3D Model Generation and Visualization of Archeological Remains in World Historical Sites: Santiago Bastion (Wilhelmus), A Famosa, Malacca.

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Commission No. 3

Presentation Outline

- Introduction
- Aim & Objective
- Methodology
- Results & Analysis
- Conclusion

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Introduction

The three dimensional computer graphics and visualization techniques have been used for wide range of applications such as manufacturing, industrial design, urban design, architecture, cultural heritage, 3D city modeling and GIS.

Introduction

The use of three dimensional computer graphics and visualization techniques using image based is becoming more and more popular, because these techniques visualize more realistic object models than graphic based object models.

According to El Hakim (1998) and Gruen (2012), a large and complex 3D models data are required in most application of 3D modeling and visualization.

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Introduction

Photogrammetry and digital image processing techniques play important role to make 3D modeling and visualization technology with practicality and cost effective.

Table 1. Effectiveness for different method in heritage modeling (Cheong et al, 2011)

Method vs Problem		Conventional	Photogrammetry	Terrestrial Laser Scanner
Time Consuming Field Work		✓ ; *More*	*X ; Least*	✓ ; *Moderate*
High Processing Power		*X ; Least*	✓ ; *Moderate*	✓ ; *More*
Man Power	Data Capturing	✓ ; *More*	*X ; Least*	✓ ; *Moderate*
	Data Processing	*X ; Least*	✓ ; *Moderate*	✓ ; *High*
Level of Details		*X ; Least*	✓ ; *Moderate*	✓ ; *High*
Accuracy		*X ; Least*	✓ ; *Moderate*	✓ ; *High*
Cost		*X ; Least*	✓ ; *Moderate*	✓ ; *High*

Aim & Objective

The aim of the study is to generate and to visualize 3D model of archeological sites using image based modeling method. In specific, this study conducted in order to fulfil following objectives:-

- ❑ To identify and investigate an effectiveness of the modeling process.
- ❑ To perform visual interpretation analysis based on generated 3D model.
- ❑ To produce user friendly and multi-purpose outputs.

Study Area

The selected study area is A Famosa, Malacca which is one of the World Heritage Sites in Malaysia. A'Famosa or "The Famous" in Portuguese is a fortress located in Melaka, Malaysia which is granted the status of World Heritage Site by UNESCO in 2008.

Built in 1511, Once as part of a mighty fortress, this tiny gate known as Porta de Santiago, one of the four main gates of the famous Portuguese fortress. The fortress consisted of long ramparts and four major towers.

