# Creative Process of Artworks with the Use of Animation

## Introduction

Graphic design is closely associated with drawing and with the visual perception of the result. Computers offer new possibilities in generating and manipulating graphics. If we consider differences between text and hypertext we see that graphic design on computer need not be just a straight conversion of graphic design on paper. Presently, human perception goes under the name "active vision", that is to understand perception as a dynamic process of constructing image. Thus it is not restricted only to perceiving objects and is often aided by computer tools enhancing and extending a user's mind. A computer screen is an example of such a tool, providing a platform for mental and external manipulations. In this context creativity can be treated as a consequence of the interaction of the artist with his/her artwork. This interaction could take many forms described by the following design cycle: drawing, inspecting a graphic; finding new things in it, or/and receiving feedback from computer system, and redrawing.

A graphic is often represented as a union of components, i.e., transformed basic shapes. A great variety of graphics is rooted in designer's creativity. However, graphical design is not reduced to the problems of selections shapes and arrangement of components. Graphics exhibit properties quite different from the mere summation of all components. Usually, during the creative process artists have based their next move on an evaluation of such properties. This paper shows how animation can be

applied both to evaluate and create graphics and provides the foundations in the development of generation and evaluation of dynamic graphics.

## **Creative process and attempt to refine and record it**

Creative process involves every step that is taken in production of any new and useful product[1] that is between the initial idea and the end result. That can be in particular a solution to a problem, a piece of art, a tool, etc. The process is not linear but iterative and recursive. It can be divided into separate branches that can further loop or divide themselves, merge with other ones or disappear. Addition of outside data or ideas is also possible on each stage. All of the sub-processes mentioned above are run rather intuitively, strongly oriented toward the final result. But changing that orientation and closer examination of designing steps may lead to finding new inspirations that could completely change the output.

In case of dynamic graphic design process each successive graphic being the result of redrawing is treated as a *key frame*. Between them one image is smoothly transformed into another. The artist begins with drawing his/her graphic $k_1$ on the monitor screen, which is the first key frame of an animation and then he/she changes the parameters of created objects (such as position, rotation, material parameters: color, glossiness and so on) to generate graphic $k_2$ being the second key frame and in consequence to establish an initial animation. Denote by $a_1$ design action such that $k_2 = a_1 (k_2)$. It is necessary to notice, that $a_1$ can be a complex action obtained as a composition of simple actions determined by different parameters.

In-between frames give the continuity and fluidity of movement, while key frames provide the overall structure of the animation. In the result of design cycles, the artist

creates the successive key frames by looking back at in-between frames, extracting some of them, which are potential solutions of the static discrete design space, and adopting them as new key frames. The consequence of applying animation to creation is a dynamic continuous design space. Computer animation allows the artist to see his/her creative process and unearth unexpected aspects of this process. This fact stimulates the artist's imagination and makes it possible to produce dynamic artworks. Each dynamic artwork can be characterized by sequence of design actions.

Let $k_1,..., k_n$ be a sequence key frames of a dynamic artwork such that $k_{i+1} = a_1(k_i)$ $i=1, ... n-1$ then composition of actions $a_1, ..., a_{n-1}$ defines design process described by the animation determining the artwork.

