Conditional Assessment using Photogrammetry: A Study of Developing Digital Techniques

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Introduction

The technique of photogrammetry is increasingly being employed in the field of archaeology, for tasks including data assessment, planning, and preservation (Fortenberry and Leifeste, 2020). Photogrammetry produces reliable three-dimensional models of objects that can be further used for detailed examination (Marin-Buzon *et al.*, 2021). This paper attempts to employ photogrammetry to create models of archaeological artefacts and use them for conditional assessment and object analysis. Using 3-D models is increasingly being preferred, since it offers the opportunity to conduct more detailed study than would have been possible using images and other 2-dimensional data (Aicardi *et al.*, 2018). For the purpose of this study, four sculptures from the National Museum of India, Delhi, were documented and rendered into models. A conditional assessment and analysis was then attempted using these models. The paper documents in brief the process of rendering these models, the methods used to study them, as well as the limitations as observed by the author.

It also discusses the benefits and limitations of conducting conditional analysis of sculptures using methods of photogrammetry. Secondary sources and reports of similar projects were studied to understand the processes, and assessment was done through models rendered by the author. Limitations to the study include the absence of proper lighting, with lower resolution cameras. Additionally, only four sculptures have been studied for this paper, while there is scope for many more artefacts to be similarly recorded and analysed.

Development of Photogrammetry in the Context of Archaeology

History of Photogrammetry

This section attempts to draw a historical timeline of the development of photogrammetry. Photogrammetry as a distinct science may have developed around the 1860s, but its origin can be traced right to the late 15th century (Guery *et al.*, 2017; Doyle 1963). In the 1480s, renaissance painters like Leonardo da Vinci developed theories on lines, points, angles, and surfaces using mathematical precision, which formed the fundamental basis of photogrammetry (Doyle, 1963, 259). This was followed by

developments on understanding perspective through the works of Duerer (1471-1528), and later Lambert (1728-1777), who wrote a treatise on 'The Free Perspective' (Gruner, 1977, 569).

Photogrammetry has been regarded as the first non-contact method of measurement (Guery *et al.*, 2017, 229). Prior to the First World War (1914-1918), progress in photogrammetry was based on experiments and the creation of new techniques largely at an individual level (Center for Photogrammetric Training, 2008). Development of the first photogrammetric system is accredited to Aime Laussedat (1819-1907), a colonel in the French Army Corps of Engineers who used terrestrial photographs taken from flying kites to create maps in 1849 (Jiang *et al.*, 2008). Later, in 1867, Laussedat also created a plan of Paris, compiled through photographs taken from building rooftops in 1867, thereby earning the title of the 'Father of Photogrammetry' (Jiang *et al.*, 2008). It was around the 1860s that Albrecht Meydenbauer (1834-1921), also known as the inventor of Architectural Photogrammetry, proposed the idea of documenting buildings and cultural objects using Photogrammetry (Albertz, 2007). According to Albertz (2007), his continuous experiments to prove the advantages of using this technique for architectural and topographic surveys were the background in which the term 'photogrammetry' was first coined.

Photogrammetry was used extensively for war photography as well for surveying land resources (Necklace, 2018). For instance, balloon photographs were taken over Boston in the United States during the Civil War (1864), and stereo photos were taken near Paris during the Franco-Prussian War of 1870 (Gruner, 1977). In the early 1900s, zonal rectification was carried out by Theodore Scheimpflug (1865-1911) and the first stereo-comparator was built by Dr Carl Pulfrich (1858-1927) (Bervoets, 1969). Rapid development in this technique took place particularly in the background of the First World War, since armies used aerial photography to map positions in enemy lines that could not be achieved through ground-level observation (Necklace, 2018). Colonial expansion in the 19th and 20th centuries also necessitated surveying of newly-acquired territories like India and parts of Africa, and creating maps for administration, defence, and the acquisition of raw material (Collier, 2002).

The period between the two world wars (roughly between 1918 to 1945) saw massive development in mathematical and computational tools for the development of analytical photogrammetry (Ghosh, 1988). The American Society for Photogrammetry and Remote Sensing was founded in 1934, with the aim to disseminate the knowledge of photogrammetry and encourage the advancement of the skill (American Society for Photogrammetry and Remote Sensing, 1989, 979). By the mid-20th century, development of analytical photogrammetry began to be used in industrial and engineering tools (Fraser and Brown, 1986). The next two decades were focused on creating systems particularly apt for industrial measurements

(Fraser and Brown, 1986). Since the 1970s, however, focus has shifted to the development of digital photogrammetry, with advancements in computer technology and softwares (Albertz, 2007). In the last few decades, advancement in both hardware and software technologies has made photogrammetry much more efficient and accessible, which has prompted the rise of newer 3-D digitisation methods (Magnani *et al.*, 2020). Having established a brief history of the science, the next section discusses the current understanding of photogrammetry, in order to better establish its relationship with archaeological analysis in the upcoming sections.

