

# Presenting Educational Contents by Using a Non-contact Viewer

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**Abstract.** We are preparing educational contents on genetic engineering by using 3D Computer Graphics. The role of educational contents is raising the user's degree of comprehension in general. In addition a non-contact viewer system, which uses a CCD camera, was incorporated in this study. This viewer system recognizes user's head movements with the CCD camera, and reacts by presenting views which are corresponding to the user's head movements such that the user has the impression of looking at a real 3D object. The result was an improvement in the user's degree of comprehension.

*Keywords:* Computer Graphics, Educational contents, Non-contact viewer

*MSC 2000:* 51N05

## 1. Introduction

Currently, the technology of genetic engineering has remarkably been advancing and has especially been applied to various fields of life science such as agriculture, medicine, and environment purification [1, 2]. This technology is also closely related to our daily life too. On the other hand, there is a tendency that people have increasingly been worrying or feeling uneasy because of everlasting lack of information and knowledge as the technology of genetic engineering has been advancing so rapidly [3]. There are many cases where such a condition has made the matter worse and thereby caused a social problem. Therefore, what is needed urgently is to develop and popularize educational contents that will relieve people from worry or uneasiness which is one of the causes of the social problem. We believe that an important target in creating educational contents is to enhance the comprehension ability of people by invoking and sustaining their interest. In the present study, therefore, the benefit of the movie media has been utilized to create contents that will provide the user with visual information by means of 3-dimensional computer graphics (3DCG). Further, as an experiment to sustain the interest of people, educational contents were created by incorporating non-contact viewer functions [4, 5] into the animation of the movie media. Our manufacturing procedures of the contents are as follows.

## 2. Visual educational contents

The most important target for making educational contents is its proper and easy transportation to the users. It is very difficult however to explain the author's intention by sentences and/or voices to the users who have no ideas or only little knowledge about the special technical terms. Therefore we tried to develop a new system to explain the educational contents with a visual method.

The *movie media*, as represented by TV broadcasting, is one of the most effective media that are used as communications means. The advantage of the movie media is that contents which are hard to be transmitted only with words or sentences can easily be visualized by means of Computer Graphics, etc. Furthermore, adding voices or superimposition as well as visual effects enhance the comprehension ability of people. In the present study therefore animation which takes the advantage of the movie media was created by using 3DCG.

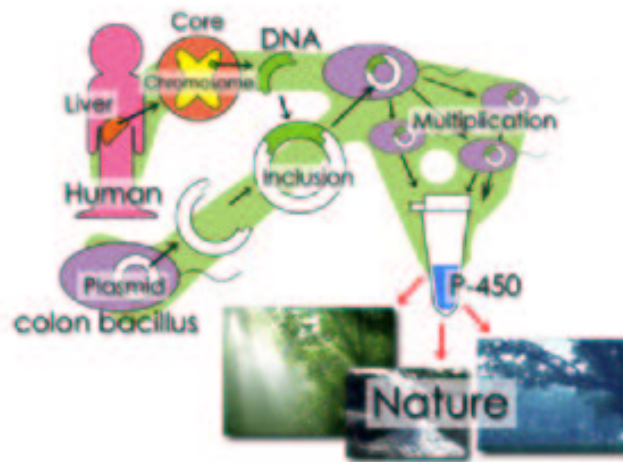


Figure 1: Content of animation

The animation that has been created is about environment purification which is recognized relatively in common. The following description shows the content of this animation. The recombinant DNA technology is used to provide the colitis germ with the function that will produce the enzyme that has the detoxication effect inside the human body. The animation summarizes the research (Fig. 1) that enables the mass-production and realizes the application to environment purification.

Now, the following descriptions give the policy that we refer to when creating an animation:

1. *Ordinary people are the object:* Ordinary people are the object, who have no preliminary knowledge about genetic engineering.
2. *Function as an educational content:* The animation is to be created based on accurate information, in order that it may have the function as an educational material.
3. *To simplify technical words:* In the animation one should avoid as much as possible to use technical words that will be hard for the user to understand their meanings only by hearing them. The comprehensive ability of the user is to be improved by visualizing technical words such as those.
4. *To simplify models:* The animation is to be created in the utmost simplified manner,

from the viewpoint that extremely complicated object models will deteriorate not only the visual impression but also the comprehension ability of the user.

5. *Explanation added with superimposition*: The superimposition is to be provided to add character information to parts which cannot be explained only by images, so that the comprehension ability of the user will be improved.

