

**“HOW” - ADVANTAGES AND APPLICATIONS OF 3 D MODELLING
TECHNOLOGY AND SOFTWARE’S CAN ENHANCE
“ARCHAEOLOGICAL RESEARCH IN INDIA”**

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ABSTRACT

The use of 3 D modeling technology is a great advancement in the computer field which can give three-dimensional views to any kinds of materials. The 3 D modeling is creating a much more active presentation of the real world and also the intrusion of the digital world into the life with the perfect illusion being created so real and very active which in turn eclipse our senses and makes each and every bit of the modeling as real as the practical world is seen. The data and results produced by the computer in the process of using 3D technology are one of the important guides in the decision making by the property owners, site managers, government officials, conservators etc.

KEYWORDS: 3D Technology – 3D Editor, Photo Modeler, Luminion, AutoCAD & Sketchup

INTRODUCTION

The use of 3 D modeling technology is a great advancement in the computer field which can give three-dimensional views to any kinds of materials. This 3 D technology show the multidimensional aspects of an object. This technology is a motion picture that enhances the illusion of depth perception, hence adding a third dimension. The 3 D modeling is creating a much more active presentation of the real world and also the intrusion of the digital world into the life with the perfect illusion being created so real and very active which in turn eclipse our senses and makes each and every bit of the modeling as real as the practical world is seen. Digital 3D modeling and data analysis have had a huge impact on the field of archaeology in recent decades. One of the important motivating forces in the 3 D modeling field is the well advanced computed tomography (CT) technology, through which two- and three-dimensional images of an object can be created with computer-processed x-rays. The interior and exterior architecture of an object can be picturized and as well the CT scanners are very much helpful in the non – destructive analysis of fossils and ancient remains, as well as living organisms and modern materials. As the use of this technology is very much needed in the archaeology research field the acquisition of the CT scanners by universities, museums, research institutes is done extensively throughout the world.

In this 21st century, the use of 3D modeling technology is fast in the improvement of its accurate measurements and works with high quality and efficiency in recording the artifacts. These photorealistic 3D models can be processed further using Building Information Modeling (BIM) to create plans, sections, digital elevation models, orthophotographs and other types of images useful for analysis and publication. The innovative methods and various tools in the 3D modeling software has made the study of the Megalithic culture very simple and informative.¹

The physical and active characteristics of the historical structures, archaeological sites and landscape are one of the major milestones in the process of conserving the material remains of the ancient period. The data and results produced by the computer in the process of using 3D technology are one of the important guides in the decision making by the property owners, site managers, government officials, conservators etc. The concepts of volume and of the third dimension are not recent discoveries. Rather, they constitute an archaeological component which has from the outset been recognized as fundamental to the discipline, expressed through documentation such as excavation plans, perspective drawings, maps and the like.² With the availability of the advanced 3D modeling technology, the older versions of the representation of archaeological data's like map, excavation drawings, artifacts and photographs etc in the form of graphical documentation has been converted into the digital mode. The 3D surface scanning is one of the most important aspects in the process of examining the artifacts, which can produce 3D models by using laser light, in turn the benefits of 3D analysis can be done more precisely than the CT scanner. This 3D surface scanner doesn't have the capacity of penetrating influence with the use of x-ray technology inside the internal structure of an artifact, but it can render the stripe patterns and full color (RGB) with the use of multiple lasers on the external surface of an object. As this 3D surface scanner has many advantages in carrying and operating the instrument with the help of a laptop, it offers the researchers to record objects in collections, laboratories and as well in the fields. While using the surface scanners resolution must be taken into important consideration as the scanner can produce the maximum resolution which ranges from several dozen to hundred microns. A speed of the scanner must also be very much required to scan objects which are more in number or complex or accessible for only a short span of time.