Some definitions of Photogrammetry

Al-Ruzouq (2012, 97) describes photogrammetry as the 'art and science of deriving accurate 3-D metric and descriptive object information from multiple analogue and digital images'. This was also explained in Romero and Bustamante's (2017, 17) words as a technique that uses images to 'derive the location of common features between multiple photographs in order to three-dimensionally reconstruct a digital model of the object'. Guery, Hess, and Mathys (2017, 229) give a more detailed definition, calling it a 'metric imaging method that enables digital reconstruction of the form and geometry of a real object in three dimensions. This reconstruction is based on a set of photographic images covering all areas of the surface with enough overlap to enable identification of common details on each photo'. Simply put, photogrammetry consists of gathering information from overlapping images and using the data to, among other functions, construct three-dimensional models (Magnani *et al.*, 2020, 738). Having established the general understanding of the science of photogrammetry, the next section attempts to establish how it can be an essential tool in archaeological study.

Photogrammetry and Archaeology

As is evident from the previous sections, photogrammetry developed initially for military and administrative purposes, and then slowly got incorporated into other fields of study (Gruner, 1977). After the first stereo computer was created in 1902, three dimensional versions of topographical data and relief could be made, which increasingly began to be used to document sites of cultural importance (Marin-Buzon, 2021). Instances include the use of balloons for mapping the Stonehenge in 1907, or for creating a mosaic of the city of Venice in 1911 (Marin-Buzon, 2021). Similarly, Ogleby and Rivett conducted several surveys in Rock Art sites near Australia in the 1980s, and published a *Handbook of Heritage Photogrammetry* that became a crucial document for further archaeological analysis (Ogleby and Rivett, 1985). Bryan and Chandler (2008) describe how it was around this time that models of sites began to be made, and came to be regarded as beneficial for providing contextual information in

archaeology. The International Committee for Architectural Photogrammetry (CIPA) was established in 1968, which set rules and gave recommendations for properly documenting and measuring sites and monuments (Bryan and Chandler, 2008). Recently, photogrammetry has also been used to document artefacts including sculptures, tools, coins, paintings, decorative art, among others (Ch'ng *et al.,* 2019).

One of the most important components of archaeological excavation is detailed documentation and survey through texts, images, illustrations and other mediums (Drap, 2012). However, Drap (2012) explains how even the most accurate images and sketches retain only certain features, and miss out on many others. This gap can be filled through photogrammetric documentation. Additionally, many potentially significant sites are often left undocumented due to hostile terrains, an issue that can be resolved through aerial photogrammetry (Fotinopoulos, 2009). There are several conditions in archaeology where photogrammetry continues to prove itself ideal for further research. For instance, objects from sites in unusual environments like the deep sea can be documented three-dimensionally, thus allowing archaeologists to better place them spatially and study them in detail (Drap, 2012). The Phanagorian shipwreck is an example, where three-dimensional documentation allowed for digital reconstruction of the site in 2012 (cf. Zhukovsky *et al.*, 2013).

Balloon and Laser scanning has also been employed in digitally recording archaeological sites without requiring too many people or complicated equipment. An example would be the project undertaken by Topotech Surveys, which used aerial photogrammetry to document five archaeological sites in Greece, where land surveys were proving to be inaccessible due to hostile terrain (cf. Fotinopoulos, 2009). Photogrammetry allows for digitisation of even the smallest artefacts with high accuracy, and adds new information (for instance, texture) to the model that would not have been visible before (Gajski *et al.,* 2016). Three dimensional documentation of artefacts are increasingly being curated into digital libraries, providing access to researchers from different corners of the world, thus widening the scope and quality of archaeological research (Gajski *et al.,* 2016).

Increasingly, multi-range photogrammetry has allowed for many archaeological surveys, including the Rock Art sites in Siberia, artefacts in the University of Ljubljana, as well as recording of buildings by Parma University in Italy (McCarthy, 2014). This technique has been applied in several significant projects through the years, including the *Teotihuacan Mapping Project*, in which photogrammetric maps were made covering the entire city of Teotihuacan in Mexico as early as the 1960s (Millon, 1964). The technique has also been used to digitally reconstruct damaged sites and artefacts through archival material like photographs and survey accounts (Wiedemann *et al.,* 2000). This can be illustrated through the

attempt made in 2000 to aid the reconstruction of two buildings in Berlin that were destroyed during the second World War (Wiedemann *et al.,* 2000). The authors gathered old images from the city's archives and used several photogrammetric principles to digitally reconstruct the monuments and also provided models to architects for actual reconstruction (cf. Wiedemann *et al.,* 2000).

