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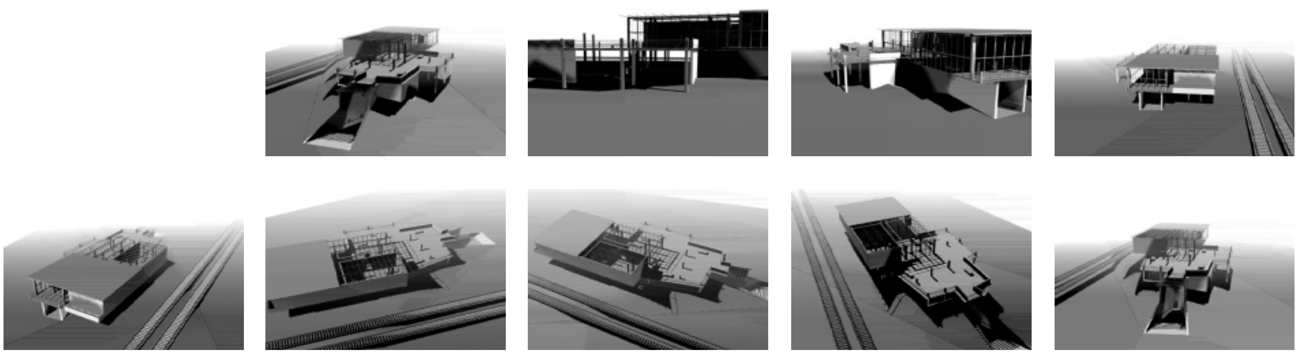

CAN COMPUTER ANIMATION AID DESIGN?

CHIU-SHUI CHAN

¿PUEDE LA ANIMACIÓN COMPUTARIZADA APOYAR AL DISEÑO?

RESUMEN

Debido a la particularidad de su movimiento uniforme, la animación ha sido utilizada en agencias publicitarias para pautas comerciales y en talleres de diseño como una herramienta de presentación que muestra los espacios interiores y exteriores de las edificaciones. También tiene el potencial para ser aplicada en otras áreas del diseño: simular el proceso consructivo, desplegar continuamente secuencias de construcción o para evaluar el funcionamiento y desempeño de un edificio. Su más desasfiante aplicación pudiera ser como herramienta generativa estimulante del diseño pensante. El tema de este artículo es explicar brevemente las características de la animación en general y describir las potencialides que, la animación computarizada pueden jugar en el proceso de diseño.

PALABRAS CLAVES

Diseño asistido por animaci;on computarizada, Diseño rquitectónico, cuadros, caminatas, herramientas de sinuación, realñidad virtual.

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ABSTRACT

Because of its ability to display motion smoothly, animation has been widely utilized by advertising firms in commercials and by design firms as a presentation tool to show interiors and exteriors of buildings. It also has the potential to serve other roles in design: to simulate a building's construction processes, to redisplay the construction sequence, or to evaluate the building's performance. Its most challenging application, however, may be to serve as a generative tool to stimulate design thinking. The theme of this article is to briefly explain the characteristics of animation in general and to describe the potential roles that computer animation can play in the design professions.

KEY WORDS

Computer Animation Aid Desing, Architectural Desing, frames, walkçthrought, simulation tools, Virtual Reality.

1. BACKGROUND

The original method for making animation had two major components. The first one was to make a series of drawings on heavy paper. The other was to “animate” the series by manually flipping the stack of drawings, thus tricking the eye into believing that the images were moving. The entire process of making and showing was manually driven by careful handling of artworks and precise control of the display mechanism to create the appearance of motion.

A more advanced, but similar, animation method was developed for filmmaking. The method involves recording drawings or images frame by frame through a camera and replaying them through projectors. Filmmaking is an expensive and time-consuming technique requiring a devoted team working intensively to complete the product. As technology developed further, it became possible to generate drawings more quickly, photograph them more rapidly, record the frames through cameras more easily, and redisplay them through video or movie projectors more clearly. But the process was still cumbersome.

