

AR Lightning Protection Device Teaching System Based On Vuforia

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ABSTRACT

With the advent of the information age, augmented reality technology superimposes virtual three-dimensional models and real environments, giving us richer visual effects. Based on this problem, the augmented reality technology is introduced in the teaching process of lightning protection, and the teaching software of AR lightning protection device is developed. Taking various common lightning arrester contents in daily life as an example, Unity3D development engine and Vuforia augmented reality development tools were used to complete the systematic development and teaching of AR lightning protection devices. The realization process includes material resource production, scene construction and function development. After the software is released, the virtual model is presented in three-dimensional form through scanning pictures, which enhances the interest in the teaching process and is conducive to improving the teaching quality.

KEYWORDS

Augmented reality; Human-computer interaction; Lightning protection device; Three-dimensional model; Fidelity

1. INTRODUCTION

At present, information technology is developing in an all-round way. In 2019, the state issued the strategic document "China's Education Modernization 2035" with education modernization as the core, which pointed out that it is necessary to accelerate the reform of education, build intelligent campuses, use modern information technology to accelerate the reform of personnel training mode, and realize the organic combination of large-scale education and personalized education [1]. Augmented reality technology is a very beneficial tool for educators, and the application of augmented reality technology in the field of education meets the needs of educational reform. Wu Qiang et al. studied the AR space teaching system by using Unity3D and Vuforia, completed the simulation of the virtual simulation space experiment process, and enriched the interactive experience between students and space experiment [2]. Li Yi summed up the traditional hydraulic transmission teaching course about the theoretical abstract, the lack of experimental equipment and other deficiencies, research and development of the hydraulic transmission course as the content of AR/VR hydraulic transmission virtual teaching system, the verification results show that the hydraulic transmission virtual teaching system is of great help to the teaching effect [3]. In order to enrich students' aesthetic perception quality, Fan Jingwei developed virtual musical instrument teaching resources by using Unity3D and Vuforia. Compared with ordinary media resources, the effect is better, which can improve the teaching effect of music class [4].

Most colleges and universities teach the content of lightning protection through traditional pictures and videos. Due to the lack of experimental equipment and serious observation of lightning protection

devices, a considerable number of students will reduce the depth of their absorption of lightning protection knowledge. Based on this problem, combined with augmented reality technology, Unity3D development engine and Vuforia development platform, the teaching system of AR lightning protection device based on Vuforia is developed, which includes common lightning protection and lightning protection devices, so that students can intuitively feel the principle and physical characteristics of lightning protection through "visualization" teaching.

2. MATERIAL PRODUCTION

The 3D model is the interactive object of the whole AR lightning protection device teaching system, and the corresponding physical characteristics of the model must be well matched to ensure the fidelity of the system model and give users a better experience.

2.1. 3D Model Material Production

The whole AR lightning protection device teaching system is based on 3D model. At present, there are many kinds of 3D model making software, including 3Ds Max, blender, etc., and their respective characteristics are shown in Table 1 [5].

Table 1. The current popular modeling software and its characteristics

Software name	peculiarity
Blender	Open source, comprehensive features, mainly used for post-film animation processing
3Ds Max	With a rich plug-in architecture, provide a variety of modeling methods, the most widely used
Solidworks	With motion simulation, structural analysis, standard parts library and other functions, mainly used in mechanical and electronic fields

Among them, it is convenient to use 3Ds Max for modeling. What is more critical is that the exported format of the model is compatible with the Unity3D engine to be used later. Therefore, 3Ds Max is selected for 3D modeling in this paper, The 3D model making process is shown in Figure 1..

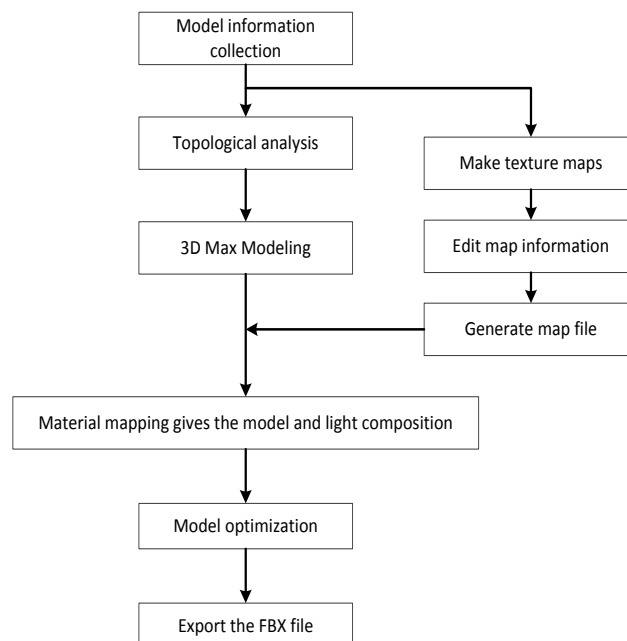


Figure 1. Modeling flow chart

First of all, the key information of the model should be collected, then the physical topology analysis should be carried out, and the map should be drawn according to its structure. After the modeling is completed, the information obtained should be mapped to the model. Finally, the model should be simplified by using the quadratic error measurement algorithm to reduce the loading pressure of the system.