This section seeks to briefly establish the vast potential of photogrammetry in archaeological study. As Ch'ng *et al.* (2019) explain, the accessibility and ease of use of photogrammetry can allow documentation of heritage in a way never imagined before. Studying artefacts and sites using photogrammetry can provide new insights and better analysis, as is evident in the study below. However, the method does have some limitations. The most crucial one is the sensitivity to light. Since photogrammetry uses images to create models, the lighting on the artefact itself will be reflected in the model. Shadows are, therefore, visible in the models and can affect detailed analysis. Objects can also not be documented in the dark, which is possible in more expensive techniques like LiDAR (Magnani *et al*., 2020). Nearby disturbances, like visitors in a museum or tourists on the site may also affect documentation (Dinkov & Vatseva, 2016). However, such technologies require more resources and technical abilities, therefore making them less accessible.

Conditional Assessment using Photogrammetry

Three dimensional recording and survey has also become essential for documentation of objects, conditional analysis, as well as the promotion of artefacts from museums (Aicardi *et al.*, 2018). Zhang (2008) discusses the benefits of using photogrammetry for a detailed conditional analysis, explaining how it enhances the distresses as well as provides spatially accurate data, which is beneficial for more in-depth analysis. Experimental constructions of three dimensional models have provided favourable results, according to Khaloo and Lattanzi (2017), as well as giving high-resolution and scale-accurate models that are cost-efficient and also save time. As a result, there are many published works with surveys and analysis relying wholly on 3-D models (McCarthy, 2014).

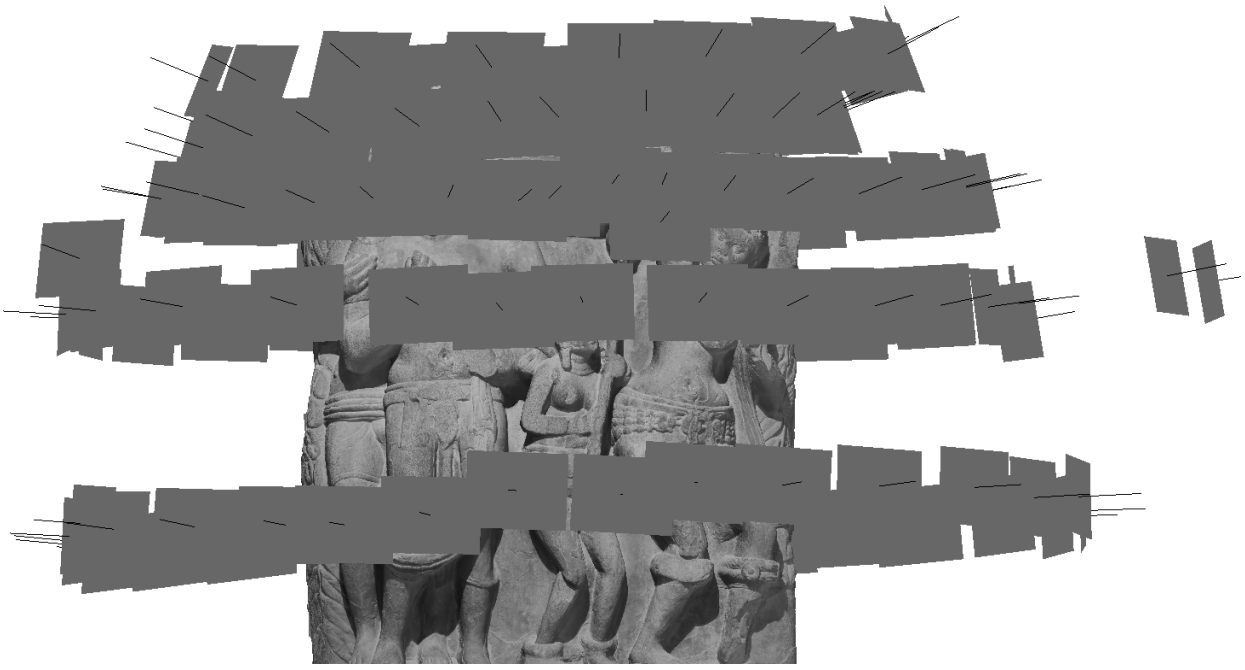
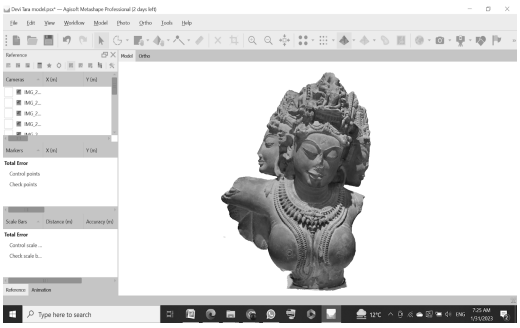
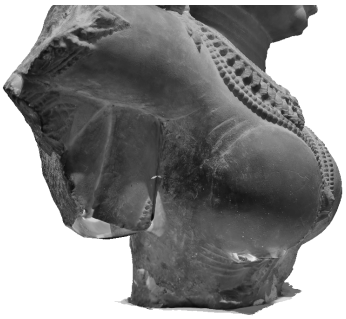


