Simulation of gear drive design based on unity3D

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Abstract. Electromechanical integration technology has developed rapidly in recent years. It is based on the information technology represented by Microelectronics technology and microcomputers. Its development is a modern industry that rapidly penetrates the traditional machinery industry and deeply integrates with electromechanical integration technology. It has mechanical technology, Microelectronics technology and information, automatic control technology, sensing and testing technology, software programming technology, interface technology and power electronics technology. With the rapid development and widespread use of computers, electromechanical integration technology has achieved advanced development and has become a system technology for computer integration, sensor detection technology, automatic control technology, and mechanical technology. And in the direction of photo-electromechanical integration, the scope of use has become larger and larger.
And we're looking at one of the most important ones -- the gear drive, which is now the most versatile of all mechanical devices in the world. Its transmission is more accurate, more efficient, compact, reliable, and long-lasting. This time we use Solid Works and 3DS Max software to map and model gear drives and analyze their main functions.
In addition, Unity3D is also a virtual simulation software that is widely used today, and domestic talents are scarce in this area. In this context, we can try to study the design simulation of gear drive based on unity3D.

1. Introduction
At present, the Chinese education system has gradually become informationized and electronic. Many computer technologies and network communication technologies have been added to education, allowing more multimedia devices to enter the classroom. This is also a sign that education is moving toward informatization. Among them, we must focus on the development of digital campus construction and strengthen practical education. In today’s higher education, higher education is combined with information technology. The virtual simulation teaching system is born in the present perfect education system. It is based on virtual reality technology. By constructing realistic virtual scenes, students can conduct hands-on experiments in the virtual environment as much as they like. The experimental results made in this way are the same as those completed in the real world [1].

This study is based on Unity3D software, transferring traditional experiments to computer screens and mobile terminals. Gear transmission simulation design is an important part of electromechanical integration. Mechanical and electrical integration technology course is a combination of theory and practice. Practical hands-on courses generally reduce the quality of the experiment itself because of venue or financial problems. Do not worry, virtual reality technology can easily provide the most advanced experimental environment for electromechanical related experiments. The virtual reality simulation training system is a historic breakthrough for the "electromechanical integration
technology" course. Electromechanical integration-related experiments generally have large use sites, high costs, complex use, quantitative restrictions, and low efficiency. The virtual reality experiment has solved this problem well [2].

2. Overall design of the system
Model Processing Software Selection: After using Solid Works to complete the modeling, you need to add texture, optimize the number of faces, and adjust the axis to enhance the realism of the model. Commonly used model processing and animation software includes 3DS Max, Maya, etc. Compared with other software such as Maya, 3DS Max is easier to operate and easier to learn, so it is suitable for 3DS Max to complete model processing and related animations. 3DS Max (3D Studio MAX) is a product released by Autodesk to create models, create animations, and add material lighting to the scene. It is one of the most widely used 3D software and its powerful multithreading function is excellent. To implement model processing and optimization, the animation editor allows users to easily create key frame animations. 3DS Max has a variety of shape modeling methods that are prominent in rendering and dynamic color grading. At the same time, 3DS Max can use rendering plug-ins such as the Vary renderer to achieve the most perfect rendering effect [3].

Finally, Unity3D will be used to provide a complete solution for the virtual simulation teaching system. Since Unity3D has highly optimized graphics and staining pipes, the display format can achieve exquisite images in 2D and 3D. It supports almost all major file format introductions. It has a built-in NVIDIA PHYSX physics engine. With the new particle subsystem and light shield system, we not only improve the effectiveness and quality but also save time. In addition, developers can create interactive experiences using non-plug-in games implemented in browsers [4].

3. Model Construction of Gear Drive Design
3.1. Constructing Gear Based on SolidWorks
Establishing the template model of the component cluster is the process of using SolidWorks to perform three-dimensional parametric design preconditions and foundations of mechanical parts, and the original user manually operates the deformation and modifies the template model to obtain new parts. This change is automatically controlled by the program. Parameterization makes it easy for the program to control the gear template to have all the functions of the part cluster components. Therefore, the common features of similar gears should be carefully analyzed when modeling to find common dimensions and structures [5].

