REPORT ON THE 3D-SCANNING AND PHOTOGRAPHY PROJECT, NATIONAL MUSEUM OF THE SUDAN, KHARTOUM (24. 01. – 04. 02. 2010)

ZPRÁVA O PROJEKTU 3D-SKENOVÁNÍ A FOTOGRAFOVÁNÍ V NÁRODNÍM MUZEU SÚDÁNU V CHARTÚMU (24. 1. – 4. 2. 2010)

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Abstract

In January and February 2010, the Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague, in co-operation with the Faculty of Environment, Jan Evangelista Purkyně University in Ústí nad Labem and the INSET s.r.o. and Emeran 1860 s.r.o. companies, carried out a 3D-scanning and Photography Project in the National Museum of the Sudan in Khartoum. The objective of the project was to test two models of 3D handy scanners on various types of objects and to ascertain the possibilities and limits of their use in documentation, archiving, presentation, and protection of cultural heritage of (not only) the Sudan.

Abstrakt

V lednu a únoru 2010 uskutečnil Český egyptologický ústav FF UK v Praze ve spolupráci s Fakultou životního prostředí Univerzity J. E. Purkyně v Ústí nad Labem projekt 3D skenování a fotografování v Národním muzeu Súdánu v Chartúmu. Cílem projektu bylo vyzkoušet dva odlišné modely 3D ručních skenerů na různých typech objektů, a tím zjistit možnosti a limity uplatnění 3D ručních skenerů při dokumentaci, archivaci, prezentaci a ochraně kulturního dědictví (nejen) Súdánu.

Key words: *sudan, 3D-scanning, photography, documentation*

Klíčová slova: *Súdán, 3D skenování, fotografování, dokumentace*

Introduction

In January and February 2010, the Czech Institute of Egyptology, Faculty of Arts, Charles University in Prague, in co-operation with the Faculty of Environment, Jan Evangelista Purkyně University in Ústí nad Labem and the INSET s.r.o. and Emeran 1860 s.r.o. companies, completed a 3D-scanning and Photography Project in the National Museum of the Sudan in Khartoum. The objective of the project was to carry out, in close co-operation with the Sudanese colleagues, a high-tech 3D-scanning of selected monuments in the National Museum of the Sudan in order to ascertain the possibilities and limits of the use of 3D handy scanners in documentation, archiving, presentation, and protection of cultural heritage of (not only) the Sudan.

In the scope of the project, two different models of portable 3D scanners were employed:

The first of the devices, the ***VIUscan***, is a self-positioning 3D scanner that records texture of objects in the range of 50 to 250 dpi in RGB colours. The record is created while scanning 3D surface and constitutes part of the whole result of files acquired. The scanner has two cameras and provides resolution at three levels.

The second model of self-positioning scanners used, the ***EXAscan***, offers increased resolution and accuracy, brought about by a third camera. The high accuracy and resolution are compensated by the absence of colour in the record.

Both models of self-positioning 3D scanners are highly suitable for various tasks in heritage preservation, such as representation of art pieces for multimedia presentations, virtual museums, digital archiving, production of replicas for commercial and marketing purposes, damage assessment, restoration of cultural heritage, virtual restoration, 3D reproduction of archaeological/historical sites, and scanning of fossils for analyses.

Methodological approach

The objects for the 3D scanning were pre-selected in the course of preparation of the project in Prague. The list of objects was later updated in the course of the project according to the availability of objects and the experience gained during the actual works. All objects to be scanned had to constitute a challenge for the scanners and, at the same time, range among attractive artefacts from the collection to be used in presentation of the National Museum of the Sudan.

The documentation of each object selected by 3D handy scanners involved the following processes:

1) removal of dust off the surface to be scanned;

2) placement of positioning targets onto the surface (Fig. 1);

Fig. 1 – Removal of dust and affixing the positioning targets. Photo Jaroslav Kroužek.