## Space dependence graph

Graph transformations are generally useful for specification, modeling and prototyping of knowledge based design tools in Computer Aided Design. In the graph knowledge representation the way of organization, processing and manipulation of knowledge is based on the spatial relations between objects[2] [3]. The knowledge in the form of graph structures is extracted from spatial relations between components of artworks created by the artist. In our approach artworks created by the artist on the monitor screen are automatically transformed into appropriate elements of the graph – based data structure (see: Fig. 1).
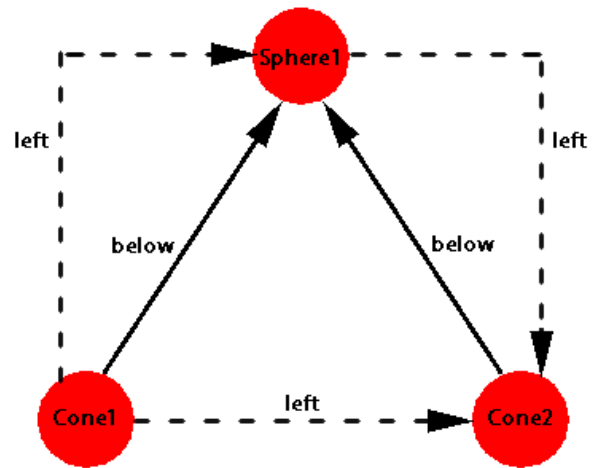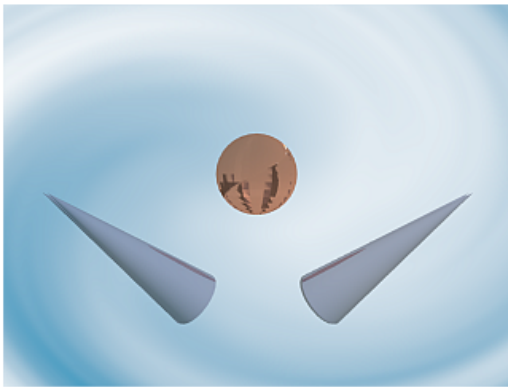
Fig. 1. Key-frame and its spatial graph.

To describe internal representations of artworks directed graphs are used. Let us consider the key frame and its internal graph representation shown in Fig. 1. Graph nodes with labels *Cone1* and *Cone2* correspond two components being cones, and meanwhile the node with label Sphere1 represents the sphere. Spatial relations between components are described by edges labeled with *below* and *left.*

To represent features of components and relations between them attributing of nodes and edges is used. Attributes describe properties like *shape, size, texture, color, position* of components and *distance* between them.

**Project environment**

When thinking of dynamic graphics, especially three-dimensional, it is impossible not to mention 3ds Max application, a powerful tool which is widely used in animation, visual effects for cinema and commercials and wherever there is a need for static or motion 3D graphics. In the presented approach, 3ds Max application is used as the artist's environment, since creation of separate environment would be redundant while

3ds Max provides the designer a wide range of functions for creating and modifying three-dimensional objects starting with its library of primitive forms. To meet the requirements of the project, some extensions of 3ds Max functions using 3ds Max script language MAXScript have been proposed.

Firstly, we automated calculations of the distance between objects and the parameters' values between animation key-frames. That was used in generation of space dependence graph, collision and intersection detection and copying parameters' values between key-frames. These features comprised crucial part of the project.

Secondly, we used .NET controls (forms, buttons, picture boxes, etc.) both on MaxScript level (using specialised MaxScript methods) and through an external .dll library written in C#, merged with MaxScript code.

The third extension consisted of creating our own classes (as a part of the .dll library), which stored graph structures representing 3D graphics and methods responsible for drawing them on the screen (using GDI+ graphics library built-in in .NET framework).

Figure 2 shows diagram of project environment elements and links between them.
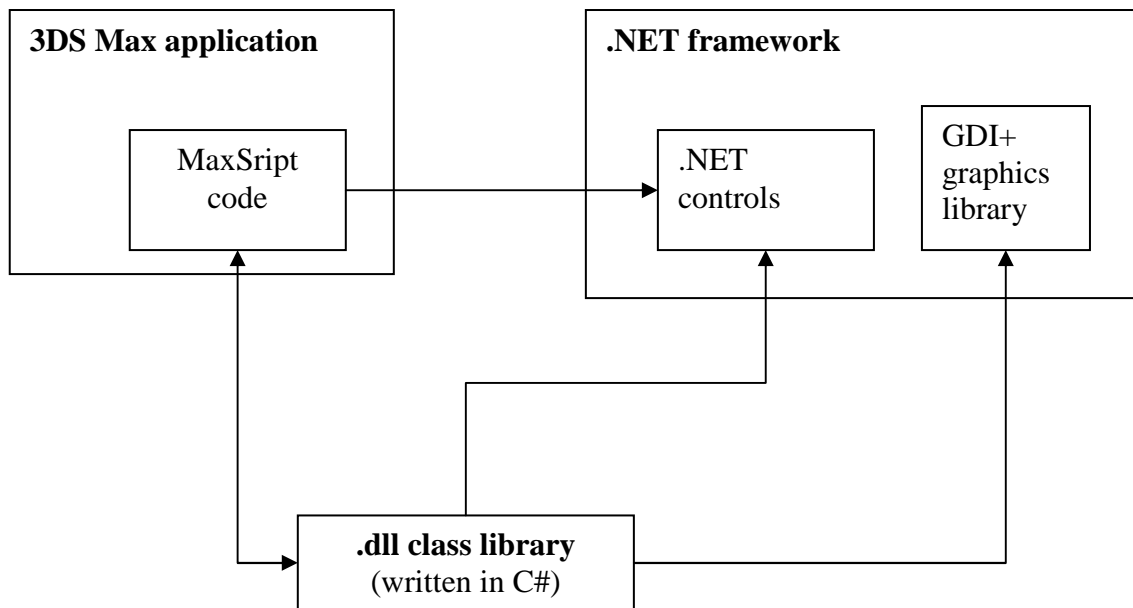
Fig. 2.  Project environment and its elements

