

CAMPUS GUIDED TOUR VR SYSTEM FOR THE UNIVERSITY OF HONG KONG

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Abstract. Virtual Reality has been an ideal environment for visualizing three-dimensional models as well as implementing simulation systems such as flight training and surgery preparation. In such a system, the user can be familiar himself/herself with a particular environment or the procedure of a task even before going into the real site or actually performing a task. In this project, we are trying to implement a Guided Tour System inside a Virtual Reality Environment. Basically, a three-dimensional model of the campus of the University of Hong Kong will be built in the Virtual Reality Modeling Language (VRML). It is now possible to have a 3D visualization of the model in any Web browser. A non-directed graph can be built based on the 3D model with every branch representing a path, and every node represents a specific location inside the campus. Based on this graph, we can calculate all possible routes between any two nodes and deduce the shortest path between them. The guided tour system is designed in such a way that whenever the user attempts to move to a new place inside the campus, he/she will be brought to there in the quickest way automatically with just a few "mouse-click". In this project, the *Cosmo* VRML player will be used as the browser's plugin, and other associated tasks are developed in *Javascript*.

1. Introduction

The University of Hong Kong (HKU) is the oldest tertiary education institute in the territory. Its estate covers a number of campus over sixteen hectares on the northwestern slopes of the Island. The main campus composes of about twenty-five buildings and these buildings are located unevenly on the campus site.



Since the campus does not reside on a flat and open environment, new students and visitors may easily find lost if they are not familiar with the buildings and their access. For now, they are guided by a two-dimensional map which only contains a simple outline of the campus site and the names of the buildings. The map is not always easy to follow as many of the walking paths are far from obvious.

Advancement in technology suggests the use of low-cost personal computer or even notebook computer to aid in this touring process. In this project, we are going to use a three-dimensional approach and furthermore, a system which tells how to arrive at a destination as well as to provide information about the campus.

Take for an example that inside the campus, there is a visitor who has a portable computer which can display a three-dimensional view of the whole campus site. What she sees on the screen is exactly the environment surrounding her, or at least at a viewpoint nearby. Now if she decides to go to the building which hosts the Department of Architecture, she simply clicks on that building and all signposts inside the campus changes immediately. Then she keeps on selecting successive signposts that will change her viewpoint and eventually lead her to the destination. By activating another button, the information of the corresponding building could also be obtained. If she prefers, there is also a round-the-trip tour to give her an overview of the entire HKU campus.

The *Netscape* Navigator with *Cosmo* Player 2.0 VRML Plug-in is an ideal platform for this system. The model of the entire campus to be built is simplified so as to boost overall system performance. The campus landscape is created with 3D *Studio Max* and converted to VRML 2.0, whereas each individual building is constructed directly with *Cosmo* World running on an Silicon Graphics O2 workstation. The algorithm which generates paths for a user is implemented in *Javascript*.

2. System Overview

The user interface for our system is intuitive: it is shown in Figure 1 which consists of a left frame viewing the three-dimensional VRML campus model, and a right frame displaying a two-dimensional map of the campus and providing detail information for every building.