With the development of computer technology, animation techniques have changed rapidly. And although computer animation is easier than conventional animation in filmmaking, it still requires a solid understanding of software applications and a high degree of creativity (Furniss,1998). This article intends to explain the characteristics of computer animation and the possible roles that animation can play in the field of design via several examples. The purpose is to illustrate how animation can be applied to enhance design thinking.

2. DEVELOPMENT OF ANIMATION

Animation relies not only on drawings, but also on film cameras and projectors, the key factors for making animated images. As Ceram (1965) explained, animation history is a part of camera history, and many experimenters, scientists, and photographers have worked on a way to photograph objects in motion and project them in motion. There are four major areas of animation: cel, object, cameraless, and computer (Halas,1976; Hoffer, 1981; Furniss, 1998; Vince, 2000). These four areas have evolved with the technological advancement from hand to machine and from 2D to 3D; and each, of course, creates different visual perception. Computer animation is the most productive and exciting type, as it can replicate entire scenes and characters, eliminating the reproduction of moving figures on a large number of individual cels and frames. Computer animation also can create imaginary creatures to produce new illusions.

Figure 2 is a walk-through animation to show a design project, which is the addition of a university theater. The design adds a passageway connecting the theater and a conference area to serve the functions of circulation, display, and reception. The walk-through includes different speeds and turns to punctuate different definitions of each space.

Figure 3 is a complete example illustrating how to use animation as a well-planned presentation tool. This example shows the entire design, from 2D drawing of floor plans and elevations to 3D modeling. One of the techniques of combining 2D and 3D animations provides a better means for grasping the concept of a building than a simple, static drawing would. Of course, the final result of using image, video, text, and sound together provides a more diverse experience. The other technique utilized in this example is the transition between two clips, such as dissolution, montage, and mutation effect, which provides visual hints to suggest and symbolize new events.

3. REPRESENTATION OF COMPUTER ANIMATION

Every text and drawing has embedded messages. Motions have vectors, which symbolize the direction of motion and its magnitude. Motion in animation is movement guided by intention. Animation is the combination of text, drawing, and movement; thus, it has a representation of images plus their intended motion. In theory, representation is having something standing in for something else and is the means for representing the things that happened in reality (Hesse, 1966; Echenique, 1972). A representation could be the act or the state of being that was represented by a model, picture, or a model in a picture to serve as a symbol; or expressed via various media including analog, iconic, and mathematic symbols. Animation, because of its dynamic expression, should be seen as another form of representation, which symbolizes the communication process that manifests metaphorical connections between abstract concepts and concrete images.

On the other end, the new culture in computer application has changed the techniques of making and replaying animation. Areas of computer animation have been expanding to cover new interest in advertising, entertainment, and mass programming. New adaptations have been made in instructional, scientific, editorial, and entertainment forms by incorporating a mixture of various media. One study even tried to develop a cognitive model to apply artificial intelligence (AI) to computer animation to get objects to behave realistically (Funge, 1999). This application of AI in animation also relates to the large market value in computer games that require sophisticated animation effects. As Norman McLaren indicated, "*Animation is not the art of drawings that move but the art of movements that are drawn; what happens between each frame is much more important than what exists on each frame; Animation is therefore the art of manipulating the invisible interstices that lie between the frames"* (Sifianos, 1995).