Study Area

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Study Area

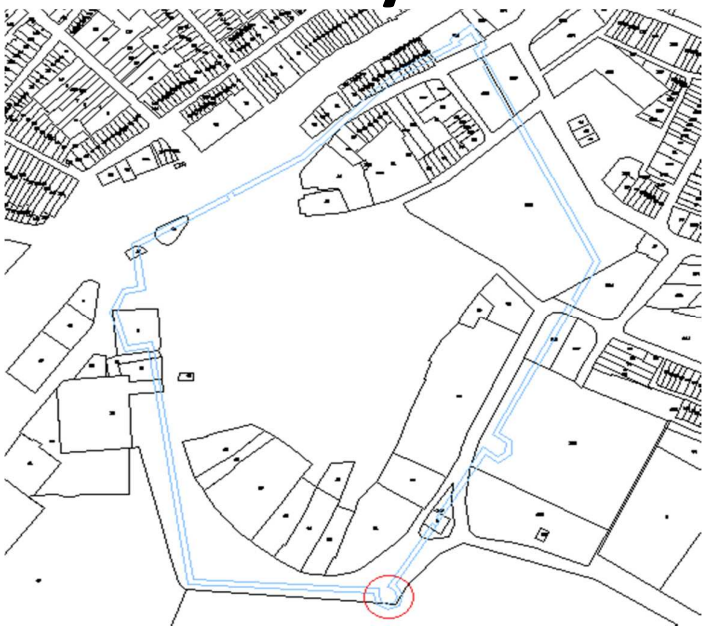
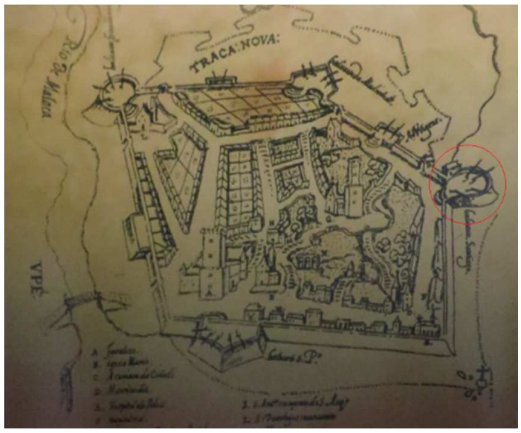
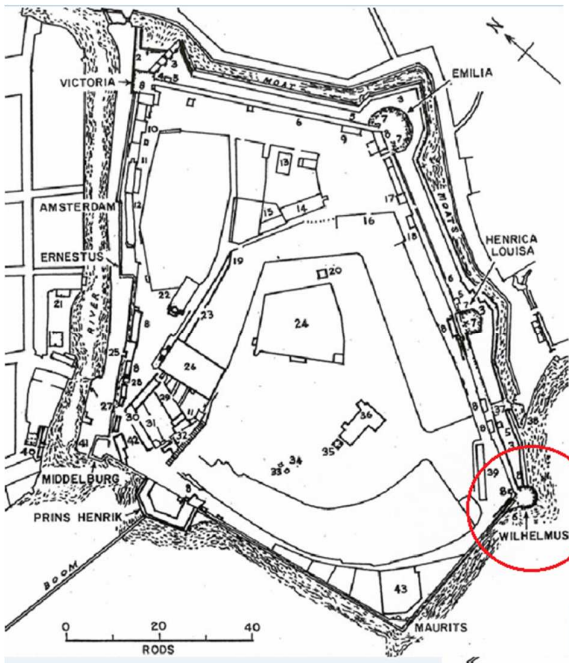


Fig.1 : A famosa fortress remain sites

Study Area



(a)



(b)

Fig. 2
Wilhemus or Bastion Santiago Plan in 1784 (a) and 1792 (b)

