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Visualising Famagusta: interdisciplinary approaches to the study of the Orthodox Cathedral of Saint George of the Greeks in Famagusta, Cyprus

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This paper explores a recent interdisciplinary project which brought together a visualization expert, an art historian, and an architectural historian, to study the ruins of Saint George of the Greeks Cathedral in Famagusta, eastern Cyprus, then create a virtual three-dimensional reconstruction of it. The motivation for this work, funded by Nanyang Technological University in Singapore, was to apply existing knowledge and expertise to a difficult, and very particular, heritage question on this Eastern Mediterranean Island. The creation of such a model could, it was felt, not only reiterate the academic value of thorough archival work married to state of the art technology, but also have very practical reverberations in terms of future heritage welfare and education via this 'borderless' domain.

Keywords: Famagusta, 3D visualisation, heritage conservation, Cyprus, New Media, Art History.

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The project objectives and a particular cultural dilemma

In June of 2012 a small pilot project began to survey and analyse the ruins of Saint George of the Greeks Cathedral in Famagusta, Cyprus, then create a three-dimensional virtual reconstruction of it. The motivation for this work, funded by Nanyang Technological University in Singapore, was not to set in motion further technical innovations as such, but to apply existing knowledge to a difficult, and very particular, heritage question. The creation of such a model could, it was felt, not only demonstrate the academic value of thorough archival work, but also have very practical reverberations in terms of heritage welfare, education and perhaps peace building. From the outset therefore, the authors would like to emphasise the holistic nature of this research project, its transient status and its wider social implications.

In order to understand the peculiarities of heritage issues in the northern part of Cyprus it is vital to situate our work within its socio-political context. In 1974, the island of Cyprus was forcibly divided by a military invasion that came at the end of a period of long-standing tension between Greek and Turkish nationalisms on the island. In 1983 the northern section of the island made permanent the partition by declaring its sovereign status as the 'Turkish Republic of Northern Cyprus'. This move was condemned by the United Nations and so to this day only Turkey formally recognises the existence of the 'nation' and its sovereignty. In 2014 this division still stands, despite a reunification effort which came very close to success in 2004 in the form of the United Nations proposed Annan Plan. As a result of the continued political impasse there is currently no international presence in the northern portion of the island that might deal with the complex cultural welfare and heritage management questions that have over the intervening decades become so urgent.

It was therefore to the 'borderless' virtual world that we turned our attention in 2012, as a domain or frontier for legal academic research. We targeted one single example, Saint George of the Greeks, as our pilot. The overall objectives of the interdisciplinary case study, undertaken by an art historian, an architectural historian and a computer visualisation expert, can be summarised as thus; to:

(1) *document* the endangered Cathedral of Saint George of the Greeks in Famagusta, Cyprus;
(2) *develop* techniques for visualisation and conservation projects using state-of-the-art technologies;
(3) *create* 3D modelling, GPS-sensitive, data recognition and visualisation methods to re-create historic spaces in a scholarly manner;
(4) *refine* educational methodologies for inculcating the importance of cultural heritage in future generations of schoolchildren in Famagusta (and further afield);
(5) *propose* to use 'shared' cultural heritage, in a 'neutral' space, as a method of political reconciliation between politically polar groups.

This paper, therefore, shares with the wider academic community the reasoning behind this project, the processes adopted and the findings to date, and highlights some of the academic objectives within the guidelines of the London Charter for computer-based visualisation of cultural heritage.[1]

