

Chapter 14

Digital Preservation of Cultural Heritage for Future Generations

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ABSTRACT

Due to weathering and natural disasters, several cultural heritage buildings are devastated all around the world. It becomes necessary to preserve these historical monuments for future generations. Therefore, 3D modelling of historical monuments is a great tool to preserve these monuments as a digital heritage. The advantage of digital modelling of heritage sites also helps archaeologists to study the various aspects of that site while sitting at their own place without any need to travel to actual physical site. It saves time as well as reduces traveling cost. Moreover, many archaeologists can participate remotely to give their suggestions for future constructions. Also, digital archive of 3D models helps in restoration of devastated parts of buildings.

INTRODUCTION

Due to weathering and natural disasters, several cultural heritage buildings are devastated all around the world. It becomes necessary to preserve these historical monuments for future generations. Therefore, 3D modelling of historical monuments is a great tool to preserve these monuments as a digital heritage. The advantage of digital modelling of heritage sites also helps archaeologists to study the various aspects of that site while sitting at their own place without any need to travel to actual physical site. It saves time as well as reduces traveling cost. Moreover, many archaeologists can participate remotely to give their suggestions for future constructions. Also, digital archive of 3D models helps in restoration of devastated parts of buildings. Existing parts of huge structures can be modelled and merged with CAD models of devastated parts. This leads to mixed 3D models of the monuments. Digital archiving of cultural heritage sites also helps in virtual tourism where tourists can explore these sites at their convenience.

Geological survey applications use 3D models of cities and other structures for city expansions, managing public supply utilities, renovation of existing buildings and for town planning. CAD models are generally used to represent various buildings, roads and plants in urban areas, however such representation

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is only approximate and design of CAD models is time-consuming and in fact depends on the skill of labor used in the design process. Geological survey applications need detailed 3D models of buildings which are placed in world coordinates. Therefore, in such applications, 3D models are built using a laser range sensor and aligned into world coordinate system using GPS. Such models augment the planning phase in understanding existing condition of buildings, roads, and plantation to geological surveyors. It helps in disaster management, disaster management emergency exit services and planning for construction of new colonies. Computer Aided Design (CAD) models CAD model—make use of computers to build 3D models of small objects as well as huge structures. These CAD models are generally limited to approximation of real objects or scenes into basic geometric entities such as spheres, cylinders and other polyhedrals. The similarity of CAD model to its real object depends on the complexity of object shape and details considered in approximating into basic geometric primitives. Some of the softwares used for the task are Maya, 3D Studio Max and Blender in addition to many others. MASSIVE is design software widely used in artificial intelligence community. The 3D CAD modelling really depends on the labor and innovation of the CAD designer apart from flexibility of software tools available for construction of such models. The main tasks involved in designing CAD models are enumerated as below. The advantage of creating 3D models from such methods is that these models are easily editable and can be reproduced with updated versions after adding more details in its coarse representation. However, such models suffer from limitations of long design times. 3D models are also extensively used in robotics and in many computer graphics applications. In robotics, for example, 3D models are used to estimate the self-position of a robot in a 3D environment. Self-position estimation helps the robot to make its next move to perform the desired task. In computer graphics field, 3D models of small objects are rendered into realistic scenes for mixed reality applications.

Several methods are used for reconstruction of such 3D models depending on the size of object or structure to be modelled and level of detail needed for the application. One class of methods reconstruct 3D models of objects by approximating their shape into several interconnected primitives. The task can be achieved by using many commercially available softwares for design of 3D models. Another class of 3D modelling belongs to methods which use real objects to reconstruct their 3D models. This is known as modelling from reality. Such models truly represent the shape and size of real object or a scene. To reconstruct 3D model of an object or a scene, either image based methods image based methods or the methods which make use of sensors capable of providing 3D information are used. 3D models of small objects are built by interconnecting basic primitives like spheres, ellipsoids, cuboids and other polyhedral surfaces generated using a computer that mimic the shape of real object. Such methods are commonly used in computer graphics field especially in mixed reality applications where a virtual object is embedded into real scene. Instead of using computer generated 3D model, which lack in details, modelling from reality modelling from reality has gained its popularity because of their ability to preserve the true shape of real object or scene. A conventional camera can be used to reconstruct 3D point cloud from image sequence or a 3D scanner capable of obtaining 3D coordinates of surface points writ. its center can be used for the task. The principle of operation of 3D scanner may be based on radio signals, optical radiation or ultrasonic waves. The resolution of obtained point cloud in the later case, in general, is much higher than that obtained using image sequences. Using 3D scanners, the scene to be modelled is scanned from many viewpoints and then aligned into a common coordinate system to obtain 3D geometric model. Texture mapping to geometric models have been attempted successfully for virtual reality applications for more realistic appearance. Although, the methods to reconstruct 3D models of small objects and those for building 3D models of huge buildings (in digital archiving, for instance) are same

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