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PLACING A CUSTOM 3D OBJECT IN THE VIRTUAL WORLD ENVIRONMENT

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Annotation. *This text offers with the design and placing of virtual reality systems. We present a project aiming at integrating immersive virtual reality technologies into a three-dimensional virtual world. We use an educational platform vAcademia as a test bed for the project, and focus on improving the learning process and, subsequently – the outcomes. In addition, Design and geometric models of 3D objects for virtual environments, in particular exterior, interior and characters, and their computer algorithms were developed. Also, we will create our software as a part of the VRML platform interface for a virtual 3D classroom, so college students, can sign in to direction that they may attend in a virtual world. Algorithms have been developed for Mesh type PR (reducing the size of polygons) and Simplify poly (simplifying the number of polygons) that affect 3D objects in a virtual software system without losing quality.*

Keywords: *3D virtual worlds, polygonal simplification algorithms, Polyreduction algorithms, virtual 3D object (artifact, internal and external texture), vAcademia, virtual reality for education.*

Аннотация. *Этот текст предлагает с дизайном и размещением систем виртуальной реальности. Мы представляем проект, направленный на интеграцию технологий иммерсивной виртуальной реальности в трехмерный виртуальный мир. Мы используем образовательную платформу vAcademia в качестве испытательной площадки для проекта и делаем упор на улучшение процесса обучения и, как следствие, на результаты. Кроме того, были разработаны Дизайнерские и геометрические модели 3D-объектов для виртуальных сред, в частности экстерьера, интерьера и персонажей, а также их компьютерные алгоритмы. Кроме того, мы создадим наше программное обеспечение как часть интерфейса платформы VRML для виртуального 3D-класса, чтобы студенты колледжа могли войти в систему, которую они могут посещать в виртуальном мире. Были разработаны алгоритмы для Mesh type PR (уменьшение размера полигонов) и Simplify poly (упрощение количества полигонов), которые влияют на 3D-объекты в виртуальной программной системе без потери качества.*

Ключевые слова: *виртуальные 3D-миры, алгоритмы полигонального упрощения, алгоритмы полисредукции, виртуальный 3D-объект (артефакт, внутренняя и внешняя текстуры), vAcademia, виртуальная реальность для образования.*

Аннотация. *Ушбу матн виртуал ҳақиқат тизимларини лойиҳалаштириш ва жойлаштиришни таклиф қилади. Биз диққатни жалб қиладиган виртуал ҳақиқат технологияларини уч ўлчовли виртуал дунёга интеграциялашга қаратилган лойиҳани тақдим этамиз. Биз вAcademиа таълим платформасидан лойиҳанинг синов майдончаси сифатида фойдаланамиз ва ўқув жараёнида натижаларни яхшилашга эътибор қаратамиз. Бундан ташқари, виртуал объектлар, хусусан ташқи кўриниши, ички кўриниши ва белгилар учун 3Д объектларнинг дизайни ва геометрик моделлари, ҳамда уларнинг компьютер алгоритмлари ишлаб чиқилган. Бундан ташқари, биз ўқувчиларни виртуал дунёда ташриф буюрадиган тизимга киришлари учун биз ўзимизнинг дастурий таъминотимизни виртуал 3Д синф учун VRML(Virtual reality modeling lenguage) платформа интерфейси сифатида яратамиз. Меш типидаги PR (кўпбурчак ҳажмини камайтириш) ва Simplify Poly (кўпбурчак сонини соддалаштириш) учун алгоритмлар ишлаб чиқилган бўлиб, улар виртуал дастурий таъминот тизимидаги 3Д объектларга сифатини йўқотмасдан таъсир қилади.*

Калит сўзлари: *Виртуал 3Д борлиқ, кўпбурчак соддалаштириш алгоритмлари, полигонларни камайтириш алгоритмлари, виртуал 3Д объектлар (артифакт, ички ва ташқи текстуралар), вAcademиа, таълим учун виртуал борлиқ.*

Introduction. Augmented Reality and Virtual Reality are not new technologies. But several constraints prevented their actual adoption. Recent technological progresses added to the proliferation of affordable hardware and software have made AR and VR more viable and desirable in many domains, including education; they have been relaunched with new promises previously unimaginable. The nature of AR and VR promises new teaching and learning model that better meet the needs of the 21st century learner.

