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Digitization: Protecting the future of history, A case study of Archaeological site of Sinauli in Uttar Pradesh (India)

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ABSTRACT - *Digitization has given a new life to history. Computing for cultural heritage has become a trend among specialists. Different technologies such as 2D/3D systems, Image scanning, Photogrammertry, AR/VR, etc. are being used for preservation. restoration and protection of cultural heritage around the world as people became aware of the importance of our remaining heritage sites and artifacts. In this paper, we discuss how different kinds of technologies can be used to full fill the purpose with the case study of a village named Sinauli, in Uttar Pradesh, India where artifacts from thousands of years ago have been found.*

***Key Words*: Digitization, Cultural Heritage, 2D/3D Technologies, AR/VR, Photogrammetry**

1. INTRODUCTION

India is a country with rich Cultural Heritage (CH) belongings, which includes many tangible and intangible types of CH remainings to cherish. There are tons of sites In India where researchers, archeologists, and other expert bodies have found CH present in various forms such as art, craft, the architectural remains of buildings and cities, costumes and jewelry, etc. These precious remains from our history show our values, roots where we come from, and what we are today as a great nation.

Since the declaration of The World Heritage Convention by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1972, all the countries have been actively taking part in cultural heritage protection programs and continuously making efforts to protect, restore and secure their cultural heritage. India is one of the countries having CH properties inscribed on the list. Some of them which are enlisted by UNESCO under their program are Ajanta, Ellora, and Elephanta Caves, Churches and Convents of Goa, forts located at different places, and other historical sites.

However, the sad part is that these valuable properties are being damaged by natural disasters, human destruction, uncontrolled urbanization, and armed conflicts. Because of these reasons preservation, restoration, and protection of cultural heritage have been an intense concern all over the world. Conventional preservation of CH needs to be carried out by special means, but they are limited.

As a solution to this problem, in recent years, the implementation of different digital approaches to do the task is gaining popularity among specialists. Which includes photogrammetry, 2D digital imaging, 3D modeling, image scanning, AR/VR, etc. This work aims to address the point that why digitizing cultural heritage is important and how modern technology plays an important role in preserving and securing the world's cultural heritage.

1.1 A case study on Sinauli, India

Sinauli is an archaeological site located near the confluence of the Ganga and Yamuna rivers [1][2], in Baghpat district, Uttar Pradesh, India. The site gained popularity, in 2018, after ASI (Archaeological Survey of India) excavated Bronze Age solid disk wheel carts, also known as "chariots" by some interpreters.[3][11] The site has uncovered connections that might be related to the Mahabharat or the Ramayana time civilization.[4]

The site at sinauli was accidentally discovered by farmers when they were performing their daily chores on agricultural land. ASI began the excavation in 2005 after getting the news.[8]

1.2 2005-06 Excavations

More than a hundred burials from the site were discovered in 2005–2006 during an excavation led by D.V. Sharma, ASI (Archaeological Survey of India), which Sharma connected to the Harappan (Indus) Valley Civilization. [6] It is more likely to be related to the Late Happen or Post-Harappan periods. [6] [9] [7] ASI uncovered several bowls/vases, gold bracelets, bangles, necklaces, containers, glass, terracotta sculptures, and many other objects alongside the tombs. [8] It is known that the two antenna swords, one of which has a copper sheath, resemble the Late Harappan copper hoard.

1.3 2018 Excavations

When ASI received the news from the residents of Sinauli in 2018, it brought the Sinauli site back into the public eye after a period of time. [6][10] This time, S. K. Manjul, director of ASI, oversaw the trial excavation. A number of carts and coffin graves were discovered during excavations in March 2018. Swords, helmets, copper ladles, pottery, pots, vases, and other items have also been found. [6][9] As a result of this discovery, S. K. Manjul, director of ASI, said "a unique discovery in the entire subcontinent". They could be dated to "around 2000 BCE" and were "contemporary to Harappan culture", he said.