Archives, manuscripts and historical research

It is vital to reiterate that this project, a work in progress, is not merely a technical exercise in what can and cannot be done using equipment and software; it is first and foremost an academic exercise into art and architectural history, whereby software and cutting-edge methodologies are created and adapted to assist in the original academic study. As such, creating a 3D representation of St George of the Greeks required a combination of technical knowledge of the building as well as a solid historical understanding of the landscape in which it sits. Of course, the most important material evidence was the remains of the building itself and so a thorough analysis and recording of what is extant today was undertaken. In addition to that, the team utilised almost 140 years of photographic sources from a vast array of collections and archives, ranging from Harvard University (Foscolo), the Courtauld Institute of Art (Conway), La Médiathèque de l'Architecture et du Patrimoine (Lucien Roy) to the National Archive of the United Kingdom (Kew). The unpublished Mogabgab Photographic Archive (currently in boxes in the Department of Antiquities in northern Nicosia), created in the 1930s–50s by the Director of Antiquities for Famagusta, is a particularly good source for understanding building details. Local archives, specifically those relating to the British period on the island, where vital clues can be gleaned from government reports (Report to the Department of Antiquities of Cyprus) relating to expenditure and permissions, were also vital. Going back to pre-photography years, we used the work of travelling artists and the journals of writers conducted almost continuously over the centuries, a fine example of which can be seen in the copperplate created by Cornelis de Bruyn in 1698 (see Figure 4).[2] We have leaned heavily too on the imagery derived from map-makers, including Sebastian Munster (1578), Simon Pinargenti (1572) and Stephano Gibellino (1571), Olfert Dapper (1688) and also on architectural models by Giovanni Sanmichele (circa 1540s) held in the Venice Museo Storico Navale. The main scholarly sources used for the project were the architectural studies of Camille Enlart (Enlart 1899), the works of George Jeffery, published throughout the first decades of the twentieth century,[3] and more recent research by Kaffenberger.[4] The 3D model of the historic structure, it is clear, utilises as many footnotes and references to archival and manuscript sources as any good journal article. Creating such an image in Singapore was only possible after long-term, trans-continental and multi-disciplinary work had been carried out.

Methodologies, interpretation and visualisation

A note on methodology here seems timely with the caveat that any attempt at reconstruction of a (partly) vanished artefact is prone to subjectivity (Figure 1). We pursued our work in the knowledge that at least three instances of subjectivity are distinguishable in the reconstruction process. A first instance lies within the source material: any source, apart from the sheer material evidence, is refracted by the perception of the original material of the person contributing to the source. The second instance occurs when the artefact and textual and pictorial sources are interpreted by a scholar, which again adds a certain amount of subjectivity, even though the output might be perceived as objective and proven. The third instance lies in the process of a reconstruction itself. Unlike a text, which refers only to a relatively well-demonstrated theory, a visualisation can be much more sweeping, especially in the traditional method of drawings and model making. To proceed with caution therefore was essential.

That said, the use of digital technologies to support the conservation of, and enhance the educational abilities pertaining to, cultural heritage by supplying new tools

