Proposed Best Practices to Visualization of Heritage Buildings Based on Artistic Considerations

ChenKim Lim, Nguarije Hambira, Azham Hussain, KianLam Tan

Abstract: ***The digital preservation of cultural heritage of 3D reconstructed objects presents a new challenge due to difficulties associated with this technique. The importance of 3D reconstruction especially in the context of preservation and visualization of heritage buildings as many studies have been conducted that underlined its importance. To this effect, the present study proposed a new digital preservation best practice to visualize heritage monuments and buildings based on artistic considerations for the graphic designer responsible for this task. The best practices presented in this study includes the open standards, procedures, observations as well as considerations that are needed on the objects to be regarded as acceptable for visualization purposes. The proposed best practices were pilot tested by having 33 computer graphics students apply these practices to visualize heritage buildings as assigned.***

Keywords: ***Digital preservation, Cultural Heritage, Best Practices, Artistic Considerations, Visualization***

I. INTRODUCTION

It is of utmost importance that we understand the role of heritage assets if we are to stand a chance of preserving and protecting these very assets. The sources of information have never been more plentiful and as easy to access as they are in this Internet age (DCLG, 2012). However, it must be kept into consideration that the three dimensional (3D) reconstruction should be done with cognizant of the fact that heritage buildings and/or monuments differ extensively from one another therefore no blanket approach should be considered for these projects (Gomes et al., 2014).As highlighted earlier on, any attempts to soundly understand and examine heritage sites and monuments requires first and foremost understanding to actively interpret data correctly. In the case of loss or harm to heritage sites and buildings, many government policies around the world have shifted to allow for digital recording and storage of such monuments so as to preserve the site and its origin should anything happen to the physical structures. The requirements and best practice for 3D reconstruction and digital preservation of heritage sites are presented in this paper.

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Going hand in hand with digitalization of heritage sites is the knowledge of building information modelling (BIM) that has to be consistent and up to date if any given digitalization project is to obtain any higher preservation standard, a design process that is or rather can prove reliable as well as cost effective across the board (Garagnani and Manferdini, 2013; Lim et al., 2018). Even if BIM can be applied to existing buildings such as physical heritage monument due to its attitude to store semantic inter-related, the scope of this paper does not cover BIM of the chosen heritage site.

II. OBJECTIVE OF THIS DOCUMENT

Instead of only physically archiving cultural heritage objects and monuments, it is recommended to alternatively revert to the use of archiving these monuments digitally as this method also allows for exact storage provided forth by physical archiving but offers more in terms of compression of data for the purposes of maximizing storage capabilities (Vilbrandt et al., 2004). The objective of this paper is to document best practice in visualization of heritage monuments. The best practices encourage procedural and appropriate use of how we can visualize cultural heritage buildings by describing the settings where the modeling may and may not be useful; consequently, the best practices also provide and propose some guidelines and key elements of modeling and visualizing that should be specified in advance. Furthermore, the procedure on the visualization also involves the artistic consideration and peculiar observation from the graphics designer. The next section looks at what is presently existing in the body of knowledge: the historic environment records available on the Internet as well as traditional archives in its relation to the way how relevant material and detailed features of heritage monuments are being digitally preserved and archived worldwide.

III. DIGITAL HERITAGE PRESERVATION APPROACHES

Safeguarding and conserving the heritage digitally is a new knowledge and thus, making it widely accessible is an important exercise of general public benefit. Generally speaking, there are seven main ways to preserve the heritage digitally using computers:

a) An online searchable database for easy accessible and retrieval of designated heritage buildings and assets allows

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the public to view models of cultural heritage such as virtual reality of objects, multimedia and games;b) A historic environment record that keeps detailed information about the monuments such as size, year, history and the feature of the buildings; c) A system that holds the records, certificates, notices issued by UNESCO World Heritage Sites for building preservation which mentioned officially that no demolishment should be taken place at those sites; d) Archiving the video such as the digital restoration process and recording the archaeological process (Stanco et al., 2011) and digital representations of raw data and of reconstructed and reverse engineered objects; e;Digitally managing the asset system where the assets are scanned from original physical reference collections as compared to engineering in reverse as well as digitally representing shapes and texts of current 3D objects for instance, buildings and sculptures;f) Visualizing the monuments and heritage buildings based on the actual information and detailed features of the building and digital reconstruction of cultural heritage that may have been lost such as temples by making use of exiting materials such as written evidence;g) Digitizing text and images from existing documents.

