Virtual Palaces

Part I. Digitizing and Modelling Palaces

Leuven, 18–19 November 2011

ABSTRACTS

Ana Almagro Vidal (Historic Heritage Conservation Department, Fundación Caja Madrid): *Islamic palaces of Al-Andalus. A perceptive approach through virtual reconstruction*

Computer graphics has a solid area of application in the field of cultural heritage if it is approached as an instrument to facilitate debate on the study of architectural heritage that has disappeared or been transformed. There is no doubt that the possibilities opening up, once the model has been generated, provide interesting ways of conducting spatial analysis and its evolution in time approaching this architecture in a way that is unthinkable using traditional means. Supported with the huge possibilities offered by being able to change scene and model parameters at a given moment, we can focus the use of this technique on comparing different states in time as well as reconstruction possibilities.

Based on a rigorous and scientific working method, digital perception through the 3D model is used as a procedure for study, analysis and establishing hypotheses, helping to better understand the development of architectural features that nowadays are no longer evident. The virtual reconstructions that will be presented in this paper are the result of the study and research developed by the author in collaboration with the research team of the School of Arabic Studies – CSIC in Granada.

The analysis of these series of Islamic palaces spread throughout the geography of Al-Andalus between the 11th and the 15th century will permit to understand the spatial evolution of palatine architecture developed in Spain during that period and will stress the importance of facilitating in the future the perception of these palaces' original form through virtual applications as well as to discover and understand through the 3D models some cultural features that could have inspired their architectural original design.

Session I. Digitizing and Modelling the Castle of Arenberg

Bill Blake (ICOMOS UK), **Björn Van Genechten** (University College St. Lieven/ K.U.Leuven) & **Krista De Jonge** (K.U.Leuven): *The integration of metric data with historical context at Arenberg Castle, Heverlee. Telling the story from the evidence of social, architectural and domestic functions revealed in the interpretation of 3D and 2D measured work by RLICC 2000-2011*

Metric data from the numerous campaigns of both student practice and research survey has provided a valuable framework for analysis of the plan, the volumes and the connections of the

components of the castle. Although the primary purpose of the documentation skills week, organised by RLICC, has been technique acquisition by students, a good body of data has been achieved and this has been enhanced with a comprehensive laser scan survey of the exterior. Working with the historic context presented in the unique *Albums de Croy, Hertogdom Aarschot* and metric data sources including 3D wireframe, rectified photography and measured drawings, some aspects of the history of the castle can be tested by a mix of regression study, 'best fit' matching and volumetric clash detection to show how the fabric as we see it today came to be.

In particular the alignment of the South façade, the connection between the towers and the evolution and influence of the location of the domestic East range are investigated in an attempt to decode the sequence of construction. An interpretation of the design module used for the castle is also investigated. In preparing this exploration of both structure and data the co-operation between historian, surveyor and graphics artist are shown to be essential in the determination of the utility of the measured data and its presentation. The reaction to the significance of the castle at regional, local, architectural, technical and social levels is recognised by the quality of the documentation presented and hopefully reflects the spirit of Charles II of Croy in its diligence.

Session II. Virtual Models as Research Tools: Case Studies - I

Károly Magyar (Budapest History Museum): *The changing ways of the visual and physical reconstruction: a case study on Buda Castle*

The excavations aiming to find the remnants of the medieval royal palace/castle at Buda started in 1948 and were closely connected with the reconstruction works of the Baroque and Modern Age palace-complex, which fell into ruins during World War II. The first phase of the excavations – carried out until the beginning of the 1960s – brought to light several *in situ* vestiges, and beside them a huge number of scattered architectural fragments. The head of the digging works, László Gerevich, and his excellent team worked out a special method for the documentation of both kind of these 'finds'. Their work, nevertheless, did not stop at the much detailed survey of these elements. Based on them they also made visual (drawn) reconstructions of some areas of the complex, especially the different sections of elevations. These drawings were published in Gerevich's great monography, the *Budai vár feltárása* (*The excavation of Buda Castle* – Budapest, 1966). At the end of this book – as a conclusion of the aforementioned partial reconstruction views – is attached a general reconstruction depicting a possible view of the palace around the 1530s.

