

# The Advanced Digital Special Images and Technology

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## Abstract

Multimedia boom has happened worldwide these days. In multimedia, we use several kinds of media such as character, figure, voice, music, still images, moving picture etc.. Then I think image including moving picture is the most effective and important media for human being. Creating digital images using a computer has the following two main approaches, depending on how the computer is used.

### 1. CG Technology.

Created images, produced through computer graphics.

### 2. Digital Image Processing.

Images processed through digital image processing technologies.

Approach (1) is very popular as Computer Graphics. Two-dimensional and three-dimensional computer graphics techniques are used over wide applications today.

On the other hand, Approach (2), which uses digital image processing technology, has been attracting attention lately, in the field of movies and television.

In this report, I will introduce these approaches of CG and digital image processing, and show some application fields such as current movies.

## 1 Introduction

Recently, technologies of digital image production are receiving attention in the worlds of movies and

television, as the production methods for special effects, or SFX. This is an area where, till now, optical processing using optical printers mainly used. But with optical processing, it took a lot of time to confirm the results, and there were limits regarding quality. Therefore, today, digital image processing is becoming more popular instead of it. And because digital processing can be done easily and quickly, it can be used to create a variety of special images.

Images can be broadly classified into two categories — one is real images, and the other is created images. Real images taken by video or film system have always been necessary in the past, and will continue to be essential in the future. But going forward, computer graphics images and images created through image processing methods also promise to become extremely important. I will introduce the current digital image processing technology and applications.

## 2 The Effects of Digital Images

Digital images created using computer graphics and other methods have a variety of characteristics which only real images do not have. These characteristics are as follows:

1. **Easy to change the scene.**  
re-makes, coloring, filtering,  
removing unwanted noise.
2. **Cost effective.**  
sometimes cheaper than taking real image scene.
3. **The possibility to create an imaginary and virtual world.**

4. The possibility to create the scene that are hard to see images of big space, or the world under a microscope.
5. The possibility to create the scene across time, namely the appearance of people from the past or future.
6. The possibility to have special effects.

Regarding these characteristics and possibilities, digital image creation technology becomes very important in many fields.

### 3 Digital Image Processing

As same as CG technology, digital image processing has many methods and application fields. The following are main methods of image processing for effective image generation.

- (1) Composing pictures or images.
  - Chromakey composition using blue screens.
    - composition of real image and CG image,
    - composition of real image,
    - composition of CG image and CG image.
- (2) Digital and paint processing.
  - Coloring.
    - coloring for old black and white picture.
  - Modification processes.
    - adding noise to make CG image becomes more real.
  - Erasing unnecessary items.
- (3) Filtering processes.
  - Anti-aliasing processes.
    - modifying unnatural edges of chromakey composition.

For example, in composition processes, item (1), the most popular and often used are the chromakey composition. In this composing process, certain areas of a picture that are of chromakey color are taken out, and inserted into a background picture created by real images or CG. Recently, this method was used effectively in the movie "True Lies".

The digital and paint process, item (2), is a method where the images that have been developed onto film are digitalized and painted, after these processes the images are developed onto film again. This digital image processing is done for the following numerous reasons.

1. Changing colors.
  - Colouring old black-and-white movies, through computer painting processes.

2. Modification processes.
  - An example is the animation "Snow White", which was produced over sixty years ago. This was digitally processed and modified into an animation movie with bright colors.
3. Erasing unwanted areas.
  - For example, in the movie "Cliffhanger" that was released in 1993, in scenes where a woman was falling, the actors had lifelines of wire rope, which were later erased.
4. The addition of noise.

Currently, three-dimensional computer graphics images are often used in movies, but the parts produced through computer graphics are often too pure, giving away the fact that they are computer graphics. Therefore, noise is added to the computer graphics images, to make them seem like real photographic images.

The filtering process, (3), is often applied after the above processes (1) or (2) are applied, in order to change these into more visually beautiful images. For an example, after the chromakey combinations are done, the unnatural edge parts are smoothed out through anti-aliasing processes.