IV. PROCEDURES OF HERITAGE VISUALIZATION

In this paper, 33 students in the 7thSemesterat degree level with specialization in computer graphics were asked to carry out a group activity involving 2 or 3 persons per team. They were asked to record their artistic consideration based on their observations and reference material gathering and studying the photos on Google. They were expected to find at least 3 distinct photographic examples of each heritage building that they wanted to visualize by illustrating the important points of the heritage building. The graphics designer had to be meticulous in picking reference images that have strong characters, unique or interesting features to highlight the details of the heritage building. They were expected to follow the list of best practices for object visualization and texturing as proposed in Table 1 to visualize the heritage monument digitally from different perspectives of consideration using any software such as Sketchup Pro, 3D Studio Max, Maya and others. The results of the visualization are illustrated herein (Figure 1).

Table. 1 Proposed Best Practices for Visualizing Cultural Heritage Buildings

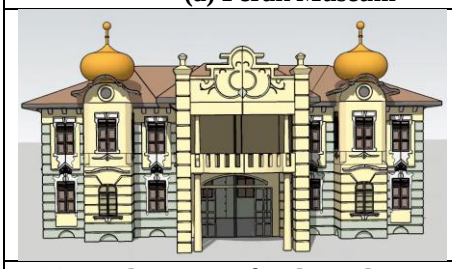
Items	Components
Object Visualization	**Polygon Distribution** a) Pick 1 closest reference example image and mark on it and/or write bullet point notes that clearly show where you would concentrate polygon distribution with concentrate features given a certain budget. Indicate approximately the percentage of the poly budget that you would allocate to certain features or areas and state the reasons for your choice.
	Silhouette a) Find 3 images that clearly demonstrate negative and positive space on the same picture. b) Source 3 images that illustrate the point of detail that can be substituted by texture rather than geometry to maintain high resolution with low polygonal counts. c) Contrasting (b) above, find 3 images that would definitely require geometry to characterize their nature or silhouette. d) For (c) above, choose one of the images that could have 3 distinct stages of build for varying distance from the camera. The further could be achieved via mainly texture alone, the 2nd stage would need a little geometry adding to the silhouette, and the final stage (close to camera) would need extra geometry to achieve convincing replication of the reference. I. Illustrate your point either with outlines marked on the reference examples for the 3 difference distances in Photoshop or if it's simple enough, you might consider building a simplified version of the asset to show your point.
	Straight Lines a) Choose images of 3 distinct structures that might appear at first viewing to contain many straight lines or features that appear "flat". Use overlay lines in Photoshop in at least 3 areas in each image to emphasize the fact that what appears to be straight lines, is in actual fact bent, curved or crooked.
	Curvature a) Choose 3 strongly "curved" or round objects in images, such as wheels, curved or circular tanks, etc. For each emphasize with markings in Photoshop where you judge the important curves are and briefly explain why they would need to be modeled rather than textured. b) Also to emphasize each point model a simplified version of the object (no textures required) in a way that (a) renders the curves accurately and effectively, then place that alongside an over-simplified version that because of lack of polygon detail loses it convincing look of a curved surface. c) Pick 2 more images, one that illustrates "large radius" and the other "small radius" and model simple versions of these (no textures required) that show how the size will influence the number of poly segments you would choose when making these for a AAA game.