Modelling steps: first, make scientific analysis of the structure and function of gear parts, determine the composition of features, size parameters, and associations. The characteristics of the parts can be adjusted according to assembly constraints and non-assembly constraints. Systems fall into two categories: the first reflects parts and external assembly constraints. The second type reflects the structural shape of the part itself. Each function is packaged with several parameters that can be divided into three types: The first type of parameter called is the parameter that determines the assembly constraint or structure shape of the part. This number needs to be manually entered by the designer, which plays a decisive role in the design results. The second type is called a subordinate parameter, that is, a change in the main parameter in the component. Structures require parameters that can be changed automatically. These parameters are usually passed by the program. After a certain calculation method, the main parameters are calculated as known quantities, usually not artificially changed; The third type is a constant, that is, a series of components is always a fixed number [6].

3.2. Model Rendering Based on 3DMAX
3DMAX has a built-in scanning line renderer and a mentalray renderer, but due to the complexity and slowness of the operation, most designers basically gave it up, but chose a third-party renderer for late rendering. If you compare 3DMAX to the character, then the light is the human eye. The good use of
matter and light can make the model vivid. Therefore, if you want your work to be more attractive, a good renderer can make a difference in the output of high-quality CG works in the future [7].

3.3. Design of Gear Drive Animation Based on 3DMAX

The 2D plane image is converted to 3D using a stretch function, and the main gear and the slave wheel are made using a Boolean operation.

Check the drive wheel to activate the "automatic frame" animation record below the window. Button, set frame 0 to a key frame, move the time slider to 100 frames, and drag the drive wheel to rotate 360°; Then click the animation control area(play) button, you can see that with the rotation of the drive wheel, the reverse rotation from the drive wheel, but the speed is changing. This can be corrected by modifying the trajectory curve. In the trajectory view, select / Y Rotation to change the curve in the right track window to a straight line. At this point, our gear animation takes shape. Finally, add the background to the gear and the proper lighting to get the long-awaited animation. Fig. 1.

![Fig. 1 Gear Drive Animation](image1)

![Fig. 2 Create folders under Project](image2)

4. Simulation of gear drive design based on unity3D

Unity3D is one of the most widely used virtual reality engines in the market and has stable, efficient and many other features. Unity3D uses NVIDIA's Phys X physics engine and has a highly optimized rendering channel and baking system. Players can make their own real physical scenes and beautiful 3D scenes. Unity3D's program editor supports three programming languages, including C#, Java Script, and Python. It provides designers with a wealth of API interfaces, and users can flexibly choose the appropriate language to implement interactive functions. At the same time, Unity3D can import common 3D data file formats such as FBX, OBJ, and 3DS, which can not only receive model information from files, but also import materials and animations from source files. The engine also supports multiple platform versions and can be released to Web, Pc/Mac, Android, IOS, Xbox360, PS4 and other platforms at the same time. Fig. 2 below shows the unity3D software operation page.

4.1. Virtual Reality Scene Design

With the rapid development of science and technology, virtual reality technology relies on advanced multimedia software and hardware, so that users can produce the function of "being in the field". Virtual reality technology is based on computer control, by allowing the experimenter to feel hearing, vision, touch and other aspects. Computer technology that makes people feel and experience in the real world. The purpose of virtual reality technology is to obtain the feeling of the real world. Therefore, multiple perception is the soul of virtual reality technology.

At present, mobile devices are developing rapidly and have a high degree of popularity. Therefore, mobile virtual technology has been proposed, and the development software of mobile virtual reality products has appeared one after another. The virtual simulation teaching system fully embodies the principles of interactivity, engineering, safety and reliability, easy to maintain, based on reality, and combination of reality and reality. It can even perfectly perform teaching functions that can not be obtained or difficult to complete in actual experiments: in cases of great or extreme environmental harm to the human body, as well as high costs, random and comprehensive training. The virtual simulation teaching system can overcome various limitations in the real environment, provide
experimental projects with strong stability, high security, and good economy, and complete the corresponding practical requirements.