4. UTILIZING COMPUTER ANIMATION IN DESIGN

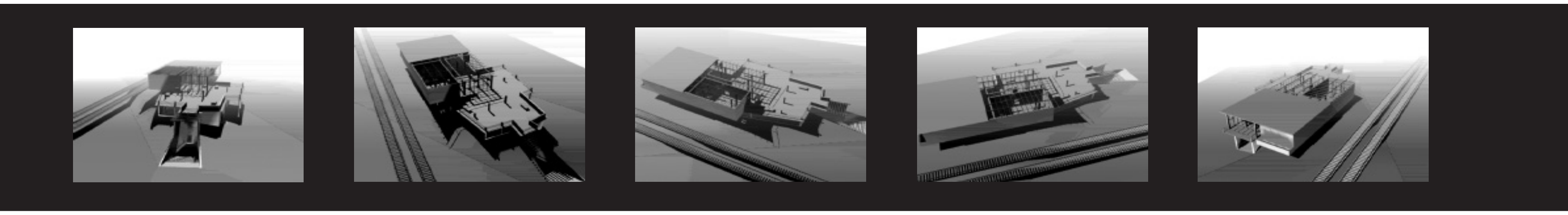
In the design professions, animation has just entered its trial-and-error stage. Most advanced or avant-garde architectural firms have used animation to display concepts to clients. However, outside of presentations, there are many other occasions in which animation can be applied. In the following sections, the possible roles of animation in design are exemplified and demonstrated briefly by selected frames representing the animation sequences.

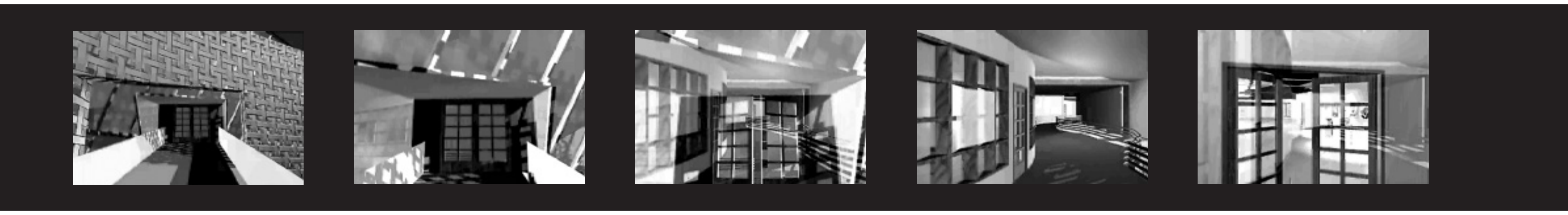
4.1 Animation as a presentational tool

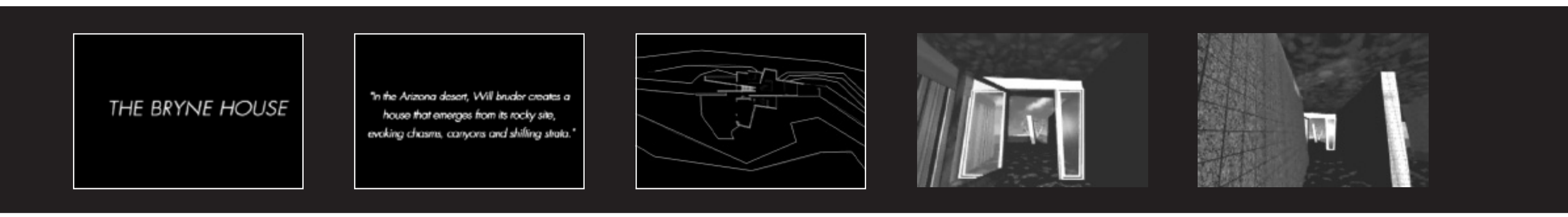
Animation is most often used as a presentation tool to show audiences the inside and outside views of a proposed building or other design project as it will appear when completed. The two methods of walk-through and fly-out around are commonly used as key frame animations. Figure 1 shows a series of selected frames for demonstrating the fly-around of a building. The intention of the movement is to allow viewers to scrutinize the building's relationships with the site and surroundings, similar to looking at physical models. However, miniature physical models might not be able to provide the realistic appearance of material textures or an internal view. The digital model of the animation example shown in Figure 1 includes key elements existing on the site for design considerations: railroad tracks. If more layers of the site context and landscape information were included in the model, then more understanding about the characteristics of the site would be obtained and more planning issues could be explored.

4.2 Animation as a simulation tool

Other than the straightforward application of moving viewers in, out, up, or down a model, animation can mand hierarchy kinematics, is to link objects in a hierarchy for animating a collection of objects, each influencing the other. In this way, animation can be used as a simulation tool to replicate the processes of concept formation and form generation, or to reveal or predict the process of construction for construction management or for facility management. In this regard, it also can be seen as a tool for justifying the processes that create design products (see Figure 4).