The visual reconstruction of the details made by Gerevich's team was highly appreciated and utilised by the architect László Gerő, who was in charge of the physical reconstruction works of the recovered vestiges. He, however, realised a series of plans that were generally much more restrained than the ones of Gerevich, but that were in accordance with the given opportunities.

All these have long been well known by the experts dealing with the topic. It has, however, just recently been recognised that the published material was only a minor part of a series of reconstruction drawings containing the less two or three variations on almost every single site and also on some wider areas.

In my paper I would like to present the methods of the step-by-step survey and visual reconstruction work of László Gerevich and also the final results of physical reconstruction realised – at least partly – on this basis by László Gerő. Finally, I would also like to flash up some most recent ways of virtual reconstruction opened up by the computer era.

J. García, J. Martinez, J. J. Fernández, J. I. San José, R. Martínez, F. J. Delgado, J. Finat (University of Valladolid): *A hybrid methodology for documentation, information and management systems. A case study for the Palatial Complex of the Alcazarejo and the Alcázar of Valladolid*

Disappeared palaces pose difficult problems for the early documentation phase from archaeological vestiges. The fusion of image- and range-based information arising from different devices is acknowledged as the most complete approach following a bottom-up methodology. The fusion is performed along several stages, following usual phases corresponding to the capture (with different devices), processing (filtering, grouping, cleaning) and analysis (reprojection on a common model, extraction of geometric primitives, linking of polygonals, volumetric segmentation). The resulting output is a 3D global model corresponding to the current state of the building, which can be visualized to different resolutions.

The second block concerns the adaptation of Information Systems, following a strategy which extends the usual 3D GIS methodology based in raster and vector data; some meaningful extensions concern the treatment of information in terms of arrays (including raster and vector data) with a temporal label, which allows to display the same spatial environmental along different centuries. The volumetric model is managed in different layers (following the same methodology as for usual GIS) which can be grouped following criteria linked to different users (experts in Architecture, Archeaology, History ... or citizens in general), which can obtain the permission from the administrator for inserting additional contents, and improve results in a collaborative framework. The information management is performed in terms of specific Cultural Heritage Ontologies in the Open Source framework provided by CityGML; our Ontology has a lexicon (collection of key words), thesauri (different meanings for key words) and taxonomies (systems of logical rules for managing knowledge), which have been developed according to W3C standards to improve the interoperability between different tools and repositories. The resulting output is an updatable Open Information System which supports different functionalities linked to Cultural Heritage environments with links to other similar repositories.

The third block concerns Management Systems and it is focused towards the reconstruction of a Cultural Space. It has two large sub-blocks relative to experts and citizens in general. Experts can arise from Administration (usually in charge of cultural goods), architects and archaeologists (for re-interpretation of space and the culture), and Computer Science (with a special regard to Computer Graphics, and more specifically, advanced rendering) for solving software development issues. Citizens are more interested in external functionalities linked to the Advanced Visualization model which allows the visualization to different levels of detail, including virtual reality models (extending visible data), and remote or in situ interactions in monitored environments from mobile devices. The final output for this block is the generation of a module of Advanced Visualization able of giving a support to experts and citizens in general.

Richard Kurdiovsky (Austrian Academy of Sciences) & **Herbert Wittine** (Vienna University of Technology): *Re-building the Hofburg of Vienna*

The virtual modelling of the Hofburg in Vienna, the former palace of the emperors of the Holy Roman Empire, is an important part of the scientific work currently undertaken by the Hofburg-research project of the department of history of art of the Austrian Academy of Sciences. The Hofburg's architectural history will be presented in a virtual model of the palace and its components (including the surrounding urban structure and the natural landscape) in

approximately two dozens of time layers from the Middle Ages to the 20th century. The project covers reconstruction (of lost parts) as well as construction, since in a reflexive sense, the actual state of the building offers both a main source and a point of reference for the modelling. Therefore, this paper is of relevance for both workshops in Leuven and Munich.

