Touching an Ancient Stone: 3d Modeling and Augmented Reality Techniques for a Collection of Petroglyphs from State Hermitage Museum.

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***Abstract* — Displaying collections of petroglyphs in a museum so that the exhibits inspire interest in the public can be considered an interesting task of turning the traditional exhibition space into the augmented space with exciting objects providing evidence of cultural developments in the Bronze Age. The paper discusses the workflow of acquiring, processing and displaying 3D data for a collection of petroglyphs with carved images (Okunev stones) from the State Hermitage Museum in Saint Petersburg, Russia**

***Index Terms* — Okunev culture; State Hermitage Museum; 3D modeling; Augmented Reality**

I. INTRODUCTION

The Bronze Age imagery from the Sayan mountain ranges, particularly, those from Okunev culture in present-day Khakassia (Russia) are an interesting representation of Siberian cultures influenced by incoming cattle herders from Eurasian steppes. The images carved on Okunev stelae tend to be related to third millennium BCE and they provide the evidence which could be interpreted to make judgements about some cultural developments in the Bronze Age [1], [2]. Constraints of physical access and handling and the difficulties of interpreting an image which is often «over-pecked, overlaid or of questionable clarity» [1] made museum curators think about 3D modeling and viewing using large-screen displays for petroglyphs early in the age of creating digital collections at museums [3]. Recent papers suggest the necessity to use 3D modeling to register, document and visualize "the excavated archeological heritage" [4], in general, and rock art, in particular [5], [6].

The paper focuses on the methods of acquiring, processing and displaying 3D data for cultural heritage through augmented reality (AR) for the State Hermitage (Saint Petersburg, Russia) collection of Okunev stones with carved images (petroglyphs). Although some high resolution images of petroglyphs from the same geographic area have been posted online and catalogued by the University of Oregon Libraries [7], Siberian petroglyphs from museum collections have never been displayed and augmented to add to our understanding of the stones' texture, shape and geometry. What can museums do to enhance their visitors experience when they deal with large, unknown or unclear objects? What are the ways to trigger people's interest and provoke further questions? What should be done when little information can be obtained from objects' iconography and textual data looks hardly compatible with augmented reality? The paper contributes to AR digital heritage approaches by discussing the best ways to exhibit large archeological objects (rock art) and meet the expectations of the public to see attractive exhibits during their tours of the Conservation and Storage Centre at the State Hermitage Museum in Saint Petersburg.

II. METODOLOGY

The issue of the best resolution for a 3D model and 3D data acquisition to achieve this goal [3] was linked to the best ways of displaying an image and interacting with a digital object.

1) Data Acquisition: Most work on digital data acquisition for rock art needs to be done in the field [5], [6]. This paper discusses image capture done at the Conservation and Storage Centre of the State Hermitage Museum under the conditions of day light. Image acquisition was done with uncalibrated camera Canon EOS 5D Mark II. High resolution gigapixel images for large objects were shot using GigaPan Epic 100 robotic system. GigaPan Epic 100 is a commercially available hardware and software and its use in a museum context is discussed in detail in [8].

2) Data Processing: The Hermitage Museum curator chose the most representative photos of valuable stones. The images were imported into a modeling environment - open source Autodesk 3ds Max 2014 software - and 3D models were reconstructed using a traditional method of polygon modeling. The stone contour was drawn with a tool from the modeling environment with the utmost precision so that we could keep the points at an equal distance. A museum visitor cannot see the back part of an Okunev stone attached to a wall and no data can be acquired regarding its shape and geometry. This resulted in a decision to use deformation tools in the application to get the geometry of the back part. The image was later stitched to the front part and a 3D model was obtained.

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Texture mapping was done with Quixel SUITE for Adobe Photoshop CS6 where a 3D model and stone photo were imported (Fig. 1).

AR user interface was developed by integrating preprocessed 3D models into Unity editor, a commercial engine for building interactive experiences.

Fig. 1. 3D model with texture mapping in Quixel SUITE

III. Expected results and conclusion

Creating an interesting petroglyph exhibition in an in-door environment is not a trivial task. Space and light surrounding a carved stone and rock art are different from the natural environment of Mongolian steppes or Siberian landscapes. An obvious solution is an interactive experience with QR codes attached to a card, large screen and computer with a camera. The resulting experience of visitors watching themselves hold and manipulate a petroglyph is supposed to have an effect of «participation, collaboration, and interactivity» [9]. Although the allure and integrity of seeming participation and illusion of creativity have been questioned in recent papers (ibid.), triggering visitors' interest in a collection of carved stones which represent the cultural developments of the Bronze Age using 3D modeling and AR interactive experience might be a useful step towards approaching this important issue of digital heritage research.

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