Study Area

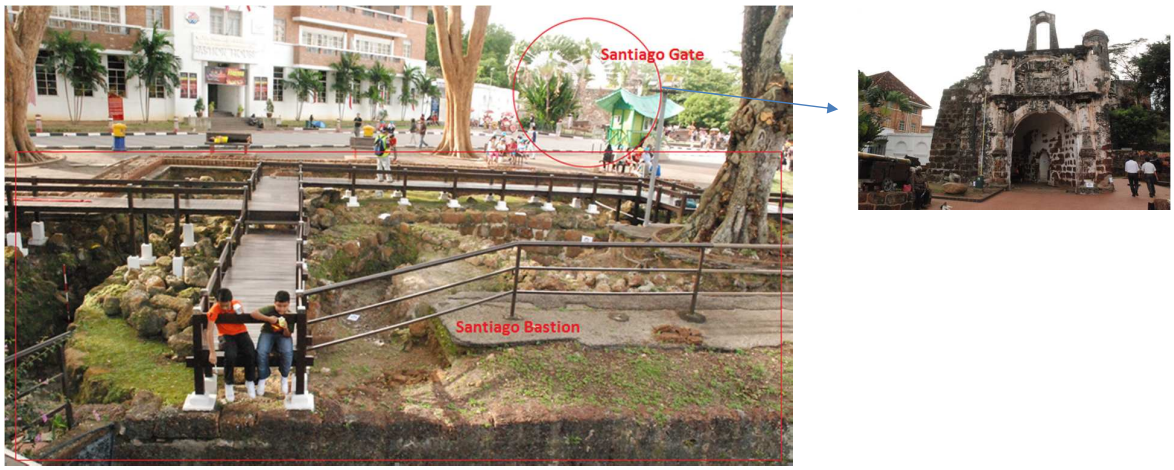
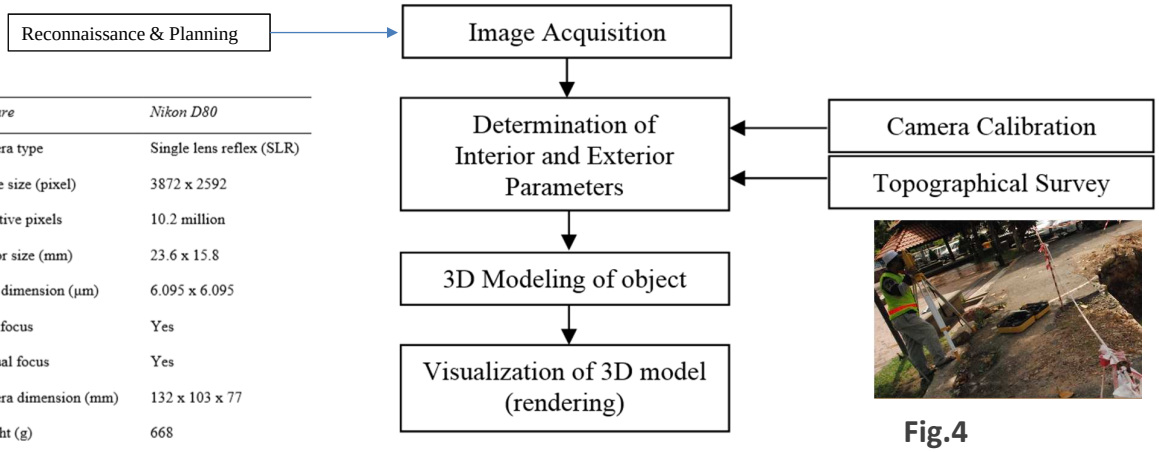


Fig. 3: Photo of Wilhemus or Bastion Santiago, A Famosa, Malacca.

Methodology



Feature	*Nikon D80*
Camera type	Single lens reflex (SLR)
Image size (pixel)	3872 x 2592
Effective pixels	10.2 million
Sensor size (mm)	23.6 x 15.8
Pixel dimension (μm)	6.095 x 6.095
Auto focus	Yes
Manual focus	Yes
Camera dimension (mm)	132 x 103 x 77
Weight (g)	668

Fig.4
Control Survey for Reference point

Fig.5
Camera Nikon D80

- Topographic Surveying
- Close-Range Photogrammetry (Terrestrial)
- Model generation & Visualization

Results & Discussion

- Photogrammetric Survey Data
- Digital Elevetion Model (DEM)
- 3D Model Generation

Results & Discussion (cont.)

- Terresterial photo Mosaics

Fig.6 Archeological site Photographs

Fig.7 Perspective view of the terresterial mosaics

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Results & Discussion (cont.)

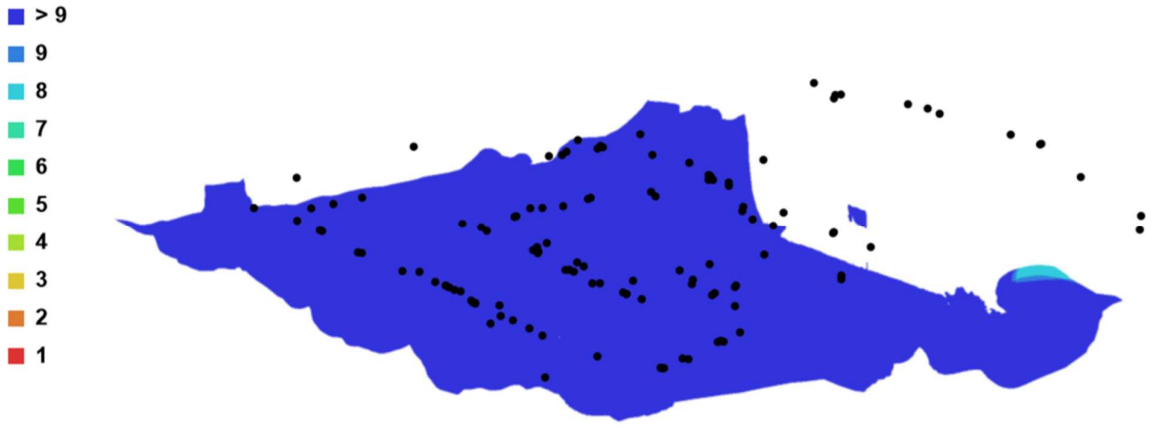
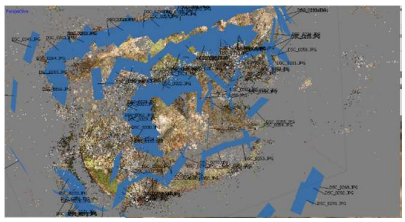


