

A Study of Changes in Production by Domestic Broadcasters Using Virtual Studio

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Abstract — This paper is for investigation and analysis of how a visual studio is widely used by domestic broadcasting companies and broadcasting companies' production environment. The history of a visual studio goes back to start of computer graphic. A visual studio is a way to produce a program using graphic sets created by a computer rather than actual setting, and it allows to express beyond limitations of actual studio settings and various imagery visual effects can be created by a computer. A visual studio can create 3-dimensional graphic and these graphics can be inter-locked with actual camera images to make visual spaces for various programs. These flows are aiming to achieve very natural image which is hard to distinguish it is artificially created rather than just to produce programs with simple image synthesis, and this paper analyzes the producing changes of domestic broadcasting visual studios as well as its usage and suggests the idealist direction for developing the production.

Index Terms — Virtual Studio, Camera Tracking, Chroma Keyer

I. INTRODUCTION

Due to development of digital technologies, the society and individuals are required to create diverse cultures. In an effort to produce diverse contents, virtual studios have been introduced in broadcasting images. However, there were almost no theoretical or practical data related to high costs, arrangement of professionals and production processes and environment, so virtual studios haven't been provided rapidly. During the black and white times when TV broadcasting was first created, images taken by cameras were fused with other images[1].

As the TV began to show color films, images were fused so that two cameras could shoot same images by applying moves of a camera to another camera beyond simply fusing images. Up-to-date graphic technologies are used to produce a virtual studio. Each broadcasting company has tried to develop different equipment and

graphic technologies[2].

As a virtual studio is linked to a camera tracking sensor, it used the production environment of a real-time rendering machine and diverse studies have been attempted about types of each sensor, its operation principles and operation methods.

The Blue Studio production environment consisting of ways to establish a Blue Screen which is the basic environment and setting about lighting is a basic condition which a virtual studio should have[3]. Information which we obtain through our eyes are changing into super-space 3D images beyond time and space owing to its operation system[4],[5]. Considering that broadcasting and cinema have expressed illusions and real images, virtual studios are expected to be utilized in more diverse ways.

A virtual studio is better than a physical set in that it can keep virtual sets designed with computer graphic and can be taken out real time whenever they are necessary. Such virtual expression use data made with 3D graphic. In broadcasting programs, virtual set design should be used following broadcasting contents and the images can be different depending on purposes to use them. This study is aimed at suggesting directions for the future of a virtual studio and preparing a frame of understanding through analyzing domestic production environment and cases.

II. RELATED STUDIES

A virtual studio is where computer graphic technologies and broadcasting equipment meet. The setting of a virtual studio looks very complicated, but it consists of a few devices. Components of a virtual studio are a camera tracking system, Chroma studio, Chroma keyer and workstation. Only when these conditions are satisfied, the virtual studio can be operated to satisfy common conditions of each device,

A. Camera Tracking System

A camera tracking system is important to get movements of a camera[6]. Camera tracking techniques are to capture real location values and movements of a camera real time while shooting[7]. This system traces values meaning values of camera lenses, motion values like pan and tilt, camera angles including ROLL, X, Y and Z and spacious locations.

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TABLE 1
COMPARISON DEPENDING ON WAYS OF
CAMERA TRACKING

Division	Manual	Infrared Ray Type	Software Type
Mechanical Zoom, Focus Devices	Necessary	Necessary (Mechanic devices are necessary)	Unnecessary
Pan/Tilt Possible	Possible	Possible	Possible
Dolly/Track	Possible (Possible at Robotics)	Possible	Possible
Shooting Possible Angles	Unlimited	Unlimited	Decided by a patten and generally 150°
Hardware Set-Up	Complicated	Relatively Less Complicated	None
Hold and Shoot	Impossible	Possible	Possible
Price	Expensive	Expensive	Relatively Cheap
Degree of Precision	Most Excellent	Excellent	Relatively Excellent
Strong Points	This is being used most universally because it has an excellent degree of precision and it makes few mistakes.	This is good for getting dynamic motions because people can shoot holding it.	Right for simple movements and cheap
Weak Points	The system is somewhat complicated. Prices range from cheap to expensive and there are flexibly various products.	Regarding space restriction, this is restricted by the scope of an infrared ray camera.	Can be used for simple movements only

B. Chroma Studio

To do the Chroma Key work, a Chroma studio and a mat to do image fusion are necessary[8]. In general, shooting places which are mostly used for weather forecasts or vote counting become Chroma studios. A Chroma studio consists of Blue Box and lighting.