## 4 CG Production Methods

### 4.1 Software Trends

In computer graphics, there are two-dimensional CG, and three-dimensional CG. Currently, the mainstream is three-dimensional CG. This is made up of Modeling, where all data for creating a visible object are stored within the computer, and rendering algorithms, where the object is visualized based on this stored data. The rendered pictures are often completed into an animated image. There are many methods available for creating animations effectively, but recently, the animation method called Morphing is being frequently seen in movies and on television. Morphing is an old method developed in the 1970's at the New York Institute of Technology. But at the SIGGRAPH Electronics Theatre held in Chicago in the summer of 1992, Morphing was used in "Black and White" (Michael Jackson's image video) by the PDI, (American computer graphics production). Since then, one could say it has become a boom.

As you can see in Fig.1, morphing algorithms are made up of a combination of Warping and Cross-Dissolving. Warping is changing shapes. Cross-Dissolving is switching smoothly from the first image to the last image.

## 4.2 Motion Capturing

At the SIGGRAPH held in Orlando, Florida in 1994, Motion Capturing became more popular. This is a system of automatically and accurately inputting three-dimensional data of human motions and facial expressions into a computer. This system makes it possible to obtain accurate motion data easily, which used to be an issue unsolved in conventional computer graphics. This makes it possible to improve the quality of images in scenes where human beings and animals appear. Today, the system is used in the production of movies, as well as production of computer graphics games, commercial film and animation.

There are two types of motion capturing systems. One is a real time, on-line system that uses codes. The other is an off-line system that uses many markers or reflecting seals on the body or face, detecting through the principles of stereosystem, using four or more cameras from three-dimensional locations.

The on-line system is effective for VR input, but its weak point is, because it has codes as shown in Fig.2, there are restrictions in some actions. On the other hand, the off-line system is used when there is not always the need to input real time, such as for movies and CM, and has been contributing mainly to improving the quality of movies and live animation. Going forward, it is presumed that motion capturing systems will become even more widely used, and it will become possible to obtain data on various human and animal movements with ease.

## 4.3 Digital Image Processing System

Kodak's Cineon Digital Film System is a system that can process digital images in various ways. The system was actually used in the creation of special effects in the movies "Cliffhanger", "True Lies", "Forest Gump", and picture modification in the animation movie, "Snow White".

The structure of the whole system is shown in Fig.3. The system is made of three devices: the "Cineon Digital Scanner", which digitally transforms film images at high resolutions with a maximum of 4096 pixel per line (RGB, 10 bits for each), which is the equivalent of the resolution of the original movie; the "Cineon Digital Workstation", which processes the high-resolution data using an SGI workstation (such as the ONYX) as a platform; and the "Cineon Digital Film Recorder", which records the digital data on film at high quality.

This system makes it easy to compose actual pictures with images created through computer graphics software. The system also allows the user to process object oriented image processing through flow graphs,

and can deal with extremely complex special effects that compose many layers of images. It also has many effective functions for creating special effects, such as "Dust Busting", which automatically detects and erases dust and clutter; "Motion Tracking", "Image Stabilizer", which stabilizes and prevents blurs, and "Grain Matching", which matches the grains of materials with different sensitivity of films.

Going forward, the system shows promise of being used not only in movies, but also in the editing of video for television.

## 5 Application of Digital Images to Movies

An area with large potential for digital images is the area of entertainment, such as movies, television, and games.

I introduce trends in movie applications, which make full use of the latest digital images.

### 5.1 Introducing Movies Released in 1995

In 1994, digital images were effectively used in the following movies, and attracted a lot of attention.

#### 1. Forest Gump

The appearance of former President John F. Kennedy, and other effects.

#### 2. The Lion King

The scene of running gnus.

#### 3. True Lies

Scenes where real pictures were combines with real pictures.

#### 4. The Mask

Three-dimensional computer graphics attracted attention (Fig.4).