Figure 3 depicts the user interface of written script, divided into two sections. First one is responsible for setting key-frames based on current frame, which is done manually by the user at any frame with desirable parameters of objects. It is equivalent to setting a new initial state for the composition. The number above the button determines the distance between key-frames (new key-frame is inserted after the last one with respect to the given number), which influences the speed of the end animation. The greater the number, the slower the animation is.

The second section contains the controls for creating a space dependence graph. That can be done either dynamically on changing parameters of composition elements (especially when new item is added or existing elements are moved or deleted) or only when user requires it. Graph visualisation appears in separate window and can be saved to one of the popular image formats.
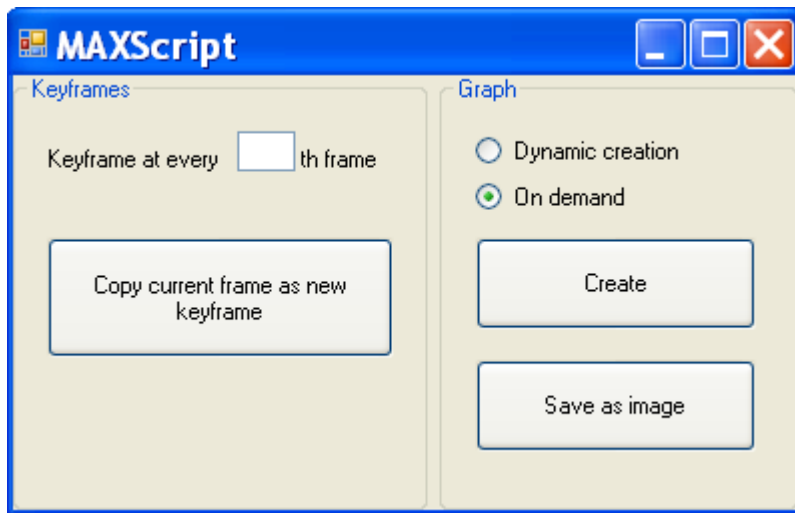
Fig. 3. User interface