— S. K. Manjul, ASI director (excavations) [6]

He stated that the carts are similar to the chariots made using Indo-Aryan technology which comes from Ochre Coloured Pottery (OCP).[1][6]

According to S. K. Manjul,

"This is the very first time such evidence has ever been recovered. The coffins and chariots are something we haven't encountered before. This discovery is not only important in the context of India but also the world," [9]

He also said,

the war chariot found at the site was the first discovery of its kind and that after advanced testing it was found to be "a horse-pulled" one, which brings the site "closer to the culture of Mahabharata". [4]

Fig. No. 1 Coffin with carving on the lid

Fig. No. 2 Copper Swords

Fig. No. 3 Chariot

Fig. No. 4 Chariot

* Image Courtesy: ASI (Archaeological Survey of India)

These discoveries are known to have connections to different eras according to the kind of properties they possess. According to the claims, these findings can be related to the late Harappan period or the early Aryan migration of Proto-Indo Iranians.[5] Some state that these

artifacts are related to the Mahabharata or the Ramayana era. Either way, the connections show how important these discoveries are for us as a nation. As protecting these properties are of utmost importance for our country, ASI began to collect and restore the findings with the techniques possible to perform them.

2. DIGITIZATION PROCESS

Here digitization process comes into play. There are enormous techniques that are being used for the preservation, restoration, and protection of cultural heritage around the world. Some of them that we can use for this case are discussed here, which shows possibilities of how we can secure our remaining cultural heritage using different computing techniques.

2.1 Capturing the Objects

First of all, we will consider capturing the objects in a raw form such as hard objects, texts, etc. and store it as photographs using any compatible camera.

2.2 Sketching and Scanning the objects-

After capturing the images, sketching takes place. Sketching using different softwares are done on damaged objects to redefine its shape and identity.

After making sketches of objects they are scanned thoroughly for creating 3D model. Different scanning techniques such as Optical Sensor Scanning, Laser Scanning, and Thermal Scanning using software like LiDAR and dToF are of great use. We can use techniques that can capture photographic images from all different angles like the 2D graphic information storing techniques and systems such as Volume Graphics, Artec Studio, Pix4D, etc.

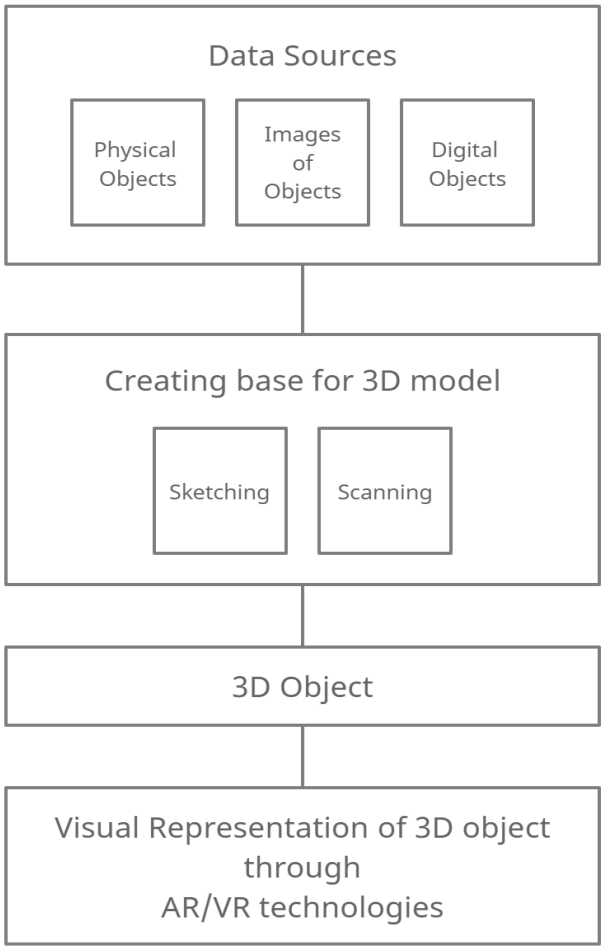

Fig No. 5 Digitization Process

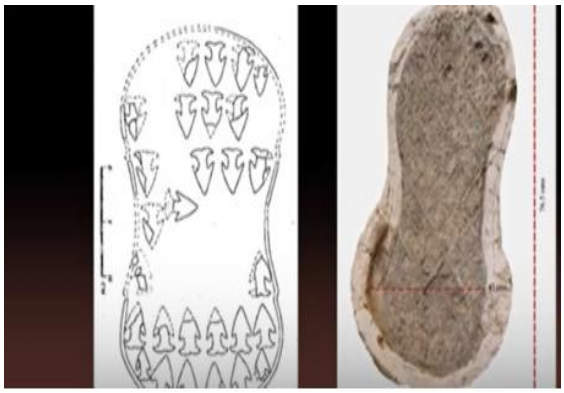

Fig. No. 6 Shield drawn and excavated

2.3 Photogrammetry used for 3D Modeling

Next step is to use these images and sketches to obtain proper model, which looks exact, twin copy of the actual object.