![Fig. 3 Cavas Settings Component](image1)

![Fig. 4 Gear Model Import Unity3D Software](image2)

4.2. Design Simulation of Gear Drive

Open Unity3D software, create a new project, name it BiYeSheJi, click Create to enter the Unity3D software operating interface. To ensure that there is a clear idea in the development process, several clearly organized folders need to be established under the Project project. Sense, Animation, Shader, Script, etc. What is particularly important is Sense, which establishes New Sense instead of New Project and creates folders that are always saved during the development process. Its folder is shown in Fig.3 below.

The establishment of a physical model is mainly a number of display objects(gears). The production of these models is generally made using tools such as 3DS Max outside Unity3D. Through rendering technology, we eventually obtain a gear model. The model is then imported into Unity3D as a file plus map in FBX format. Fig. 4 is a gear model created by 3DS Max.

![Fig. 5 Development of Gear Drive Script](image3)

![Fig. 6 Construction of Message Delivery Script](image4)

Gear drive script development, this article is using the C# language. Fig. 5 is the relevant script for the gear drive.

The gear drive is an event drive that depends on message delivery. First, create a text file My Template Script t.cs.txt as a script template and place it under the Edit folder of the unity project. When in use, right-click-&amp; GT; in Project view Create-&amp; GT; C# FrameScript creates a script template, so first you want to create MenuItem with a path to Sets/create/c#. After clicking on the script to create the script, you need to modify the script name, so you need to inherit FromNameEdit Action in the extension editor script to listen for callbacks. After the script name is entered, the corresponding script template is automatically created. Then, in project, click Create C# FrameScript, type the script name, and the corresponding script has been created as shown in Fig.6.

The Unity editor manipulates the implementation, creates an event script, and then adds the corresponding UI object. The binding event (as shown in Fig. 7) is as follows: Add EventTrigger components to the UI object, and "Add New" → Select "PointerClick". With the trigger object dragged to the trigger, click "No Operation" and select the click event we wrote in the script. Then you can observe the transmission of the gear in Unity3D software, as shown in Fig. 8.
5. Conclusion
With the continuous development of virtual reality technology and the popularization and development of the mobile side, virtual experiments will gradually move toward mobile development, and virtual experiments on the mobile side will become more and more. Because mobile virtual experiments are easy to use, anytime, and there are no time and venue restrictions. However, virtual experiments on the mobile side are now mainly used in experimental teaching and training in basic subjects. For example, the NOBOOK Virtual Laboratory Development Programming Language based on Action Script 3.0 implements multi-touch functionality. We can see from the virtual experiment that the virtual experiment platform is mainly based on PC platform and mobile virtual reality device. And those experiments that are used for large-scale engineering cannot run directly on the mobile end or on the experimental platform. This is also one aspect that we need to focus on in the future.

References
[1] Chen Y b, Lin C N, Li J F. Research and Development of Immersive Simulation Training System [J]. Power System Technology, 2015, 33:100-106.
[2] Mukhanov B, Omirbekova Z, Alimanova M, et al. A Model of Virtual Training Application for Simulation of Technological Processes[J]. Procedia Computer Science, 2015, 56:177-182.
[3] Gao F, Zhao L Z. The Research and Development of Integrated Operation-Maintenance Simulation Training System[J]. Journal of Power and Energy Engineering, 2014, 33:100-106.
[4] Grabowski A, Jankowski J. Virtual Reality-based pilot training for underground coal miners[J]. Safety Science, 2015, (72):310-314.
[5] Kuliga S F, Thrash T, Dalton R C, et al. Virtual reality as an empirical research tool-exploring user experience in a real building and a corresponding virtual model[J]. Computers, Environment and Urban Systems, 2015, (54):363-375.
[6] Barata A N A, Filho A R, Nunes M V A. Virtual reality applied to the study of the integration of transformers in substations of power systems[J]. International Journal of Electrical Engineering Education, 2015,52(3):203-218.
[7] Acharya K, Ghoshal D. Nature Inspired Prototype Design of Collision Avoidance Aircraft System and Design of a Pair of Wing Flaps in Autodesk Maya Software[J]. Procedia Computer Science, 2016, 89:684-689.