3) creation of co-ordinates using the positioning targets;

4) actual scanning of the artefact, in the case of VIUscan sometimes performed in two steps, with the first scanning performed at high resolution and the other scanning focused on the scanning of texture (Figs. 2 and 3);

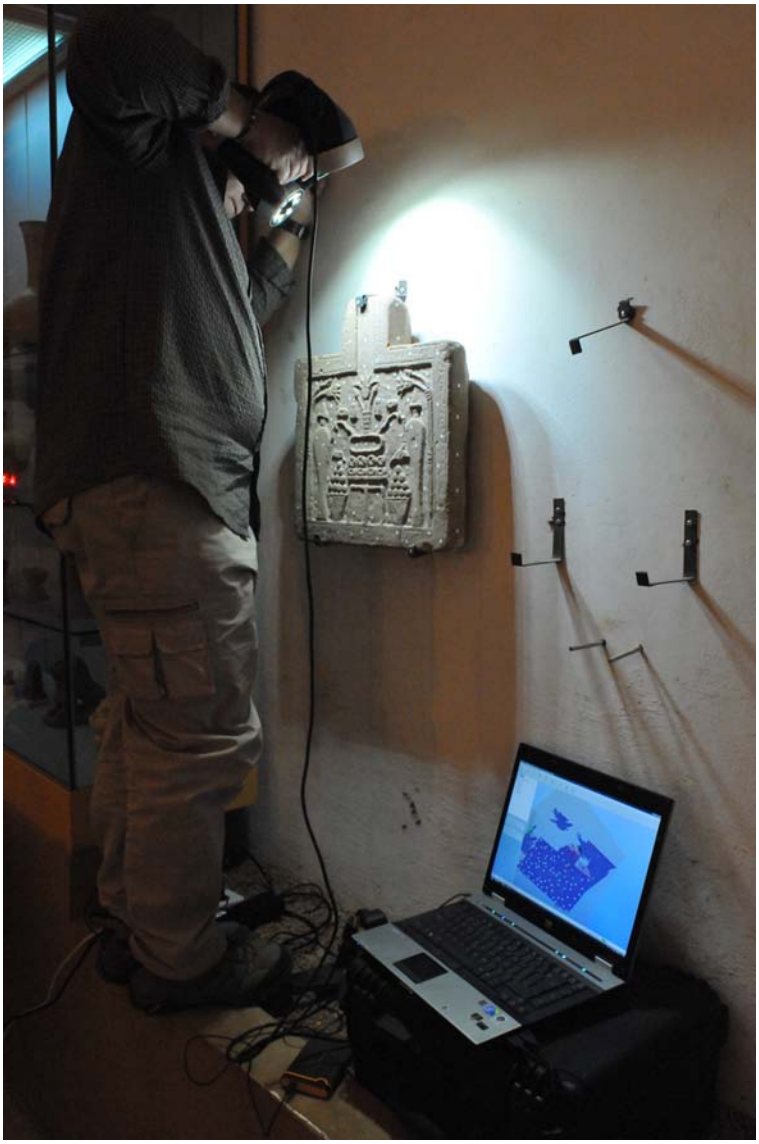

Fig. 2 – Scanning with the VIUscan 3D handy scanner. Photo Jaroslav Kroužek.

Fig. 3 – Scanning with the EXAscan 3D handy scanner. Photo Jaroslav Kroužek.

5) removal of positioning targets.

For the purposes of the project, necessary photographic documentation of the objects and artefacts was taken in the course of the works.

Results of the project

Altogether 17 objects were scanned by either VIUscan or EXAscan or in co-operation of both models during 9 working days in the National Museum.

Sandstone altar (base for a barque) with a hieroglyphic text in sunk relief on one side (Object No. 1)

Free-standing object in the Inscriptions Hall in the garden of the National Museum

Reasons for scanning: On one of the sides of the altar there is a hieroglyphic inscription in sunk relief (three columns of text).

Description of work: The hieroglyphic inscription was scanned by VIUscan in colour at middle resolution for both surface and texture.

Date of scanning: 24. 01. 2010 (VIUscan)

Sandstone block with a relief from Jebel Sheikh Suleyman (Object No. 2)

Free-standing object in the Inscriptions Hall in the garden of the National Museum

Reasons for scanning: A large block with a raised relief and later hieroglyphic inscriptions engraved into the surface offered the opportunity to test the compatibility of the two models of 3D scanners when documenting a single object.

