 5 while 10% of then rated 4. The SmartG application has also achieved 100% user understanding of the application that proved the application reponded within the expectation of the respondents. Finally, 80% of respondents rated 5 of augmented reality implementation while the remaining 20% rated 4, which shows a positive feedback towards the augmented reality technology in promoting the Malaysian tourism.The success of the proposed system evaluated according to the researchers implementation by emerging tourism in web based system consisting multimedia features and integrated implementation of augmented reality by merging 3D virtual world and real world. Evaluation process also needs testing to ensure the quality of the end product. Quality assurance is mainly to ensure that the proposed system meets the user requirement.

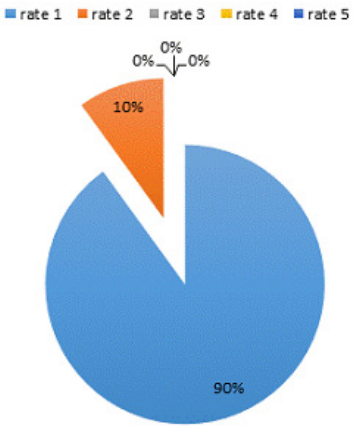

Figure 11. Responses on navigation.

5. Conclusions

The Malaysian Economic Transformation Programme focuses on increasing revenue growth in the tourism industry as well as improving capacity for competing in the global market. In line with this effort, this research proposed a unique marketing strategy, which combines an intelligent decision making system that satisfies budget constraints while at the same time attempts to achieve purpose, activity, and accommodation objective through the use of augmented reality. The research was benchmarked against the Australian tourism industry, which was ranked first in global tourism industry. The questionnaire results showed good responses from the users due to AI-driven marketing approach embedded in the SmartG application. The only limitation faced by the application is preparing for the travel budgeting based on specific geographical areas that needs a lot of time in order to obtain unbiased information.

The application was developed using C sharp programming platform with .Net framework, which is flexible enough to combine both decision making system and the augmented reality technology. The Silverlight platform enabled best user interface to attract tourist with features like audio, video, and colourful themes. In order to support the marketing activities, this research created a Facebook fan page for the application to get attraction directly from the source of larger community through the concept of social media marketing. In the future, the research intends to explore the QR code, which is popular marketing tool for smartphone users so as to promote the application within their social circle such as friends and family.

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