The major part of the digitized basic information is formed by different kinds of elevation data, three-dimensional scan recording is used only collaterally. Classical sources are archaeological results and findings as well as the analysis of written documents and visual references like vedutas or plans. The degree of accuracy of detail depends on the quality and quantity of these primary sources of which records are kept according to the London Charta from 2009. In this special regard, Daniel Suttinger's illustration of the Ottoman emplacement in front of Vienna's Hofburg from 1683, is often used to depict the edificial situation of the Hofburg because of its many details and clear design. As a bird's eye view it offers a good survey of the whole area and allows to get a glimpse of parts that are usually hidden by the palace's defensive system. But closer observation reveals many inconsistencies that cannot be matched with other vedutas of the Hofburg. Only the synoptical interpretation of numerous sources from different fields and different periods allows to clarify how the terrain profiles of the fortifications relate to different parts of the palace in size, height etc. Due to their flexibility, virtual reconstructions that are based on these informations not only enable to check the plausibility of these assumptions, but also to reassess the information content of Suttinger's vista – that finally turns out not to be smaller than expected, but only more complex.

It has been foreseen to use the results of the virtual modelling for popular media like animated film or for media with a broad public like exhibitions and for tourism in general.

Session III. Virtual Models as Research Tools: Case Studies - II

Anca Bratuleanu (Ion Mincu University of Architecture and Urbanism, Bucharest), **Giovanni Mataloni** (G. d'Annunzio University of Chieti-Pescara) & **Stefano D'Avino** (G. d'Annunzio University of Chieti-Pescara): *Romanian court residences. The Potlogi Palace: history and virtual recording as restoration tools*

The court residences in Walachia – the historical province situated in the Southern part of Romania – constitute one of the important chapters of Romanian architectural history and heritage. Their development in the 17th and 18th centuries made the object of studies regarding their architecture seen as a response to the political and economic conditions, as well as to the social need of representation of their owners. Among them, Constantin Brancoveanu, the ruler prince of Walachia (1688-1714), was the creator of a new pattern of such residences: the palaces he ordered were built to shelter the prince and his suite all along a summer itinerary repeated every year. Their architecture reflects the prince's exigencies regarding the ceremonial and the etiquette the court should observe. The Potlogi palace (erected in 1698) was the first to present the characteristics of this new orientation; its architectural features will constitute the pattern for the court residences built later by the prince. The next fifty years, the Romanian "boyars" borrowed the same architectural characteristics – at a smaller scale – for their court residences.

Using this case study, the presentation will put in light the way in which the historian's tools could be helped by virtual recording methods; together they constitute a good basis for the study of the extant state of the historic building. Furthermore, the results of the historic architectural research and the effective use of digital tools could contribute to a correct decision regarding intervention/restoration; they will help as well the completion of an accurate analysis of the whole structure at the end of the restoration process.

(This paper is the result of the work of an interdisciplinary team - working together with students from both our Universities - during the investigation of the Potlogi palace, within the

framework of the Cooperation Convention between the Department of History & Theory of Architecture and Heritage Conservation from "Ion Mincu" University of Architecture and Urbanism, Bucharest and the Dipartimento di Scienze, Storia dell'Architettura, Restauro e Rappresentazione, Università degli Studi "Gabriele d'Annunzio", Chieti-Pescara.)

Noémie Renaudin (CNRS MAP/Gamsau, Marseille), **Bertrand Rondot** (Etablissement Public du musée et du domaine national de Versailles) & **Livio De Luca** (CNRS MAP/Gamsau, Marseille): *3D virtual reconstruction and visualization of the Petit Trianon in Versailles*

It is difficult to grasp the complex history of the successive changes made to the furnishings and to the layout of the Petit Trianon. Our ongoing project addresses this challenge. Based on 3D digitizing, high photorealistic rendering, real-time visualization and spatio-temporal data structuring, our approach provides more than a straightforward 3D model of the rooms: it ensures that the content of the rooms is not fixed in its existing state, but enhanced based on additional perspectives. The refurnished virtual rooms are paradoxically more realistic. They are free from the limitations imposed by visitor traffic and security, and presented not in their current fragmentary state, but as a complete whole. Our data structuring method also enables to explore the successive changes to the furnishings over time (integrating pieces of furniture conserved today in different museums in the world), providing a dynamic vision of these spaces.

The current project focuses on the 3D reconstruction and virtual visualization of rooms and their furnishings in their current state.