Description of work: The side of the block with relief scanned by both types of 3D-scanners in co-operation, in the same accuracy – middle resolution. The whole block was divided in 14 sectors (cubes), with left part (6 cubes) scanned by VIUscan in colour and with right side (8 blocks) scanned by EXAscan without colour. Sector E1 subsequently scanned by VIUscan in colour at maximum resolution of texture (250.00 dpi) (Fig. 4) and by EXAscan at maximum resolution with the third camera (Fig. 5 – the green line indicates borders of the cubes or sectors, they overlap).

Date of scanning: 24. and 25. 01. 2010 (both scanners)

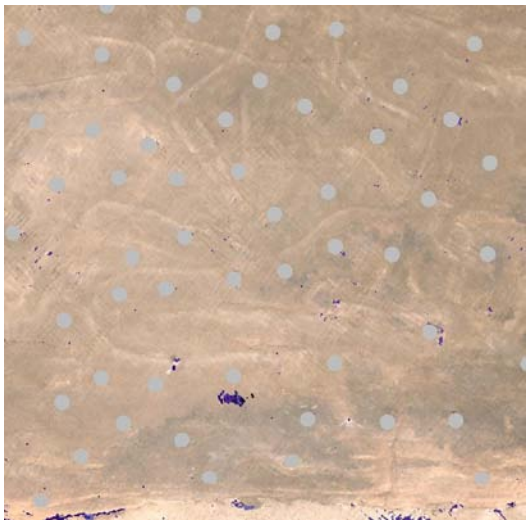

Fig. 4 – Raw scan of the inscription with texture and colour acquired by VIUscan (prior to processing).

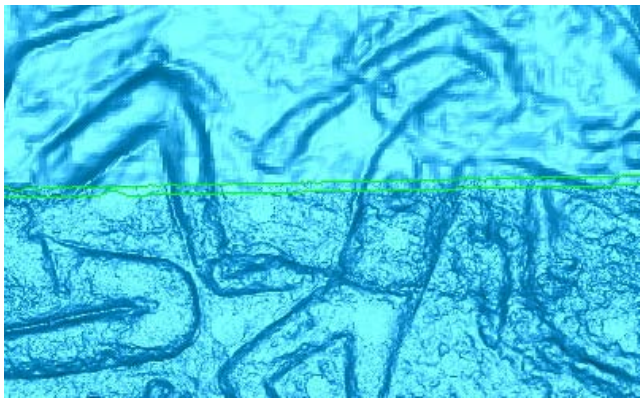

Fig. 5 – Detail of the high resolution sample acquired by EXAscan (partly processed).

Black granite stela of the royal scribe Amenemhat, 18th Dynasty (Object No. 3)

Free-standing object in the exhibition hall of the museum building

Reasons for scanning: The upper part of the stela bears an offering scene, below which there are 10 lines of hieroglyphic inscription. All in fine sunk relief, painted in yellow colour.

Description of work: Both types of scanner used. The stela was divided in 6 sectors (cubes). All were scanned first by VIUscan in colour with texture at 200 dpi and high resolution, Sector E scanned in colour at resolution of texture at 250 dpi. Subsequently, Sectors A and C were scanned by EXAscan at high resolution with the third camera (Fig. 6 – detail is shown in side light to emphasise the sunk hieroglyphs).

Date of scanning: 25. 01. and 26.01.2010 (VIUscan), 26. 01. and 27. 01. 2010 (EXAscan)

Fig. 6 – Detail of the scan acquired by EXAscan (without texture and colour, partly processed).

Sandstone offering table, Meroitic Period (Object No. 4)

Free-standing (hung) object in the exhibition hall of the museum building

Reasons for scanning: A raised relief on an object to be scanned as one cube (sector).

Description of work: The face of the offering table scanned first by EXAscan at high resolution and with the third camera. Subsequently, the same object scanned by VIUscan in colour at high resolution and with texture at 200 dpi.

Date of scanning: 25. 01. 2010 (EXAscan), 26. 01. 2010 (VIUscan)

Black granite obelisk of Pianchi, Napatan Period (Object No. 5)

Free-standing object in the exhibition hall of the museum building (Inv. No. 462)

Reasons for scanning: A larger 3D object (132 x 24 x 24 cm) to be scanned on all sides. The object features a column of hieroglyphic inscription in sunk relief running through the smoothed central section of each side of the obelisk and rougher texture on the corners (or edges) of the obelisk due to later rounding-off.