Image 1: The placement of images while documenting an object. The blue boxes represent the images taken for the creation of this model, in circular motion, beginning from the bottom and building upwards (Software: Agisoft Metashape™; Source: Author)

With some good quality overlapping images and using widely-available software, archaeological objects can easily be rendered into 3-D models and used for preservation, promotions, and even analysis (Kaleta *et al.*, 2014). Professionally, smaller objects are often placed on turntables and documented with sophisticated equipment, but it is also possible to document them with simple hand-held cameras or mobile phones (Historic England, 2017). Even smaller objects like coins and jewellery can be rendered into models and used for detailed study and analysis (Historic England, 2017). For the next section, four objects housed at the National Museum of India, Delhi were documented digitally and rendered into models, and a conditional assessment of the objects was attempted through the models.

Object Analysis

Model 1: Bust of Vajra-Tara, Sarnath, Benaras, circa 10th century CE, Accession Number: 47.32

Fully-formed model in the Agisoft Metashape's interface 	Front view of the model, clearly showing the texture of the surface and symbolic features 
Side view of the sculpture 	Back side of the model, zoomed in to show the details 
View of the faces, along with the ornamentation and other symbols 	The top of the sculpture, otherwise not visible to the observer, but becomes accessible through the model 
A solid map of the model, to understand	Confidence Variation Map of the object, to

the surface better, with the upper texture removed. 	understand the number of cloud points formed 

Table 1: Features of Model 1

The box highlights the surface damage, including scratches and other signs of wear 	At the back of the model, the lower box highlights a prominent crack that has been repaired. Other boxes show scratches on the surface 
The top view allows to assess the considerable damage visible on top of the model, with clear cracks and marks of breakage.	Iconographic features, like the seated figure of the Buddha (highlighted by the box) can be studied in detail, with the option to zoom in to study the attire, sitting style and scene in detail.

