

Designed objects visualization with Autodesk CAD systems

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Abstract — *The product development begins with the design process. CAD (computer aided design) is used in generating ideas, making drawings, in project management and in presentations. The purpose of CAD is to make the design process more productive. So designer's ideas and creativity, operative decision making, or other design-related activities is very important. Visualization is a new aid tool also for the design of different infrastructures. For advertising and presentation purposes visualization becomes important when 3D object are created. Traditionally the design drawings have not visualized the object of design. Benefits of designed objects closely correlative with visualization process of designed features, it's publishing to web site and drawings. Visualizations show how a creating object will be in real life – without the need for expensive external resources. Designers can detect certain errors in the beginning stages of the design process — the earlier find them, the easier they are to fix.*

Today Autodesk corporation product – computer aided design (CAD) systems are very popular in the world. These systems a most frequently used during the learning process for today technical engineers preparation and later for design works in enterprises. The CAD systems and designed objects visualization help students to understand different stages of the design process, help get a deeper understanding of how an objects works before they built.

Autodesk corporation creates several special visualization products including Autodesk Impression, VIZ, 3ds Max, Maya, Sketchbook Pro and Freewhell. Using of noted software related with expenditure of money additional special knowledge assigned to it handling. It is very important to communicate with listeners effectively, using contemporary presentation tools, which are coming to standard computer aided design system and are used for product design.

The aim of this work is to investigate current possibilities of visualization of designed objects with Autodesk CAD systems (AutoCAD, Mechanical Desktop and Inventor).

Index Terms — *automated design systems, CAD, visualization, presentation.*

INTRODUCTION

The purpose of CAD is to make the design process more productive. The ability to visualize and think in three dimensions is one of the most important requisites, indeed an essential skill, for the successful scientist and engineer. The process of visualization stimulates the designer's creativity, decision making, or other design - related activities. CAD systems are used in all fields of engineering: mechanical, electrical, cars and airplane building and elsewhere. Visualization is a new aid tool also for the design of different infrastructures. CAD systems helps to users try their ideas before they are real by providing 2D and 3D technologies to visualize, simulate, and analyze the real - world characteristic of their designs early in the design process. So with special visualization tolls we can create, edit, animate, publish realistic views of 3D objects. 3D visualization and animation can be used beneficially for many different purposes such as product design, product presentations, training materials and maintenance instructions. For this purposes using the special visualization products such as Autodesk Impression, VIZ, 3d Max, Freewheel and other we colliding with required special knowledge (how work with this softwares) and additional expenditure of money (for buying this systems) [1].

It is very important that the process of visualization should be integrated into the design processes. Especially in learning process is topical to recognize drawing creation process, simulate and visualize the final product. This process show all steadies of product from ideas, drawings to products in real life.

STANDARD TOOLS OF AUTODESK CAD SYSTEMS FOR PRESENTATION AND VISUALIZATION

AutoCAD and Mechanical Desktop (MD) systems allow perform visualization process of created object using two ways: by shading of an object (commands SHADE, SHADEMODE) and its rendering (command RENDER and its subcommands). There are some predefined visual styles such as:

- 2D Wireframe. Displays the objects using lines and curves to represent the boundaries. Raster and OLE objects, linetypes, and lineweights are visible.
- 3D Wireframe (upper left in the Figure 1). Displays the objects using lines and curves to represent the boundaries.

- 3D Hidden (upper right in the Figure 1). Displays the objects using 3D wireframe representation and hides lines representing back faces.
- Realistic (lower left in the Figure 1). Shades the objects and smooths the edges between polygon faces. Materials that you have attached to the objects are displayed.
- Conceptual (lower right in the Figure 1). Shades the objects and smooths the edges between polygon faces. Shading uses the Gooch face style, a transition between cool and warm colors rather than dark to light. The effect is less realistic, but it can make the details of the model easier to see.

In shaded visual styles, faces are lighted by two distant light sources that follow the viewpoint as you move around the model. This default lighting is designed to illuminate all faces in the model so that they are visually discernable. Default lighting is available only when other lights, including the sun, are off. [2].