Description of work: The object, divided in 5 sectors (cubes) was scanned by EXAscan at high resolution without third camera.

Date of scanning: 25. 10. and 26. 01. 2010 (only EXAscan)

Faience plaque (amulet) showing three deities, el-Kurru, Napatan Period (Object No. 6.1)

Showcase F1 in the exhibition hall of the museum building (Inv. No. 02022, or 2023)

Reasons for scanning: A small object (max. width 7.4 cm, max. height 8.8 cm, max. thickness 0.7 cm) with raised relief to be scanned on a plate with pre-attached positioning targets (Fig. 7) with the aim to establish the advantages and limitations of both types of 3D handy scanners in documenting objects of smaller dimensions.

Description of work: Scanned by VIUscan in colour, at high resolution and with texture at 250 dpi, first in a cube of 400 x 400 x 400 mm and subsequently in a cube of 100 x 100 x 100 mm, for comparison of degree of accuracy.

Date of scanning: 26. 01. 2010 (VIUscan), rescanned 02. 02. 2010 (VIUscan)

Fig. 7 – Scanning of small objects (Object No. 6.1) placed on a plate with pre-attached positioning targets by VIUscan. Photo Jaroslav Kroužek.

Faience plaque (amulet) showing Hathor, el-Kurru, Napatan Period (Object No. 6.2)

Showcase F1 in the exhibition hall of the museum building (Inv. No. 02012)

Reasons for scanning: A small object (max. width 7.1 cm, max. height 8.7 cm) with raised relief to be scanned on a plate with pre-attached positioning targets with the aim to establish the advantages and limitations of both types of 3D handy scanners in documenting objects of smaller dimensions.

Description of work: Scanned by VIUscan in colour, at high resolution and with texture at 250 dpi, first in a cube of 400 x 400 x 400 mm and subsequently in a cube of 100 x 100 x 100 mm, for comparison of degree of accuracy. Scanned also by EXAscan without colour at high resolution and with the third camera in a cube of 100 x 100 x 100 mm (a smaller cube cannot be achieved).

Date of scanning: 26. 01. 2010 (VIUscan, EXAscan), rescanned 02. 02. 2010 (VIUscan)

Faience plaque (amulet) showing a cow-goddess, el-Kurru, Napatan Period (Object No. 6.3)

Showcase F1 in the exhibition hall of the museum building (Inv. No. 2009)

Reasons for scanning: A small object (max. width 6.3 cm, max. height 7.6 cm, max. thickness 0.6 cm) with raised relief to be scanned on a plate with pre-attached positioning targets with the aim to establish the advantages and limitations of both types of 3D handy scanners in documenting objects of smaller dimensions.

Description of work: Scanned by VIUscan in colour, at high resolution and with texture at 250 dpi, first in a cube of 400 x 400 x 400 mm and subsequently in a cube of 100 x 100 x 100 mm, for comparison of degree of accuracy. Scanned also by EXAscan without colour at high resolution and with the third camera in a cube of 100 x 100 x 100 mm (a smaller cube cannot be achieved).

Date of scanning: 26. 01. 2010 (VIUscan, EXAscan), rescanned 02. 02. 2010 (VIUscan)

Funerary mask with traces of colour bands, New Kingdom (Object No. 7)

Showcase E8 in the exhibition hall of the museum building (Inv. No. 11844)

Reasons for scanning: A small polychrome object to be scanned on a plate with pre-attached positioning targets with the aim to establish the possibilities and limitations of VIUscan in documenting colour objects of smaller dimensions.

Description of work: Scanned by VIUscan in colour, at high resolution and with texture at 250 dpi, first in a cube of 400 x 400 x 400 mm.

Date of scanning: 26. 01. 2010 (VIUscan)

Basalt (?) amulet heart scarab with a text from the Book of the dead on the rear side, New Kingdom (Object No. 8)

Showcase E8 in the exhibition hall of the museum building (Inv. No. 28747)

Reasons for scanning: A small, flat object carved and inscribed at a great degree of detail to have the top and bottom part measured and scanned separately and to have both parts later joined together to form a single 3D object.

