

Utilization of Automated Virtual Panoramic Environment in Online Public Accommodation Booking System

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Abstract—Nowadays, reservation of an accommodation such as hotels and resorts can be made via online booking system. It enables user to search and book any room from any nearby accommodation instantly via browser. However, users cannot visualize accommodation surroundings as the searching result is currently presented in a list view that consists of text and picture. Although some online booking systems offer virtual tour using panoramic view with hotspots of the hotels or resorts, still the hotspots are static and not meant for availability search. This is due to the difficulties in the process of creating and managing a Virtual Panoramic Environment (VPE) where in turn; the systems shortcomings have prevented the users from immersing themselves into the environment. This research proposed a model of Online Public Accommodation Booking System using Virtual Panoramic Environment (OPABS-VPE) that support virtual tour environment for online accommodations reservation. The model is aimed for accommodations' owner to easily upload updated accommodation details and automatically viewed in accommodation availability searching result through a dynamic virtual tour environment.

Index Terms—Virtual Reality: Image-Based Approach; Virtual Panoramic Environment.

I. INTRODUCTION

Virtual Reality (VR) is a compelling technology which aims to mimic real world by computer-generated environment and engage all the senses of people. By kinds of advanced human-computer interfaces and emulation systems, a brand-new virtual world is maturing day by day with various applications, such as digital heritage, training simulation, digital carving and virtual concert and so on. Compared with traditional graphic research, virtual reality technology emphasizes on the interaction between user and system. For example, a user could enter and experience the digital environment in real-time, feeling like being there actually.

There are three approaches to realize the tour in the virtual world: (i) convert the entire real environment into electronic models with 3D modeling toolkit; (ii) stitch the photographs of actualities into a picture of virtual environment. The virtual tour to Carnegie Mellon University (CMU) [1] is a successful example of this type; (iii) setup the scene by 3D models combined with photograph conjoining (the hybrid of the two approaches above). An example application of this approach is the Virtual Sagalassos Guide system by Van Wyk [2].

Based on current research, stitching photographs to construct the virtual environment are most suitable in

generating dynamic virtual environment. This is due to the implementation of online public accommodation booking system that requires dynamic update of still photo from accommodations' owner to be automatically converted into virtual environment. Nowadays, online accommodation booking system becomes important in the online tourism sector [3]. The most important criteria must include in the online booking system are the pictures, location, users' interaction and highest usability of the systems. Based on the survey, the Virtual Reality Panoramic (VRP) technique has not been widely used in the online business especially for online accommodation booking system [15].

Regarding user interaction on online accommodation booking system, searching function with the use of panoramic view is still unexplored [12,13]. The searching queries of accommodation availability are currently presented in text and photo only that arranged using list view. Thus, it has limited the user to visualize and immerse them into the environment that will help them to choose most appealed accommodation with most attractive surrounding places. In realizing the searching result into virtual tour environment, dynamic hotspots which reflect to the specific searching criteria need to be designed.

The main challenge in developing such dynamic virtual tour online booking system is the difficulty in maintaining the dynamic information posted by accommodations' owners. All raw photos and text information need to be automatically sorted and converted into virtual public accommodation panoramic environment. Thus, Online Public Accommodation Booking System using Virtual Panoramic Environment (OPABS-VPE) model is proposed to ease the implementation. It helps accommodation's owners to post personal panoramic accommodation image to be appeared in the online public accommodation booking system with virtual tour capabilities. The paper also describes the tool implemented to support the application.

This paper is structured as follows. In the next section, related works on virtual panoramic environment are presented. Section 3 describes the proposed model. Then, section 4 presents the implementation results and discussion. This paper ends with a conclusion.

II. VIRTUAL PANORAMIC ENVIRONMENT

VR technology mainly involves with user interactions and computer simulation. Such interaction comprises visualize, manipulate and interact whereas the computer simulation gives the feedback to the users with the immersive feeling.

There are three types of VR modeling approaches that have been classified as Geometric-Based Model (GBM), Image-Based Model (IBM) and Hybrid-Based Model (HBM) [4]. The GBM is a traditional approach that has been developed by Liarokapis [5]. Meanwhile, IBM model is a conventional approach that uses resources from original image whereas the HBM approached is based on a combination of GBM and IBM. IBM approach is the fastest rendering process compared to the other two. It manipulates current images to be automated rendered in producing virtual environment [6]. IBM is described as one of the alternatives of traditional VR. It has the advantage of presenting the presence of panorama with image calibration [7]. Some application have been developed based on IBM by using the actual images taken from the real environment by using camera as a reference [8][9][6].