Apart from the above materials many other equipment and new 3D software are being engaged and used in the archaeological research in many universities, public institutions, laboratories etc throughout the globe. The aim of this article is to highlight the use of 3D modeling technology and the benefits of employing them in archaeological research in India to reconstruct its ancient history with utmost accuracy to a great extent and also to teach the students who is not well known about the advantages of 3D technology to acquire a small idea about the use of these technologies which would give them a small insight in their higher studies. The author who is also a doctorate in Archaeology and having a basic knowledge about the designing and graphics have made a small attempt to give a glimpse of the use 3D technology in giving three-dimensional view on the artifacts, architecture, sculpture and other archaeological antiquities to the beginners in the study of archaeology. It is also to note that though India is one of the leading nations in the world in producing many scientific inventions; its scientific expertisation is not well utilized in the archaeological research field. This is the reason why the historical antiquity of the nation is not well exposed to readers of various disciplines like computer science, information technology, engineering, and others. Hence this brief discussion and a small contribution of writing may evoke readers to study archaeology in multidimensional approach.

3D EDITOR FOR ARCHAEOLOGY

A 3D editor is the software which develops a mathematical representation of any *surface* of an object (either inanimate or living) in three dimensions via specialized software. The workspace in this editor includes the selection of a suitable platform for implementation, designing various specialized functions for working in archaeology discipline, how to implement the functions in Micro-Station Development Language - MDL. Reminders of the foundations of the ancient periods, artifacts, etc are traditionally drawn in the map manually, which is the time-consuming process. To reduce space of the time, the new way existing to reconstruct the 3D models is by use of the computer. A computer can

be used to make the user-assisted process of creation of 3D model easy by automation of typical operations. The editor called Archaeo – Builder can also be used for the reconstruction of complete villages (groups of buildings). As far as the implementation is concerned appropriate platforms namely *AutoCAD* and *Microstation* could be used to reconstruct the 3D models of the archaeological materials. As the use of AutoCAD is going to be dealt with in detail in the paper later micro-station platform is considered for the explanation. Microstation can be implemented in various computer platforms like (Unix, Windows, DOS). For 3D design, MicroStation provides only modeling of surfaces. Solid objects are represented by their surface. This fact can cause problems in the modeling of buildings where it is needed to know solid parameters of modeled bodies for simulation of mechanical properties. MicroStation Development Language (MDL) is a complete development environment which takes full advantage of the power of the MicroStation CAD engine.³

In the case of the destroyed housing structure, various functions are executed to reconstruct the same in the 3D editor. The archaeologists would select the appropriate circles and enter the heights of stocks and then the small stock will be inserted in the map which contains a small circle by the editor, where the original stock could have been inserted in the ground. Later in the map where there is an oblong shape the editor would insert the fence (a set of stocks). Then the projection of the wall is shown and when the archaeologists enter the height and type of roof the editor automatically place the roof. Texture mapping is an important function in the editor as it matches different types of texture to the surface of the stone which would have been in the destroyed structure.

PHOTO MODELER

PhotoModeler is used to perform measurement and modeling in archaeology, architecture, etc. PhotoModeler, which was first publicly released in 1993, was the first commercial all-digital close-range photogrammetry and image-based-modeling system.⁴ PhotoModeler creates accurate 3D models (consisting of Points, Lines, Curves, Edges, Cylinders, Surfaces, NURBS, and Shapes), and accurate 3D measurements from photographs taken with most standard cameras (either digital or film). PhotoModeler has the ability to read the following image formats: JPEG (.jpg), Tiff (.tif), Windows BMP (.bmp), PC Paintbrush (.pcx), Targa (.tga), Portable Network Graphics (.png), Pict (.pct), Photoshop (.psd), Portable Pixmap (.ppm), Macintosh Paint etc. PhotoModeler is a Windows software package for measuring and modeling real-world objects and scenes through the use of photographs. The PhotoModeler Software extracts 3D Measurements and Models from photographs taken with an ordinary camera. It is a cost-effective way for accurate 3D scanning, measurement, surveying and reality capture. This equipment is very efficient as it saves time in the field work and also it measures small or large objects and scenes. Using the Photo Modeler software is very much effective in modeling various artifacts and excavation sites which are aerially photographed. It can perform morphological measurements, extract the 3D surface of the cave paintings, petroglyphs or carvings and the curator of a museum is very much benefited by this software. As this software is proved to be a very valuable tool in documenting the heritage sites across the globe, it will be a fascinating tool in the reconstruction of the various heritage monuments in India more particularly in Tamilnadu which are under threat of destruction or reconstruction in the form of modernization by various means. The goal of using this software is to add 3D modeling technology to traditional methods for analyzing the ancient structures of the buildings.