**Examples**

To illustrate the method described in previous sections we will take a simple three-dimensional composition of primitive objects and change their parameters in iterative way to obtain the final result. Fig. 4 presents key-frames creating successive stages of the composition. The first frame represents the initial state of objects and the second one introduces some changes made by the artist, like moving the sphere to another position or changing the color of metal cones. Those frames comprise the initial animation. Next steps were done as follows: animation bar was scanned by the user in search of an in-between frame with finer properties than those introduced manually (as all of the objects' parameters had been interpolated by the program between the key-frames). When such frame is found, its all parameters are copied to the new key-frame that became a new initial state and the process started again until the satisfying result was obtained. Successive key-frames and frames interpolated between them comprised the animation being the recording of creative process.
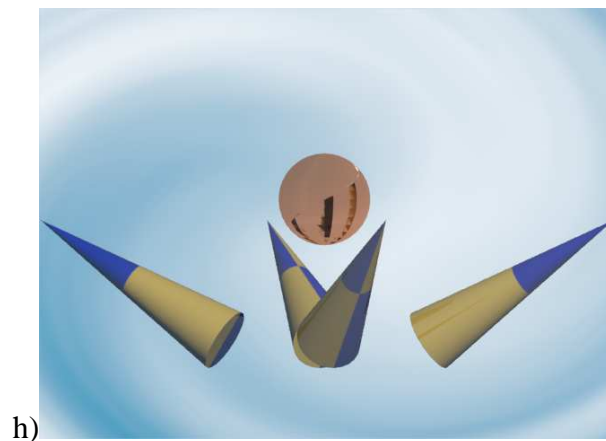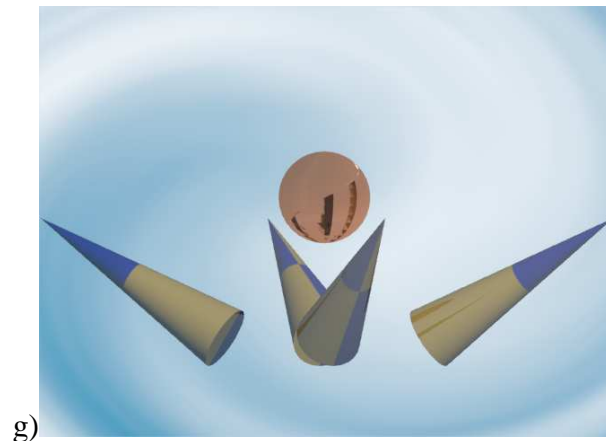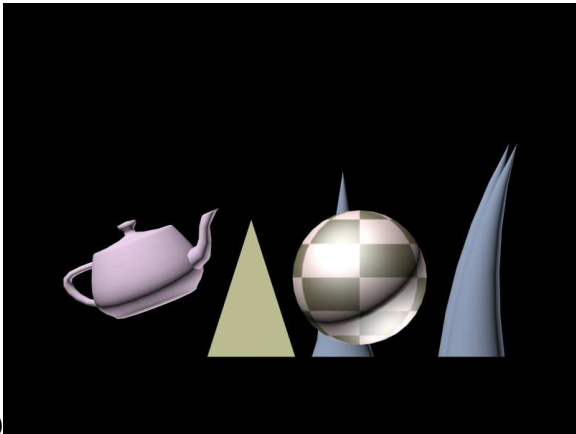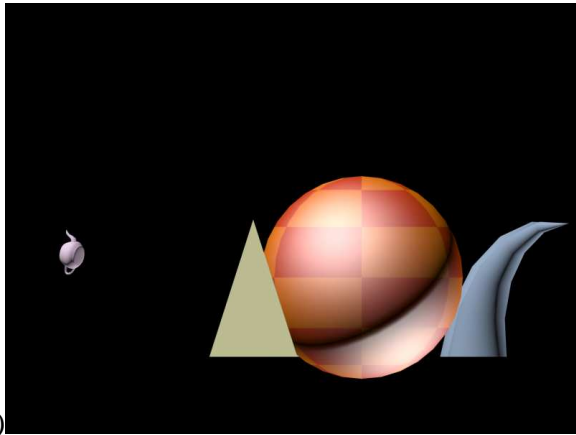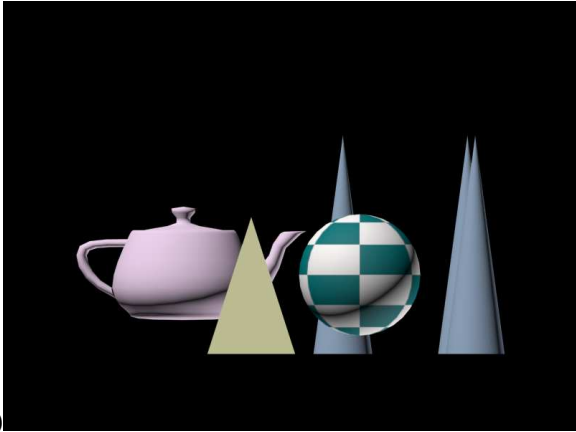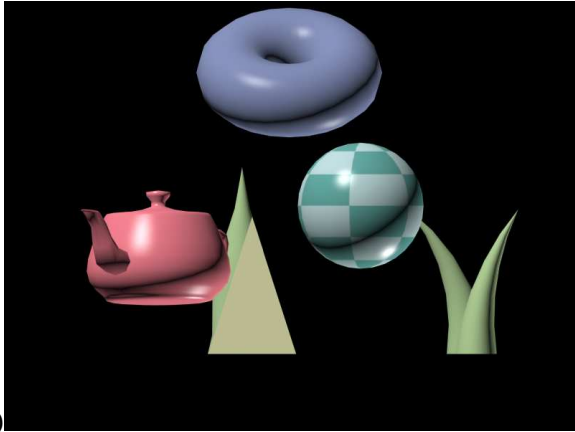
a)



