



Creating a Three-Dimensional Virtual Hall for Engineering Education

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Abstract. In the context of rapidly developing technological trends, virtual reality (VR) represents a highly impactful tool for innovation in various sectors, including education. The authors of the article share their experience of creating a virtual classroom with a specialized interactive assembly model with the application of modern technologies in engineering education.

Using an integrated approach combining the competencies of tools such as Blender, SolidWorks and Unity, an innovative educational solution has been created that provides a deeper learning experience. The virtual classroom will allow students to be part of an intelligently constructed educational space in which they will be able to not only visualize and manipulate objects, but also assemble them in the virtual space. The essential advantage of this approach is the active involvement of students in the learning process. The virtual environment stimulates interest and imagination by providing the opportunity for real interactions and experiences.

The relevance of the article stems from the growing need for innovative educational approaches that reflect modern technological changes and requirements.

Keywords: VR, Blender, SolidWorks, Unity.

1. INTRODUCTION

The relevance of the proposed article stems from the growing need for the use of innovative educational approaches in engineering education that reflect modern technological changes through digital tools providing a deeper and more engaging learning experience. Virtual reality (VR) is asserting itself as a tool to modernize the educational process with its possibilities for visualization and interaction with the learning content. Combined with an interactive assembly model, learning becomes dynamic and intuitive (Jha, 2019).

The essential advantage of this approach is the possibility of conducting motivating and practical training in engineering specialties. The virtual hall for engineering education creates an environment where students can form and validate their knowledge by interacting with the learning content objects. This not only facilitates the assimilation of complex subjects, but also promotes creative thinking and

analytical skills. At a time when technological progress is changing the face of the economy and society, the skills to work with modern tools are becoming mandatory competencies necessary for the future professional realization of students in various engineering sectors (Kshirsagar, 2021).

Preparing the next generations to successfully meet these challenges requires a change in educational approach.

The authors of the article share their experience in revealing the possibilities for the development of innovative learning environments that meet modern educational requirements and prepare future engineers for success in the high-tech and changing reality.

2. SOFTWARE TOOLKIT FOR CREATING A VIRTUAL HALL AND GEARBOX MODEL

In the field of 3D design and modeling, choosing the right software for creating three-

dimensional objects is essential. The right software can significantly affect the efficiency and quality of the interactive content design and creation process.

Some of the leading criteria in choosing the right software for creating a virtual hall and gearbox model are:

- The user interface and workflow of the software. They are important for productivity and user-friendliness. It enables effortless navigation between tools and functions, streamlining workflow and enhancing designers' creativity;
- The range of functionalities offered by the software - capabilities for modeling, texturing, rendering, animation and simulation, etc.;
- the software's ability to integrate into an existing workflow and support specific plugins or add-ons;
- capabilities provided by imaging and visualization software. High-quality rendering is important for the realistic representation of 3D objects. Features such as ray tracing, global lighting, physically based rendering and capabilities are required for creating photorealistic materials and lighting effects.

The selected software environments used to create the virtual hall and gearbox model are Blender and SolidWorks (Naik, 2020).

2. 1. Methodology for creating a virtual hall with Blender

Blender is an innovative software that revolutionizes the way 3D visualizations and animations are created. It stands out for its free, open source philosophy that supports the creative possibilities of each user and offers free and professional 3D modeling and animation.

The methodology for creating a virtual hall with Blender is expressed in following the following sequence:

- Open a new Blender project;

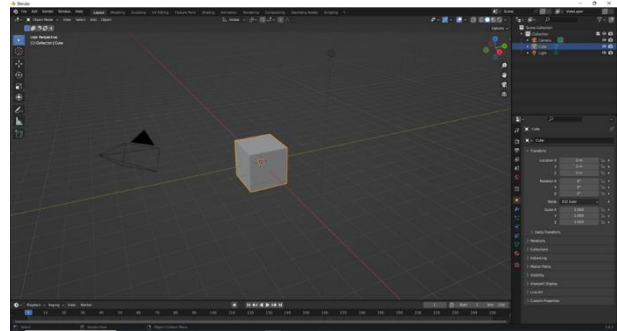


Fig. 1 New project in Blender.

