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Research in Web3D Virtual Technology based Online Education Platform for Historical Battle

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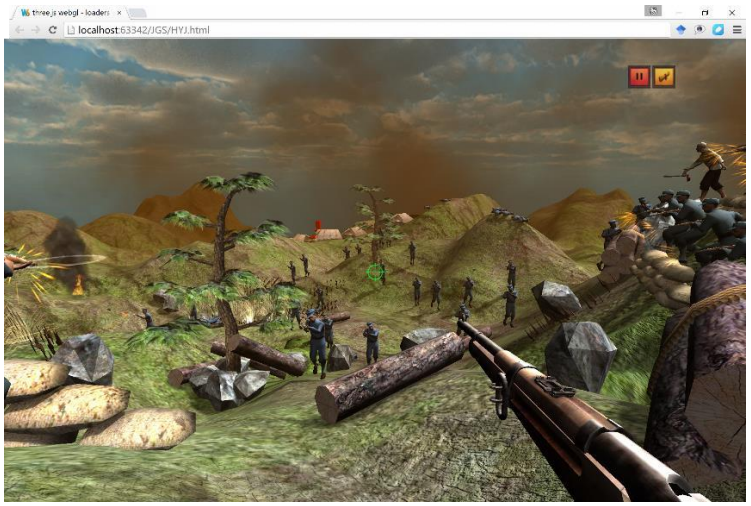


Figure1.The effect of real-time rendering the historical battle

Abstract: This paper explores how the reconstruction of special history scenario will be applied in online education. After investigating various virtual reality techniques including design of virtual educational system, reconstruction of virtual scene, management of scene, AI and light shadow rendering, we build an online education platform for touring a web3D virtual battlefield scenario called Huangyangjie in China. We firstly present the solution and scheme for rebuilding the web 3D battlefield Scenario using lightweight 3D models. Secondly, we present voxel of interesting (VOI) scene management strategy. Thirdly, we optimize A* algorithm in AI management process. Finally, we design an experiment for comparing virtual reality based technique teaching mode with traditional teaching mode.

Keywords: Virtual reality, Virtual education, Scene management, Light weight 3D model

1. Introduction

With the rapid development of the virtual reality technique, its application in education has received significant attentions as its ability of allowance for students to get more immersive and realistic experience in learning. In this paper, we has studied the application and construction of virtual reality technique in education based on the 3d historical battlefield scene of Huangyangjie in China in term of virtual system design, scene reconstruction, scene management, lighting and shadow rendering. The pipeline is assembled by rebuilding the 3D battlefield scene in a lightweight manner, voxel of interesting (VOI) scene management for real-time rendering on the web. We believe the virtual reality technique will have a profound impact on the education.

2. Education Platform for Historical Battle

We rebuild the 3D lightweight model of elements in battlefield (Laixiang Wen,2015), including battlefield terrain, soldiers, weapons and so on. For generating a voxel index structure, we firstly segment our terrain data.

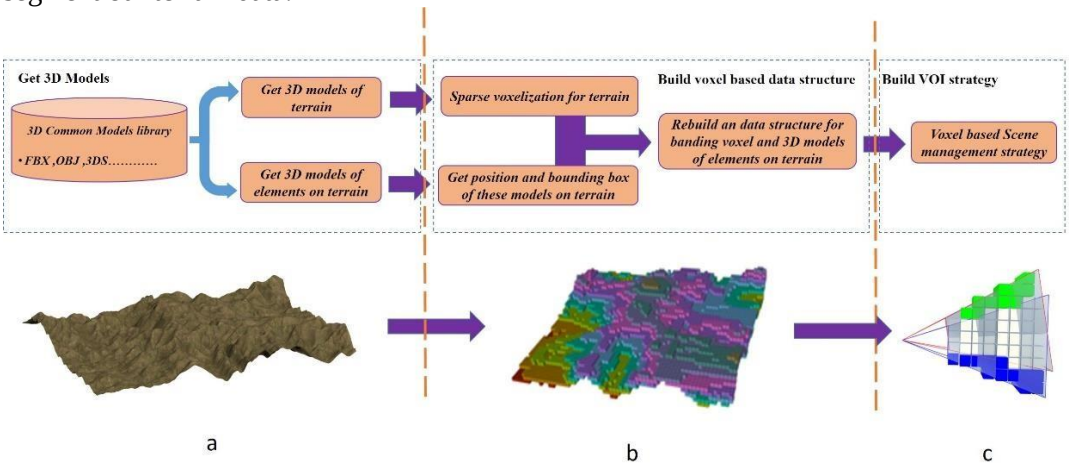


Figure 2. Scene management strategy's technology roadmap. a. 3D model of terrain; b. sparse voxelization of the terrain; c. voxel of interesting based scene management

We conduct a sparse voxelization method and record the index based on the positions between voxels and scene models (including terrains). With this index structure, we can constrain the data loading region to the voxels just around the viewpoint. A voxel index structure for terrain segments and common 3D models has been constructed (shown in Figure 2b) and all the complicated process is just simplified into a sparse voxelization. The VOI loading strategy mainly consists of two aspects: progressive dynamic loading and preloading. In preloaded process, as shown in Figure 2c, the preloaded frustum (blue frustum) corresponds to a perspective amplification and field of view lengthening of current frustum (red frustum).