Virtual Panoramic Environment (VPE) also known as Virtual Reality Panoramic (VRP). It is a technique that have been categorized under the IBM approach in VR technology [11][12]. VPE is a new method in computer graphics and virtual reality [13][14]. VPE is one of the VR technology used to develop virtual environments adapted from actual sceneries [13][20]. VPE capability allows users to see the surrounding environment in the form of a regenerated view using the original image, and let the user to select the view you want to see [15]. According to Xiao [11], VPE allows users to see, navigate and manipulate as well as enabling access control in a virtual environment. User can immerse themselves which can let users to explore more with the virtual environment like a real world. It can show a virtual environment that allows users to see the environment and objects in 360 degrees either from left to right or from top to bottom.

According to Fleishman [6] the panoramic images are more appropriate to be used in virtual environment. Panoramic image is the result of a combination of several images [17]. To get the combination of panoramic images, stitching process must be done on individual images. The process is carried out by incorporating multiple images with overlapping fields of view (FOV) either vertically or horizontally [4][10][17]. Panoramic image consists of four types; horizontal, cylinder, cube and sphere [18]. Matthew [16] has proposed a novel formula for fully automatic panorama stitching by using the invariant local features and a probabilistic model to verify image matches. This allows them recognize multiple panoramas in unordered image sets, and stitch them fully automatically without user input. There are also several tools for stitching in developing panoramic image such as Adobe Photoshop, Panoweaver 8, VR Worx 2.5, PTGui and so on. However, all of these tools required specific skill in manually stitching the images for a panoramic image.

Panoramic images can be interacted using virtual tour. The tour is quiet similar to Google maps but different in its own way. This virtual tour can be used on many viewing application such as accommodations, museums, tourist locations and the list goes on and on. The best feature about this virtual tour is that user can get inside the panoramic image and immerse themselves to see a surrounding images. It offers much better technique of viewing images rather than just looking at static pictures using slideshow.

Instead of having techniques, there is still a challenge in using the technique towards managing dynamic VPE information especially in online accommodation system.

The information consists of text and images that are continuously need to be update from time to time by the accommodation's owners. Based on observation of existing popular public accommodation booking system such as agoda.com, tripadvisor.com, booking.com, wotif.com, safarinow.com, expedia.com, travelocitA.com, venere.com, hotels.com, and tiscovcr.com, none of these are utilizing the VPE in their online system. The difficulties in managing the dynamic information in accommodation online system become a motivation to conduct this research.

III. MODEL OF OPABS-VPE

Managing different accommodations booking system requires certain compliance standard for all accommodations' owner. Usually accommodation information is managed dynamically by accommodations' owner themselves through self-updating of text, picture, video or audio into the system. However, virtual panoramic environment is not easily embedded into public accommodation booking system except for private website linkages. Our integrated model aims to automatically integrate individual updates of Virtual Panoramic Environment materials in generating public online VPE accommodation booking system. The model called OPABS-VPE will provide automatic stitching technique by using image based model and dynamic virtual panoramic environment.

Online accommodation booking system mainly used by users in four main functions; searching availability, booking room, survey accommodation details and explore nearby attractions or facilities. In order to take advantages of virtual panoramic environment into the system, all these main functions must be implemented using virtual tour and panoramic components. Figure 1 shows the model of OPABS-VPE. The details of the model and functionalities are described in the following subtopic.

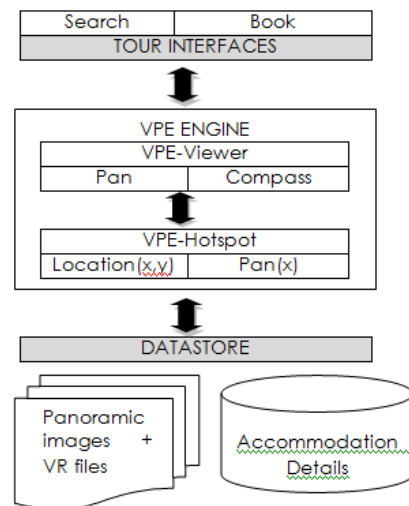


Figure 1: Model of OPABS-VPE

A. Virtual Tour Engines

VPE- Viewer: In order panoramic image to be rendered in virtual tour environment, an engine must be designed to handle the process. JsphereLite applet is one of open source online virtual tour engine that can be used to automatically render panoramic image files provided by accommodation's owners. This image files represent the accommodation

environment such as room setting, lobby view or surroundings sceneries. Using the applet, current pan value can be extracted for supporting the virtual tour with other external viewing direction usually shown in a compass. The pan value is represented in integer range from -180 to 180 as shown in Figure 2.