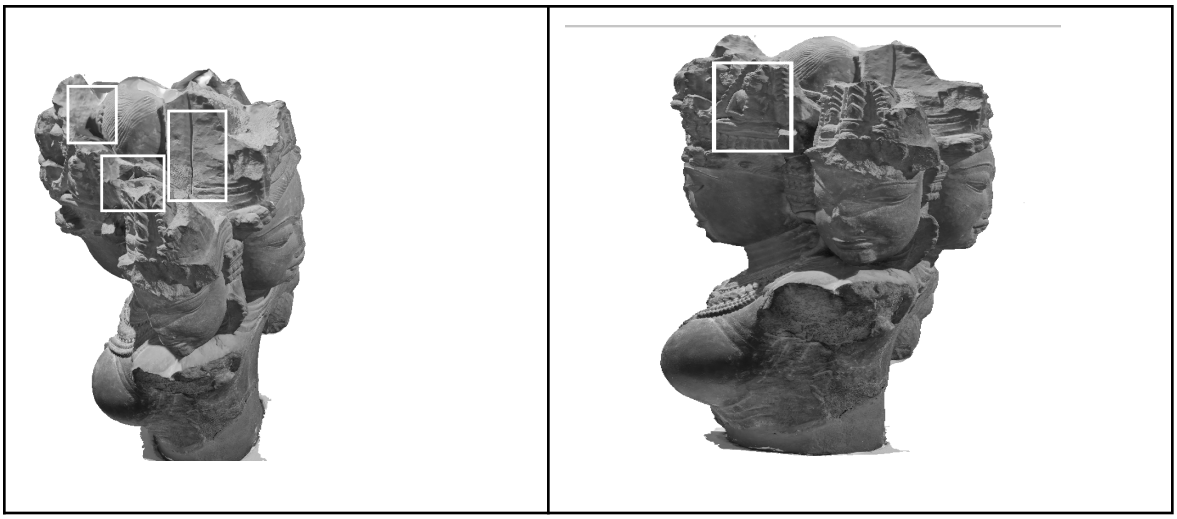


Table 2: Conditional Assessment and analysis of the Object using the 3-D model

This sculpture has four faces, each with varying iconographic features on each side. The crown, however, shows signs of damage, which makes it harder to study these details through still imagery. However, through 3-dimensional models, the defects as well as the iconographic features are clearly visible and available for study. A figure like this one, that has different features on all four sides, is much better analysed as a model, since a model allows the researcher to study the model in a flow rather than putting together various images and filling in the gaps through imagination. If this sculpture would have been documented through pictures, many of the features that are present on the sides would have been missed. The images in Table 2 are taken from moving around the model in various angles, and observing all the damages that the naked eye would not have caught at first glance. Some angles, like the top-angle view, would not even be visible at eye-level. Using a model here evidently gives a much more thorough and detailed analysis.

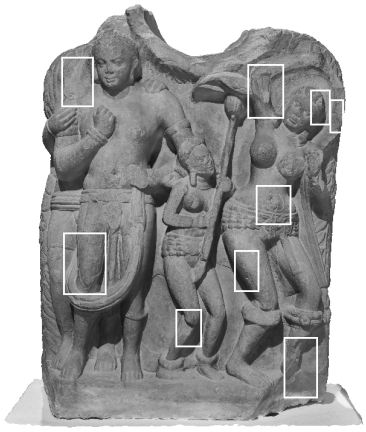
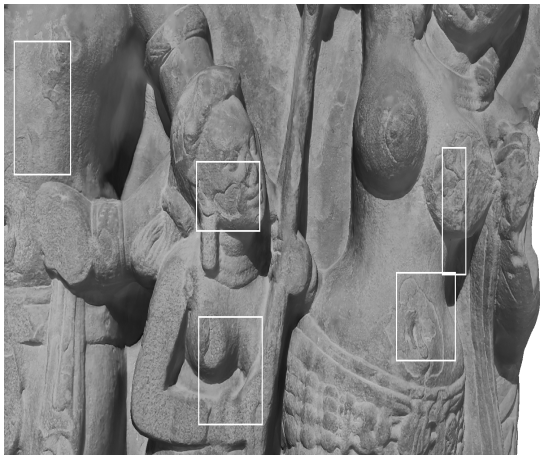
This sculpture was documented from the National Museum of India, where it has been displayed without any glass barrier. This made it easier to document the object without being concerned about reflections. A total of 68 pictures were taken for this sculpture through an android phone with a 48 OIS+8+5+2 MP Quad Camera, and the images were stitched together on Agisoft Metashape. Pictures were roughly taken at an angle of 45-50 degrees in order to ensure an overlap of at least 60%. Although all areas of the sculpture were covered, the confidence variation shows that more pictures could have helped in making a clearer model.

Model 2: Scene from Vasantasena's House; c. 2nd Century CE (Kushana Period), Accession Number: 2800

Full model of side-1 	Zoomed-in view of side 1 
Some ill-effects of light are visible here- the top portion is more faded due to the lack of proper lighting 	To study the structure without the hindrances of lights and reflections, the solid mode is available for study 
Confidence Variation: the object has been relatively well-photographed, as can be seen by the large number of points on it	The model allows the observer 360-degrees access for study. The model can be rotated at various angles, zoomed in and out, and even incorporated into interactive designs

Table 3: Features of Model-2

The boxes highlight weathering, breakages and surface damage that can be seen in the model 	The face, navel, and other features have all been damaged possibly due to abrasion 
There is clear discolouration in the highlighted sections of the sculpture, which could be caused due to exposure to light or other	Some parts, like the calf of the figure highlighted, have completely broken off. Other features have been smoothed over time.

environmental factors. 	

Table 4: Conditional Assessment and analysis of the Object using the 3-D model

Again placed openly in the Museum, this sculpture was documented in a total of 139 images, also through an android phone with 48 OIS+8+5+2 MP Quad Camera. However, due to overhead lighting, some of the features were difficult to capture as the object cast shadows on the faces present in the sculpture. If looked at closely, some spots in the model are darker than the others and therefore would hide any features present there.