For more information, visit: http://www.map.archi.fr/3D-monuments/site_trianon

Daniela Oreni (Politecnico di Milano): *The vaults of Villa Reale in Monza: a three-dimensional virtual model for the accurate understanding of their genesis and construction techniques*

Since 1777, Villa Reale in Monza still maintains the original plan designed and built by the imperial architect Giuseppe Piermarini, upon a desire of Maria Theresa of Austria. The transformation of the building in the 19th century concerned only limited portions of the structures, leaving intact the spaces and volumes of the noble floors and main rooms. The modification concerned the finishes and the rich decorations, in order to comply with the changing needs of the court. In fact a new way of life meant a different distribution and use of space and of the functions for each rooms, but not a variation of the original structures.

The survey campaigns of the indoors of Villa Reale in Monza, conducted since 2002 and still in progress, allowed to accurately investigate the geometry of the noble rooms, all covered by brick or wooden vaults. Analysis and cross-checking of dimensional constructive data with information obtained from direct observation of the extrados of the vaults, allowed to deduce important observations on the genesis and construction techniques of the vaults.

This information, compared with Piermarini's original drawings and with the technological information provided by ancient manuals, consented for example a hypothesis on the shape of the wooden centring used for the construction and on the arrangement of the bricks.

The virtual three-dimensional model of Villa Reale was designed using both photogrammetric and laser scanner survey products, in order to build detailed models useful for improving remote access of 3D data. In the future, this kind of models could provide support to advanced programmes for preventive conservation of the architectural heritage, in order to guarantee sustainable interventions and maintenance over time. On the other hand, the virtual models are of great importance for easy knowledge dissemination through a web vehicle, sharing survey products tailored under specific thematic axes of interest for citizens and general public.

Session IV. Technological, Methodological, and Theoretical Aspects

Rand Eppich (Tecnalia Research & Innovation): *New possibilities, an assessment and the future of three dimensional tools for capturing, modeling and documenting cultural heritage*

Never before in the history of drawing have we been able to record, capture, document, visualize accurately or virtually recreate in three dimensions historic places – not only in 3D but also in the fourth dimension – through time. As recently as fifteen years ago the creation of these virtual places took sophisticated and expensive tools and specialised knowledge and extensive training. An entry level system cost thousands of euro (or more) and countless hours spent in front of small monitors learning very limited software.

But this has changed with the recent explosion of inexpensive (or free) tools and hardware and easier-to-use software thus bringing the cost of recording, creating and visualization within the reach of millions. It is an exciting time as the wide spread accessibility to these tools has opened up new possibilities for creativity and collaboration and has produced countless models of our cultural heritage. In addition, there are new possibilities recording cultural heritage to increasingly high accuracies from laser scanners to high resolution digital cameras. There are also new channels for distributing this creativity via smartphones, augmented reality, fully integrated global positioning systems, user customized content not to mention traditional entertainment channels such as games, movies and television.

This explosion and all the new possibilities deserve a pause and assessment; as well as a 'look back' and 'look forward.' Where are we now? What are some of these new tools and techniques? And how are they being used? Are there good examples out there? Or are most of these virtual palaces of our cultural heritage poorly created? What is going to happen with all this information in terms of storage and future accessibility? Are there possibilities for verification? What are the standards that are out there? Where were we just a few short years ago? And will this help us predict the future?

This discourse will be an attempt to 'take stock' of where we are and address where we have been and where we might be going. It will cover low cost techniques and tools and an assessment of 'older' tools, standards and organizations that may not be known or have been forgotten. It will also cover more advanced tools with the anticipation that expensive technology eventually becomes inexpensive. Indeed, it is an exciting time and such a current assessment will help in taking advantage of what is out there now and what will be coming.

David Lo Buglio (CNRS MAP/Gamsau, Marseille) & **Livio De Luca** (CNRS MAP/Gamsau, Marseille): *Comparative study of the cognitive aspects contained in the 3D representation of cultural heritage: review of six technical and methodological approaches*

This paper focuses on the epistemological aspects surrounding the architectural survey. It offers a critical review of the technologies used (by art historians, archaeologists and architects) in the field of the 3D digitization of architectural heritage. When research seems to use primarily the survey tools to reproduce accurately, even exhaustively, all the morphological attributes of an architectural object, one must pay attention to the cognitive issues of the representation systems. More precisely, the study evaluates how the tools and methods used for the acquisition and representation of data contribute or not to the improvement of our architectural knowledge.