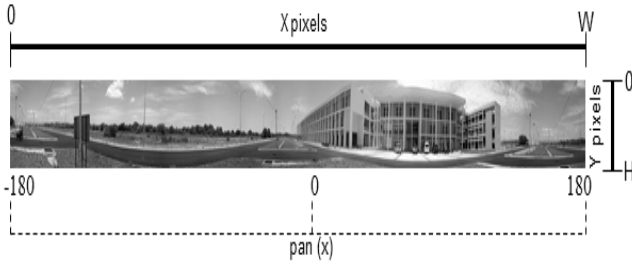


Figure 2: Pan value of panoramic image

Compass can be used in notifying users of current angle of the panoramic image view. The angle usually represented in degree (d) which can be taken through JsphereLite pan (x) value using following conversion equation:

$$\begin{aligned} d &= \{x \mid x \in \mathbb{Z}^*\} \text{ or} \\ d &= \{180 - x \mid x \in \mathbb{Z}^-\} \end{aligned} \quad (1)$$

VPE-Hotspot: Hotspot is a hyperlink text shown in the panoramic image enabling user to enter on specific accommodation page for booking rooms or gaining more information. Searching room availability on certain criteria in panoramic map image requires accommodation hotspots to be dynamically shown based on the queried result. In achieving this, each accommodation location must be located in the panoramic map image using X,Y coordinates.

From Figure 2, X is the pixel location of horizontal axis ranging from 0 to the width (W) of panoramic map image size in pixels. Meanwhile Y is the pixel location of vertical axis ranging from 0 to the height (H) of the panoramic map image size in pixels. Once all accommodation locations are determined and mapped, the hotspots can be dynamically drawn onto the image based on the availability query result. However, since the panoramic map image is viewed in cylindrical panorama for virtual tour, the X pixel location of available hotspots needs to be transformed accordingly with the user tour pan value (x) changes. First convert the location of X pixel location into pan value using the following equation:

$$Xpix = [X \times 360 / (W \times 4)] - 180 \quad (2)$$

Then, shift the X pixel location to the current tour pan value (x) using the following equation:

$$currentXpix = x + Xpix \quad (3)$$

Lastly, reconvert the current pan value of the location into pixel value using the following equation:

$$newXpix = [currentXpix + 180] \times [(W \times 4) / 360] \quad (4)$$

Now use newXpixel value as the current value of the X pixel location of the hotspot to be drawn onto the panoramic map image.

B. Data Store

Database: Accommodation attributes in database must include the X and Y pixel location based on the specific panoramic map image size. This attribute will be used to support availability search query result where all the available accommodation will be appeared as a hotspot in a panoramic map image.

Other attribute need to be considered is the main URL link of the accommodation virtual tour page files. This link address will be automatically viewed in a specific frame for each accommodation page. If no link specified, VPE-Viewer will automatically play all the panoramic images as slide show of the particular accommodation.

Panoramic Images: Panoramic images stored in OPABS-VPE are categorized as dynamic and pre-set images. Dynamic panoramic images are image files uploaded by accommodation owners to show room, lobby, or accommodation sceneries. Pre-set panoramic images are maintained by system admin for showing full map of all register accommodation in panoramic images. All of these raw panoramic images will be viewed in virtual tour environment using VPE-Viewer engines.

Virtual Tour files: Accommodation owners can also develop their own virtual tour environment with local hotspot using third-party tools or software. They can host the virtual tour files in OPABS-VPE or other external host server. This virtual tour will be shown in a separate frame in the OPABS-VPE of the specific accommodation page.

IV. RESULTS AND DISCUSSION

A prototype of the model is successfully implemented consists of real VPE viewer on the room types, dynamic searching hotspot and automatic conversion of panoramic image into VPE.

