バーチャルリアリティによる遺跡探訪
3D Archaeo-Copter

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Abstract. An experimental system for virtual travelling over an archaeological region has been implemented. The central idea for building this system is simulation of 3D travelling over a region by taking a helicopter. Nara Basin has been employed as an example of archaeological region.

Keywords: 3D, Virtual reality
, Archaeological site

1. Introduction

Computer technical innovation dramatically changes visualization of archaeological monuments. A typical way of archaeological visualization has been presented by animated pictures generated by computer graphical techniques. A number of papers on such type of visualization have already been published[1-3]. The authors have also been engaged in making animated pictures of Japanese ancient scenery. During our working process, a special type of modeller named ASM has been developed by which some animated pictures of scenery of ancient villages have been created[4].

In recent years, another technique has been available for archaeological visualization: Since computing power and memory space of computer has grown quickly, real-time generation of pictures can practically be carried out by a personal computer. This may bring about a new revolution in archaeological visualization. Namely, the virtual reality techniques (or realistic virtual imaging) are now available. An immediate application of such virtual reality techniques is given by the so-called "walk-through" an ancient place [5].

In archaeology, geographical relations between a find and other finds, between a find and its site, and between a site and other sites are seriously considered for understanding the ancient society. To handle such relations in a new type of archaeological visualization, a fairly wide range of region should be covered, including a number of archaeological sites. The most macroscopic view of the region will be given by bird-looking from a very high view-point. If this was possible, we would be able to understand immediately inter-site geographical relations. On the other hand, it will also be desirable that when we wish to make a precise inspection of a site, we can look it from a lower view point or can "walk through" the site.

This story has reminded us of travelling the region by taking a helicopter. This paper presents an experimental system to simulate such type of virtual travelling over an archaeological region by using the virtual reality techniques. We call the system 3D Archaeo-Copter.

2. 3D Archaeo-Copter

The system has been designed according to the following typical steps to visit a site by taking a helicopter:
(1)Looking at the entire region from a very high view-point, determine a site to visit,
(2)Circling over the site at a lower altitude, reconfirm the site,
(3)Landing at a point near the site, confirm the site with eyes,
(4)Make a precise inspection by walking through the site.

The system acts in terms of transition between the four modes corresponding to the above (1)-(4) as is shown in Figure 1. The first mode is termed HA (High altitude) mode, which is initially presented for a user of this system. The display image in HA mode is a distribution map of a selected kind of sites superimposed on the 3D digital terrain picture (See Figure 2). A user can move anywhere on this map as if controlling a helicopter. Specifying a small area of the region, he can switch the present HA mode to LA (Low altitude) mode in which he can make bird-looking inspections. Display images in this mode are given by high-speed 3D imaging based on the 3D digital terrain data (See Figure 3). The next is G (Ground) mode. Here, a user can obtain text information of the site; e.g. name, address, archaeological significance or recommended walking routes of the site (See Figure 4). The final mode is WT (Walk-through) mode in which he can freely walk around in the site, visiting pit-dwellings or high-floured houses. Figure 5 presents an example of frame picture generated in a walk-through process.

After precise inspection of a site, if trying to visit another site, you have to back to the HA mode. Then you can visit another site in the same way as described above. Figure 6 illustrates the conceptual system structure of 3D Archaeo-Copter. The three sets of data play key roles in performing functions of the system. Object models include all the surface models of objects to be visualized; e.g. Keyhole tomb mounds, houses, fences and trees. Site data is a database of Keyhole tombs in Nara Basin. 3D digital terrain data is employed to generate the display images in HA and LA modes. Especially, object models and the terrain data need so large amount of memory that space and time to be travelled have been limited by hardware. The present system runs on Windows 95/98 through API called DirectX.

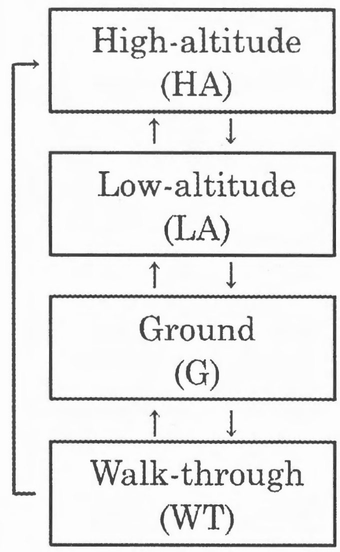
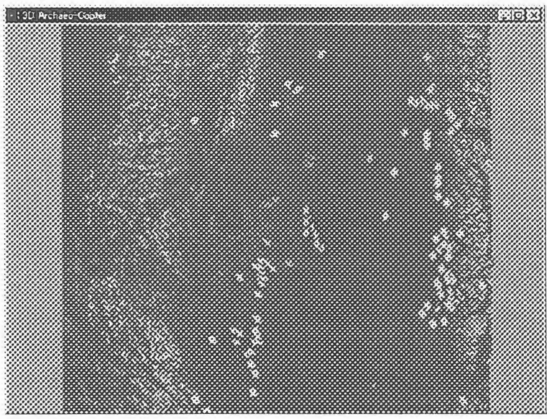


Figure 1
Transition diagram of the four modes.