The sculpture shows a narrative that moves from one side of the sculpture to another, which can be understood better through a model that can be rotated along the sides than still images that would have to be placed adjacent to each other and then analysed. This sculpture was placed lower than face-level of the viewer, which means the viewer would likely miss details on the bottom of the sculpture. This issue is again resolved through a model such as this that provides a more detailed look, highlighting the faults and fissures in the sculpture as well.

Model 3: Chaturmukha Shivalinga, Mathura School of Art; circa 2nd century CE (Kushana Period), Accession Number: 65.172

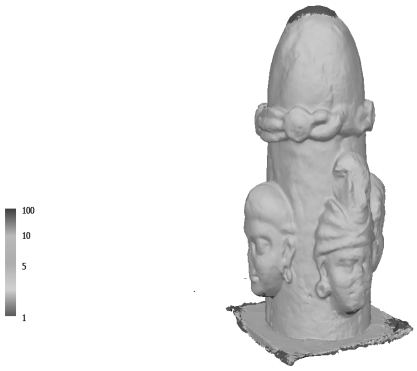
Zoomed-in view of the facial features 	Side view 
A no-texture version of the model to understand the base better when the texture is too pixelated 	The portions in red showcase a lack in proper photography, possibly due to difficulty in access 

Table 5: Features of Model 3

The differences in texture highlights the breakage and abrasion on the surface	In some regions, the surface is uneven and discoloured, as is visible from the boxes highlighted before. This shows the environmental damage on the sculpture

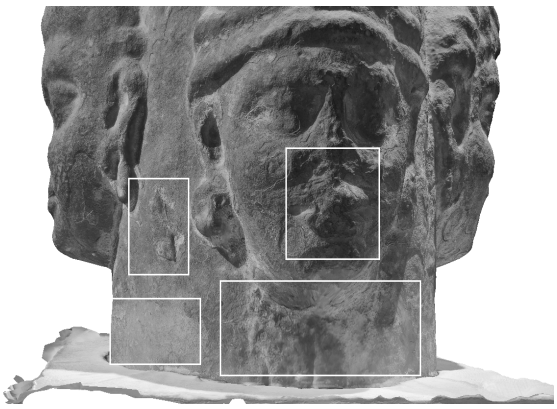
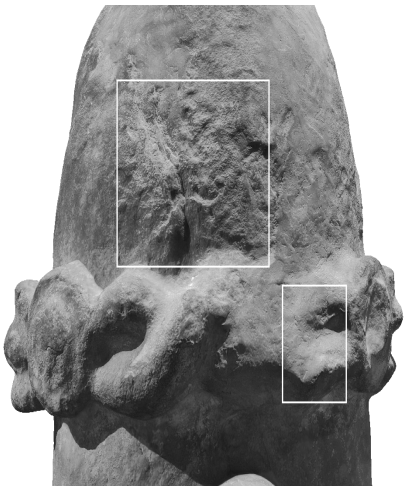
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<td>Years of weathering has resulted in smooth surfaces. The box at the top highlights a particularly disturbed part of the surface, which could be further investigated.
  </td>
<td>The side view not only shows the facial features of the various manifestations of Shiva, it also makes the discolouration and damage on the sides visible, which would not have been possible in a 2-dimensional image
  </td>
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</table>

Table 6: Conditional Assessment and analysis of the Object using the 3-D model

The third model, again placed openly, was easier to document save for the topmost part, which went out of reach for the author. Therefore, the model shows a small blind spot on the top-most part of the model. A total of 95 images were taken to document this object, but due to lack of resources, it was processed at a lower quality, thus making the model more pixelated than the others. The resolution of the device was

similar to the other two, with a 48 OIS+8+5+2 MP Quad Camera. The model is a *Chaturmukha Shivlinga*, decorated with a different manifestation of Shiva at all four angles. This can again be studied better if the model is rendered into a small animation showing the object slowly rotating, thereby providing a holistic view of the sculpture with more details than an image would have captured. In this sculpture, like the others, signs of discolouration and weathering are clearly visible. However, the texture of this model can also be removed before study, since the lower processing quality pixelated the surface, hindering the iconographic features of the deity. As is evident, photogrammetric models allow much more flexibility in analysing models than a general image or illustration, capturing data that might have been missed by the general observer or was out of sight in an image.

Model 4: Lion Capital, Haryana, circa 2nd century CE (Kushana Period), Accession Number: 67.617

Side view of the model 	The Confidence Variation here shows that the sides were documented relatively well. 