b)

c)



d)

e)



f)

g)



h)
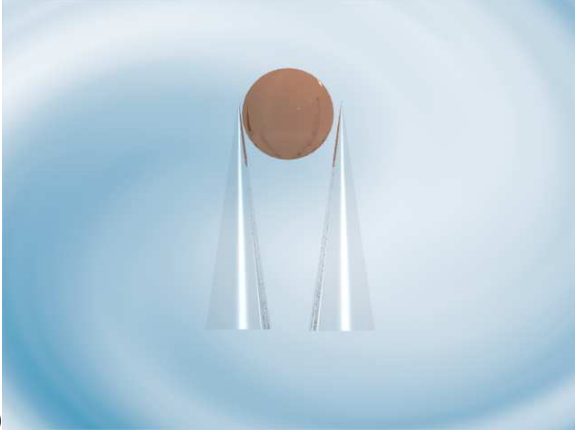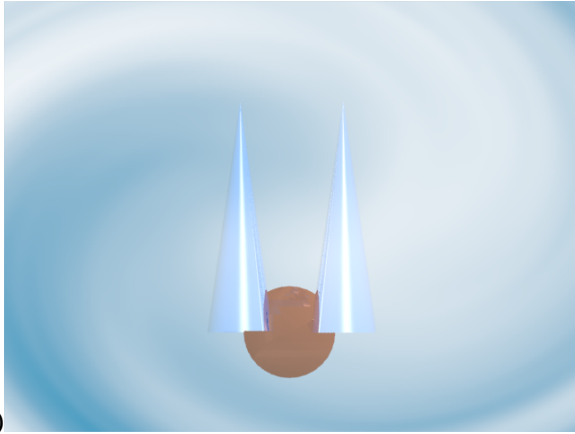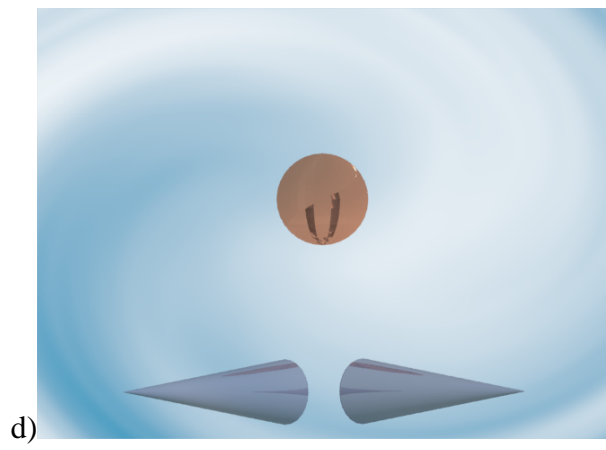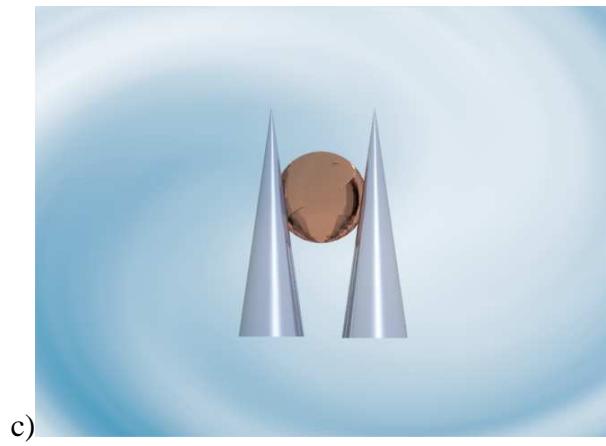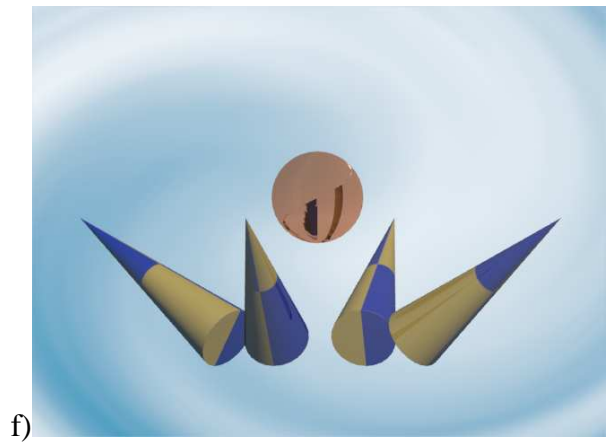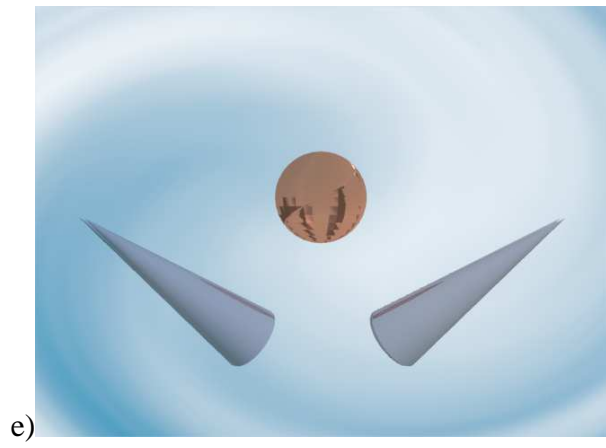
Fig. 4. Frames a and b comprise the initial animation, frames c, e and g are in-between frames adopted as new key frames, while frames d, f and h are those where artist's changes were introduced into the scene.