Description of work: Scanned without colour by EXAscan at high resolution and with the third camera. The object was measured and scanned in a cube of 180 x 180 x 180 mm. Later on, the object was rescanned using different methodology with the aim to remove the stratification of surfaces (compare Figs. 8 and 9).

Date of scanning: 26. 01. 2010 (EXAscan), rescanned 03. 02. 2010 (EXAscan)

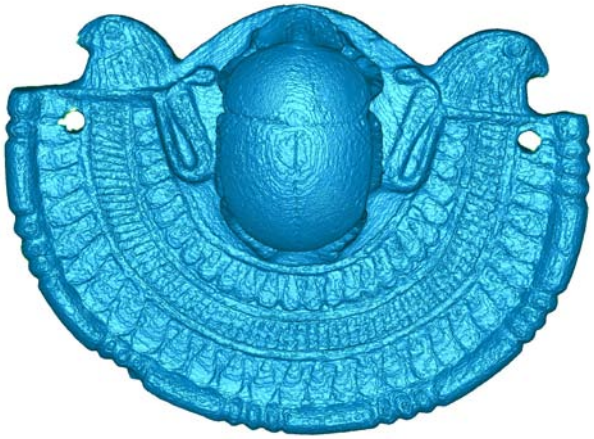

Fig. 8 – View of the upper part of the scarab scanned with EXAscan (first attempt, without texture and colour, partly processed).

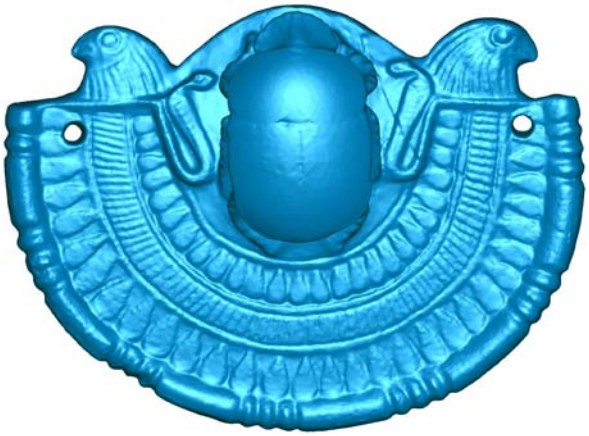

Fig. 9 – View of the upper part of the scarab scanned with EXAscan (second attempt, without texture and colour, partly processed).

(Quartzite?) statuette of the scribe Sebek-em-heb, New Kingdom (Object No. 9)

Showcase E8 in the exhibition hall of the museum building (Inv. No. 31)

Reasons for scanning: A 3D object of medium size, with fine details, to be scanned from all sides.

Description of work: Scanned without colour by EXAscan at high resolution and with the third camera, with special attention dedicated to the details of head and inscription on the legs (Fig. 10).

Date of scanning: 27. 01. 2010 (EXAscan)

Fig. 10 – View from above ("groundplan") of the statue of Sebek-em-heb scanned by EXAscan (without texture and colour; partly processed).

Sandstone relief (sculpture) showing a ram-headed god, Musawwarat es-Sufra (?), Meroitic Period (Object No. 10)

Free-standing (hung) object in the exhibition hall of the museum building (Inv. No. 19466)

Reasons for scanning: A very articulate (or sculptured) relief with a great number of sunk-in parts. The object constituted one of the greatest challenges for scanning.

Description of work: The relief, divided into 4 sectors (cubes), was scanned by VIUscan in colour first at the highest resolution (Fig. 11) and subsequently in texture set at 250 dpi.

Date of scanning: 26. 01. and 27. 01. 2010 (VIUscan)