AUTOCAD

AutoCAD is a commercial Computer-Aided Design (CAD) and drafting software application, developed and marketed by Autodesk.⁵ AutoCAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, and many other professionals. AutoCAD is implemented only on PC architecture (Windows NT, MS-Windows, MS-DOS). It provides all typical operations for 2D design. For 3D design, it provides the possibility for modeling surfaces and solid bodies by using predefined objects or by rotation and projection of 2D objects. Using AutoCAD we could scan the hand drawings and recreate the drawing in digital format. AutoCAD is for 2D and 3D computer-aided design and drafting, as it creates measured drawings and is compatible with other software, the advantages are endless. The many advantages include cleaning up lines, creating a style, view ideal for reports and making small details easier. While excavating a site the use of this software is very much useful as the trench plan is easily drawn in the AutoCAD through which the original trench is laid out. Digital mapping in AutoCAD is essential for the accurate laying out of trenches. Coordinates need to be generated from digital data to enable the trenches to be set out accurately in relation to each other and to the site grid. In the renovation process of an ancient temple, the use of AutoCAD is very much applicable to maintain the originality of the temple. The ancient temple of India which is beautifully constructed with various raw materials like stone, sandstone, stucco, etc has minute carvings and designs on their structure. Many of these unaccountable monuments were disturbed or destroyed by various means of vandalism. So in the process of re-uniting them in their older designs, AutoCAD software may be used to map the measurements accurately after mapping drawing the temples in the 2D versions. First, the conditions of crack or damage in the temple are drawn and photographed by sthaphathis. Later the parts of damaged structure are drawn which is later converted into the 3D version by AutoCAD software. Apart from the temple renovation, this AutoCAD software could be applied in the preservation process of the ancient stone tools pertaining to Palaeolithic, Mesolithic, Neolithic, Chalcolithic cultures, potteries, coins etc. The drawings of the stone tools are very important because these tools are identified from various sites that are easily available to the public, which is the basic reason resulting in the damage of the original structure of the tools. Even the students and scholars who visit the sites for research purpose also take the tools with them which are also another reason why the artifacts could not be accessed by the later researchers in studying the tools deeply. So in such type of unawareness among the public and even the researchers there arise the necessity to preserve the artifacts by taking photographs and line drawings which may be later converted into 3D drawings using AutoCAD software which may be helpful for the public and later researchers to view the objects in various dimensions and could access how the tools could have been used by ancient people for various reasons. The same is the case when potteries are considered. The different dimensions of the drawings can make the people have a basic knowledge about the shape and size of the pottery and they could imagine for which purpose the potteries could have been used.

OPEN SIMULATOR

Open Simulator is the virtual world platform with user-generated content. Archaeologists use various computer models for visualizing ancient artifacts and cultural heritage sites by employing virtual archaeology which is a fusion of different techniques and methodologies. This software makes the researchers get more involved in the 3D reconstruction of a historical site or an artifact as the virtual technology serves as the kinaesthetic communication which helps in human – computer interaction that can create the bodily sensation to perform an action in a computer. India encloses the innumerable number of ancient historical sites pertaining to various cultural periods. Some of these sites are in the

condition of dilapidation. In such cases the use of this software and the virtual technology in re-constructing the ancient sites to bring those sites to the general visitors in a 3D mode would be gracious gift and also makes the researchers to have a study on the basic constructional pattern and the way the sites have developed to present status in a three dimensional aspect. The Open Simulator, a free hand, and open source service provider could be installed in the computer to experience the virtual atmosphere. The role of this software is to study the available technologies employed by communities of the virtual world and also the cyberspace that creates virtual objects. Organizing an exhibition on the heritage sites could be a costly process and also maintaining it seems to be a great work as like real museums. Earlier the online catalogues of the museums were available on the website which can be easily accessed by the visitors just with the help of a computer with internet connection. The images in the computer just give a visual experience which a solitary one without any interaction with images. But the software like open simulator allows visitors to get an interaction with the images, artefacts in the museums with the available 3D technology that visualizes the replicas of the real artifacts and sites and makes the visitors to get an idea about the reality of the artifacts by scaling them to their easy access. Different type of avatars and images could be created using various tools and controllers to educate the younger audience. This may help them to have a basic knowledge and perfect understanding on the originality of the monument or artifacts and provides a good platform in the investigation about the local history and culture of a nation or region.