THE BRYNE HOUSE
"In the Arizona desert, Will bruder creates a
house that emerges from its rocky site,
evoking chasms, canyons and shifting strata."

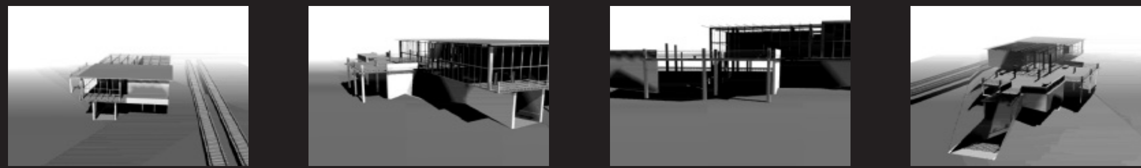


Figure 1. A fly-around animation by Chris Trettin

Figure 2. A walk-through animation by Gordon Vanhoutan

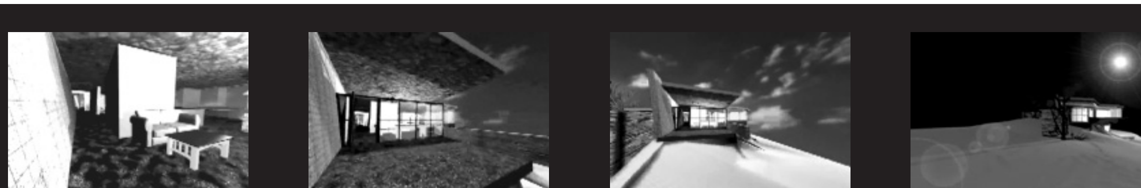


Figure 3. A complete building project presentation by Elliot Stendel

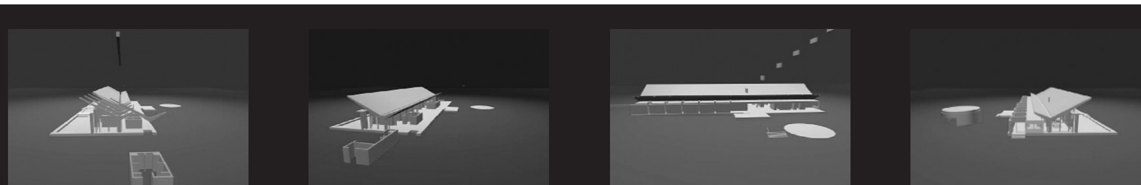


Figure 4. Simulation of construction processes by Thong Vouthilak

Figure 5. Simulation of changes in shadows by Wesley Gee

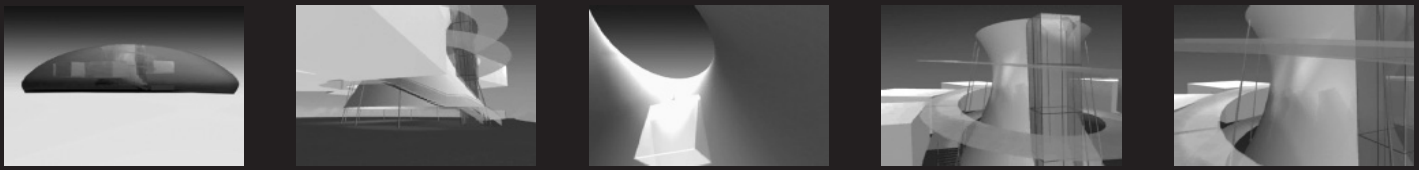


Figure 6. Animation of the view of corridor regulation during the day by Aaron Twedt