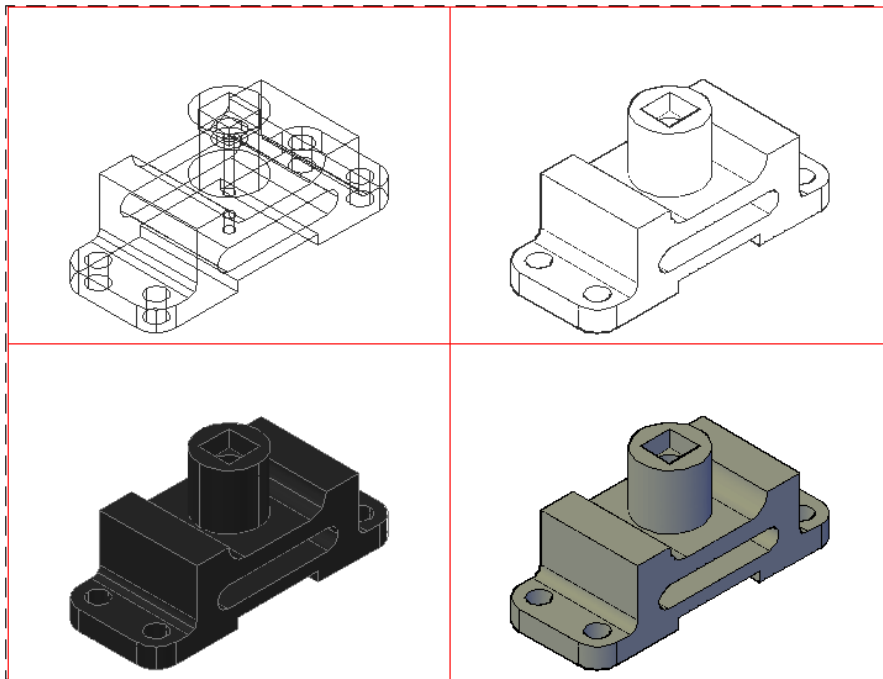


FIGURE 1
SHADED OBJECT WITH VISUAL STYLES

In AutoCAD and MD visualization tools enable to produce realistic renderings with minimal effort. Rendering like shading can be applied for surfaces and solids. It is complex process during which we can obtain various undertones, put down a shades and etc. Anyhow we need do some preparations before rendering:

- Pick required projecting direction to the part;
- Use the render settings pallet;
- Create custom render presets;
- Control the rendering environment [3].

AutoCAD and MD also include the full range of lighting, materials, and rendering capabilities to be able to create highly photorealistic rendered images. The application comes with over 400 predefined materials, which can simply be dragged and dropped onto any desired surface in the 3D model. The scale of materials is automatically based on the size of models. You can create your own materials, if required, using an enhanced materials editor. The editor has many advanced parameters, by applying those parameters you can achieve a realistic looking material. Interactive light tool has been introduced that allows you to quickly and accurately place point, distant and spot lights in a model. The light position and direction can easily be modified using grips or move and rotate.

Rendering of a new model using the basic rendering option (render) presented in Figure 2. This render preset produces very low quality rendering, but results in the fastest rendering speed. The final view can be formed by applying above mentioned presets for improved realistic view creation – lighting, materials, shading etc. The view created in drawing area is temporary, but can be saved to one of several file formats, such as BMP, TGA, TIF, PCX, JPG, and PNG (Figure 3).

For technical material presentation, it is very convenient to use AutoCAD script file [4]. Scripts are the files, which lists a sequence of AutoCAD commands, one on each line. This file can be used to automate any AutoCAD command sequence. Scripts provide an ideal method for automating the process of displaying a number of slide files in a predetermined sequence. For script file creation fits any text editor, which provide save file in a plain ASCII format. Scripts file extension SCR. The simplest way for SCR files creation – to use AutoCAD integrated text editor Notepad.

Short script file, created for slide presentation, can be written like it seen in the Figure 4. Where DELAY command setups delay time in milliseconds (5000 equal to 5 seconds); REDRAW command regenerates view and displays normal view. If vice REDRAW, RSCRIPT command will be used, slide show will be repeated.

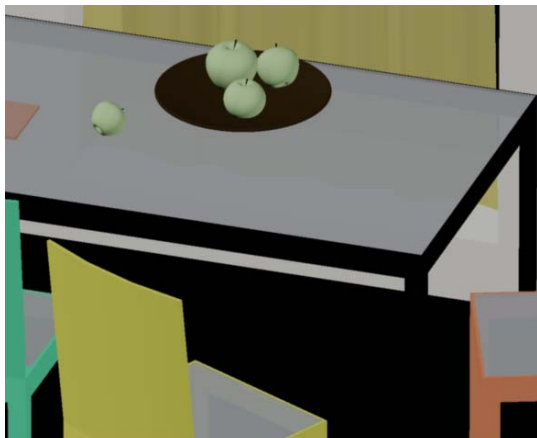


FIGURE 2
AUTOCAD RENDER BASIC LEVEL



FIGURE 3
AUTOCAD PHOTOREALISTIC IMAGE

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VSLIDE Slide-1
DELAY 5000
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VSLIDE Slide-N
DELAY 3000
REDRAW (or RSCRIPT)
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FIGURE 4
EXAMPLE OF SCRIPT PROGRAM

AutoCAD slide files contain snapshots of the AutoCAD drawing area and can be created with AutoCAD command MSLIDE. You can save any type of view (shaded or simple). Slide file extension SLD. AutoCAD command VSLIDE can be used to view any slide file created with MSLIDE command.