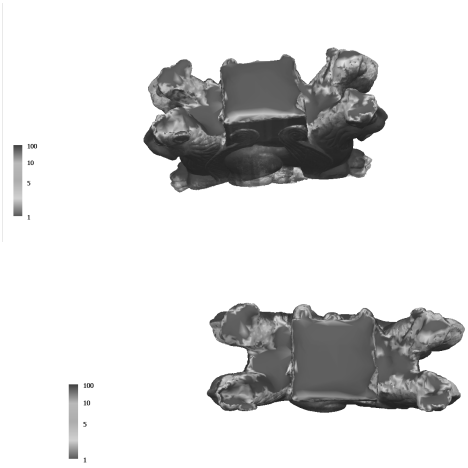
However, the top portions have been neglected and therefore would not be produced accurately in a model. This is again caused due to lack of accessibility. 	Solid model for structure study 
Scratches, environmental damage and abrasion evident here while zooming in and tilting the model slightly upwards 	The topmost side has not been photographed well, which has resulted in a different texture and a cruder presentation. 

Table 7: Features of Model 4

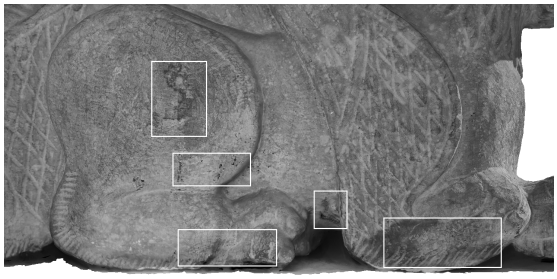
<table>
<tr>
<td>The box highlights the otherwise not very prominent marks on the model, like the swastika-like mark visible near the neck of the tiger. The model also allows a detailed analysis of the mane and the wings separately.
  </td>
<td>The boxes highlight the clear environmental damage, including small holes at the bottom, and what seems like moisture-induced issues at the right corner. This can be further investigated with specialised equipment, and preventative measures can be taken.
  </td>
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<tr>
<td colspan="2">On the other side of the model as well, there are prominent signs of abrasion and surface damage.
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Table 8: Conditional Assessment and analysis of the Object using the 3-D model

The last model was documented with 139 pictures on a 48 OIS+8+5+2 MP Quad Camera, although a portion of the top had to be omitted due to unreachability without proper equipment. This model clearly shows not only the carved details on the pillar, but also clearly highlights the scratch marks that are visible on the pillar. Like the others, other features, like discolouration and weathering are also evident. In an image or even while viewing this artefact generally, not many signs of damage would be visible. However, a model allows zooming-in, rotating, and analysing the objects using the several tools available for use, including the thermal analysis and measuring scale options. The pillar was chosen to be modelled specifically because of the nature of its make, with lions depicted on two sides and two other presumably female figures visible on the third. Rendering such objects into models makes it easier for the researcher

to work on them than using images, as it provides the ability to zoom in, rotate the model, and look for specific features.

Benefits and Disadvantages of Using Photogrammetry for Conditional Assessment

As is evident in the models above, photogrammetry allows for visualisation of all the features of an object in far more detail than images and videos (de Luis-Ruiz *et al.*, 2021). The method is accessible, cost-efficient, and can assist in scientific documentation of objects (Breko and Mathys, 2020). Photogrammetry is preferred by scholars as it simply requires a good camera along with a licensed or open-source software (Magnani *et al.*, 2020). 3-Dimensional models created in softwares like Agisoft Metashape allows the researcher to georeference the model, providing high-quality, ortho-rectified, and spatially referenced models for research (Howland *et al.*, 2014; Kim *et al.*, 2019; Fortenberry & Leifeste, 2020). It is also a contactless way of documenting and measuring artefacts, which also prevents artefacts from the risk of getting damaged if handled physically (Guery *et al.*, 2017).

This technique can also be applied for recording vulnerable artefacts before and after damage, and then be used for accurate restoration (Mileto, 2017). These models can also be used to plan museums, galleries, and other spaces. Virtual heritage spaces can be developed with these models to encourage interest in the field and to educate the audiences. It also allows for in-depth remote study when the artefact may not be accessible to the researcher. As mentioned before, creation of models using photogrammetry is relatively cost-efficient and accessible, which allows a much larger pool of scholars to use this technique and enhance their study.

However, acquiring data for photogrammetry takes a long time, since every image requires significant overlap for rendering a good-quality cover (Ahmed *et al.*, 2019). It also requires a keen attention to detail to capture every nook and cranny of the object being documented, and has the risk of distortion of sections that may have not been documented accurately, according to Ahmed *et al.* (2019). In India, many sites are situated in close proximity to residential quarters or even industrial buildings, and many in-situ objects might be hidden behind vegetation. This would be a hindrance while creating a model as it comes in the way of taking accurate pictures at correct angles, creating lacunae in the data gathered.