SKETCHUP

Sketchup is a 3D modeling computer program used for various drawing related applications like architectural, interior designs, landscape architecture etc. It is available as a web-based application Sketchup free6, Sketchup make etc. SketchUp was developed by startup company @Last Software of Boulder, Colorado, co-founded in 1999 by Brad Schell and Joe Esch. Google acquired @Last Software on March 14, 2006, and later Trimble Navigation (now Trimble Inc.) acquired SketchUp from Google on June 1, 2012. This software would useful for the archaeological research as it has the ability to create interpretations about the archaeological sites and places. SketchUp provides the user with the functionality to geolocate a model in a spatially correct location as well as providing the correct topographic representation found within Google Earth itself.⁷ In the archaeological research the use of Sketchup gives a good platform in the creation of 3D representations of a site and then employing it in the virtual world with certain annotations could make a great revolution in presenting the site to the general public in a better way rather than publishing the details of the site in a traditional monographic form.

LUMINION

Luminion is a powerful, easy, fun-to-use, effective architectural visualization tool that allows anyone to build a 3D environment and then create beautiful images, impressive video presentations, and live walkthroughs. The design what we create can be given a real-life environment by adding different materials, lightning, objects, and compelling effects. Luminion is compatible with all 3D design software programs, such as Revit, SketchUp, and ArchiCAD. Luminion includes a huge content library with tools, materials and artistic effects. Everything is perfectly integrated so we can immediately add trees, people and other content to breathe life, lighting, and atmosphere into your visualizations. *So, in what way the use of this software would be helpful in promoting the archaeological studies in India?* This seems to be a needed question as research’s done in this field is going in the form of presenting the results in the monographic format, documentary films on archaeological evidences photo documentation etc. Hence the researchers in archaeology have to be competent in handling the virtual technology in order to make the general public to get easy access to the

archaeological sites and artifacts in virtual mode. Having a glance at the heritage sites and artifacts which are created with beautiful lightning and riveting effects with different environmental background the viewers might get a good insight into the heritage sites with virtual reality. This might be a great boon in the archaeological studies, as this subject is considered as a dry area by general public and to the spectators belonging to disciplines of computer technology, engineering studies. The study of ancient monuments in the virtual mode makes the modern architects acquire a good knowledge about architectural excellence and the multi-diversity aspects of the sculptures. Though this is a computer era the accessibility of computer is not a much easy task to the growing population particularly in the rural areas, hence the government agencies, and the interested private institutions which formulate research on archaeological studies in correlation with various sub-disciplines like geology, anthropology, chemistry, biology etc should also take necessary steps to educate the common man to have interest in archaeological investigations by handling computer with special interest in virtual technology, which may lead the man to have a multi-dimensional approach on the archaeological finds, that helps in the enhancement of archaeological studies in India.

The above mentioned few 3D modeling applications and software's were in constant use in the archaeological research in various countries of the globe. Implementation of the use of various geographical instruments and correlation of geographical studies with archaeological data explores enormous outcome in the archaeological research in those countries. Enabling the use of 3D technology has made the subject Archaeology to be a common man's one and observes more income of researcher's in this field from various technology-oriented disciplines like computer and engineering field. So, this article is a small review about the 3D technology and software's which would enhance the interest of general public and other trained faculties of various other disciplines of computer courses in the archaeological studies and research in India. A countless number of archaeological findings in the shades of monuments, artifacts, coins, inscriptions etc are present in the Indian subcontinent. As the people are more attracted towards the animations and various dimensional effects given in movies, documentaries, advertisements, the use of virtual technology would make more and more visitors move into the archaeological world were a real-life experience with different dimensions could be given to them. Different type of avatars and images could be created using various tools and controllers to educate the younger audience. 3D technology may serve as the communicative medium as the human-computer interaction can produce a sensation in the body to perform an action in a computer. For this purpose, in the first instance the archaeological experts should be well equipped in the virtual technology and to make use of the software's that are available in the market. The government agencies should take necessary steps to promote virtual archaeology with reasonable cost because for a general public or a researcher obtaining classes in the private agencies would be a difficult task as they may fix large sum of money as the training fees.

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