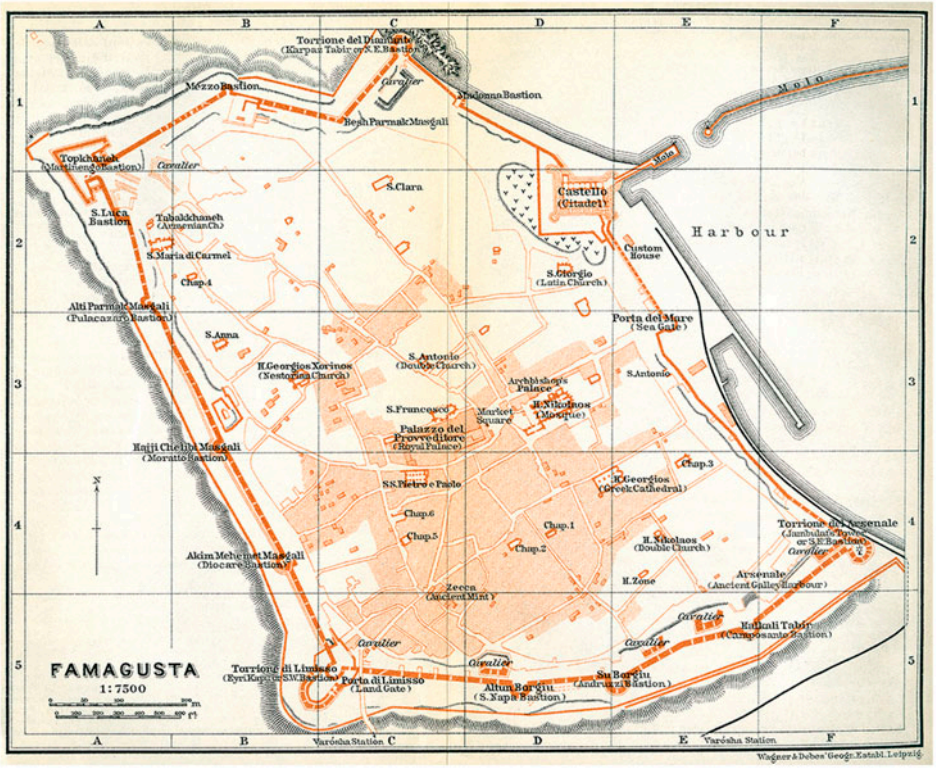

Figure 1. Map of Famagusta, circa 1917. Private collection, originally from Karl Baedeker, *Konstantinopel, Balkanstaaten, Kleinasien, Archipel, Cypern, Leipzig 1914*. 146×179mm.

for research and dissemination was the assumed starting point of this project. We also worked on the understanding that these digital technologies, through their capacity to create networks and re-create experience, might allow the scholar to foster a wider, better informed, more engaged audience. In addition to creating a snap-shot of how the cathedral looked in 2012, therefore, we felt that our 3D visualisation might foster, then enable, a sophisticated academic debate which would allow the virtual structure to be continually re-modelled based on emerging and contrasting research. We knew too that such 3D visualisations might offer experts the opportunity to analyse the durability of the structure and to prepare for the years ahead by mapping areas that are most at risk. In Famagusta this is an important task as historic monuments remain uninspected. A second advantage of the 3D model is that, whether utilised by a specialist scrutinising every detail or offering light entertainment to a virtual tourist in a distant location, Saint George of the Greeks can now be transported anywhere there is an Internet connection. As such, a huge awareness of what is in Famagusta (and endangered) has been created, as has the opportunity to 'visit' the site without actually physically walking over it and causing further destruction.[5] Additionally, the audience has been broadened to include classrooms, museums, heritage organisations and governments who otherwise may not have been aware of the existence of these heritage sites or the dangers they faced. The recent study on the Roman villa of Casa de Freiria in Spain (Rua and Alvito 2011), the iPad application 'Virtual History ROMA' (Arnoldo Mondadori Editore, SpA) and 'Chaos to Perfection' (Les 84 and ChateauVersailles 2012) are all testimonies to the

Figure 2. Hagios Georgios (right larger structure) and Hagios Epiphanios (left smaller structure), south-eastern facades. Photograph by Thomas Kaffenberger.

varying uses of 3D visualisation in conservation, education and immersive experience.[6] It is well understood that presenting the 'artefact' online can be achieved either by utilising the newly improved capabilities of HTML 5 and WebGL (and so making it available to most browsers),[7] or through the use of third-party plug-ins. In addition to screen-based media, educators are also turning to the use of physical computing and immersive experience as a means for sharing information and entertainment. By using a cave, for example, or augmented reality, users can experience the site as if they were standing inside it and so an experimental digital classroom project (Educube) is currently being tested at a school in Singapore. Here students could potentially experience a virtual classroom with interactive walls and touch screen interfaces as they learn 'within' Saint George of the Greeks. Just as one explores the rainforests of the Amazon, so too one can 'experience' the endangered art and architecture of Famagusta (Figure 2).

The Cathedral of St George of the Greeks

In its heyday Famagusta was one of the wealthiest cities in the medieval Mediterranean world and it was probably the coronation place of the Lusignan dynasty, which held the crown of both Cyprus and Jerusalem. It was also a city condemned for its hedonism by Saint Brigitte of Sweden, earmarked for destruction in Dante's *Inferno* and the setting for Shakespeare's tragedy *Othello*. Its end came in one of the most infamous sieges in military history (1571), after which it was entirely forgotten and, because of earthquake, plague and policy, abandoned for three centuries. Experiencing a degree of revitalisation under British administration (1878–1960), Famagusta's heritage was granted a brief reprieve, but this, for the reasons outlined in the opening section, was to be short-lived.