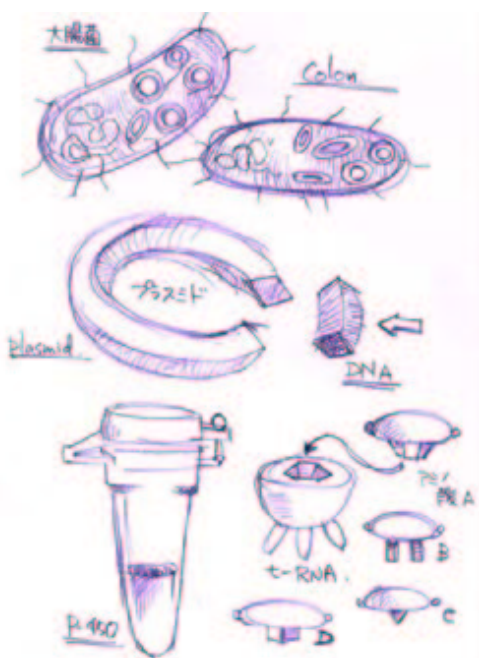


Figure 2: Rough sketch

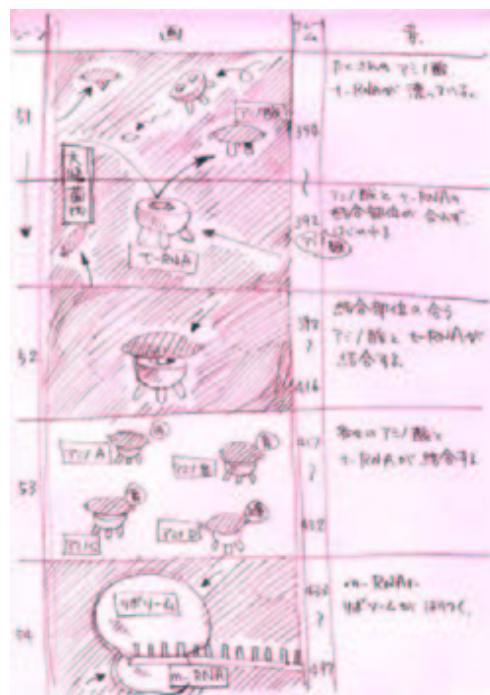


Figure 3: Creating picture script

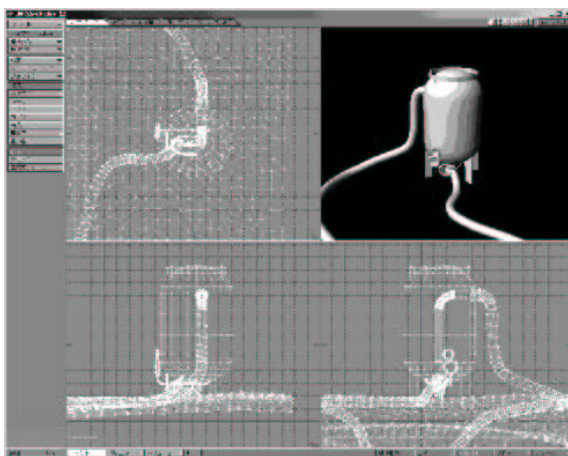


Figure 4: Modeling work

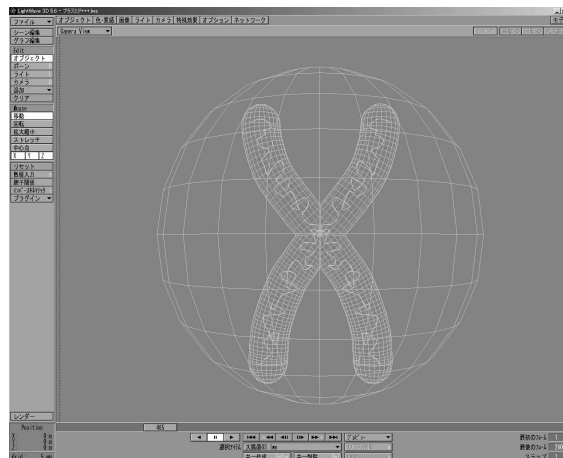


Figure 5: Layout work

Now, the following descriptions give the procedure of creating the animation.

1. *Rough sketch*: In order to grasp a general image, objects and scenes will be sketched and summarized (Fig. 2).
2. *Creating a story*: The flow of the overall animation will be determined.

3. *Creating picture script*: The motions of the objects, the camera work for each scene, and the visual effects will be determined based on the rough sketch and story (Fig. 3).
4. *Modeling work*: The images determined by rough sketch will be used to transform them into three-dimensional models (Fig. 4).
5. *Layout work*: Based on the picture script, set motions, visual effects, and camera work on the objects that have been created in the modeling work (Fig. 5).
6. *Rendering*: The animation will be completed.
7. *Creating sounds*: Background music or effect sounds will be created and narration will be added.
8. *Editing movie*: The created animation and sounds will be integrated with each other, and the whole part will be given a fine adjustment (Fig. 6).