3. AI management in battlefield scenario

To enhance the students' sense of participation, we designed multiple role-playing games for users in the complex battle scene and the defender is set as the main role by default. In these games, the student who is designated as a soldier of defender will be involved in the whole battle from his own viewpoint. For the purpose of education in entertainment, the Non-player Character (NPC) and AI management which is closely related with the interest of games must be efficient. In this paper, we mainly focus on two critical AI technologies, AI trigger of historical events and AI path finding algorithm. In our system, we reproduced some typical event details from experts with offensive side's AI triggering which includes the trigger for bamboo array and trenches while offensive side marching, the trigger for roller element stone when in ambush region, the trigger for guns and mortars.

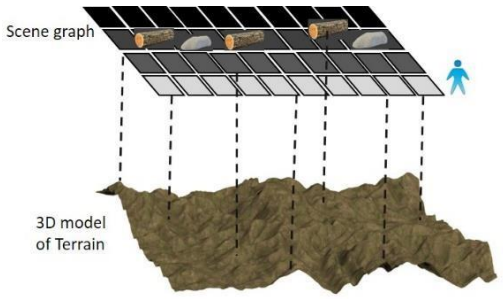
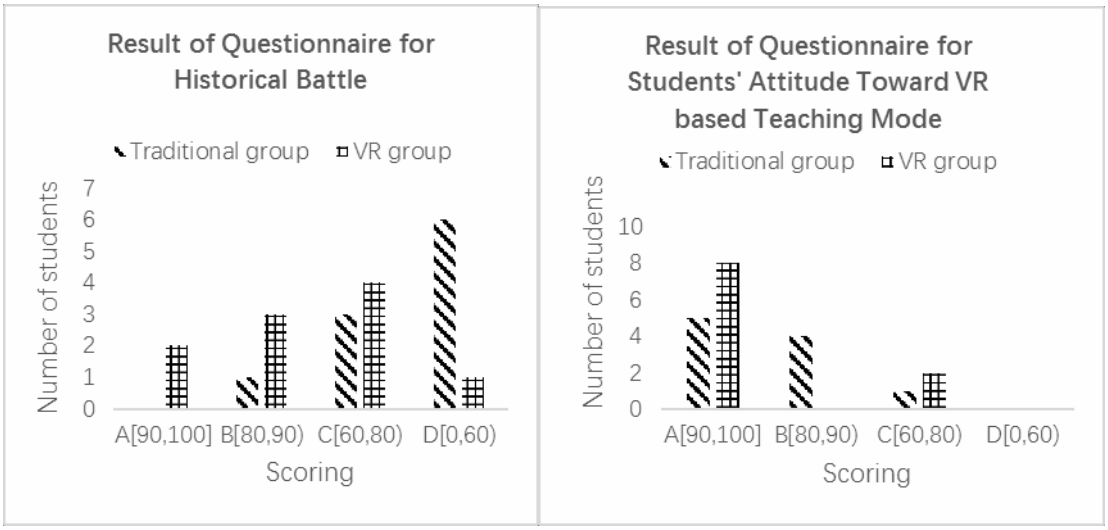


Figure 3. Scene graph map to the 3D model of terrain

As shown in Figure 3, the scene graph mapped the whole complex terrain onto a grid with MN cells and moving between these cells will produce a certain cost. In our algorithm, we design the cost to refer the attack risk and aim to find the best attack path that have the lowest risk cost.

4. VR based teaching mode's experiment and result

For comparing virtual reality based technique teaching mode with traditional teaching mode, our experiment is designed to test 20 undergrad students.



Figurue4. a Result of questionnaire for historical battle b Result of questionnaire for students' attitude toward VR based teaching mode

From figure 4a above, we find that the effect of historical battle study using VR based teaching mode is better than using traditional teaching mode in the same time. And from figure4b above, 84% students without using VR based teaching mode want to try it. 80% students who have used VR based teaching mode have a positive attitude toward this teaching mode.

5. Conclusion

We implement an online 3D virtual education platform in order to help students to engage the courses. Our contributions include virtual scene reconstruction, scene management, AI algorithm, and educational analysis. In the whole process, we present the solution and scheme for rebuilding the web 3D battlefield scenario, create voxel of interest (VOI) scene management strategy based terrain-voxel-model uniform structure, and optimize A* algorithm in AI management process. The effect of historical battle study using VR based teaching mode is good, and most of students have a positive attitude toward this teaching mode.

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