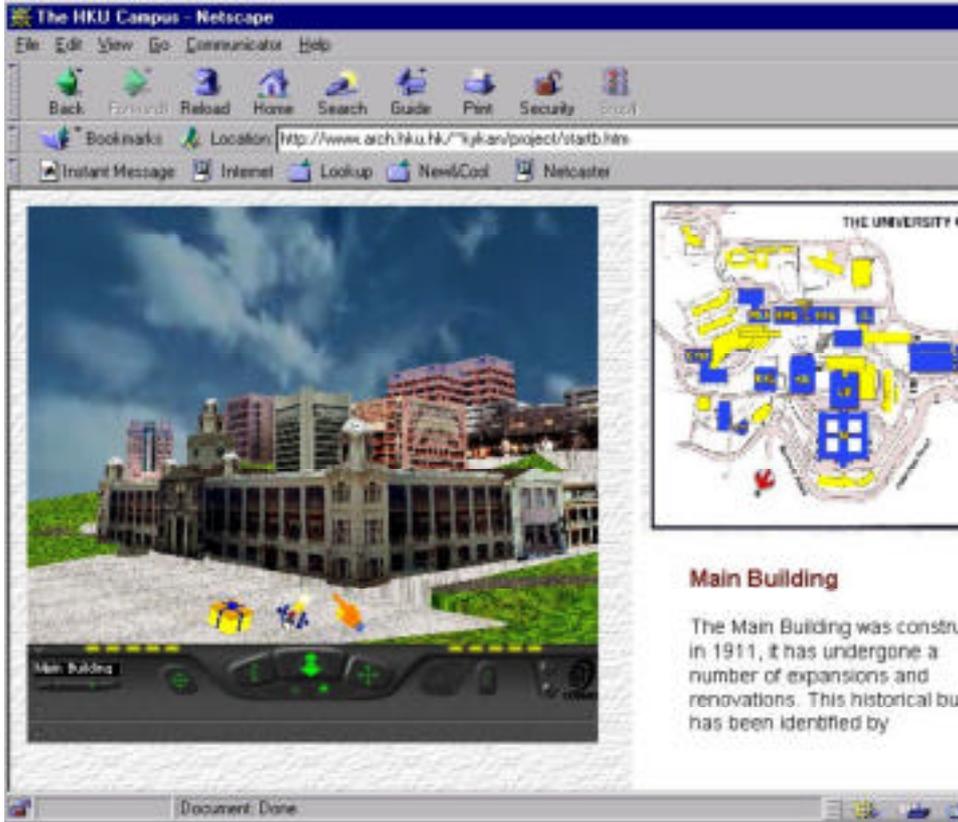


Figure 1. User Interface in a browser

Information for each building can be obtained by clicking the corresponding building on the two-dimensional map or the “information” icon on the three-dimensional campus model-viewing screen.

Basically, a user can navigate freely throughout the campus with the navigation tools provided by the Cosmo Player. However, in order to achieve a faster performance and enjoy the complete advantage of the Guide Tour System, the user can also navigate using many pre-defined viewpoints. On each viewpoint, a default menu of icons is presented as below (Figure 2):



Figure 2. Default navigation icons.

The meaning of the icons are explained as follows.

Information:	provide detail information on current building;
Aeroplane:	take an aerial view of current building;
Tour:	join the “round the campus” trip;
Lego:	follow this tour guide to walk around the building;
Navigation:	follow the link to next <i>waypoint</i> and final destination if activated repeatedly;

3. Shortest Path Algorithm

In fact, the system being implemented is more than barely a three-dimensional visualization of the campus. We have embedded a useful extension - the shortest path algorithm, to help locating any particular building in the most efficient way.

To simplify the navigation, there are *waypoints* defined throughout the campus. When a user performs a mouse-click on the navigation icon on the menu system of any waypoint, his viewpoint will change gradually and he will be brought to the next waypoint pointed to by the current navigation icon. By further clicking, he is able to tour the campus easily and arrive any specific destination.

The important issue here is how we can control the waypoint pointed to by each of the navigation icon. We resolve this problem using a modified shortest path algorithm. This algorithm automatically computes the shortest path from the current waypoint to the destination. In addition, the algorithm also keeps track of the shortest paths from all possible waypoints to the destination. One example of path calculation is shown in Figure 3. One significant contribution of our algorithm is that all data regarding the availability of waypoints and paths are computed real-time based on the information from a back-end database. As such, a user is guaranteed to receive most updated direction even though there is an emergency closure on any waypoints or paths.

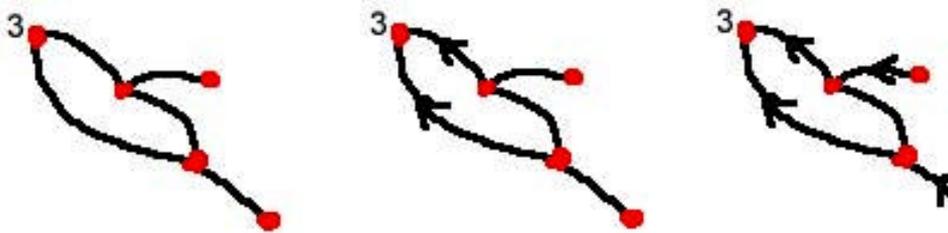


Figure 3. Shortest path routing to waypoint no. 3

However, in the current implementation, the path calculated is only the shortest distance but not necessarily the best. Normally we would like to follow

the easiest path. For example, there are times that we prefer making use of the elevators instead of walking up the stairs.

This happens because all the paths defined are not weighted. In the future, we may improve the algorithm by assigning a combination of weights to each path and waypoint. The greater the weight, the easier the path is to follow. The algorithm could then calculate the path with the heaviest weight.

4. Conclusion

In this paper, the functionality of a Guided Tour VR System for the University of Hong Kong is presented. It has been developed using VRML 2.0 and Javascript running under Netscape Navigator and Cosmo Player 2.0. The system provides a three-dimensional view of the main campus of the University so that the user can have a virtual feeling of presence. Information of each building can also be obtained in the browser while the user is navigating through the campus, either manually or automatically guided.

Several future improvements could be made on the system. For example, we can include a comfortability factor in the shortest path algorithm and this factor can be modified real-time to reflect personal preference and contingency events such as and road blocks due to construction.

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