Amongst the many ruins and medieval structures within Famagusta Walled City, around 30 churches are preserved or traceable today. Saint George of the Greeks lies in

Figure 3. Southern wall (4th bay) of St George incorporating northern wall of the older Hagios Epiphanios. Photograph by Thomas Kaffenberger.

the south-east, some 100 metres south of the Latin Cathedral of Saint Nicholas, in the so-called Greek Quarter. Consisting of a much-altered older part, Hagios Epiphanios, and the monumental new cathedral erected in the fourteenth century, Hagios Georgios (Saint George), the complex demands the highest possible scholarly treatment.[8] Hagios Epiphanios, presumably functioning as a place of veneration of the island's most important saint bishop, originates in the Middle Byzantine era (around 1000 AD) and was renovated, rebuilt and extended at least five times. By the mid-fourteenth century the church was two-aisled and surmounted by four domes, yet compared to the newly erected Latin buildings in the city it was small in scale. Nevertheless, the old structure, thus functioning as material testimony of the bishopric's long tradition, was preserved during the erection of the splendid new cathedral of Hagios Georgios in the second half of the fourteenth century. The new structure, which incorporates the older building in its southern wall (Figure 3), now shows an elaborate blending of traditional Cypriot, Crusader Style and French Gothic elements.

Figure 4. Copperplate of Famagusta portraying St George of the Greeks with a dome, circa 1698, Cornelius de Bruyn. Private Collection.

It is made entirely of limestone ashlars and has three aisles of five bays each, all ending in semi-circular apses. While the apses, facade and aisle walls are plain, the basilical clerestory was supported by a row of flying buttresses, which held back the thrust of the cross vaults surmounting every bay. A long scholarly debate as to whether there was a dome or not was ended only recently by the uncovering of definitive evidence (Figure 4) in support of the notion.

Minor alterations to the church occurred in the fifteenth century, but the structure seems to have stayed intact until the Ottoman cannonade of 1571. In fact travellers' accounts and artists' impressions from the seventeenth century[9] show that while the cathedral was undoubtedly badly damaged in the siege of 1571, its final demise probably came in the great earthquake of 1735.[10] It was only after this point that Saint George of the Greeks was finally abandoned and remains a ruin to the present day (Figure 5).

Figure 5. East-facing interior of St George of the Greeks, 2012. Photograph by Sven J Norris.

Mainly intact are the three apses, the southern aisle wall and the lower storey of the facade, while the northern aisle wall, clerestory and the vaults (including piers) are mostly gone.[11] Rests of the cross vaults are visible in the Eastern bays, where also the last flying buttress gives support to the main apse semi-dome. Stones of the church have been removed over the centuries for building projects further afield (it has been suggested as far away as Egypt),[12] further collapse has occurred over time and, despite an intervention in the 1930s,[13] the once vibrant murals are now exposed to baking heat in the summer, the destructive effects of rainwater in the winter and neglect.

Platforms, reconstructions and limitations

In re-creating the structure, the modellers adopted two distinct methodologies which would later be combined. The first of these was a high resolution or polycount, which enabled photo-realistic rendered images or pre-rendered walkthroughs of the space in the form of video. This particular output and style of 3D modelling is most commonly found in architectural visualisation or set design for film production. The second was a low resolution or polycount version of the model, which enabled a real-time 3D engine to process the structure and permit a real-time navigable experience as is common with many 3D video games today, such as the *Assassin's Creed* series (Ubisoft Montreal, 2007–13), *Elder Scrolls: Skyrim* (Bethesda Game Studios, 2011) and *Dear Esther* (Briscoe, 2012). This low resolution method was the main goal in terms of creating the 3D model of St George of the Greeks and, while being light in terms of physical construction of the 3D mesh (a low polygon or face count), inherited textures rendered from the higher resolution model. The idea behind this, and indeed how many contemporary video games and real-time applications function, is that an aesthetically realistic environment or object can be presented to the viewer while the underlying physical structure of the model is in fact quite crude. A physical analogy of this might be a film or stage set which might be painted and dressed very accurately from the audience's point of view but is in fact just a facade made of scaffold and canvas behind the scenes.

Following the modelling of St George of the Greeks in 3D space, and in order to texture it, the image had to be unwrapped and given UVW coordinates which mapped the 3D object onto a 2D plane. This then allowed the painting and art manipulation of the object and specified where a 2D image should be projected on the 3D surface. A simple analogy is how the pelt of an animal appears once it has been skinned. Most 3D models in contemporary real-time environments are made up of a number of different textures which contain various image data used to project realism into a 3D surface. The most common textures used are: Diffuse Map (displays general colour and pattern); Normal Map (used by the game engine to give appearance of 3D depth on a flat surface); and Specular Map (affects the glossiness or matt appearance on the 3D object surface).