In the second example a group of students were asked to do the collaborative task and make changes to the simple composition given. They were obliged to follow the steps of design process of dynamic graphics. Every next person worked on the output composition of the previous person, selecting one of the in-between frames of his/her choice and making it a new start point for further changes. The consecutive stages of composition from the initial set of solids to the last student's work are shown on the figure below.
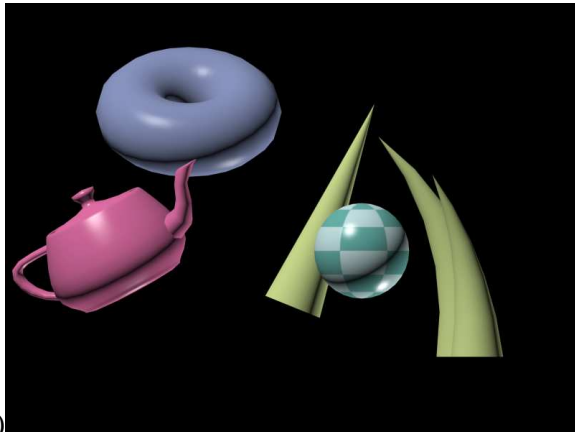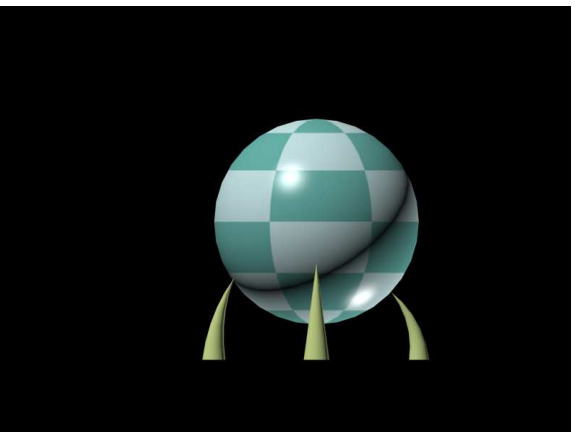
a)



b)

c)



d)



e)