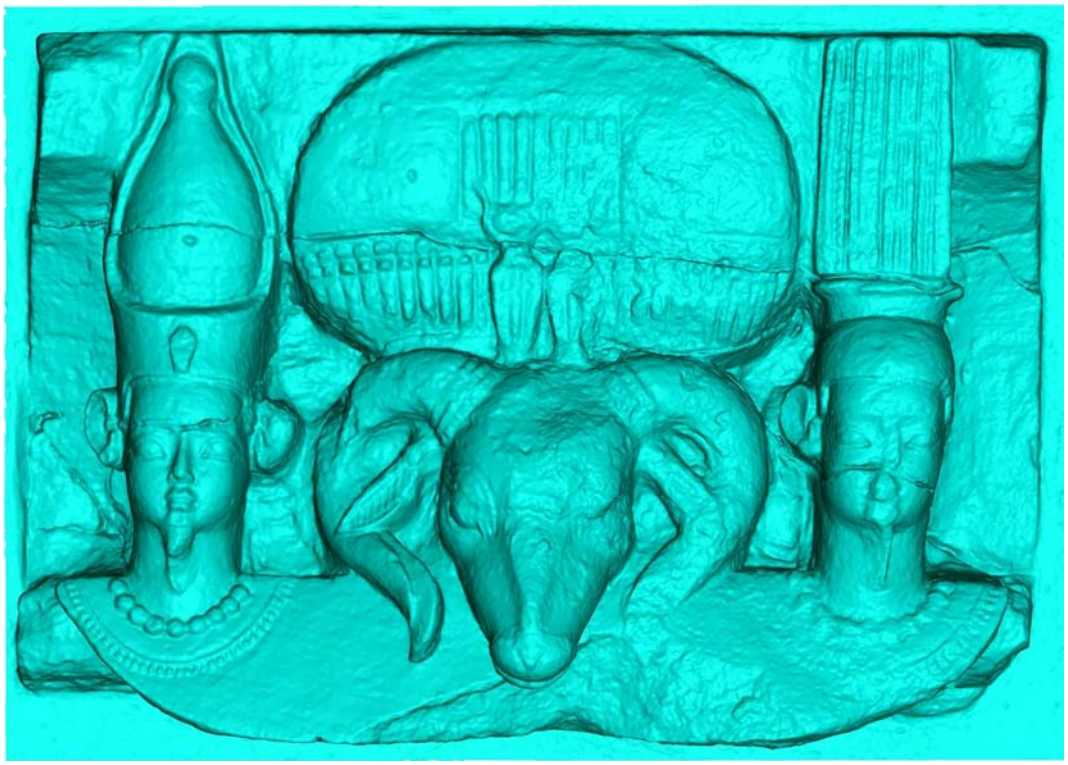

Fig. 11 – Relief with the ram-headed god scanned by VIUscan (scan acquired without texture and colour; partly processed).

Two scenes (one fragmentary) showing Hapy, the Nile god, bringing "... all manner of good things to the temple" (Object No. 11)

Buhen Temple, Vestibule, West Wall (Plate No. 47)

Reasons for scanning: A very fine raised relief of medium size (dimensions 110 x 65 cm), with traces of polychromy.

Description of work: The relief was divided into 6 sectors (or cubes) and scanned in colour by VIUscan at high resolution and texture at 200 dpi.

Date of scanning: 31. 01., 01. 02. and 02. 02. 2010 (VIUscan)

Section of the relief showing the king on a barque and a offering being made (Object No. 12)

Temple of Semna, Interior of the Sanctuary, West Wall, Inner Face

Reasons for scanning: A very fine raised relief, with small sections featuring sunk relief extending over a large part of the west wall of the sanctuary (255 x 195 cm).

Description of work: The relief was divided into 20 sectors (or cubes), each of which was scanned without colour by EXAscan using the third camera. The sectors were later joined together.

Date of scanning: 31. 01. – 02. 02. 2010 (EXAscan)

Painted relief showing Thutmose II reciting the daily food-offerings to be made to Horus of Buhen (Object No. 13)

Temple of Buhen, Inner Sanctuary, East Wall (Plate 76)

Reasons for scanning: A very fine painted (raised) relief.

Description of work: In order to document one sector (400 x 400 x 400 mm) of the painted surface, light-adhesive positioning targets were applied. The sector was scanned in colour by VIUscan first without texture at high resolution and later on at lower resolution with texture at 250 dpi (Fig. 12).