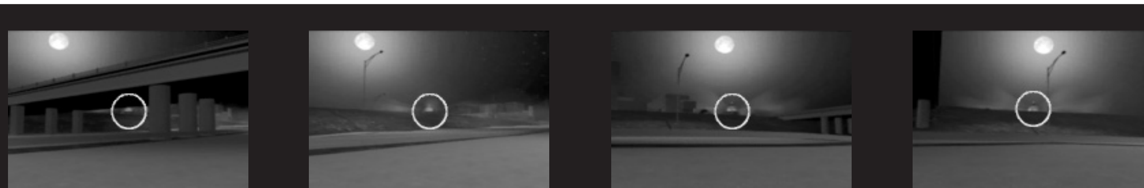


Figure 7. Animation of the view of corridor regulation at night by Wesley Gee

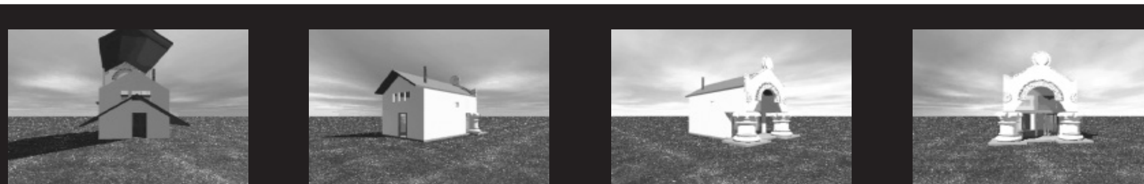


Figure 8. Study of topology- the change of facade by Ancrew Weyenberg

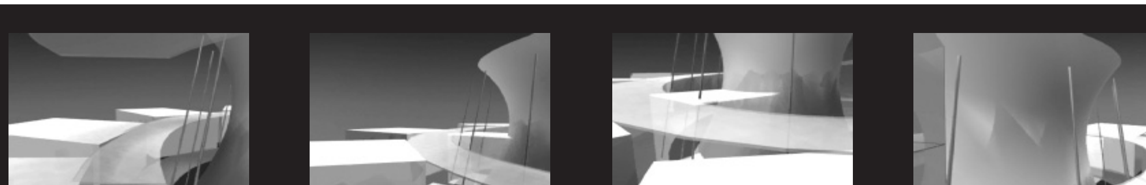


Figure 9. Animation on a 3D double-diagram generator by Yand Jiao

Another example of animation as simulation is to have a building animated to evaluate the building's performance in lighting or energy efficiency. For example, it is possible to check: (1) how shadows on the façade would affect the aesthetic value of the design, (2) the illumination intensity of interior space, and (3) the comfort level achieved inside the building. The example in Figure 5 animates the daily change of the sunshine angle on a building façade.

Animation also can be used to simulate and to demonstrate urban regulations. For instance, the example in Figure 6 is an animation that implements the city planning regulations on viewing access to the state capitol building in Des Moines, Iowa. The capitol building houses the Iowa Legislature and is a symbol of state power. Maintaining the view from surrounding areas will preserve the building's monumental and symbolic meaning. The City Community Development Department set up visual corridors to prevent the view toward the capitol from being blocked by any future designs. Because city regulations are not easy for the public and designers to interpret and comprehend, animation on digital models makes the statement clear. The animation in Figure 6 simulates driving along Interstate 235 westbound looking toward the state capitol building on a sunny day. The dome in the center of the scene is the target point, which cannot be blocked in the future.

Figure 7 is the animation of the view corridor at night. The scene is the same as in Figure 6, but it simulates driving a car on a foggy night under moonlight. The driving speed is 70 miles per hour. The lit dome in the middle of the pictures is the golden dome of the capitol building seen at night.

4.3 Animation as a study tool

Animation can be used in design as a study tool. Figure 8 is an instance of studying topological changes on façades. The building is a vernacular style of a residence in a rural area. Three different possible facades are posted to allow examination of the alternative character of the building. Methods of animation are to combine the

ove objects and viewers together to experience complicated motions. A technique of making complicated motion, called spiral rotation of the model while plugging in other models to see results in motion. The method can be used to get an immediate impression about various forms and styles with regard to elevation. Of course, if adjacent buildings are included in the scene, perceptions on forms will get instant results.