To understand the relationship between technology and knowledge transfer, this paper presents a comparative analysis of the main techniques used for the representation of architectural artefacts. These are initially observed through a set of digitization work done on remarkable architecture. Our approach attempts to identify, for each techniques and methods approached, some factors that improve or alter the set of information conveyed in the

representations produced. This first field of investigation extends from the automatic reconstruction techniques to the manual restitution techniques, including the semi-automatic restitution techniques by Generative Modeling Language.

We propose an approach that focuses on two distinct issues: the first is to set up a reading grid able to describe the cognitive contribution of the observed documents, the second is to compare or cross, the results obtained in order to explore the *tensions* between the acquisition of high-fidelity physical data, the graphical abstraction of architectural elements and the communication of information necessary to evaluate the knowledge mobilized. This critical overview allows to define more accurately a dual issue of a cognitive nature: the first, perceptual, refers to the comprehension of the object and the second, descriptive, refers to the intelligibility of the 3D information model.

Belén Jimenez Fernandez-Palacios (Bruno Kessler Foundation, Trento): *Importance of 3D models for studies and analyses of architectural structures*

Architectural documentation of monuments and historical buildings is a valuable source of information to preserve, reconstruct and restore the existing Cultural Heritage. The creation of digital documentation should be considered a necessity if one wants to document and protect the architectural heritage from degradation and other man-made or natural disasters that may cause its loss. Detailed studies and analyses are in fact required and must be performed by specialists in order to allow architects to define the priorities and procedures before the restoration works actually start. It is therefore essential that an accurate 3D survey is conducted to obtain a detailed geometric model of the heritage, which will serve as reference for the successive studies.

Nowadays, Geomatics has become a strategic and vital tool for the management of Cultural Heritage for sustainable development and cultural tourism, monitoring and emergency management of heritage sites, etc. Geomatics embraces and integrates disciplines such as topography, cartography, photogrammetry, remote sensing, laser scanning, Geographic Information Systems (GIS), Global Navigation Satellite Systems (GNSS), geo-visualisation and geospatial data analysis. Thanks to the technical advances in the last years, it is nowadays possible to acquire large amounts of data quickly and accurately, so that cultural heritage sites can be reproduced in digital form at very detailed level of detail.

This paper reports primarily two case studies and 3D modelling experiences aimed at documentation, study, analyses and preservation of heritage monuments and sites. Both projects deal with theoretical, methodological and technological aspects of the archaeological and architectonical research. The first case study is about the Etruscan hypogeous frescoed tombs, dating back to VII-IV century B.C. where detailed 3D models were used to verify archaeological hypotheses and derive metrically accurate maps. The second case study deals with experiences related to mountainous and hill-top medieval castles located in the Trentino-Alto Adige region in northern Italy where 3D records are the basis for architectural restoration and conservation purposes.

Session V. Poster Presentations

David Tingdahl (K.U.Leuven) & **Luc Van Gool** (K.U.Leuven): *3D modelling of immovable heritage with ARC3D*

As a result of recent advances in computer vision, it is now possible to create accurate and visually pleasing 3D models using only digital photographs. In contrast to active methods such as laser scanners, image based methods are cheap and simple as the only hardware required is a

digital camera. It is also considerably faster, as one can shoot images continuously while walking around the object. This makes image based 3D reconstruction especially suitable for large, immovable heritage: a whole building can be captured in the time frame of hours, rather than days.

In this work, we present the recent advancements of ARC3D, our own 3D modelling tool. ARC3D is a web service that runs on our computer cluster in Leuven; the user simply uploads pictures to us which are automatically turned into 3D by our algorithms. ARC3D is completely free to use for non-commercial purposes. The service has recently received a major upgrade and does now produce a complete and textured ready-to-use 3D model instead of individual depth maps.

As a concrete example of the capabilities of the system, we demonstrate how ARC3D is used to create 3D models of the Arenberg Castle in Leuven. The resulting models can be used in fields such as digital preservation and virtual tourism.

Miklós Rácz (Hungarian National Museum, National Center for Cultural Heritage): *Digital modeling of the existing building remains as a basis of analysis and reconstruction in the case of the castle Csesznek, an early 15th-century country residence in Hungary*

An important but in many cases missing link between reality and virtual reconstruction of building remains and past building phases is a digital model of the existing situation that is capable of representing the current state, its components, building phases and research results as the basis for reconstruction.