Fig.8 Shows the camera location (below and black dots) and number of overlapping photographs (coloured).

Number of images:	127	Camera stations:	120
Flying altitude:	6.3371 m	Tie-points:	288591
Ground resolution:	0.00143041 m/pix	Error:	0.474258 pix
Coverage area:	210.322 sq m		



Results & Discussion (cont.)

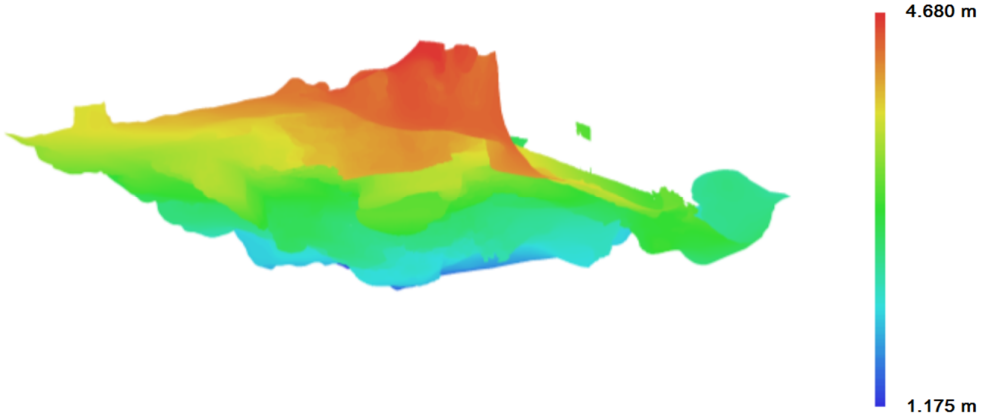


Fig.9 Digital Elevation Model (DEM)

Results & Discussion (cont.)

Fig.10 Shows real scene photographs

Results & Discussion (cont.)