Date of scanning: 02. 02. 2010 (VIUscan)

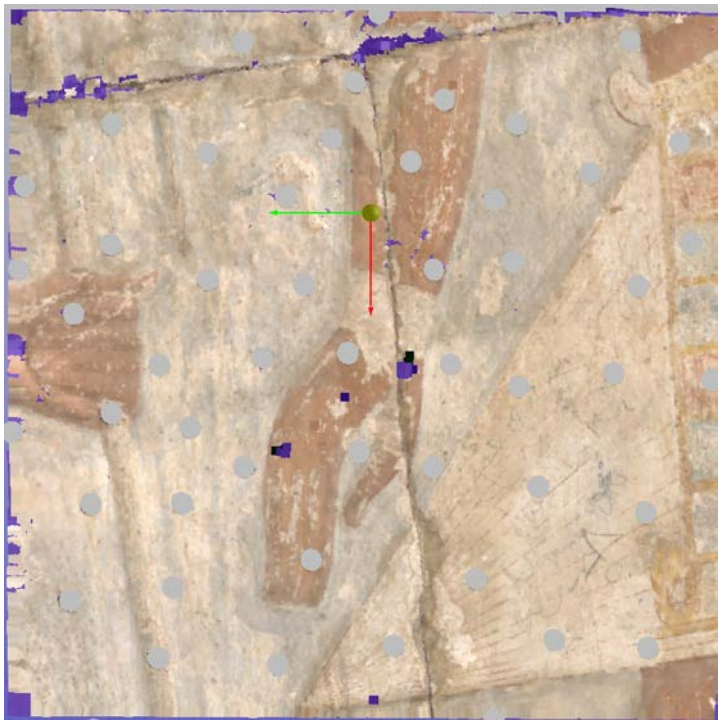

Fig. 12 – Detail of the raw scan of the relief acquired by VIUscan (with texture and colour; prior to processing).

Relief showing four priests pay homage to Horus of Buhen (Object No. 14)

Temple of Buhen, Column 31, West Side, Upper Panel

Reasons for scanning: A panel featuring sunk relief with remains of polychromy is located at the height of 2 metres on a drum of a column (diameter approx. 1.05 cm). It constituted another type of object and challenge for testing the equipment.

Description of work: The panel (50 x 90 cm) was divided into two sectors (or cubes) and scanned without colour by EXAscan at high resolution using the third camera (Fig. 13).

Date of scanning: 04. 02. 2010 (EXAscan)

Fig. 13– View of the whole panel scanned with EXAscan (without texture and colour; partly processed).

Stela bearing 35 lines of text in Meroitic language, Hamadab (Object No. 15)

Free-standing object in the exhibition hall of the museum building (Inv. No. 32200)

Reasons for scanning: A partly damaged inscription in Meroitic language offers a good opportunity to test the possibilities and informative value of epigraphic documentation of damaged texts by 3D scanners.

Description of work: One cube (sector) of 450 x 450 x 450 mm on the right side of the stela (Line 1–14, approximately) scanned without colour by EXAscan using the third camera.

Date of scanning: 03. 02. 2010 (EXAscan)

Statue of baboon (Object No. 16)

Free-standing object in the exhibition hall of the museum building (Inv. 2689)

Reasons for scanning: Another 3D object to be scanned from all sides.

Description of work: Scanned without colour by EXAscan in two cubes at low resolution, with some details scanned using the third camera.

Date of scanning: 03. 02. 2010 (EXAscan)

Granite statue of King Taharqa, Napatan Period (Object No. 17)

Free-standing object in the exhibition hall of the museum building

Reasons for scanning: A large statue offering a possibility to test the applicability of 3D handy scanners to scanning (documentation) of large 3D objects.

Description of work: Two separate sectors – head and waist – of the statue were scanned without colour by EXAscan using the third camera (Fig. 14).

Date of scanning: 04. 02. 2010 (EXAscan)

Fig. 14 – Head of the granite statue of King Taharqa scanned with EXAscan (without texture and colour; partly processed).

Conclusion

The data obtained in the course of the 3D-scanning and Photography Project carried out in the National Museum of the Sudan in Khartoum is currently being processed and evaluated. The results of the whole project, together with an assessment of advantages and disadvantages of

both models in various tasks of cultural heritage preservation, will be presented after completion of all works.

Acknowledgement

We would like to thank the National Corporation for Antiquities and Museums of the Sudan (the NCAM) and the National Museum of the Sudan in Khartoum for their consent to our 3D-scanning and Photography Project and for their co-operation and assistance granted to our team prior to as well as in the course of our works in the National Museum of the Sudan.

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