LESSONS LEARNED FROM CULTURAL HERITAGE DIGITISATION PROJECTS IN CRETE

E. Maravelakis a∗, M. Andrianakis b, K. Psarakis b, N. Bolanakis c, G. Tzatzanis a, N. Bilalis c, A. Antoniadis c

a Design & Manufacturing Laboratory - Technological Educational Institute of Crete, Greece - (marvel, bolanakis, tzatzanis)@chania.teicrete.gr
b Greek Ministry of Culture, 28th Ephorate of Byzantine Antiquities, Greece
c Dept. Production Engineering & Management, Technical University of Crete, Greece – (bilalis, antoniadis)@dpem.tuc.gr

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ABSTRACT:

This paper presents some lessons and experience gained from several cultural digitizing projects in Crete Island. Local Technological Institute introduced modern 2-D and 3-D digitizing technologies to various target groups, closely related with the rich cultural heritage of the island. These projects include 2D and 3D digitising of ancient ceramics, monastery relics and wooden artifacts, 3D modeling and FEM analysis of traditional local musical instruments, 3D modeling and 3D reconstruction of an ancient Minoan scull, recreation of the face of an ancient Minoan man and development of the virtual museum of San Salvadore. The familiarization of archaeologists, local authorities, museum experts, architects and others who worked in these projects with the potential usage and advantages of the new 3D digitising technologies was one of the most difficult and important results.

1. INTRODUCTION

1.1 Crete – An Island full of history

Crete is an island in the southern part of Europe and its strategic important location was the main reason for historically being first priority for many different civilisations and cultures. Known history in Crete starts during the neolithic ages (6,000-2,600 BC) and continues with the famous Minoan Empire (2,600-1,100 BC) which established a naval empire in the Mediterranean during this period. Importing, processing and re-exporting of metal, together with intermediate trade, accumulated wealth to the island. During this time, art and science flourished. The Dorian years (1,100-67 BC) were marked by the first appearance of iron tools, and the deterioration of the Minoan Empire to various city-states. The Romans arrived in Crete at 67 BC as mediators but settled in as conquerors. Under Roman rule, which brought peace and some autonomy to the island, Crete enjoyed a period of prosperity, as many Roman remains show. The island was part of the Byzantine Empire from 325 AD to 824 AD and then converted to Christianity. The Arabs also left their mark on the island, from 824 to 961 AC. Noble families from Byzantium, merchants from Europe and Christians from eastern countries settled in again and rejoined Crete with the Byzantine empire (961-1204 AD). They built 14 forts around the island and fought the Venetian fleet for four years before finally yielding in 1210. The Venetian occupation lasted for 450 years (1204 - 1669 A.D.). The surviving Venetian fortifications and castles remain in good condition today. Many artists and scholars found refuge in Crete during the decline of the Byzantine Empire and after the fall of Byzantium itself. They established schools and Orthodox monasteries. Also literature and art flourished. Despite the Venetian influence, Cretan traditions continued. Crete falls to the Turks in 1669. This occupation lasted until 1878 and then Crete remained autonomous until 1913 when it united with Greece. During the Second World War the Germans occupied the island for 4 years. Crete avoids worst of the following Greek civil war and then the first infantry steps in exploiting archaeological resources started.

1.2 Digitising Cultural Heritage of Crete

All these different civilisations and cultures left their mark on the island. A huge variety of archaeological sites and exhibits from this rich Cretan culture still remains. Furthermore the need for promoting this cultural heritage by means of multimedia applications and by improving processes like cataloguing, studying, preserving and replacing production has become more and more obvious (Maravelakis et al 2006).

2D and 3D digitising equipment of the latest technology provided by the local Technological Institutes of Crete combined with special trained personnel, initialised the process of digitizing the cultural heritage of Crete some years ago. As a result, a close cooperation with local authorities and archaeological foundations was established and some digitising cultural heritage projects started.

This paper presents some lessons and experience gained from selected cultural digitizing projects, run by two local academic institutes and a archaeological foundation: the Technological Educational Institute of Crete, the Technical University of Crete and the 28th Ephorate of Byzantine Antiquities. These projects include 2D and 3D digitising of ancient ceramics, monastery relics and wooden artifacts, 3D modeling and FEM analysis of traditional local musical instruments, 3D modeling and 3D reconstruction of an ancient Minoan scull, recreation of the face of an ancient Minoan man and development of the virtual museum of San Salvadore. One of the main goals of these projects was to become pilot projects in digitizing the cultural
heritage of Crete, a task that for sure needs more than one generation to be completed.

2. SELECTED DIGITISING CULTURAL HERITAGE PROJECTS IN CRETE

2.1 2D & 3D Digitisation of Ancient Ceramics

For this project the standard procedure of a digitising cultural heritage project was followed including:

- Development of an action plan: clear identification of targets, reassuring the appropriate resources needed, selection of the trained personnel, determination of an activities list
- Selection of the exhibits to be digitised
- Adjustment of the available environment for the digitisation process
- Selection of the appropriate equipment needed for the project
- Reassuring appropriate treatment for sensitive and easy to be damaged exhibits
- Selection of metadata and database
- Promotion of the digitised exhibits by means of multimedia applications
- Definition of IPR procedures

A collection of 500 ancient ceramics which came from various excavations and donations were selected. A set of 50 different ceramics were chosen for 3D digitising by 3D scanning. The collection was shared in two different environments: a museum (figure 1) and the archaeological laboratory of the castle of Firkas (figure 2). Different storing and lighting conditions, different time and space availability required a special digitisation approach for each location.