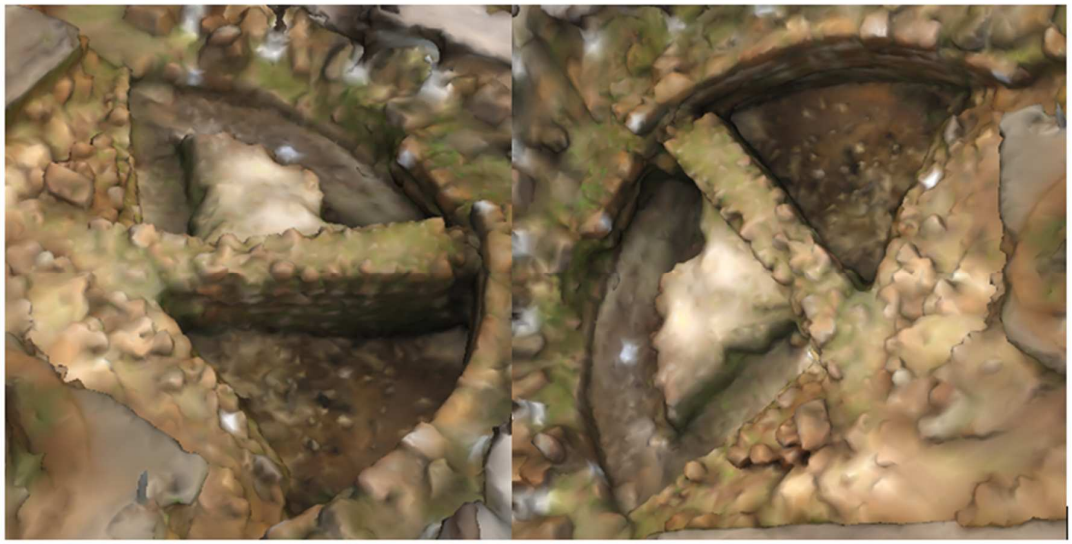


Fig. 11 Shows low density pre-processing the surface photo textured model

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Results & Discussion (cont.)

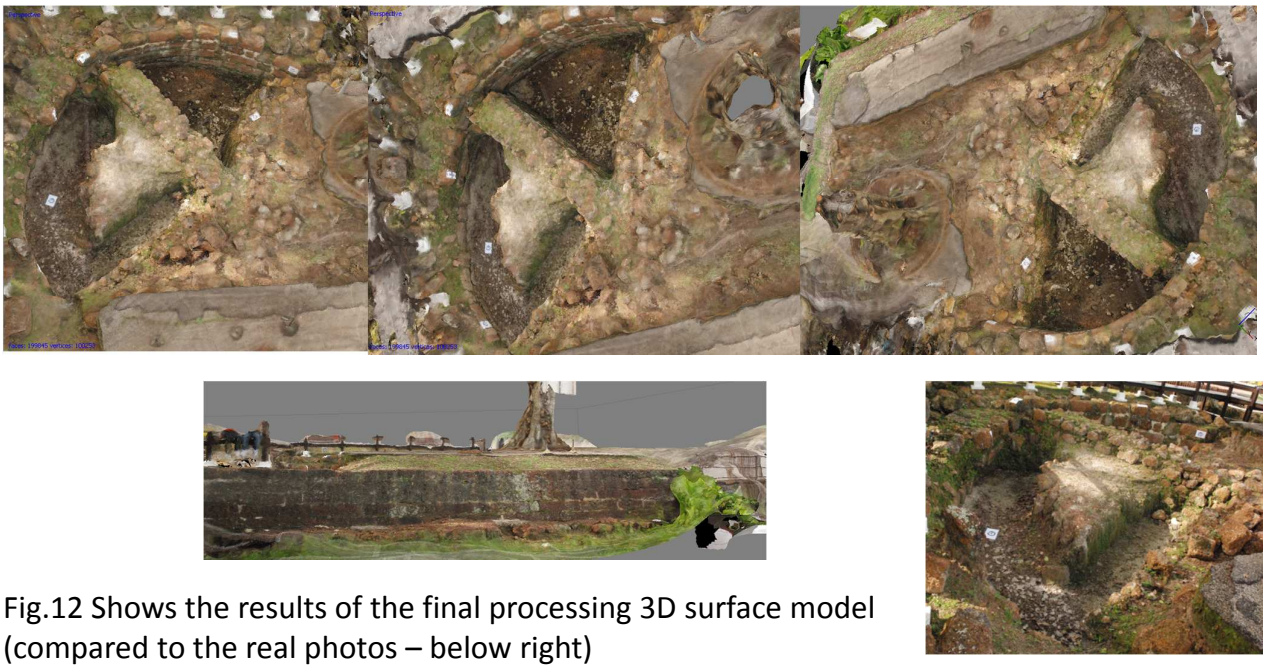

Fig.12 Shows the results of the final processing 3D surface model (compared to the real photos – below right)

Results & Discussion (cont.)

Fig.13 Close-up 3D surface model

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Results & Discussion (cont.)

Fig.14 Top view 3D photo textured surface model

Results & Discussion (cont.)

Fig 12a.