3. Region

The region which the present system covers is Nara Basin where the Japanese ancient regime begun in the 4th century. In later periods, ancient capitals had



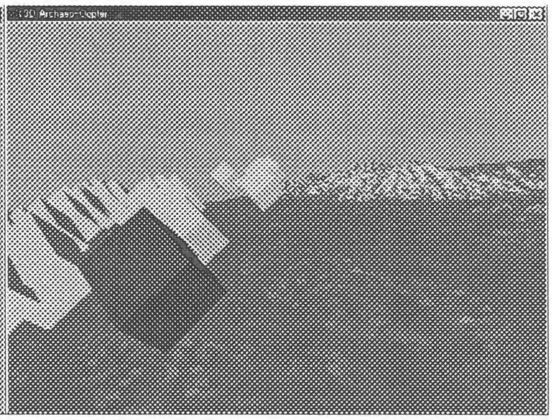
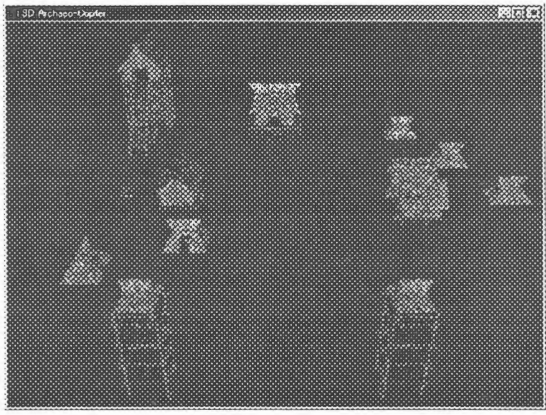


Figure 2 High-altitude

Figure 3 Low-altitude



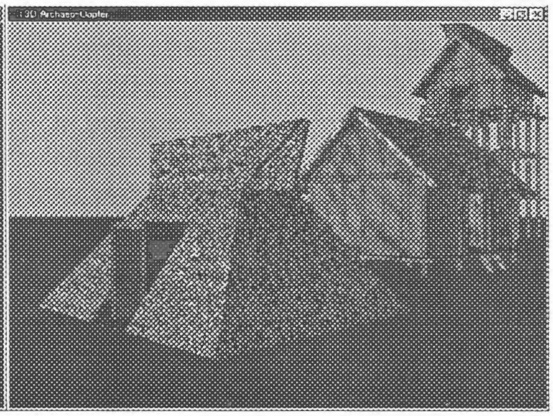


Figure 4 Ground

Figure 5 Walk-through

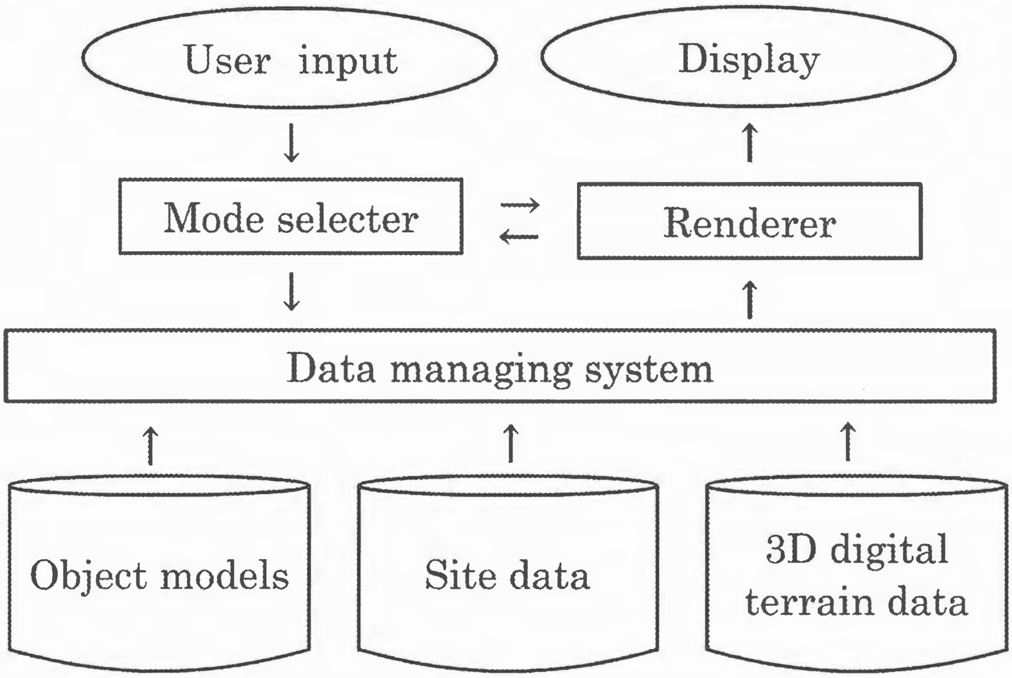


Figure 6 Conceptual system structure of 3D Achaeo-Copter

continued to be built within this region untill it moved to Kyoto. Because of its long history, Nara Basin is widely recognized as one of the most important regions with rich archaeological monuments.

The 3D digital terrain data provided by the government has been employed for generating the distribution map in HA mode. The minimum unit of the terrain data is a 50m by 50m square area.

The sites handled by the present experimental system are limited to a small set of monuments; i.e. the Keyhole tombs and their neiboured villages. Namely, the system can treat simply Nara Basin in the Ancient Tomb Period. In fact, the authors have been engaged in building a database of Keyhole tombs since 1980. This is a reason why we have employed the set of Keyhole tombs as an example set of sites for 3D Archaeo-Copter.

4. Conclusion

This paper presents the conceptual system structure and functions of 3D Archaeo-Copter. Virtual travelling by the present system has been limited to Nara Basin only in the Ancient Tomb Period. As stated previously, this region includes a rich amount of archaeological monuments stored up during a long range of time. One of our future tasks is to extend the time range so that a user could visit more sites other than the Ancient Tomb Period. When this was taken place, another option to select a period of interest would be required in HA mode. Secondly, it will be a future work to extend the region to be handled. Such extensions obviously need a huge memory space beyond the present situation of computer hardware. Technical innovation is, however, so rapid that both extensions in terms of time and region look to be taken place very soon.

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