By following the procedure explained above, the present movie was created (Fig. 7).

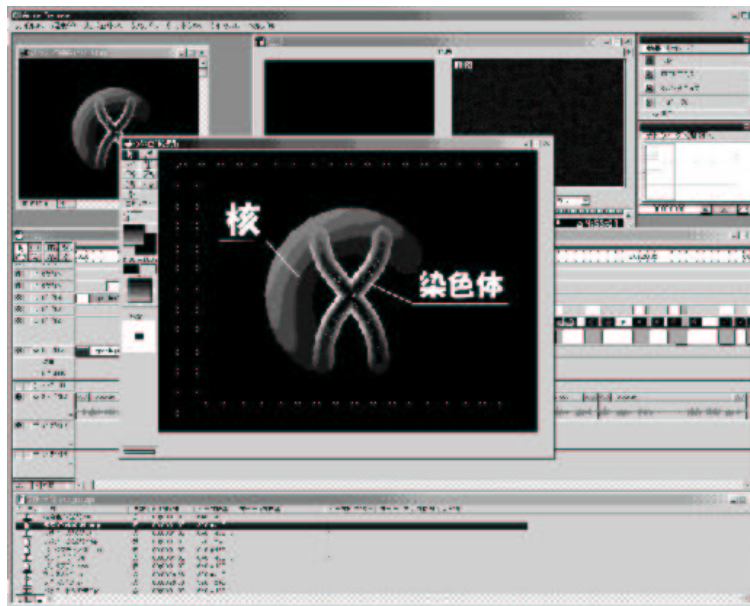


Figure 6: Editing the movie

### 3. Non-contact viewer system

Further, we created a visual educational content which is incorporated with a non-contact viewer. The objective of this content is to further invoke or sustain the interest and enhance the comprehension ability of the user, in comparison to conventional visual educational contents. In the present system, a personal computer and a CCD camera were used in order to realize a non-contact operational environment. This measure was taken in consideration of the “voyeur” action of the user, with a view to realizing an operational environment that will allow anyone to use the system. A CCD camera placed on the upper part of a personal computer takes in a motion of the head of the user and makes the personal computer recognize the motion to perform the sequential operations, as explained below. Fig. 8 illustrates the overall system configuration. The following descriptions give the details of the processing for identifying the head of the user.

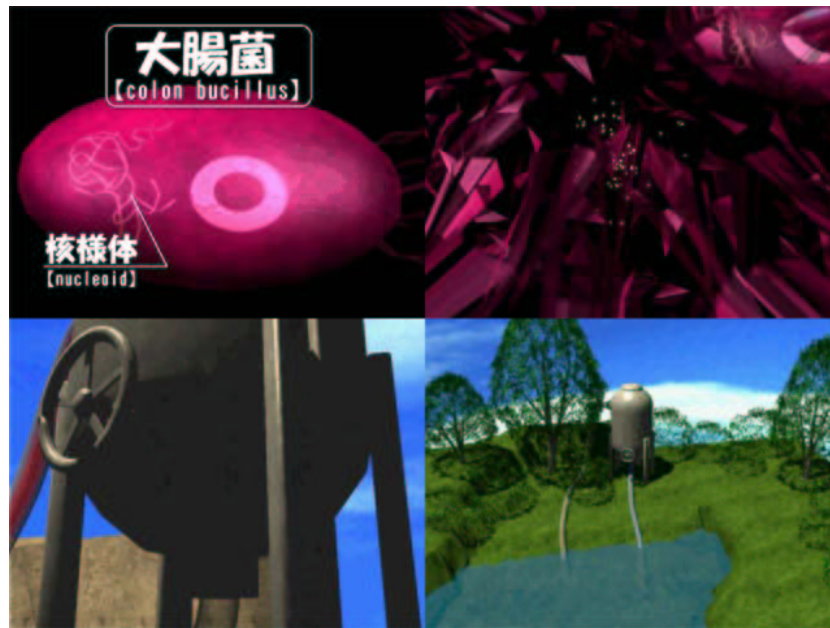


Figure 7: Editing the movie

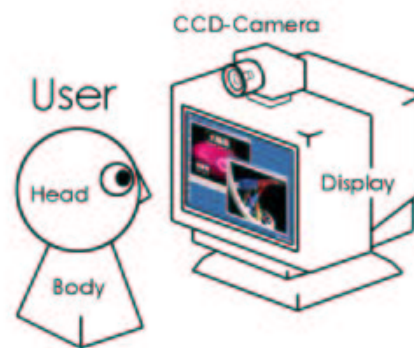


Figure 8: System configuration

1. *Difference processing between background image and input image* (see Fig. 9): Make the personal computer perform difference processing for each pixel, between a background image previously taken in and an input image of the head of the user. If the difference value obtained is equal to or less than the threshold value, take it as the part that is not changed by the motion of the head of the user, i.e. the background.
2. *Labeling regions* (see Fig. 10): Set the largest region as that of the head of the user and the second largest region as that of the hand of the user.
3. *Analyzing motions*: Make the cursor move jointly with the motion of the head of the user that has been taken in. Operate the non-contact viewer by such a movement of the cursor.