Three-dimensional Virtual Worlds(VW) provide both opportunities and challenges for education, and many topics in this area need further research[1,2]. Despite the repeated positive conclusions, 3D VWs have not become widely used, and researchers often report that their studies have experimental nature. The most common problems with applying 3D VWs in the everyday teaching are steep learning curve and demand for computational and network resources [3]. As stated in recent surveys, the use of these technologies as learning environments is a new emerging trend and still under development [4]. While the computers and networks are constantly improving, the 3D VWs also require significant improvement to make them more convenient for educators and to deal with the steep learning curve. These facts motivate further research in the area.

The general motivation for designing the vAcademia-Kinect prototype is providing users of the 3D VW with a possibility to control their avatars with natural gestures. Our specific motivation for designing this system lies in making the teachers able to conduct regular lectures and presentations in the physical and in the virtual world at the same time, controlling their avatars with natural gestures.

We use two available technologies to implement the proposed system, Kinect and vAcademia. Kinect is used for capturing the movement of a lecturer (Fig. 1), while vAcademia is used for creating and recording the virtual replica of a lecture (Fig. 2). The third component of the system is a software plugin for vAcademia that translates the motion data from Kinect, the sound, and the contents of the whiteboard into the 3D VW.

Such a hybrid experience can be captured using the virtual recording feature of vAcademia. Several techniques are used by educators for getting content out of traditional classes, such as video recording of face-to-face lectures and recording of web conferences.

Fig. 1. Lecture capturing process in Real world

These methods allow creating cheap educational content for asynchronous learning. 3D VWs are also used for generating such content, but learning activities are usually recorded as ‘flat’ 2D video, which eliminates many advantages of 3D VWs, such as sense of presence. [4]

The principles of creating an interactive virtual learning environment are as follows:

- ❖ Implement learning content as if students were participating in a normal natural learning environment;
- ❖ Encourage effective participation. Here you can see all the participants, the presentation file, information about the session;
- ❖ There will be an opportunity to implement the lesson through various learning scenarios and serious games. Office and learning environment modeling;
- ❖ Diversity of teaching aids. It includes presentations, a webcam, a file sharing app, and voting systems.
- ❖ Support for student group status;

Today, a number of systems for evaluating virtual education in foreign countries (Codeingame.com, vAcademia.com, fun-mooc.fr, rwaq.com, VirBela.org etc.)

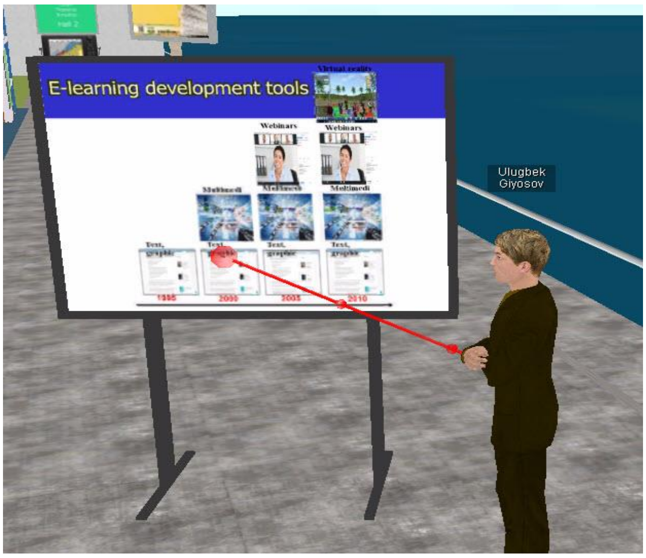


Fig. 2. Lecture streaming process in virtual world

Main part. Virtual worlds as learning environments

- Three-dimensional representation of learners and objects
- Interaction in simulated contexts
- Sense of presence
- Variety of tools
- Low cost and high safety

Virtual objects (artifacts)

What is possible only in Virtually:

- ✓ You can simulate the environment
- ✓ You can simulate events
- ✓ You can simulate joint actions

Further training or retraining of teachers involved in virtual learning can be achieved by increasing the level of their training. To solve these problems, it is necessary, first of all, to revise the existing regulatory legal acts on virtual education and develop standards and rules necessary for the implementation of virtual education. Also, it is necessary to analyze the current technical condition of existing computer networks, increase their speed and take measures to strengthen their material and technical base.