And in 1995, many movies released have used digital image processing, making it a record-breaking year that did better than even 1994.

It has become impossible to list all movies that use digital images.

The following is a list of some titles.

I classify into 3 categories, (1),(2) and (3), according to the level of effective usage of digital image processing.

(1) Computer Graphics or digital image processing plays the major role.

#### 1. TOY STORY (PIXER, Disney)

The whole movie was made by CG.

2. **Casper (ILM)**  
The leading role was made by CG.
3. **BABE (Rhythm and Hues)**  
Image processing was used effectively.
4. **Species (Boss Film)**  
A CG character was the leading role.

(2) Without digital image processing, creation would have been impossible. Or, insert long scene of digital image processing.

1. **Batman Forever**  
(Metrolight, Rhythm and Hues)  
CG.
2. **The Indian in The Cup (ILM)**  
Composed pictures.
3. **Virtuosity (Sony Picture Image Works)**  
CG.
4. **Star Trek GENERATIONS (ILM)**  
CG.
5. **Star Gate (Kleiser Walczak Construction)**  
CG, morph.
6. **Disclosure (ILM)**  
CG.

(3) Works where digital image processing was used effectively

1. **Apollo 13 (Digital Domain)**  
CG, extremely high quality composition scenes.
2. **Pocahontas (Walt Disney Feature Animation)**  
three-dimensional trees.
3. **OUTBREAK (Boss Film)**  
CG (helicopter explosion scene).
4. **Congo (ILM)**  
picture processing.
5. **Water World (Boss Film)**  
picture processing.
6. **French Kiss**  
composition pictures.
7. **Die Hard With a Vengeance**  
(Sony Picture Image Works)  
composition.

## 5.2 Regarding "TOY STORY"

In the world of movies, it is possible to say that the biggest news in 1995 was the movie "TOY STORY" that is the first ever movie to be made using computer graphics from start to finish (Fig.5). At the SIGGRAPH '95 held in Los Angeles in 1995, Steve Jobs, (the president of PIXER, and the founder of Apple) listed as following.

Movie time:	79 minutes.
Number of Frames:	114, 240 frames.
Number of Shots:	1635 shots.

Over 400 toy models produced.  
Render man file of 34 terrabites.  
80,000 machine hours (rendering time).  
a million leaves on a single tree in the background, etc.  
The production took two years, and 110 people.

The movie was a big hit, and despite the fact that it was released on November 22nd, it ranks number three in industrial income on the list of movies released during 1995.

## 5.3 Babe

Along with Toy Story which was released in 1995, another movie which uses mainly digital images is Babe (by Rhythm & Hues) (Fig.6). This was released in the United States in August, and shown in Australia and other English speaking areas in winter 1995. It is still running as a hit in the world, popular among both children and grown-ups. Babe also becomes the candidate for Academic award 1995.

**Story:** A pig succeeds as a sheep dog.

**Production method:**

Three-dimensional CG (Model-type digitize),  
and texture mapping,  
lip sync.

## 6 Conclusions

This report is a brief introduction of the current situation regarding the use of digital image processing including computer graphics. Computer hardware and software are certain to develop further in the future. And in the twenty-first century, super parallel computers with tens of thousands of CPUs will emerge, making it possible to cut down on the many hours required for image production today, to make production real time, and cut down on costs, making it much cheaper. When this happens, new possibilities that we cannot even imagine today, will become reality.



Fig.1: Example of morphing image.