Fig. 1. Blue Screen

C. Chroma Keyer

Chroma Keyer is a core system of a virtual studio composing images with background images. The function of Chroma Keyer is usually loaded in ordinary switchers[9]. In addition, there are products with excellent performance,

but virtual studios prefer independent Chroma Keyer.

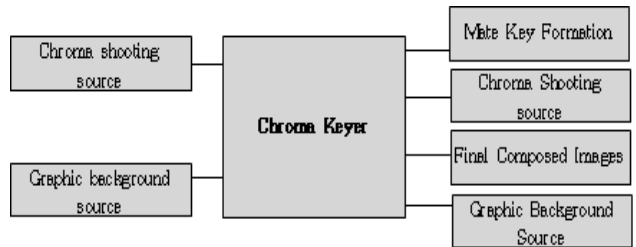


Fig. 2. Working processes at Chroma Keyer

D. Graphic Workstation

A virtual studio server is a system producing visuals (background set) at a virtual studio[10]. A graphic workstation is considered the most important element sending the real-time rendering value using values conveyed by a sensor to Chroma Keyer again.

III. PRODUCTION ENVIRONMENT OF DOMESTIC BROADCASTERS' VIRTUAL STUDIOS

A. KBS

KBS developed the “SMOCKEY (synchronized motion chroma-keyer)” system, a virtual studio which is a hardware processing type developed by its research institute using its technologies in 1995. After it, KBS also developed SMOCKEY II, a system whose performance was innovatively improved.

This system which consists of highly functional graphic computer and camera interface devices has simpler appearance and better functions and performance than the old version[11],[12]. After the SMOCKEY II system, KBS continuously conducted researches about a virtual studio using a graphic engine and developed a new product, Dream Set which could compete with an existing commercial virtual studio[7]. KBS currently is using Vizrt and Brainstorm software. As a virtual studio system which had been used for ballot counting began to be applied to History Special, the system was used for diverse programs[13].



Fig. 3. KBS Dream Set

1) Structure and Characteristics of Virtual Studios

KBS has three sets of virtual studios and one consists of TS-7 (Television Studio) which is a digital studio, News Studio and Annex Studio. TS-7 is as wide as about 60 pyeong ($10.7 \times 16 \times 5$: studio, $9.7 \times 7 \times 3.7$: blue box), the News Studio is about 30 pyeong and the Annex Studio is about 32 pyeong including a control center.

2) Information of Virtual Studio System and Present Conditions for Labor Force

(A) Virtual studio program (brainstorm / vizrt)

Estudio of Brainstorm which is software being used by KBS has excellent the user interface that users easily can set various parameters for producing programs. Viz-Virtual Studio of Vizrt is attracting interests from operators by providing the intuitive and easy user interface environment at the Unix operation system.

(B) Main computer (Onyx)

KBS virtual studios used Onyx1 but sharply improved performance by adding Onyx 2. Virtual studios of KBS additionally was equipped with digital video input cards which could be input shadow videos captured by shadow cameras[14]. Those studios put model information and images on the memory, not hard discs, to form real-time videos, process 3D models and images using hardware boards and print them out using option boards for image printing.

(C) Camera tracking system

The virtual studio camera tracking system of KBS is mostly using the RADAMEC RP2 system. The camera tracking system can be divided into a remote control part and pedestal part. The TS-7 installed a remote part and pedestal part.

(D) Chroma keyer (Ultimate-400, Ultimate-8, Ultimate-9)

All three virtual studios of KBS use Ultimate. Most of the nation's broadcasting companies produce programs using the Ultimate Chroma Keyer. The digital Chroma Keyer is used for combining the actual images filmed by cameras to the virtual graphic background created by the main computer in real time.

(E) Present conditions for labor force operation

Three virtual studios of KBS are being operated by a significantly large staff. The TS-7 has a total of 7-8, including a technical director for each of MAYA, 3D MAX and 2D, two animators. The News Studio has four or five, a technical director, a 2D designer and three 3D designers. The Annex Studio for traffic broadcasting has four, two operators for 3D and 2D graphic operation, a system manager and a technical director.