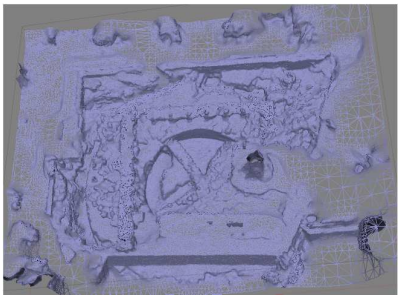
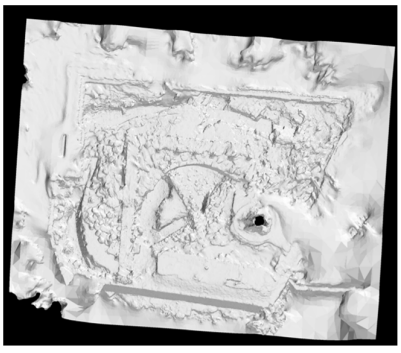


Fig 12b.



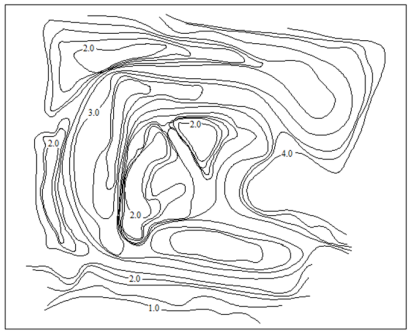


Fig 12c.

Fig.12 Rendered surface model (wireframe and shaded) and generated contour (Fig12c.)

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Results & Discussion (cont.)

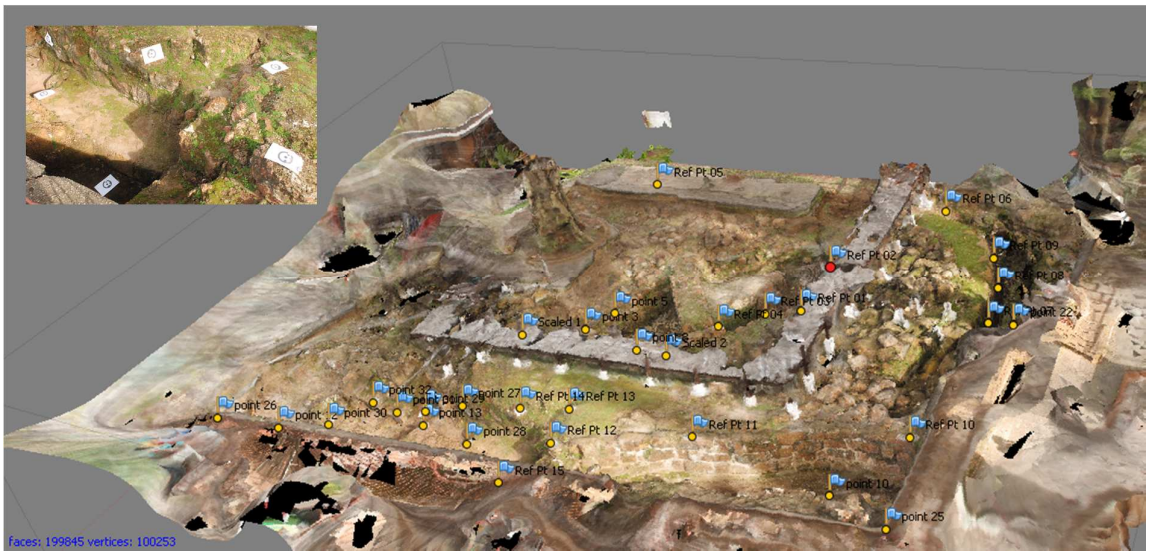

Fig.15 Control point distribution and target used (top photos)

Results & Discussion (cont.)

Fig.16 Generated plan view of the archeological sites.

Conclusion

- 3D models of cultural heritage are best suited to give a clear visualization of existing situation with an effective and practical modeling process.
- Future situation after planned restoration project can be compared with existing situation using 3D model of cultural heritage with visual interpretation analysis.
- 3D model generation and visualization of cultural heritage has potential for being new product in the area of documentation of cultural heritage and planning of cultural heritage restorations.

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Thank you for your attention!

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