	Beveled Edges a) Find 3 distinct images that illustrate the need to model the object with bevels on main edges or corners. You do not need to model these if you can mark in Photoshop where you would put the bevelling in the would-be 3d model. b) Choose a 4th example (for example a building) and show where and why (with markings and accompanying notes) there would be areas of bevelling in the 3D model but also areas where you would not need to waste poly's on bevelling. Make sure your diagram and explanation of why this is, are clear. c) Choose 3 images that illustrate examples of objects that demonstrate very thin or minor edge detail that you would not model as such but might mark into the diffuse, specular or normal map to highlight these areas for effective lighting results. I. For one of these examples model a simple model and demonstrate the effect by emphasizing some thin lines, edges or details which are not modelled but only highlighted in the maps artificially.
Texturing	**Edge Detailing** a) Choose 3 images that show different examples of edge detailing (such as highlights, wear and tear, "polishing by use" etc). Clearly illustrate their presence in a second image that you mark in Photoshop. Pick out as many as you can, numbering them and explain them as numbered points, as to how/why they might be present on this particular object. i.e. explain the mechanism of occurrence for each one.
	Top and Bottom a) Choose 3 image examples that illustrate the point of the difference between "top" and "bottom" details on a wall, building, structure, door, etc. For each, mark the differences and there should be own justification why or how there is a difference for this mechanism based on one's artistic consideration.
	Joining Elements a) Choose 5 example images that clearly demonstrate various "joining" methods from real world construction techniques. Mark and explain what these joints are and how they (a) were created in the real world and (b) how you might go about creating them in your games assets. Explain why you might use texture on some and modelled detail with texture on others. b) Choose 3 example images that illustrate the concept of "passing through" rather than "stuck on the side". If necessary explain the basic principle behind how it would be constructed in the real world and also how you might recreate this in a games asset. Consider again geometry versus texture. Explain your choices. c) Choose 1 more complex example image, such as a vehicle, machine, complicated building or structure. On a copy of the image mark and explain at least 10 different areas where joining techniques are used in the real world construction and briefly explain what these are.
	Different from Reference a) Choose 3 images – 1 for each of the following 3 categories – where the reference may in some way be "floored" or not suitable for replication in-game. I. Environment Terrain: choose 2 images, one for a foreground portion and one that illustrates an effective background (longer distance). In Photoshop construct a montage of the two images replacing the background from one with the other. These should blend as well as you can without spending too much time on this example. I. Child Asset: choose a photo or more that illustrates examples of what could be categorized as a "parent" object near to or accompanied by a "child" object. Briefly explain why you chose these 2 buildings and what elements (textures?) you could possibly share between them. I. Incomplete Reference: Pick an image that demonstrates clearly that the artist would have problems recreating the object (building or structure preferably) because of incomplete reference information in the shot. Explain what the problems might be, then search for other suitable images that could provide adequate "substitute" materials, information about that item. Explain which parts, elements, texture, object details you would use to "complete" your model. Illustrate your point in pointers and images as necessary. If it helps, explain what you are "searching" for in terms of object detail or missing textures via simple sketches in Photoshop or on paper and scan them in to include in your submission.

The work that the students came up with in terms of following the proposed best practices guideline (Figure 1) produced illustrations that were considerably consistent internally in that they respectively represent each site within each angle of as determined by respective group members.

(a) Perak Museum

(b) Rumah Teh Bunga



(c) Proclamation of Independence Memorial Malacca

(d) St George Church Penang

Fig. 1 Visualization Output of Heritage Buildings in Malaysia(a) Perak Museum, (b) Rumah Teh Bunga, (c) Proclamation of Independence Memorial Malacca, (d) St George Church Penang

V. CONCLUSION

There are various reasons as to why the digitalization of cultural monuments and/or sites is ever more important and desirable: digitalization allows for replica that resembles the real object to the finest of perfection that could ever be found. It also has the capabilities of storing data securely over long periods of time, this also becomes crucial in that the storage space required can be as small as a few square meters all thanks to advancement in technology that has allowed for creation of small storage devices that take as little space as possible. These functionalities also mean that various copies of the same file can be stored across various places that in the end provides for a security guarantee in case of theft or fire at one of the storage facilities. Lastly, the fact that digital data can be hosted online and shared results in global access to such rich historical data cutting out the need to physically travel in order to gain access to these records.

As noted, visualizing heritage building based on referenced photos from physical heritage building tend to be iterative and thus it is often necessary to amend the features based on new specification of the actual monuments. This is the first attempt to visualize some of the heritage buildings in Malaysia and the final version should be clearly indicating the overall impression of the heritage building. In addition to the continuation to the proposed best practice in this paper, the omission to the visualization of the building should be signed, dated, justified and properly recorded in a digital asset management system. One major limitation to this paper is the experiences on monumental sites digital preservation of cultural heritage was carried out based on photorealistic visualization without involving Building Information Modelling (BIM) design process.

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