4.4 Animation as a design tool

Animation can also be used as a generative tool to stimulate creativity. Figure 9 is an example showing a way to apply animation generating 3D bubble diagrams to determine the functional relationship between spaces in six degrees of freedom or in three dimensions. In the conventional design method, 2D bubble diagrams are used to determine spatial relationships among design units on plan view. But animation can be used as a 3D bubble diagram, not only to decide vertical relationships, but also to evaluate circulation through movement. While navigating 3D bubbles, artificial and natural lighting can be simulated simultaneously to determine the quality of lighting in spaces.

Figure 9 is a design of a training center for information technology. The purpose was to apply animation to explore the possibility of integrating design methods and information technology into each design stage. Experimental activities ranged from finding the right concept and form to searching for an appropriate definition of space representing the future image of information technology. In this case, the building type is an information center. Driven by the issue of information technology, the emphasis was on creating a new spatial program by (1) identifying the morphology of a generic learning space and (2) looking for the right parti to define the space that fits the future custom. Animation, in this regard, was used to evaluate alternative solutions and as a study tool to guide the design process (Jiao & Chan, 2000).

5. DISCUSSIONS

Examples given in the previous figures were created via interfaces between Photoshop, AutoCAD, 3D Studio VIZ, MAX, and edited by Adobe Premiere. Extensive time and labor were spent for their generation. Several advantages and disadvantages were observed in the process. One advantage is that most animation systems have close connections between digital modeling and computer graphic ability. It is easy to generate 2D images, construct 3D models, map 2D graphics to 3D models, then view the models in perspective with lighting added to create a perception of real conditions. The sequences of generating the model and the scene are user-friendly.

The second advantage is that the interface is equipped with a multi-media environment. Animation can incorporate special visual effects to create surprising transitions, and it can mix audio to provide dramatic sensual associations that broaden design thinking. Particularly, sounds and images together would trigger, stimulate, and fertilize a multi-directional mode of thinking.

The third advantage is that animation allows viewers to virtually perceive interior space to appreciate its spatial proportions, to understand the environmental impact caused by interior lighting and by color, and to observe the texture of the materials, all of which are impossible to obtain through examining miniature physical models or 2D drawings.

However, there are disadvantages of making and recording animations. On the production side, it takes time to render 24 frames (for film) or 30 frames (for video) of one second-long animation. As a rule of thumb, a convincing clip should have at least one minute of presentation time to express the key concept. Therefore, it is important to have some network rendering ability with several machines executing the job 24 hours for 1440 or 1800 frames. On the processing side, the inefficiency of making an animation is a computing bottleneck that would cause difficulties.

Another disadvantage is that some movie files generated in Macintosh computers and software are sometimes not accepted or displayed by IBM personal computers and vice versa. The hope is that when the technology has advanced to some greater level, these disadvantages will no longer be concerns or burdens. Of course, these arguments were based on the studies conducted so far. With the rapid advances in computer technology, some of the disadvantages might be interpreted as advantages for some users.

6. CONCLUSIONS

Animation is a powerful and unique way of clarifying and simplifying a complicated process: either a manufacturing process, a design concept-formation process, or a form-generation process. It also has the ability to break down events into understandable time segments to simulate their evolution. For instance, it is feasible in problem-solving theory to break the design thinking process into a number of episodes, symbolizing the stages of achieving design goals (Chan, 1990). These problem-solving episodes, in theory, can also be animated graphically.

Animation is the combination of a series of images replayed in motion. Images are 2D and 3D representations (Chan, Hill & Cruz-Neira, 1999), and motion represents time. Therefore, by adding the 3D representation to the time dimension, animation becomes a four-dimensional form of knowledge representation. The question of how to use animation as a design tool relates to the question of how to treat movement as a new mode ofrepresentation rather than as a storyboard for visual presentation. As long as the intention of movement is well organized and presented through the results, the problem at hand will turn into a more transparent situation that triggers creative thinking in viewers and makes it easy for them to tackle the problem solutions. Because a picture is worth a thousand words, and a series of moving pictures is worth a chain of thousand words, computer animation-aided design is a new frontier for design and for research in design thinking.

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