Figure 6 shows an example of the earliest initial setup in Autodesk 3D Studio Max, where the plan, sections and elevations (the latter of which are not shown) were placed to scale as visual aids for the modelling process. The building plan being used (Figure 7) is a modernised adaption of Theophilus Mogabgab's original plan while the cross-section was drawn by Camille Enlart in 1896 (Figure 8). It must be noted that all of these references varied by date, accuracy and interpretation.

This setup was used for the initial 'blocking in' of the structure, a process which can be compared to the initial sketches an artist makes before a final painting is produced. This procedure helps to identify major structures and components, while aiming

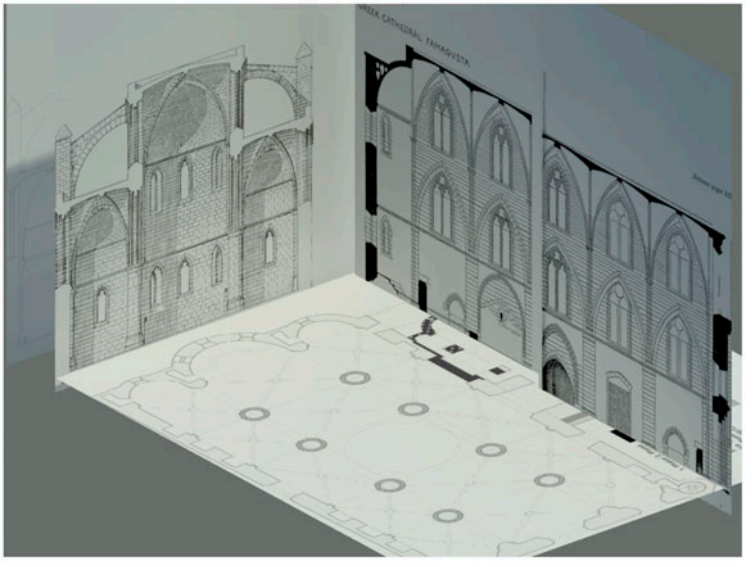

Figure 6. Screenshot of initial setup in Autodesk 3D Studio Max, 2012. Image by Sven J Norris.