3D Auditorium-Trainers who address in the 3D Auditorium will have the option to stack explicit introductions from VLE and even transfer slides. Homeroom/Meeting Room-These rooms can be utilized as a gathering territory for venture accomplices, or as a study hall for a little gathering of understudies. We will survey the model of the college, a few understudies pick their subject over the span of the learning plan. Presently understudies can encounter the themes they are learning. The utilization of augmented reality innovation has been appeared to build understudy cooperation and consideration, while vivid and intelligent situations urge understudies to become dynamic students.

Adaptive Social learning

Collaborative lessons

Real-time changes to optimize learning

Cognitive load theory:

- Reduce destruction
- Emphasize effort on learning not just doing
- Learning is enhanced by pointer & guided exercise

Worked example and 'faded example' are better than full problem solving

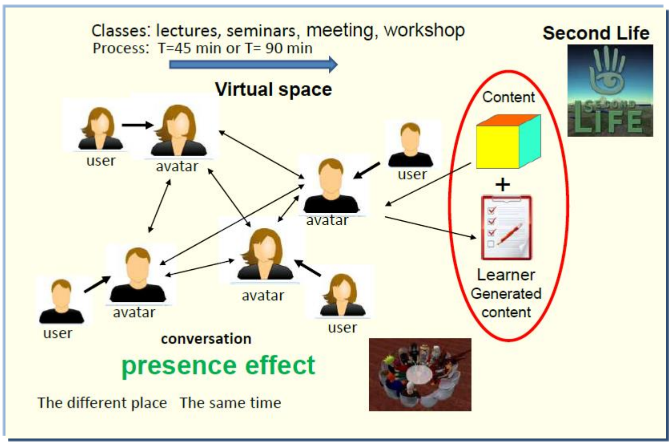


Fig. 3. Educational Virtual World

Educational activities

- Problem based learning
- Enquiry based learning
- Game based learning
- Role playing
- Virtual Quests
- Collaborative Simulations(learn by simulation)
- Collaborative construction(building activities)
- Design course(internal and external artifact, game fashion ,architectural)
- Virtual laboratories
- Virtual field work

Customizing objects in the Virtual World

Currently supported models are Collada, 3DS, OBJ, SketchUp (SKP). Without installing additional plugins, you can export 3D models from 3dsmax, Maya, Blender to 3DS and OBJ format. Export from 3dsmax and Maya to Collada format can be done through the ColladaMax and ColladaMaya plugins, respectively. Blender exports models in Collada format without installing additional plugins with numerous simplifications and errors. A more accurate export to Collada can be achieved by installing plugins, for example the Collada Plug-in from Illusoft. A large number of free 3D models in Collada and SketchUp format are presented in the Google 3DwareHouse library.[4]

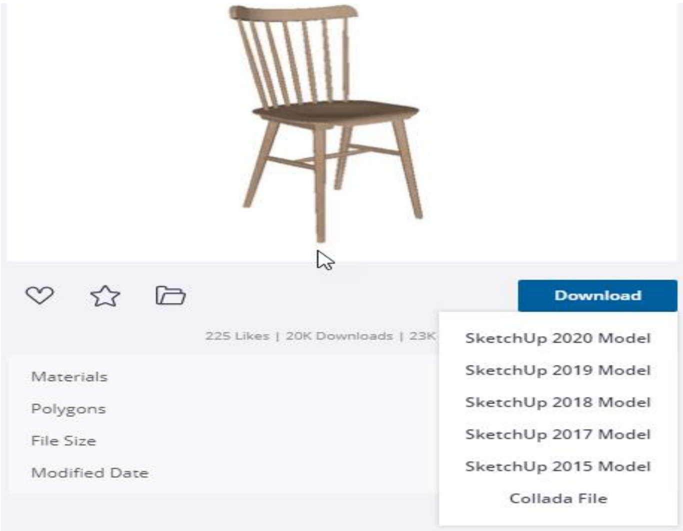


Fig. 4. Ready 3D model in the web site(https://3dwarehouse.sketchup.com/)

If the 3D model is only in SketchUp format (* .SKP), conversion from this format to Collada is possible. To do this, follow these steps:

1. Install Google SketchUp (this is a free editor, available for free download from the Internet).
2. Open the SKP file in SketchUp (File → Open).
3. Export the model to Collada format (File → Export → 3D-model → Collada file (* .dae).
4. SketchUp will export the 3d model into a set of files - a 3d model DAE file and several textures (PNG, JPG, etc). You must zip all of these files into one zip archive (folder structure doesn't matter).
5. You can use this archive to upload to the Resource Collection.
6. If the loaded model does not have textures, you can load a file in the dae format directly into the Resource Collection.