2.2. 3D Model Simplification

Due to the use of a large number of lines and points in the creation of the model, the system will be stuck in the process of loading model resources, and the commonly used methods are fixed-point deletion, vertex clustering, triangle folding and edge folding [6]. The purpose is to reduce the redundant edges and vertices to simplify the model. For this reason, this paper studied and analyzed the quadratic error measurement algorithm, and the effect is shown in Figure 2. In the figure, we tried to observe the model through the wire frame. The figure on the left side underwent lightweight processing, and its number of edges and vertices was much smaller than that on the right side, and its shape basically did not change, which met the requirements of lightweight processing.

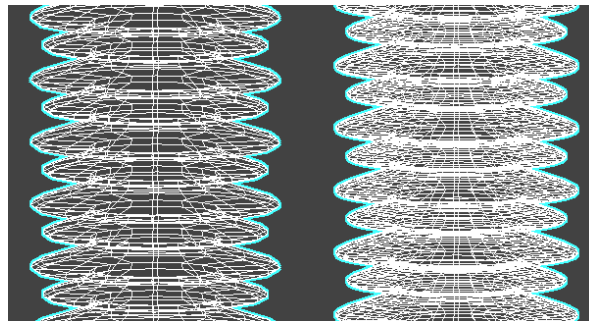


Figure 2. Model lightweight processing effect

3. SYSTEM FUNCTION DEVELOPMENT

Software development is firstly about making the model, then building the Unity3D virtual platform and importing the lightning protection device model; secondly, configuring the Vuforia development environment, including JDK Settings; after obtaining the license key, uploading the prepared AR identification map to the official website of Vuforia to obtain the SDK; only when the recognition rate of AR identification map is high enough can it be used. The corresponding functional code was written in C#, Button and image were created on canvas in the Unity3D virtual engine, and the script was mounted to the corresponding Button and model to complete the development of human-computer interaction, and finally the interactive function was tested.

3.1. Model Import

Export the 3D model created by 3Ds Max into FBX format, create the Unity3D project, and import all FBX model resources into the project folder. Since Unity3D is compatible with FBX format files, it can be directly imported into the Unity3D engine to operate it.

3.2. Framework Design of AR Lightning Protection Device Software

The AR lightning protection device teaching software uses augmented reality technology to realize human-computer interaction. The video animation module demonstrates the lightning hazard. The introduction of the lightning protection device lists a variety of arresters, including their working principle and characteristics. The model can be interacted with the screen by flicking the finger,

including scaling, rotation, disassembly and other functions, The framework design is shown in Figure 3.

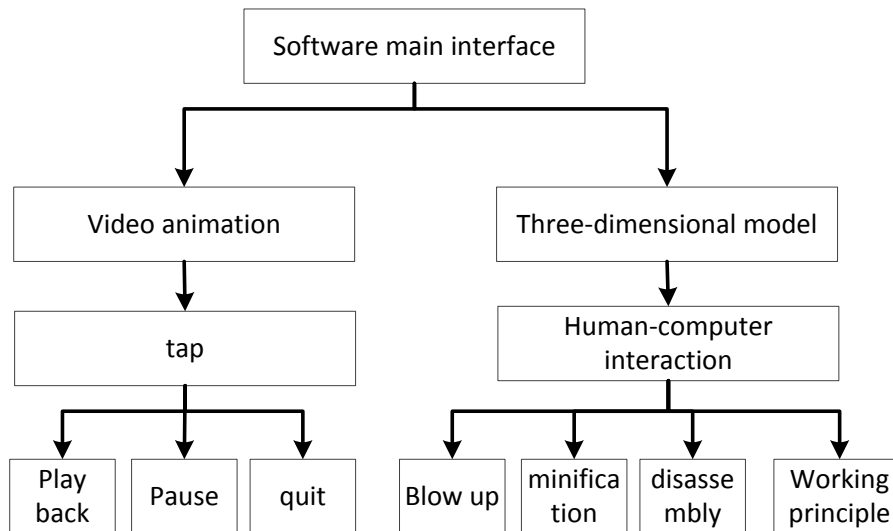


Figure 3. Frame design drawing

3.3. System Function Design

The human-computer interaction function of the system software relies on C# script, which is written in the Visual Studio development platform to control the interaction of the script, which is mainly used to judge the finger touch screen, so as to respond to the click event [7].

The scripts are mounted to the models that need interaction to complete the human-computer interaction of the lightning protection device model [8]. The interface design is carried out through Canvas canvas, and the number of keys is designed according to the function. At the same time, for the sake of aesthetics, our home is placed in a suitable position through anchor setting [9].

4. PACKAGE AND RELEASE THE APPLICATION

Based on augmented reality technology, the teaching system of AR lightning protection device was developed on the development platform of Vuforia. 3D models of various lightning arresters were created through 3Ds Max modeling software, and the models were lightened by quadratic error measurement algorithm to reduce the loading and operating pressure of the system. Through Unity3D engine and C# programming, the interactive function is realized, which improves the scalability of the system. The development of this system, the common lightning protection device package together, so that students have a clearer understanding of the lightning protection device, through the promotion of testing, this system for students to understand the lightning protection equipment is very helpful.

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