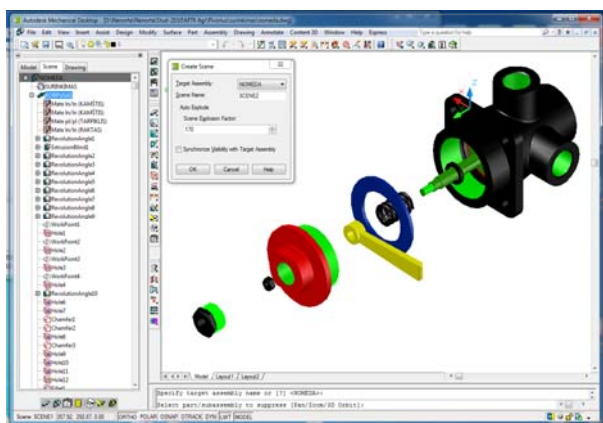


FIGURE 5
EXAMPLE OF SCENE

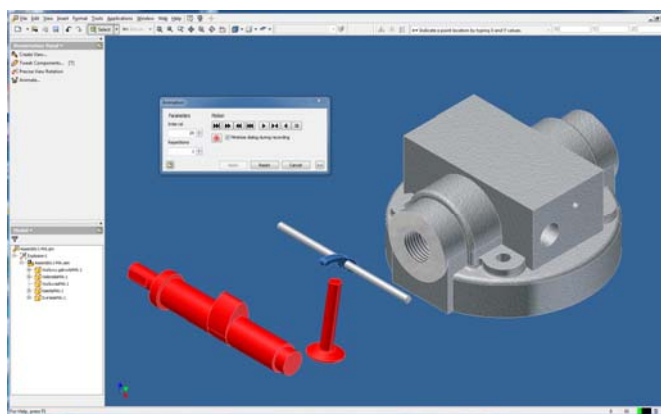


FIGURE 6
EXPLODED VIEW OF THE UNIT

Mechanical Desktop and Autodesk Inventor are 3D parametric solid modeling software for 3D mechanical models design. Designed 3D models can be used for assembly creation, 2D technical drawings and documentation assigned to it preparation. Mechanical Desktop software founded on the AutoCAD software base, so all the presentations described over fits for it. All the auxiliary possibilities of the presentation related with 3D objects, scene creation. Example of scene sees in Figure 5 [5]. A scene is an exploded view that separates the parts of an assembly to show how they fit together. Scene does not affect model file and updates automatically when the assembly you change. Trails indicate the path of the assembly explosion. Scenes can be viewed with SCR file.

Autodesk Inventor is the foundation for the digital prototyping solution at Autodesk. It has a special tools and possibilities for presentation files preparation: creates exploded view files for presentation with extension IPT and video files with extension WMV see Figure 6. Additionally system allows to create motion constrains i.e. specify the intended motion between assembly components and record it. Parts that are constrained using motion constrains will drive according to the direction and ration specified.

VISUALIZATION AND PRESENTATION TOOLS OF AUTODESK INVENTOR

One of the powerful capabilities of 3D design software such as Autodesk Inventor is support for creation of 3D images of proposed designs. Autodesk Inventor lets to creative high-quality, photorealistic renderings and animations within the Autodesk Inventor design environment. The special tools help to define lighting, camera angles, animation parameters and background style to make images that best present your ideas [6].

With Inventor, we can:

- Create both still and animated renderings of parts and assemblies to visualize the appearance and motion of a design before it is built.
- Specify geometry and settings for background, lights, and cameras to create a scene for a rendering or animation.
- Create and save multiple animations in one assembly file.
- Reuse constraints or parameters between animations in one assembly file.
- Reuse position values for the target and camera locations, and copy cameras within a document or into documents that have the Inventor environment active.

The rendering progress is displayed in a separate window (Figure 7). We can save rendered output to standard formats BMP, JPG (Figure 8), JPEG, TIF, TIFF, and PNG.

The animation environment results in mechanistic movement according to the application of constraints, and provides high-quality output. The presentation environment is designed for documenting exploded views.

We can create animations of:

- Rotation, as on a turntable, as a function of a camera or a model.
- Mechanistic movements of a model based on assembly constraints.
- Positional representations created and saved in the assembly environment.