The non-contact viewer window is divided into  $9 \times 9$  square regions (Fig. 11). If the cursor moving jointly with the motion of the user's head passes over the regions, a still image provided for each of the regions (Fig. 12) will be displayed. In this way the rotation of an object can be represented.



Figure 9: Difference processing between background image and input image



Figure 10: Labeling

0-0	1-0	2-0	3-0	4-0	5-0	6-0	7-0	8-0
0-1	1-1	2-1	3-1	4-1	5-1	6-1	7-1	8-1
0-2	1-2	2-2	3-2	4-2	5-2	6-2	7-2	8-2
0-3	1-3	2-3	3-3	4-3	5-3	6-3	7-3	8-3
0-4	1-4	2-4	3-4	4-4	5-4	6-4	7-4	8-4
0-5	1-5	2-5	3-5	4-5	5-5	6-5	7-5	8-5
0-6	1-6	2-6	3-6	4-6	5-6	6-6	7-6	8-6
0-7	1-7	2-7	3-7	4-7	5-7	6-7	7-7	8-7
0-8	1-8	2-8	3-8	4-8	5-8	6-8	7-8	8-8

Figure 11: Divided region of non-contact viewer window

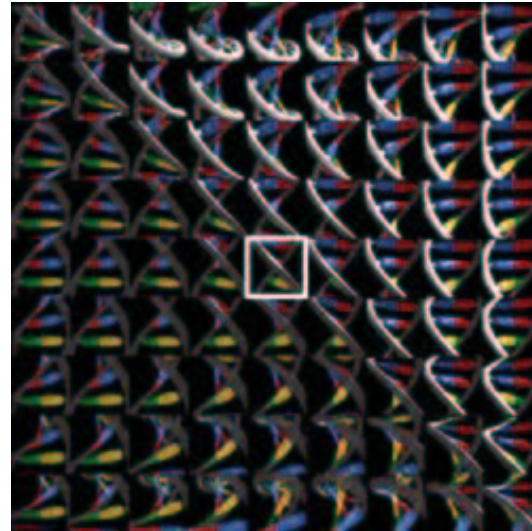


Figure 12: Still image provided for each region

The following descriptions give the summary of operations of the present system. When in particular the user is raising his hand then the system performs a single clicking.

1. *Reproduction of movie*: The movie is reproduced.
2. *Pausing movie*: Single clicking gives pause to the movie when an object to be observed appears during the reproduction of the movie.
3. *Starting non-contact viewer*: Display the object to be observed on another window and start the non-contact viewer, simultaneously when giving pause to the movie.
4. *Observing object*: Observing an object is possible by rotating it in the upper, lower, right, or left direction, while making a joint movement with that of the user's head. The rotation of an object will be achieved by displaying still images consecutively (Fig. 13).
5. *Continuing reproduction of movie*: After the observation of an object is completed, a single clicking will close the non-contact viewer window. At the same time, the movie will resume and continue. Fig. 14 illustrates an actual operating screen.

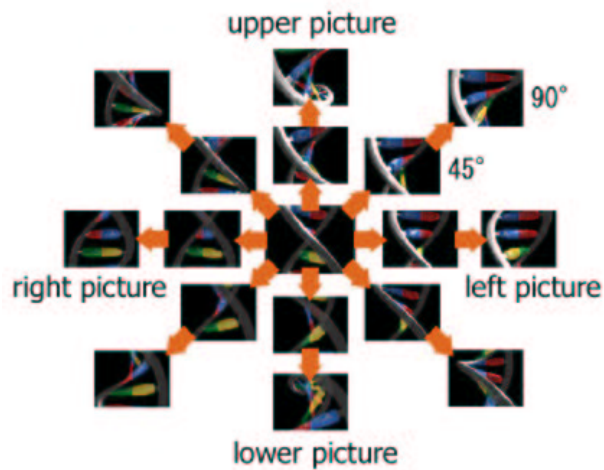


Figure 13: Rotating object



Figure 14: Operating screen

## 4. Review

In the present system, incorporating a non-contact viewer into a movie has made it possible to observe side and back views of an object and has also made it easier to grasp the positional relation or the shape of an object. As a result, the present system has been proved to be effective because incorporating a non-contact viewer into a movie can further invoke the interest of the user and enhance his comprehension ability, in comparison to the case where the user only watches a movie.

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