Due to the technique being highly accessible, there is also a risk of inadequate surveys and analysis in practical field work, as is illustrated by Anderson (2010). The researcher needs to make sure that the data collected is rendered ethically and with great precaution, since it would be used for further analysis.

Lighting, or lack thereof, also affects the models as demonstrated in the models above. Shadows falling on the object can block out certain features from being recorded, which needs to be kept in mind while documenting and studying these objects. Therefore, while the technique is widely available, it can sometimes get difficult to document the objects, especially if the object is in daylight or has overhead lighting.

Scope of Photogrammetry in India

This study was conducted on four sculptures that are housed in the National Museum of India, and are, therefore, better preserved and protected than many other artefacts in the country. However, there are numerous unprotected sites in India, housing objects that are directly exposed to the elements and are under threat (Behera, 2013). Many of these are entirely undocumented. Even in museums, the objects may be placed in less than ideal conditions due to lack of resources or storage space. This puts these objects at direct risk of potentially irreparable damage. Additionally, rapid urbanisation in Indian metropolitan cities has challenged the existing heritage sites and monuments, thus posing threat of their destruction (Udeaja, 2020). This, added with increasing cases of encroachments and destruction of structures, has raised the need to conserve and protect them before they are completely lost (Udeaja, 2020).

As is shown in the paper, photogrammetry is an accessible tool to document artefacts, without requiring expensive equipment, large teams, or expertise in the field. This study was focused only on sculptures, but photogrammetry can be applied on sites, architectural features, paintings, ornaments, inscriptions, and any other kind of artefact (Ahmed *et al.*, 2019). Therefore, it can be used for the preservation and promotion of these artefacts. Even though museums often have their own digitisation programs, they can be limited to certain artefacts or collections that are deemed important enough to be documented (Ch'ng *et al.,* 2019). With photogrammetry, the public that generally visits these sites and museums and takes a few pictures themselves, can be encouraged to use photogrammetry and digitise the objects in front of them. This serves the dual purpose of not only allowing for a mass documentation of artefacts, but also rousing public interest in the same.

Sites that face the threat of encroachment or destruction can be documented digitally for preservation and future research. Models of artefacts can also be used to promote them in websites and digital platforms, like the website of the National Museum of India. The technique could be of immense help in epigraphy and numismatics, documenting the smallest of details for a closer study. It also minimises the threat of losing or damaging the artefact, since a digital backup would be available. With enough time and resources, numerous other objects can be digitised this way for better analysis and preservation.

Conclusion

The paper discusses a few artefacts, created with modest resources available to the author. This showcases the potential this technique has for expanding and improving future study. Much more informative models can be made using the same techniques used for various kinds of study in the future. Three dimensional models help in a much better analysis and study than two-dimensional images, providing many more insights than simple photos. They allow observers to turn it around and look at the sculpture with many more perspectives, providing new angles of future study. Also, the condition of these objects can be observed in detail and can be used as a reference for planning further conservation of the artefact.

However, one of the most important uses of this technique, especially in the context of India, is the preservation and promotion of these artefacts. Rahaman (2021) lists several 3-D repositories like the Smithsonian, MyMiniFactory, Turbo Squid, and Europeana, that archive models of heritage-related objects. Archives like these can be created for Indian artefacts as well. In areas with high risk of calamities or rapid commercial development, creating models allows for their digital preservation in case of the loss of the actual artefact (Ahmed *et al.*, 2019). This technique can therefore be applied for recording vulnerable artefacts before and after damage, and then be used for accurate restoration (Mileto, 2017).

These models can also be used to plan museums, galleries, and other spaces. Virtual heritage spaces can be developed with these models to encourage interest in the field and to educate the audiences. It also allows for in-depth remote study when the artefact may not be accessible to the researcher. As mentioned before, creation of models using photogrammetry is relatively cost-efficient and accessible, which allows a much larger pool of scholars to use this technique and enhance their study. Many mobile apps like Polycam, Scan 3D (Android) and Qlone (iPhone) have also been developed, that allow making of models from the mobile phone itself- more and more accessible (Ortiz-Sanz *et al.*, 2020) Therefore, enthusiasts from non-academic background or local stakeholders can also be involved in archiving these artefacts. This technique also opens the doors to commercial promotion of sites related to the sculpture, or museums where they are placed. Models can be used to create virtual reality experiences and activities, and with further resources, can be printed and sold as souvenirs. It can also be used to design and plan spaces digitally. This technique, therefore, allows for public engagement and interaction, in addition to contributing to through analysis, documentation, and preservation.

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