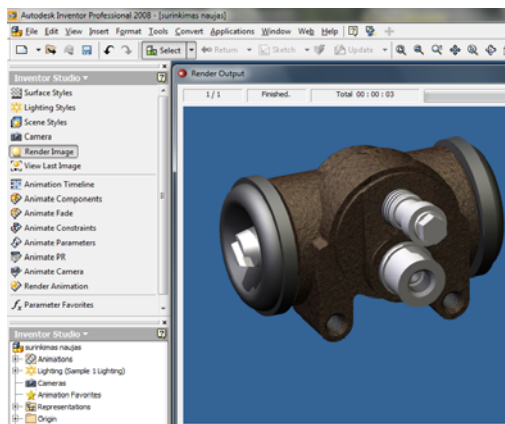


FIGURE 7
EXAMPLE OF RENDERING



FIGURE 8
EXAMPLE OF SCENE

Many Autodesk and non-Autodesk products can publish DWF files. The AutoCAD family of products uses the File > Publish command to begin publishing a DWF file that can be used by Design Review.

Autodesk Design Review is a program that lets you view, compose, and markup 2D and 3D drawings, images, bills of material, and animations, even if you do not own or know how to use the software that created the drawings. Design Review lets you easily share drawings with team members and clients through email [7].

DWF stands for Design Web Format. An open, secure file format developed by Autodesk, DWF enables you to combine rich 2D and 3D design data, as well as other project-related files, into a single, highly compressed file. These files help you enhance collaboration with team members, customers. DWF files have the proper coordinate system and data precision so they can be measured accurately. Advanced compression technique makes them as small as possible. DWF files do not require design application software and can be integrated into other documents such as HTML pages or Microsoft Office documents and leverage capabilities like hyperlinks and text search. Before DWF file is published, we need determine which features (model, layouts, layers, blocks, named views, and so on) will be included in the published file. Design Review program becomes part of the review workflow and allows:

- Add comments and markup to the DWF file using callouts, text blocks, shapes, dimensions, stamps, and custom symbols;
- Save the DWF file with your markups;
- Send the marked up DWF file back to the original publisher;
- Based on the reviewed DWF file, the draftsman or designer uses the publishing software to revise the original content [8].

Figure 9 presents the student's models created with Autodesk Inventor and published DWF (Figure 9, A) and JPG (Figure 9, B).

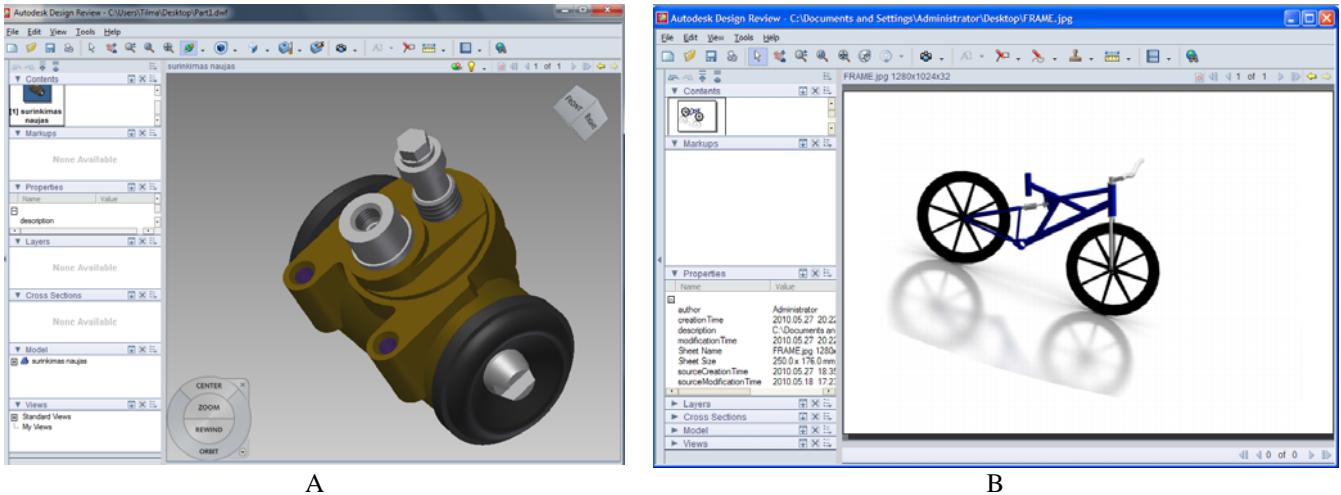


FIGURE 9
MODELS' DESIGNED WITH AUTODESK INVENTOR PUBLISHED DWF (A) AND JPG (B) FILES

CONCLUSIONS

All the described techniques allow improve student's imagination experience, lightens learning process in classes and to make visualizations of how a project will appear in real life - without the need for expensive external design resources.

Visualization and animation are becoming more and more important in many of today's design projects. Generating and presenting accurate and realistic images of the finished product can be essential for approval of the project.

The proper choice of visualization tool helps for good presentation and fast of the new product the market. So it is very important present the final realistic 3D views for customer with using presentation tools, with are coming to standard computer aided design system.

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