Nicholas Gara, Palatine of the country (1402-1433), a chief supporter and later brother-in-law of Emperor Sigismund of Luxemburg received the castle with his brother John as a royal donation in 1392. The Palatine and his family completely rebuilt the existing castle by 1424, commemorated by a building inscription.

The castle Csesznek comprised of the three-storey central block of the upper castle, an eastern tower and two perimeter walls, the outer of which enclosed the lower castle. It is one of the few mountain castles built on a completely new layout in the late Middle Ages. The spatial and functional system of the early 15th-century castle underwent later modifications, but its extensive ruins with the results of archaeological excavations, more recently led by the author provide a firm basis for study and reconstructive considerations.

In the model of the ruins early modern and 20th-century additions could be treated separately from the medieval fabric, while attempts were also made to reconstruct modern-period losses to the ruins. This way research helps provide an advanced model of the ruin that can be a reliable base for reconstruction.

The project represents a digital model as a research database at the outset stage of virtual reconstruction.

Inga Genytė (Vilnius Gediminas Technical University, Lithuania): *Recovery aspects of the Castle Palace in the Baltic Sea Region*

The objects of our investigation on regeneration methods are the Castle Palaces in the Baltic Sea region. For recovery of the Castle Palaces, traditional and innovative methods are used, either selecting one or combining several methods: traditional recovery methods, when ancient techniques of a specific time and place are used; innovative techniques, when reproduced with modern materials, close to the ancient materials, or in a contrasting way, when invasive elements are used. By combining several techniques there is a possibility to achieve a good result for aesthetic and functional needs. Before the restoration works, virtual image recovery

technology is used to achieve better results. Three-dimensional images created with special programmes are used to present the vision of the restoration.

Major factors that have an influence when forming the building's architectural vision are: the urbanistic setting, the remaining authentic material, and contemporary theory on the conservation of monuments.

The result of all these factors is the architectural concept of the palace's restoration: 1) The volume of the Palace and its external façades are to be recreated (restored) with the support of visual material, archaeological findings, and studies on similar objects; 2) The façades of the building's courtyard, of which there is no surviving information, would be designed with more caution; 3) The entire volume of the above-ground building is to protect and exhibit as much as possible of the most valuable part of the object: the authentic remains of the palace.

Martina Ballarin (Università IUAV di Venezia): *Digital technologies for knowledge: the 3D model of the Tribuna of Palazzo Grimani in Venice*

The paper concerns the study and creation of a 3D model of the Tribuna of Palazzo Grimani in Venice, a room built during the sixteenth century when the palace was transformed and two new wings were added. This reconstruction was promoted by its owner, Giovanni Grimani, patriarch of Aquileia and well-known aristocratic protector of artists. After this reconstruction the entire palace became a display of Giovanni's religious devotion and passion for ancient art. At the corner of the two new wings was the Tribuna, a room built to be a monumental container for his antiquarian collection. The Tribuna provides an excellent example of how the Renaissance society worked: it is influenced by the artistic culture of South Italy, but it is itself a model for Europe.

The room has been studied through a laser scanning survey, with the support of more traditional methods that initially helped verify, and subsequently test, the precision of the data obtained by the laser scanner. Our decision to utilise this technology was determined by its capacity to acquire information on the geometry of such a complex object in an accurate, fast and non-invasive way.

The analysis of the data obtained by this instrument allowed us to identify some interesting geometries probably used for the construction of this room. In fact, the main task of this work was the realization of a proportional study that allowed us to identify the geometric rule used to build the room. In the end, we created a digital model of the room, useful for studying and spreading the knowledge of this space. Moreover we could virtually place the original statuary inside it: this product would represent the Tribuna as it was in the sixteenth century, before the statues were moved to the National Archeological Museum of Venice.