- Delete standard object "Cube";

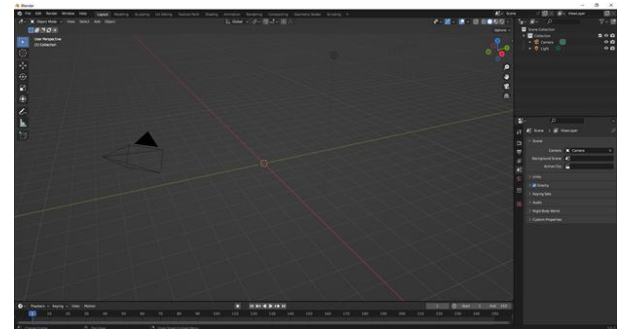


Fig. 2 Setting the scene.

- Adding a floor;

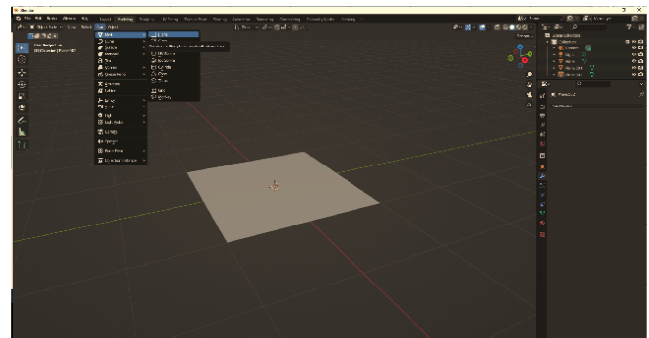


Fig. 3 Base of the hall.

- Add walls, textures, materials, doors and windows.

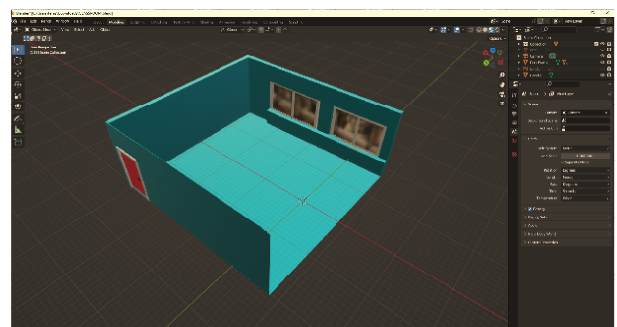


Fig. 4 Adding doors and windows.

- The next stage is to create furniture and accessories using the modeling tools. In fig. 7 presents the designed virtual hall.



Fig. 5 Furnished room.

2. 2. Designing a main drive and differential with SolidWorks

SolidWorks is a leading integrated computer-aided design and modeling (CAD) system, with application for automated industrial design in the mechanical engineering industry. This software combines powerful 3D modeling tools with a user-friendly interface, giving engineers and designers the ability to create complex and innovative products.

The 3D model of the main drive and differential was created in the SolidWorks environment, using various tools and methods to create three-dimensional objects representing each individual part of the model.

The technical process of creating 3D models in SolidWorks is essential to ensure accuracy, functionality and compatibility of parts in later phases of design and integration into the Unity virtual environment.

In Fig. 6 shows an assembled model of the main drive and differential.

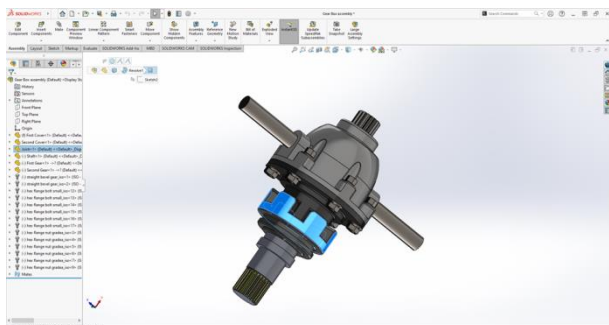


Fig. 6 Assembled model of main drive and differential.

After successfully modeling the objects in SolidWorks, the process of transferring the models to Blender is important to achieve the integration and realization of the virtual hall. This step requires careful planning and the use of appropriate methods to ensure that the models are transferred without loss of quality and detail and to maintain the possibility of further editing and animation in Blender (Coward, 2019).

The stage of transfer from SolidWorks to Blender is important for the successful integration of the 3D model in the educational environment. This process allows the models to be imported into the Blender virtual context where they can be maintained and edited according to the needs of the virtual room. After the successful transfer, additional textures can be added that improve the visual aspect of the models, create realistic surfaces and details. It is possible to create animations if needed for the educational environment. This integration process combines engineering and visual aspects. The following figure shows an assembled model of the main drive and differential placed on the workstation in the virtual room.