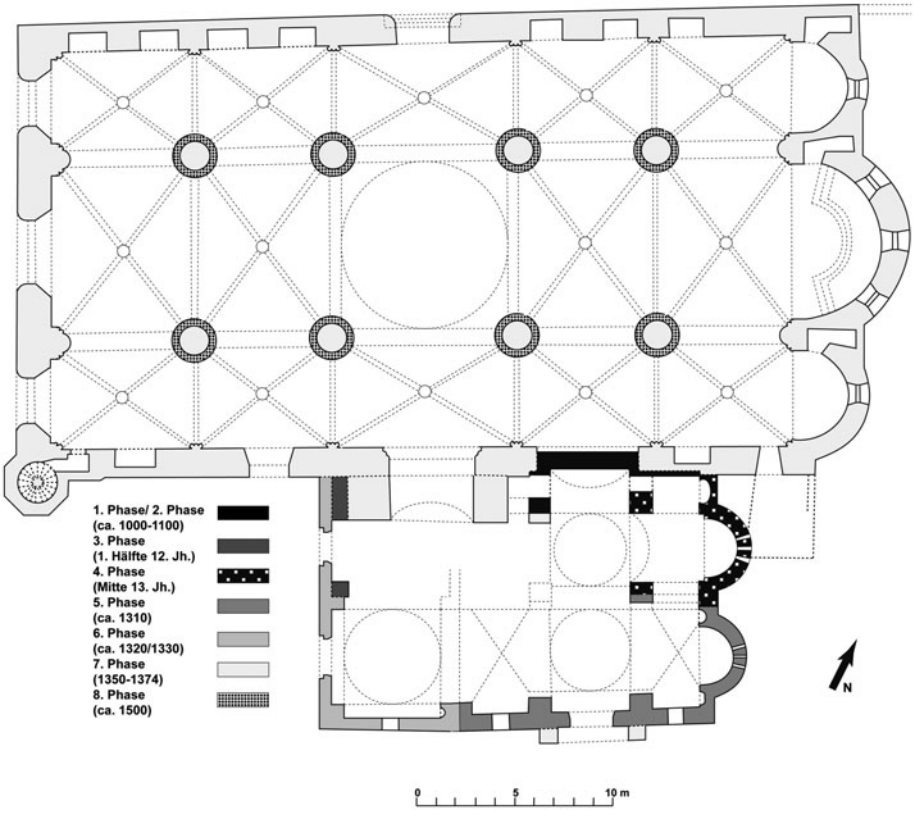

Figure 7. Plan of St George of the Greeks and Hagios Epiphanios. Photograph by Thomas Kaffenberger.

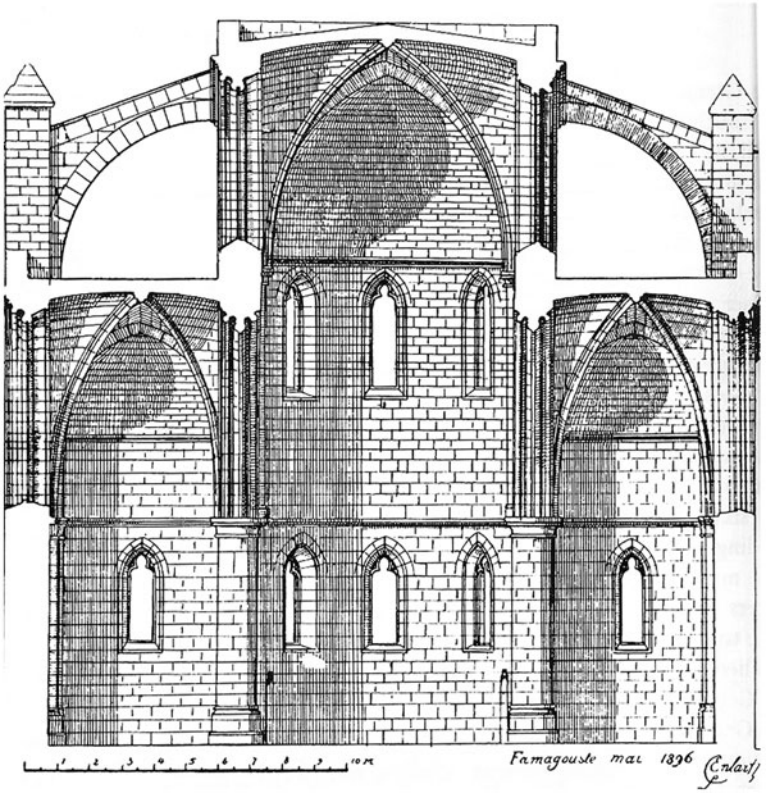

Figure 8. East-facing section of St George of the Greeks, 1896. Illustration by Camille Enlart.

to capture the actual composition and scale of the building. For example, certain areas of the cathedral, such as windows, some vaults and arches, are repetitive and these were modelled once and then instanced.

The included example render from a recent but not final version (Figure 9) depicts both structures from a south-western orientation of the site showing St George with its roof intact, buttresses and a suggested dome which has since been modified. Figure 10 shows an early interior render of St George indicating a very different experience to the present-day roofless site.

As almost all of the interior decoration of the building has been eroded and destroyed over time, many of the original frescoes are lost forever and can therefore not be reconstructed accurately. The 3D model enables the possibility of at least displaying the existing remnants of frescoes within the interior.

Future trajectories

As well as photorealistic renders and walkthroughs of the buildings from any angle, the creation of a real-time 3D version has begun using the popular game engine Unity 3D. Embedded within this digital interface (for Web or tablet), the user will be able to access first-person control and bird's eye views of the structures both inside and out. In addition, much like a kiosk experience, contextual displays and interactive hotspots will enable the user to read information, hear audio and perhaps watch related video footage.

Figure 9. South-western sample render of the modelled structures (in progress), 2013. Image by Sven J Norris.