Session VI. Virtual Reconstructions and their Uses

Ignacio Arce (Director Spanish Archaeological Mission to Jordan): *Qasr al-Hallabat, Qusayr'Amra & Qastal. Three case studies of virtual reconstruction of palatine architecture between late antiquity and the early Islamic period*

Since 2002 the excavation and restoration project of the palatine complex of Qasr al Hallabat/Hammam as-Sarrah has uncovered a unique sample of palatine architecture that illuminate the transitional period from Late Antiquity till the advent of Islam. A former Roman fort of the Limes Arabicus was transformed into a palace *cum* monastery by the Ghassanids, the Christian Arab *foederati* entrusted with the defence of the borders of the Roman Empire from the 6th C. AD onwards. After the Islamic conquest, the Umayyad caliphs refurbished further the

complex as one of the desert palaces (*qusur*, sing: *qasr*) used as a key element of the clientelar policy that supported their power in the region.

The analysis of the material evidence has offered an unique insight to the socio-political transformations that marked the shift from Late Antiquity to Early Islamic period. All the evidences gathered in years of analysis and study have allowed the reintegration of the original appearance of the complex throughout the ages by mean of virtual reconstruction models, illuminating these changes that were the ultimate reason of the physical transformation of the complex.

Hafizur Rahaman (National University of Singapore) & **Mizanur Rashid** (International Islamic University Malaysia): *Revisiting the past through virtual reconstruction: The case of the Grand monuments of Paharpur, Bengal*

This study aims at developing a virtual model of the lost architectural heritage of the Buddhist Monastery of Sompur Mahavihara at Paharpur, Bangladesh. The ruins of the 8th-century monastery have been listed as a UNESCO World Heritage Site since 1985, which is also one of the earliest evidence of monumental architecture in Bengal. The monument drew the attention of the architectural historians of South and Southeast Asia from the very discovery of the ruins because of their unique architectural features and strategic spatio-temporal location. However, the architecture of this monument was scantily documented because of the unavailability of first hand resources after the amnesia of a millennium. The fragmented archaeological resource, literary evidences and epigraphic records at the disposal of the architectural historians appears as the main thicket. This study is an attempt to develop a virtual model of Sompur Mahavihara that would accommodate different contesting narratives regarding its architecture. It looks into the history in a more dynamic way and uses virtual reconstruction as flexible tool to reconstruct the lost monument.

The main scope of this paper therefore remained twofold. First, to develop a methodological framework for retrieving and commemorating both tangible and intangible aspects of the monastery, perusing a critical theoretical construct, and finally to apply this knowledge to develop a conjectural virtual reconstruction. Second, to develop an online interactive platform to collect public comments and contributions regarding the past culture and history of Sompur Mahavihara, so as to reinvent and renew the previous model. We hope this participatory approach of reconstructing will minimize the distance between the people and object of heritage as well as engender a new way of exploring, experiencing, evaluating and appreciating heritage buildings.

João Neto (Instituto Superior Técnico, Lisbon), **Maria Neto** (History of Art Institute, University of Lisbon) & **Ricardo Silva** (Instituto Superior Técnico, Lisbon): *Historic buildings through a multimedia experience. The example of a research project in the palaces of Sintra, Portugal*

We are currently in the process of making a series of interconnected multimedia applications, in order to value and enliven the cultural heritage in the palaces of Sintra, Portugal. These applications heavily rely in making 3D models with high quality standards, focused on replicating the original buildings with precision. This process is virtually impossible to accomplish unless the model is obtained by combining a set of *state of the art* technologies, such as laser scanning and photogrammetry. Like no other methods, these techniques allow to create models with complete reliability from the original architectural structure. This technology permits to digitally record in high resolution and accuracy the geometry, dimensions, positioning, textures and materials of the building and also mapping the pathologies and issues.

The project *Fala Comigo* (Talk2Me) incorporates the 3D models in multimedia applications, which also include Embodied Conversational Agents (ECA's) as a mean of conveying information for educational purposes. This is an interdisciplinary project, since the historians generate the content, and the engineers and technicians will design content-driven multimedia applications. From the work that is being developed, we can highlight a set of serious games, which also include ECA's with voice recognition and speech synthesis, with expressive facial animations to suggest complex emotions.

Any application created for cultural heritage purposes is only proven advantageous if the users profoundly interact with them. The engagement of the user towards the created applications is established by creating a sense of epoch spirit and excitement while the information is delivered. The 3D models play a very active role in transmitting information, mainly from their correspondence to the original buildings. The model's exactness potentiates the user's immersion in the application, thus aiding in the learning process.

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