A special light box and white balancing was used in order to achieve uniform light diffusion and accurate colour recording. The Minolta Vivid 910 Vi non contact laser scanner was used to obtain the 3D geometry and texture of the selected ceramics. 3D output formats including contour lines of cross-sections, vrml models and 3d nurbs models were produced (figures 3,4).

Figure 1: 2D digitising process in a museum

Figure 2: 2D digitising process in the castle of Firkas

Figure 3: Different output format of 3D ceramic models

Figure 4: 2D photo and VRML representation of a fish form ancient ceramic
2.2 Monastery relics and wooden artifacts

In the island of Crete, there are more than 4,000 Churches and Monasteries. Monastery relics and wooden artifacts are used for the interior decoration of these buildings. Two of the most famous monasteries in Crete were chosen for digitisation: The monastery of Gonia in Kolimbari and the Monastery of Preveli (figures 5,6).

The exhibits selected for 2D and 3D digitisation included: icons, crosses, books, wooden temples and priest clothes (figure 7). Parts of wooden temples were also scanned for a twofold usage. Creation of 3D models and replica production (figure 8).

2.3 Traditional musical instruments

The most famous local musical Instrument in Crete is the “Cretan Lyra”. There are many “Cretan lyres” manufactures but only a few are famous for the quality of their instruments. This project had two main goals:

- To analyse and compare the acoustic properties of these instruments
- To see if modern 3D scanning and Rapid Prototyping techniques can be applied in order to have a replica with similar acoustic quality

Three of the most famous cretan lyra manufactures were chosen, and their instrument were scanned using the Minolta Vivid laser scanner. FEM analysis was used to analyse the acoustic properties of the instruments (Gymonopoulos et al 2006). An STL model was also created, which was used for the replica production with rapid prototyping (figure 8).

2.4 Virtual Museum, case of San Salvador

Very important archaeological material, gathered from excavations conducted by the 28th Ephorate of Byzantine Antiquities in the city of Chania, as well as from private collections and donations, has created a unique collection which is presented in the museum of San Salvador. This collection, clearly records the historical course of the westernmost county of Crete from the first years of Christianity to, and including, the years of the Turkish occupation. Representative samples of this collection display an outline of the historic and artistic face of the county during the Byzantine and Post-Byzantine periods. The exhibits have been grouped according to type: mosaics, tomb stone inscriptions, murals, icons, architectural sculptures, ceramics and coins.
In this project Multimedia 3D visualising techniques were used in order to create a virtual representation of the museum. Special tripod head and fisheye lens were used to create spherical panoramas of the various rooms of the Museum. In addition 3D scanning techniques were used for the creation of 3D VRML exhibits which were linked with hotspots in the virtual panorama (figure 9). To our knowledge this is the first Virtual Museum in Greece with real 3D exhibits.

2.5 Recreation of Ancient Minoan Scull

Archaeological human bone findings are extremely rare and sensitive. One of the most challenging tasks in archaeology is to obtain the most information that we can get from for these findings, without destroying them.

An ancient Minoan scull of very archaeological importance was found in Crete (figure 10). The main aim in this project was to build an exact replica of this scull that could be used in all archaeological research activities, without using the real one and increasing the possibilities of destroying part or the majority of the scull. For this reason Computer Tomography (CT) scans were used in order to create the 3D model of the scull. Then a Dimension Stratasys SST 778 3D printer was used to get the physical replica prototype (figure 11).

Going one step forward, according to archaeologists, (Poulianos, 1999), anthropologic features show that the modern population of Crete (in a sample of 3000 individuals) remained the same at least from the Minoan Period season and belongs in the native Aegean anthropologic type. Based on these studies and using special software on the 3D skull model, the face of the ancient Minoan Man was recreated (figure 12) (Sfakiotakis et al 2006).

3. LESSONS LEARNED - CONCLUSIONS

Our experience from digitising projects in the island of Crete, during the last 5 years revealed some interesting remarks and lessons.

3.1 General Lessons
- The familiarisation of archaeologists, local authorities, museum experts, architects and others who worked in these projects with the potential usage and advantages of the new 3D digitising technologies was one of the most difficult and important results.
- Virtual representation of 3D exhibits and the virtual Museum proved to be very attractive and useful to archaeologists and other users.
- There was a very good response from Local Authorities and municipalities to the potential usage of 3D technologies. New ideas like 3D digitising of castles, churches, walls and ancient ruins have been emerged and a great demand for new digitizing projects was shown.
- One of the important tasks for the virtual heritage system is how to manage the various kinds of cultural heritage assets (Kwon et al 2001).
- The task of digitizing the cultural heritage of Crete needs more than one generation to be completed.

3.2 Specific Lessons
- The rule in digitizing projects is that unexpected problems may emerge frequently. For example our digitizing team had very difficulties in finding time in the museum when no visitors where allowed. Monks in the monastery were not always so enthusiastic with our team disturbing their usual peace and time of isolation. Many of exhibits were extremely sensitive and difficult to handle. But also small problems made the work more difficult: lighting conditions, lack of
stable power supply, lack of space for setting up the necessary equipment to mention a few.

- The project for digitizing musical instrument showed that still the work of an expert cretan lyra manufacturer can very difficult be copied and reproduced using the available 3D scanning and 3D printing techniques.
- Recreation of ancient sculls or bones with 3D printing proved to be very helpful to archeologists, who since now had tied hands in their research due to a strong possibility of damaging the real exhibit.

4. REFERENCES

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5. ACKNOWLEDGEMENTS

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