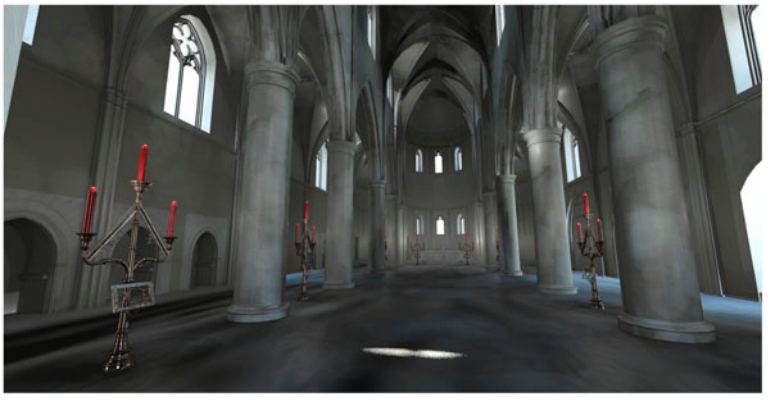

Figure 10. St George of the Greeks, early draft render of interior, 2013. Image by Sven J Norris.

To date we have generated the models showing the buildings as they may have been at a given moment in history. Next we would like to generate models (including the present-day situation) where users are able to switch between time periods dynamically, perhaps through the use of a chronological timeline slider or mechanism within the interface. As different phases of the building are added to the model, these can be incorporated into the chronological timeline mechanism.

Documentation remains a vital part of the process (and the progress) and as such, a Wordpress site has been set up. This 'wiki' can help to preserve the transparency of the development of the project, contribute to the sustainability of the work output and eventually be made public as part of a wider citizen science project.

Though the team does not wish to re-involve cultural heritage in the same political theatre that has been so detrimental to it, it is nevertheless interested in motivating communities to act together to safeguard heritage despite all other differences. Costa Carras, Vice-President of Europa Nostra, for example, underlined that 'culture can work as one of the creative forces in European society that brings people together.'[14] Michael Møller, the UN Chief of Mission on Cyprus, also emphasised his pleasure that such work in Famagusta would 'encourage the two communities to work together and, just as importantly, [of] encourage[ing] them to safeguard the common cultural heritage of Cyprus'.[15]

Lastly, might not the outcomes of this project, so easily disseminated worldwide, act as a lobbying tool for universities, non-government organisations and perhaps even governments to permit a return of scholarship and conservation expertise to a city that has been abandoned by the international community for too long? The reasoning was certainly endorsed by World Monuments Fund when they wrote:

> The scale of preserving the remaining historic elements of Famagusta is of such enormous proportions that one almost does not know where to begin. It is therefore of vital importance to increase the world's awareness of the special qualities of Famagusta and to lay the necessary ground work for an appropriate evolution of the city from an isolated gem to an accessible, well protected, historic, urban site.[16]

Perhaps our work has taken a first, small, step in that entirely necessary direction. Though there is still much to be done on the pilot study of St George of the Greeks, one's attention already turns to the wider implications of this successful experiment for each and every monument in Famagusta, or to the entire historic city as a 'heritage unit'. Allowing ourselves to widen our perspective further, might there even be positive ramifications for the other fragile heritage sites of the northern part of Cyprus as a whole, and indeed for the endangered heritage of other unrecognised 'states' worldwide? It seems that with the rapid development of visualisation technologies, anchored by solid academic research, there might now be room for optimism in terms of re-engaging international scholarship and engineering know-how with monuments previously deemed out of reach.