Virtual Panoramic Environment: VPEs for the prototype are based on accommodations location, room types and nearby interesting places. Through these VPEs, the user may visualize and explore the rooms before they book for it. The visualization of the panoramic image in the VPE can reveal the real scenarios. Figure 3 shows the room type viewed in virtual tour environment. User can tour the room using the VPE to see all around it including the scenarios and facilities in the room. Compass is embedded in the VPE to show the angle in degree of the current view. User is allowed to tour the VPE up to 360 degree using mouse. Meanwhile, buttons are also provided to enable user to interact with the VPE to change the angle of the view.

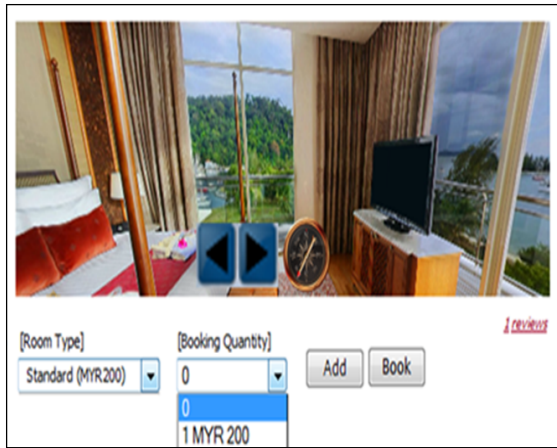


Figure 3: VPE on room types

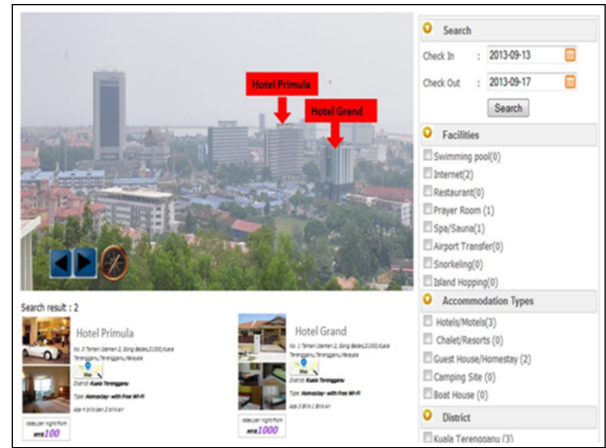


Figure 5: Accommodation search-based-VPE

Figure 4 illustrates the VPE of interesting places nearby the accommodation. Accommodation's owner can choose from the list of nearby interesting places to be appeared in their accommodation details. The interesting places are a collection of VPEs that provided by system administrator.



Figure 4: VPE of interesting places

Dynamic searching hotspots: The hotspots are dynamically appeared in the VPE based on the availability search that is requested by user. The search criteria may be on the check-in and check-out dates, offered facilities, accommodation types and location. The search results will be published in the VPE together with dynamic hotspots of the available accommodation names. Figure 5 shows the VPE query result that enable users to navigate the result in virtual tour. Together with the VPE, traditional result of available accommodation list is also shown under the VPE.

Automated Panoramic Images: The proposed model allows the owners of the hotels and resorts to automatically create VPEs from the panoramic images uploaded. JsphereLite has been used as the tool to create the VPEs. Rather than the static images commonly published in the website, the created VPEs are able to be visualized clearly and navigated in 360 degree by the customers. In this case, the owners of the accommodations may upload easily the panoramic images captured using cameras, video cameras, smart phones or even tablets to update the VPEs in the website.

V. CONCLUSION

This paper has discussed the model of OPABS-VPE. The model consists of three main functions; accommodation VPE viewer, VPE dynamic searching hotspots and nearby VPE attractions exploration. VPE technique is used in the model. The proposed model allows the owners of the hotels and resorts to automatically create VPEs from the uploaded panoramic images. It also enables users to view the accommodation availability result in VPE. Future related research will be on generating dynamic hotspots into a VPE map viewer for a result that comprises wide and far locations.