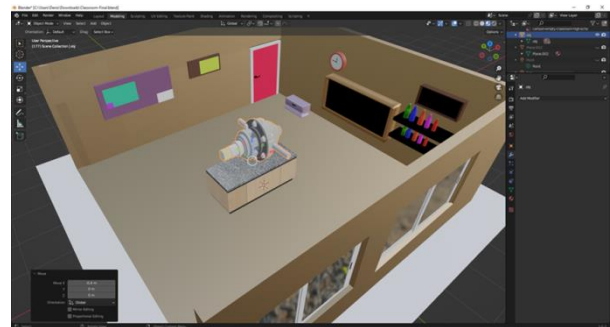


Fig. 7 Assembled model of the main drive and differential placed at the workplace in the virtual room.

2. 3. Integration in virtual reality of a three-dimensional model of main transmission and differential

The Unity platform provides opportunities to create intuitive and functional VR experiences. The article presents how the use of Unity conveys functionality and dynamism to the virtual hall. In Fig. 8 is a preview of the virtual dice in Unity.

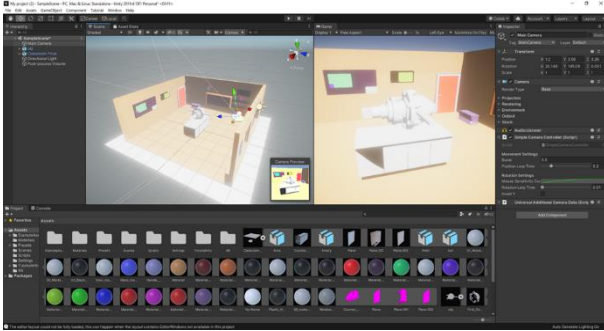


Fig. 8 A preview of the virtual dice in Unity.

3. SIMULATION OF GEARBOX DISASSEMBLY IN A VIRTUAL LAB

The virtual room where the gearbox simulation will take place is shown in the following figure.

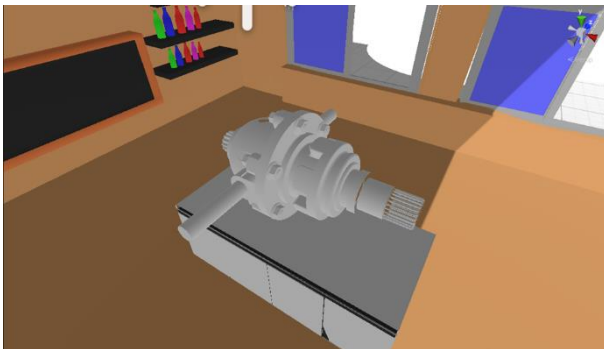


Fig. 9 The virtual hall.

The following activities are simulated:

- Marking nuts, pulling them and placing them in a convenient position in space;
- Marking and removal of bolts and nuts;
- Removing the cover and gears.

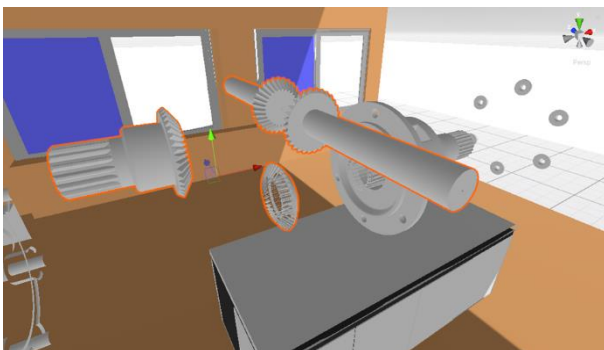


Fig. 10 Removing gears

When creating scenarios, they can be set up with different rules, errors can be simulated during the assembly process in order to provoke

a correct decision. We can set a specific assembly order that cannot be broken during the exercises.

4. CONCLUSIONS

Combining the capabilities of tools such as Blender, SolidWorks and Unity enable the creation of an innovative educational solution - the virtual classroom, allowing students to be part of an intelligently constructed educational space in which they can visualize and manipulate objects.

ACKNOWLEDGMENTS

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