TABLE 2
COMPARISON DEPENDING ON WAYS OF
CAMERA TRACKING

Division	KBS Virtual Studio		
Division	Special Video Production Room (TS-7)	News Studio (Newsroom)	Annex Studio
Graphic Workstation	Onyx II IR3 x 2 2 GIVO, 2 DIVO	Onyx II (2) 1 GIVO, 1 DIVO	Onyx II IR3 x 1 2 GIVO, 2 DIVO
Virtual Software (S/W)	Vizrt, VR-STUDIO	Brainstorm	Vizrt, VR-STUDIO
Camera Tracking System	RADAMEC, RP2 (2) dolly possible shotoku- VR, crane(1) (TK-38LVR)	RADAMEC, RP2 (1) 435VR (1), RP 20,000 dolly possible	RADAMEC RP2 (1) 436 VR
Chroma Keyer	Ultimatte 8 (1) Ultimatte 9 (1)	Ultimatte 9 (2)	Ultimatte-9 (1) Ultimatte-400 (1)
EFP Camera	Ikegami HK-377 Ikegami HK-388PW	Ikegami HK-388PW	panasonic, AJ- D910WAP
PROMPTER	TOUCH-Q	TOUCH-Q	TOUCH-Q

3) Present Situations of Program Production

Programs produced at virtual studios of KBS include “Open the World of Children’s Songs”, “Weekend Notice”, “Classic Odyssey” and “Secrets of Birth, Old Age, Sickness and Death.” Following is basic set image files of “History Special[13].” and “Classic Odyssey[15].”

(A) History Special

This program uses two kinds of sets. One basic set is used for every episode regardless of the program theme. It is made to be suitable for the program concept and to effectively express historic maps, pictures, books and letters. The other set restores historic relics and includes towers, ancient structures, royal tombs or temples.

(B) Classic Odyssey

This program introduces classical music. Five virtual sets have been used and they were produced to make viewers feel comfortable because of characteristics of the program that it is aired at night and classical music is introduced during the program.



Fig. 4. Images of History Special, Classic Odyssey

B. MBC

MBC has the Magic Studio system. This system uses DVG (digital video graphic), including two pipe printing Onyx2 which MBC bought from Silicon Graphic in 1999 as on-air graphic equipment[16]. MBC provides various 3D programs with a sense of realism through diverse event programs regarding elections and wars, as well as regular programs, such as those for children and entertainment, by realizing design and broadcasting progress with its technologies.

1) Structure and Characteristics of MBC Magic Studio

MBC is operating three mobile cameras using X-pecto of Orad, a infrared tracking system, as a camera tracking system. The MBC Magic Studio which is as wide as about 30 pyeong (8 × 12 × 3.5) uses blue as its key color.

TABLE 3
ULTIMATTE VIDEO PAINT

Video levels when 89.9% white is at 100.	Red	Green	Blue
#05720 Rosco Ultimatte® Blue	22	40	82
#05722 Rosco Ultimatte® Super Blue	7	18	72
#05721 Rosco Ultimatte® Green	29	84	36

2) Information of Magic Studio System and Present Conditions for Labor Force

MBC uses three cameras. Up to 24 infrared cameras attached to walls of the studio trace targets stucked to studio cameras. These cameras are used for extracting and using information on 3D (X, Y and Z) locations of cameras, pans, tilts, roles, zoom and focus. MBC expresses virtual sets with clear pictures for broadcasting by loading Cyberset-O S/W. Main functions of graphic include to control objects to be before or after people and to materialize 3D charts and expression of Hangeul to display various data[17]. With Mapset, a mapping tool, textures which were rendered at 3D graphic packages and can be brought in and expressed in real time.

TABLE 4
INFORMATION ON MBC MAGIC STUDIO SYSTEM

Division	MBC Magic Studio		Producer
	Model	Use	
Graphic Worksttion	Onyx2 2Pipes 2 GVO, 4 DIVO	For virtual studios	SGI
Virtual Software	Cyberset-O (2) Cybergraphics (2)	Software for operating virtual studios	ORAD
SURI	SURL 2.0	Software for creating 3D charts and Hangeul	
Camera Tracking System	XYNC, X-pecto dolly possible 24 Surveillance Camera support	Capture value of camera movements in real time	ORAD

Camera	LDK-20P	Digital EFP camera	BTS
Digital Chroma Keyer	Ultimatte 8 (2) Ultimatte 9 (2)	Top quality for combining digital images	Ultimatte
Digital VMU	DVS-1000	Digital VMU for switching among multiple cameras	Snell & Wilcox
Routine Switcher	Integrator 32x32 Digital Routine	Effective management of digital signals	Leitch
CYBER STUDIO	Cyber Character S/W (Clovis)		Medialab
Special Effect	Shake	Image effect	Noting Real
3D Graphic Production	MAYA / 3D Max / XSI	Produce background and provide source	Autodesk

TABLE 5
RESENT CONDITIONS OF LABOR FORCE FOR MBC MAGIC STUDIO

MBC	Present Conditions of Management Labor Force	Management Staff
Magic Studio	1 technical director, 1 for system 1 for system development, 2 system operators and 2 designers	About 7~8 persons

3) Present Conditions for Program Production

Virtual studios of MBC has experienced three general elections and two presidential elections since 2000 in particular. In addition, MBC virtual studios can produce programs using the 3D-type chroma key technique getting out of 2D chroma key technique such as weather forecasts or relay seat screens of game programs. MBC Game made the first attempt in the history of broadcast by displaying games at virtual studios of its main building within the 3D space without spectators.