f)
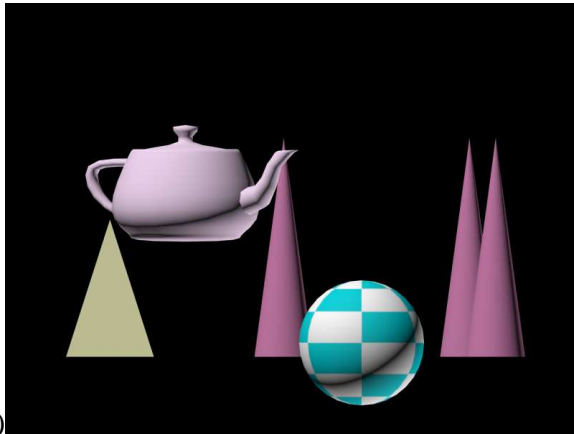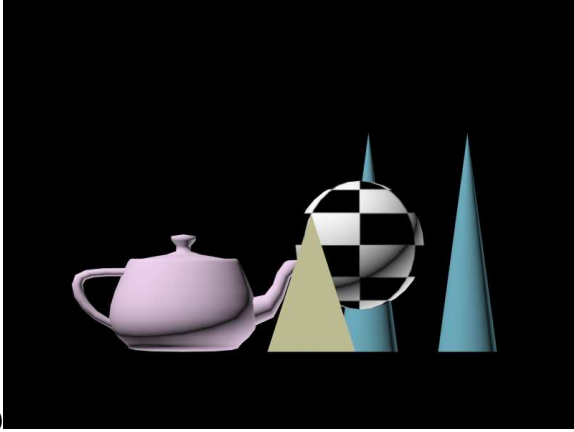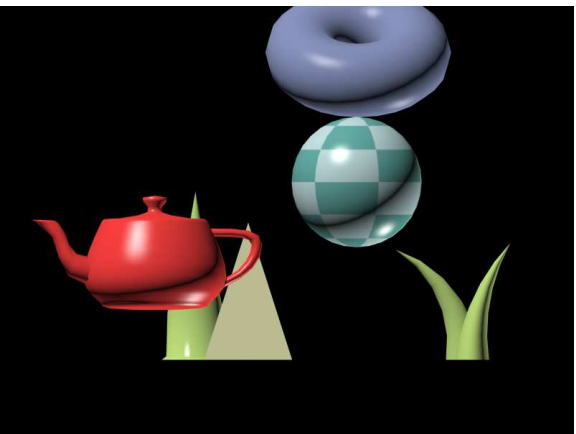
g)
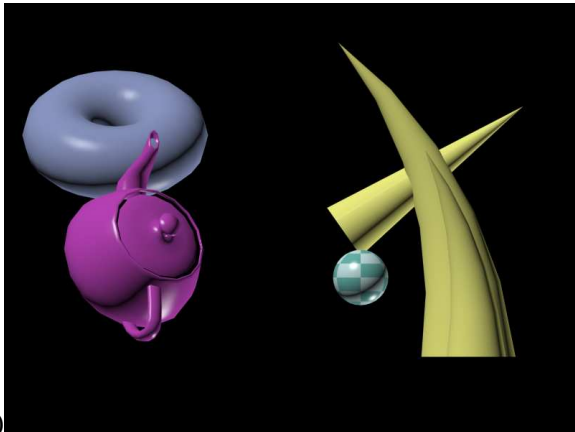


h)



i)



j)

Fig.5. Frames a and b comprise the initial animation, frames c, e, g and i are in-between frames selected consecutively by each student and adopted as new key frames, while frames d, f, h and j are those where student's changes were introduced into the scene.

**Conclusion**

The computer opens a new horizon in visual creation. The challenge for modern design process supported by computer is to visualize concepts that are assumed to exist in a given design domain and relations that hold among them during design process. Interaction between human and machine leads to enhancement to artist's creativity and allows to organise design process into clear steps.

This paper is an attempt to handling creative generation of artworks in computer aided design context with the use of animation. It leads to dynamic design. Additionally, we can also consider created animation as an artwork, being a "side effect" of design process in a way.

Joanna Tarko, Ewa Grabska,

Faculty of Physics, Astronomy and Applied Computer Science

Jagiellonian University

Reymonta 4, PL30059 Cracow, Poland email: jtarko@gmail.com

[1] Mumford, M. D., *Where have we been, where are we going? Taking stock in creativity research* (Creativity Research Journal, 15, 2003): 107–120

[2] E. Grabska, G. Ślusarczyk: *Knowledge and reasoning in design systems* (Automation in Construction 22, 2011): 927- 93