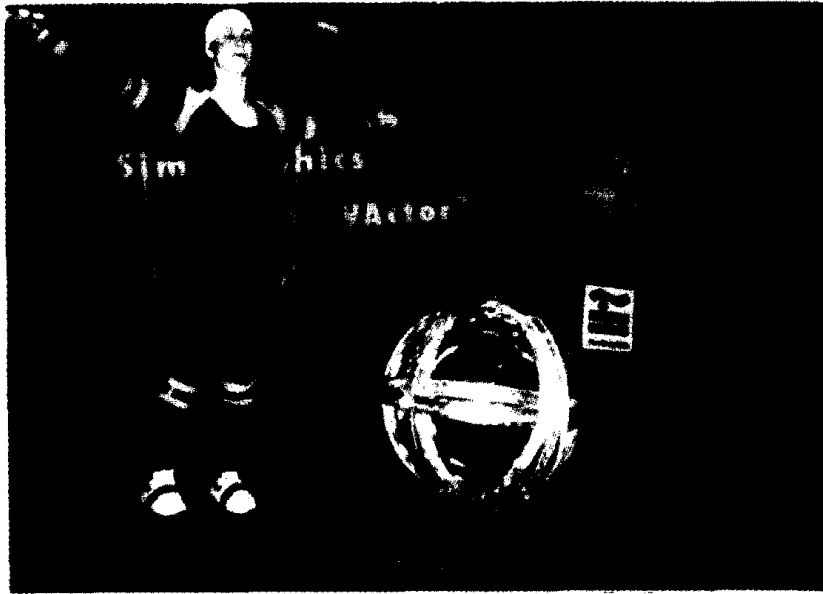


Fig.2: Example of real-time motion capturing system.

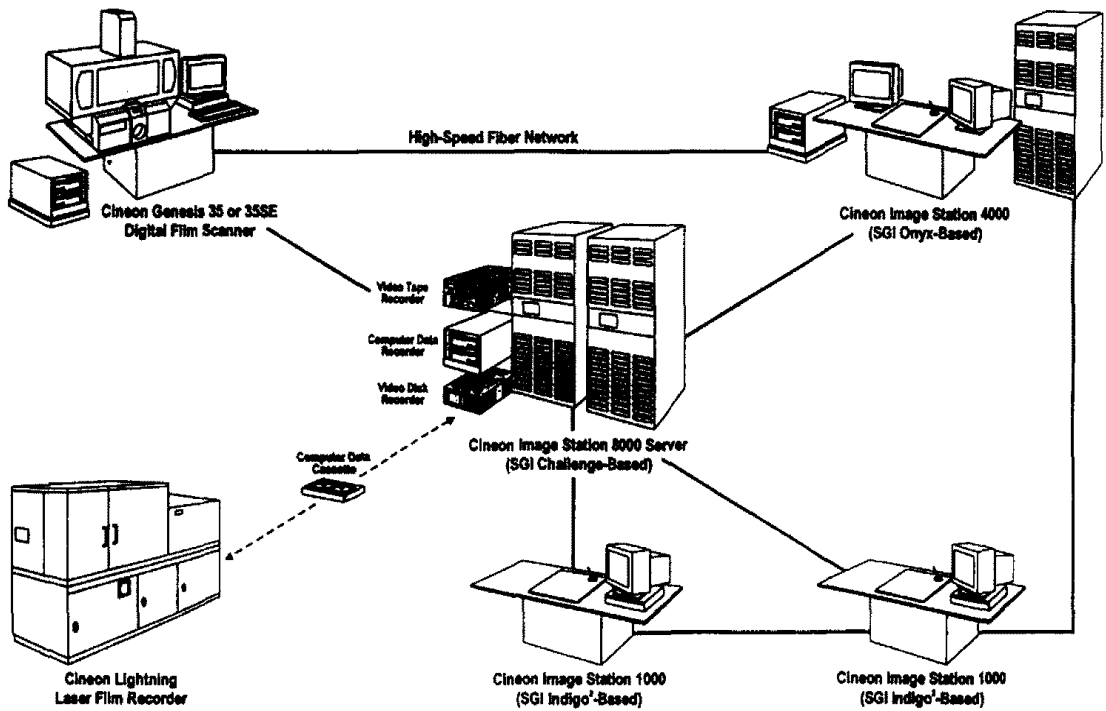


Fig.3: The structure of Kodaks' Cineon Digital Film System.



Fig.4: One scene of MASK.



Fig.5: A brochure of Toy Story.

Fig.6: A scence of Babe from Cinema magazine.