Photogrammetry techniques are used widely by experts, which is a reliable technology for obtaining information about physical objects and the environment through the process of recording and measuring photographic images. Photogrammetric analysis may be applied to one photograph or may use remote sensing to detect and record complex 2D and 3D fields. Photogrammetry uses methods from many disciplines, including optics and geometry. Digital image capturing and photogrammetric processing includes several well-defined stages, which allow the generation of 2D or 3D digital models of the object as an end product.

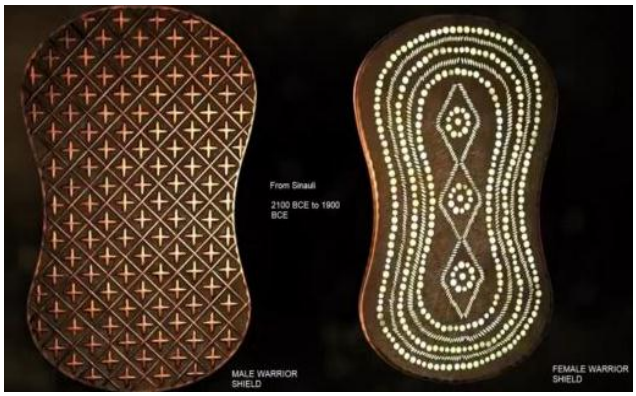

Fig. No. 7 Shield rebuilt using technology

There are various photogrammetry software such as Agisoft Metashape, Meshroom, and Autodesk ReCap Pro used for this purpose. Using this kind of software 3D models of any object can be developed. In the same way, we can use high-quality dense cloud generation to obtain a more detailed geometry of the original photo. Using these softwares and techniques one can rebuild the damaged parts of an object or restore it to perfection. After making the necessary changes we can save our work.

2.4 AR/VR methods

Once the 3D models are obtained through photogrammetry, we can move forward to display the results. Nowadays AR/VR systems are blooming around the world, as it provides realistic experiences with less work to users. VR creates an immersive, mesmerizing, life-like virtual environment, while AR augments real-world scenarios. The combination of both of these offers excellent systems, when combined they provide an enhanced and more engaging experience.

Different kinds of softwares such as Adobe Aero, Amazon Sumerian, Google Tilt Brush, etc. are being used by experts all around the world to create great VR and AR experiences for people.

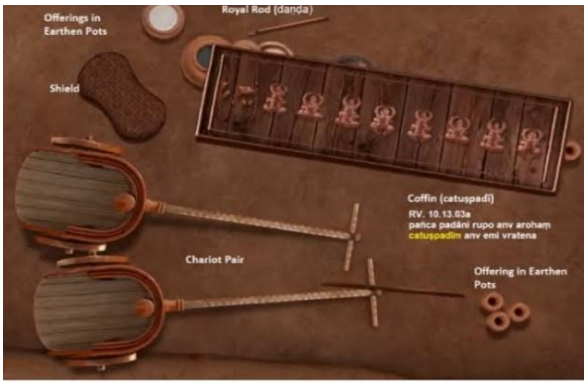

Fig. No. 8 Coffin, Carts, etc. visualized

This process and the techniques/software can be helpful in obtaining the desired results in the field of digitization of cultural heritage.

3. FUTURE SCOPE

Beyond what was envisioned in the pre-digital era, the move to digitally conserve endangered cultural property offers new potential to safeguard and broaden the reach of knowledge for any generation. Technology that is data-driven will improve research capabilities and opportunities to preserve cultural heritage for future generations. Institutions can look for chances for partnership with technology leaders like IBM, Google, and Microsoft that fund and launch their own projects on protecting cultural heritage using digital technology in order to improve the prospects for cultural heritage in the digital era. Understanding the current technological constraints that require improvements in any manner feasible is also crucial. The proper application of digital technology will assist preserve current cultural heritage and create a learning opportunity for our future generations.

4. CONCLUSION

This study has taken as a base the excavations at Sinauli, Uttar Pradesh in India to demonstrate how the digitization process can be performed on cultural heritage sites and objects. We discussed how preservation, restoration, and protection can be done through digital technologies. In this paper, we tried to explain the importance of our cultural heritage and why securing it is important for future generations.

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