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REFERENCES

- [1] Lehmann, K.S., Ritz, J.R., Maass, H., Cakmak, H.K., Kuehnappel, U.G., Germer, C.T., Bretthauer, G., Buhr, H.J. 2005. A Prospective Randomized Study to Test the Transfer of Basic Psychomotor Skills From Virtual Reality to Physical Reality in a Comparable Training Setting. *Annals of Surgery* 241(3):442-449
- [2] Van Wyk, E., & De Villiers, R. 2009, February. Virtual reality training applications for the mining industry. In *Proceedings of the 6th international conference on computer graphics, virtual reality, visualisation and interaction in Africa*. 53-63.
- [3] Dickinger, A., & Mazanec, J. 2008. Consumers' preferred criteria for hotel online booking. *Information and Communication Technologies in Tourism 2008*, 244-254.
- [4] Arif, W. N. W. A., Ahmad, W. F. W., Nordin, S. M., Abdullah, A., & Sivapalan, S. 2009. Designing 3 Dimensional Virtual Reality Using Panoramic Image. In *Visual Informatics: Bridging Research and Practice* Springer Berlin Heidelberg. 404-414
- [5] Liarokapis, F., Sylaiou, S., Basu, A., Mourkoussis, N., White, M., & Lister, P. F. 2004, December. An Interactive Visualisation Interface for Virtual Museums. In *VAST*. 47-56.
- [6] Fleishman, S., Chen, B., Kaufman, A., & Cohen-Or, D. 1999, December. Navigating through sparse views. In *Proceedings of the ACM symposium on Virtual reality software and technology*. 82-87
- [7] Haque, S., & Srinivasan, S. 2006. A meta-analysis of the training effectiveness of virtual reality surgical simulators. *Information Technology in Biomedicine, IEEE Transactions on*, 10(1):51-58.

- [8] Tzovaras, D., Moustakas, K., Nikolakis, G., & Strintzis, M. G. 2009. Interactive mixed reality white cane simulation for the training of the blind and the visually impaired. *Personal and Ubiquitous Computing*, 13(1):51-58.
- [9] Othman, Z., Yaakub, A. R., & Zulkifli, A. N. 2002. Virtual environment navigation using an image-based approach. In *Research and Development, 2002. IEEE.SCOReD 2002. Student Conference on* . 364-367
- [10] Mehrish R.,Priyadarsini M.J.P, Murugesan K., Inbathini S. R., Jabeena A. and Revathi S., 2014. Comprehensive Analysis And Efficiency Comparison Of Image Stitching Techniques. *ARPJN Journal of Engineering and Applied Sciences*. 9(6): 935-952
- [11] Yi Xiao, D. 2000. Experiencing the library in a panorama virtual reality environment. *Library Hi Tech*, 18(2):177-184.
- [12] Awang, N., Yaakub, A. R., & Othman, Z. 2009, August. Assessing User Acceptance towards Virtual Museum: The Case in Kedah State Museum, Malaysia. In *Computer Graphics, Imaging and Visualization, 2009. CGIV'09. IEEE.Sixth International Conference on*. 158-163.
- [13] Yu, D., Jin, J. S., Luo, S., Lai, W., & Huang, Q. 2010. A useful visualization technique: a literature review for augmented reality and its application, limitation & future direction. In *Visual Information Communication*. 311-337
- [14] Andrews, P. 2003. 360 Degree Imaging: Photographer's Panoramic Virtual Reality Manual. Rotovision publisher.
- [15] Essawy, M. 2005. Testing the usability of hotel websites: the springboard for customer relationship building. *Information Technology & Tourism*, 8(1):47-70.
- [16] Brown, M., & Lowe, D. G. 2007. Automatic panoramic image stitching using invariant features. *International journal of computer vision*, 74(1):59-73.
- [17] Dorta, T. V. 2004. Drafted Virtual Reality: A new paradigm to design with computers.
- [18] Tzavidas, S., & Katsaggelos, A. K. 2005. A multicamera setup for generating stereo panoramic video. *Multimedia, IEEE Transactions on*, 7(5):880-890.
- [19] Michael Cieply. Report Shows Quarterly Decline in Video Rental Revenue; Digital Streaming Increases. [Online] Available from: http://mediadecoder.blogs.nytimes.com/2012/04/29/report-shows-quarterly-decline-in-video-rental-revenue-digital-streaming-increases/?nl=business&emc=edit_at_20120430 [Accessed 9th August 2015].
- [20] Hvannberg, E. T., Halldórsdóttir, G., & Rudinsky, J. 2012, October. Exploitation of heuristics for virtual environments. In *Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design*. 308-317.