3D models in 3DS and OBJ format can be downloaded from a large number of online model libraries, for example, http://www.all3dmodel.com or purchased a collection of models on disk. Note that a model without textures is often provided for download (no texture files). In this case, the model will be displayed in gray.

The 3D model loaded into the collection of resources must contain no more than 50,000 polygons and no more than 12 textures. In total, custom objects within one location must have no more than 50,000 polygons, the number of objects does not matter. Polygon counting does not include nestable non-user objects from the vAcademia Object Gallery.

Placing objects is also available in a special location "My home". Custom objects placed in it must contain no more than 100,000 polygons in total.

Placing custom 3D models is possible inside temporary locations and locations in designated activities. In spontaneous, unplanned activities, you cannot place custom 3D objects.

To place your 3D model in the world, first convert it to Collada, 3DS, OBJ or SKP format and zip it together with textures. If the 3D model has no textures, you can load the dae file (or 3ds file, obj file, SKP file) of the model directly instead of an archive.

1. Placing a custom 3D object in the vAcademia virtual world
2. 1. Make a 3D model in 3dsmax. Export (File -> Export) the model to 3DS format. Transfer the 3DS file and the desired textures to a separate folder. Zip all files (both model and textures).
3. In vAcademia, open the resource collection.

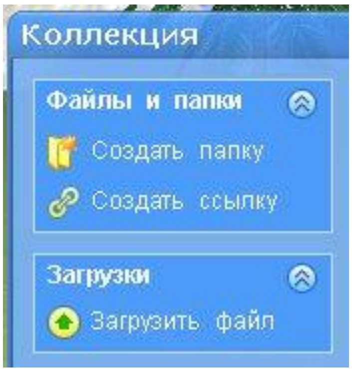


Fig. 5. Select "Upload File".

4. Select your file and wait for the download to finish. If the download was successful, the following window will appear.

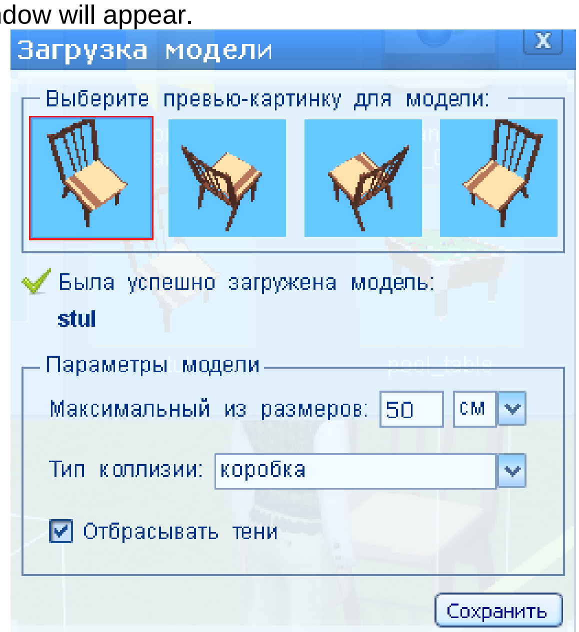


Fig. 6. Enter the primary size (for example, 80 cm) and click the "Save"

Polygon reduction algorithms aren't the only way to create a model with fewer faces. Artists will always be able to do a better job of representing a model using fewer polygons than any reduction algorithm. Polygonal simplification techniques offer one solution for developers grappling with complex models. These methods simplify the polygonal geometry of small, distant, or otherwise unimportant portions of the model, seeking to reduce the rendering cost without a significant loss in the scene's visual content. This is at once a very current and a very old idea in computer graphics. As early as 1976, James Clark described the benefits of representing objects within a scene at several resolutions,1 and flight simulators have long used hand-crafted multi resolution airplane models to guarantee a constant frame rate. Recently, a flurry of research has targeted generating such models automatically. If you're considering using polygonal simplification to speed up your 3D application, this article should help you choose among the bewildering array of published algorithms.[8]

triangles triangles triangles triangles

Fig. 7. Managing model complexity by varying the level of detail used for rendering small or distant objects. Polygonal simplification can create multiple levels of detail such as these.