Endnotes

1. For a full text of the London Charter see 'The London Charter for the Computer-Based Visualisation of Cultural Heritage (Version 2.1, February 2009)', in *Paradata and Transparency in Virtual Heritage*, Drew Baker, Anna Bentkowska-Kafel and Hugh Denard (eds), Ashgate, Farnham, 2012, pp. 73–80.
2. Michael Walsh, '*Othello,* "Turning Turks" and Cornelis de Bruyn's Copperplate of the Ottoman Port of Famagusta in the Seventeenth Century', *Mariners Mirror*, November 2012, pp. 448–466.
3. C Enlart, *L'Art gothique et la Renaissance en Chypre*, vol 2, Nabu Press, Paris, 1899; English translation: D Hunt (trans) *Gothic Art and the Renaissance in Cyprus*, Trigraph, London, 1987. George Jeffery, 'The Orthodox Cathedral of Famagusta, Cyprus', *The Builder*, vol. 87, 1904, pp. 31–4; George Jeffery, 'Notes on Cyprus, 1905' *Journal of the Royal Institute of British Architects*, vol. 8, 1906, pp. 481–93; George Jeffery, 'The Byzantine Churches of Cyprus' *Proceedings of the Society of Antiquaries London*, vol. 28, 1916, pp. 111–34.
4. Thomas Kaffenberger, Harmonizing the Sources: An Insight into the Appearance of the Hagios Georgios Complex at Various Stages of Its Building History, forthcoming.
5. This kind of interference was evidenced by the recent documentary *Cave of Forgotten Dreams* (Werner Herzog, 2010).

6. H Rua and P Alvito (2011) 'Living the past: 3D models, virtual reality and game engines as tools for supporting archaeology and the reconstruction of cultural heritage - the case study of the Roman villa of Casal de Freiria', *Journal of Archaeological Science*, vol. 38, no. 12, 2011, pp. 3296 – 3308; Les 84 and Chateau Versailles, 'Chaos To Perfection - A tour of Versailles', 2012, available at <http.www.chaostoperfection.com>, accessed 10 September 2012.
7. French developers Les 84 in collaboration with Google Culture and Chateau de Versailles have already made a stand on the use of this kind of technology in order to bring a vibrant feel to cultural heritage and appreciation by creating *Chaos To Perfection* (Les 84 and ChateauVersailles 2012).
8. All information concerning the chronology of the building is presented as in Thomas Kaffenberger, *Harmonizing the Sources – Textual, Pictorial and Material Evidence Contributing to a New Insight Into the Construction History and Original Appearance of the Orthodox Episcopal Churches of Hagios Georgios and Hagios Epiphanios*, in *The Harbour of All This Sea and Realm: Crusader to Venetian Famagusta*, M Walsh, T Kiss and N Coureas (eds), CEU Press, Budapest, in press.
9. See Walsh.
10. The pilgrim Richard Pococke states in 1738: 'St George's, one of the most magnificent [churches], was thrown down by the earthquake.' For Pococke's full account see: Claude Delaval Cobham, *Excerpta Cypria. Materials for a History of Cyprus*, Cambridge University Press, Cambridge, 1908, pp. 251–70.
11. For a more immersive view of the present-day structure, a 360-degree panorama can be viewed at <*http://360.io/Gv92Mj*>, created 26 June 2012.
12. Elizabeth Hoak-Doering 'Stones of the Suez Canal: A Discourse of Absence and Power in Cyprus and Egypt', *Journal of Balkan and Near Eastern Studies*, vol. 14, no. 2, 2012, pp. 199–228; M Walsh, '"On of the princypalle Havenes of the See": The Port of Famagusta and the Ship Graffiti of Its Ruined Churches', *International Journal of Nautical Archaeology*, vol. 37, no. 1, 2008, pp. 115–129; M Walsh, '"The Vile Embroidery of Ruin": Historic Famagusta between Ottoman and British Empires in *Fin de Siècle* Cyprus: 1878–1901', *Journal of Intercultural Studies*, vol. 31, no. 3, 2010, pp. 247–269.
13. The works were initiated by Theophilus Mogabgab, head of the Department of Antiquities at that time. Theophilus Mogabgab, 'Excavations in Famagusta', *Report to the Department of Antiquities Cyprus* 1935 (1936), pp. 20–22; Theophilus Mogabgab, 'Excavations and Improvements in Famagusta', *Report to the Department of Antiquities Cyprus*, 1936/II (1939), pp. 103–105; Theophilus Mogabgab, 'Excavations and Researches in Famagusta 1937–1939', *RDAC*, 1937/1939 (1951), pp. 181–90.
14. Private communication between Carras and Walsh.
15. Private communication between Møller and Walsh.
16. R Silman and K Severson, *The Historic Walled City of Famagusta*, World Monuments Fund, New York City, 2008.