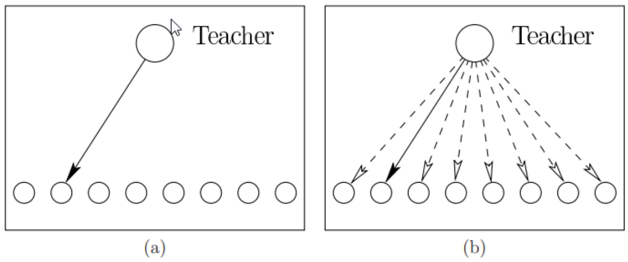


Fig. 7. (a) A top-down depiction of an ordinary classroom is shown, in which a teacher can look directly at one student. (b) In a VR classroom, the teacher could be looking at each student simultaneously, at least from the perspective of each student.

This is physically impossible in the real world, but it is easy to make in VR because each student could see a different version of the virtual world. Of course, the students might reason that the teacher could not possibly be paying attention to all of them, but the chance that she might be watching could have a significant effect on learning outcomes. The classroom could also appear to have a small number of students, while in reality thousands of students are in attendance

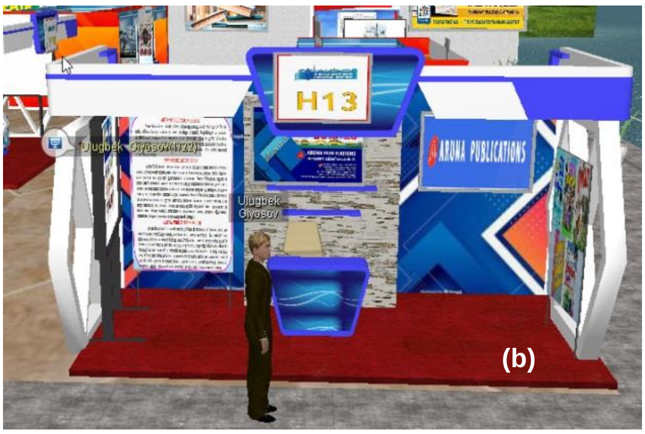
Constructive Solid Geometry allows the construction of complex 3D graphical shapes using:

- Object selection –the user can point at objects and select them, placing them into one of several clipboards.
- Object transform–perform translate, rotate, and scale operations, in a variety of different ways.
- Create primitives – 3D primitives can be created in the virtual world, from infinite planes as the simplest, to complex graphical models such as a water heater.
- Combine primitives – previously constructed and manipulated primitives may be combined together using Constructive Solid Geometry (CSG) operations to produce higher level graphical objects.

Implication of 3d modeling by software and experimental result

IntelligentBox is a constructive visual software development system for interactive 3D graphic applications. With IntelligentBox system, it is possible to construct 3D graphic applications such as Virtual Reality Applications by means of combining individually existing 3D primitive components through direct manipulations on a computer screen. IntelligentBox provides reactive 3D visual software components called Boxes.

Each Box has a unique function and a 3D visible shape. It is possible to construct composite complex (intelligent) Boxes by composing an individually existing Box with another Box to combine their functionalities through direct manipulations on a computer screen. In IntelligentBox, this construction process is regarded as a construction process of 3D graphics applications.[6]



(c)

Fig. 8. (a) After Simplifying 3D Tradeshow stand model, (b) Another 3D Tradeshow stand model 2, (c) Full view of Pavilion 2

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Conclusion. The educational programs helped to shift the official language theme from classroom to computer classroom, which made the learning process fun and enjoyable for students and facilitated the teacher to complete the assessment. The use of virtual reality technologies can increase students' interest and attention, while the immersive and interactive environment encourages students to become active students. “Tell me and I will forget; Show me and I may remember; Involve me and I will understand”[7]

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