(A) MBC Weather Center, Election Broadcasts

The technique development team of MBC has developed election broadcast systems of MAGIC (MBC's Advanced Generator for Information & Communication MBC's state-of-the-art election broadcast system) series since the 1992 presidential election. MBC is thought to have made the best use of weather-related virtual studios in the nation's broadcasters.



Fig. 5. MBC 2006' Election Broadcasts, Weather Center

(B) MBC GAME

Like Avatar, a film which recently has been a big issue, the 2010 'Nate MSL final' first introduced a new concept of image relay in a way to proceed with a game in the virtual space in accordance of the times when IMAX or 3D images created a sensation.



Fig. 6. 2010' nate MSL final

C. SBS

In the process of developing "Cyber Studio" program, SBS provided various appearances to viewers through its accumulated technologies. SBS sent designers and programmers to the Israeli RT-SET and taught virtual technologies through local system education and focused on development of virtual sets after forming related team. In the 1997 presidential election, SBS prepared a 10m-high 250-pyeong studio for vote counting in CCMM Building. At the studio, about 50 officials, including an anchor, analyzers and persons in charge of collecting viewers' opinions, served the viewers so that they could see ballot counting at a glance[18].

1) Information on Virtual Studios of SBS

SBS used the Larus System for election broadcasts and increased stability and the speed of information conveyance forming dual Onyx which can energetically express advanced engineering graphic workstation, which is used for production of 3D graphic VIPON-5 that is used as ballot counting results and analysis data, and various 3D graphics.

TABLE 6
SBS INFORMATION OF VIRTUAL
STUDIO SYSTEM

Graphic Worksttion	Onyx2,1 GIVO, 1 DIVO,02
Tracking System	Hawkeye(Fixed), dolly Impossible
Crane	Sotoku(Use Radamec Tracking)
Virtual Software	Vizrt, Viz Content Pilot
Keyer	Ultimate7
Software	Making Object : 3D MAX, XSI, MAYA

2) Present Conditions for Program Production

Virtual studios of SBS are producing various programs, including 8 O'Clock News, weather reports, cultural programs, entertainment & sports. "Yasimmanman I Asked 10,000 People" (directed by Choi Yeong-in), in particular, showed "Paris Lovers Special," an exceptional studio talk summer feature which was attempted in the nation for the first time.



Fig. 7. SBS Weather & Healthy Living

IV. DEVELOPMENT DIRECTIONS AND SUGGESTION

Chapter III is about the environment of various virtual studio production and management of domestic broadcasting companies and a survey of programs representing those companies. Prior to producing programs using virtual studios, following four aspects should be considered.

A. Expressional Aspects

- 1) It is necessary to make a library of images, such as natural phenomena to make viewers feel a sense of reality.
- 2) Design should be made by combining creative ideas of the camera director, producer, technical staff and designers with features of virtual sets.
- 3) Diversity of images should be pursued to produce an atmosphere with a sense of reality using colors and tones of background sets.
- 4) Lighting and sets should be formed to display a sense of unity. Those sets should not make a sense of difference with real sets and should make a broad use of the width of expression.

B. Technical Aspects

- 1) A number of cameras should be applied to programs easily. All camera techniques used for existing sets should be applied.
- 2) A number of tracking systems should be made easily.
- 3) Techniques to process visual effects in real time should be developed. Only when real-time rendering processing techniques develop in composition of a large number of images, various virtual realities can be materialized.

- 4) Investment and researches should be made in order to develop virtual studio software for which the nation's broadcasting companies depend on foreign countries.

C. Cultural Aspects

- 1) In virtual space production, visual contents of programs should not have excessive illusions and distorted truth.
- 2) A virtual set designer should make colors and atmosphere suitable for the time of program airing.
- 3) Virtual reappearance should make truth-based expressional verification.

D. Economical Aspects

- 1) Accumulated data should be stored and backed up to be used for other programs.
- 2) Interface should be used for used data after arranging them by field so that they can be used any time they are necessary to reduce costs needed for production time.
- 3) As many as contents should be secured to replace expensive real sets with virtual sets.

E. Spatial Aspects

- 1) We need to analyze and categorize programs to overcome environmental obstacles of virtual sets.
- 2) We should review the analyzed programs to see if space is well exploited for the use of virtual sets.
- 3) Designers should have regard to camera's moving lines and subjects' movements when making the virtual sets.

Development of virtual studios is getting the spotlight as a state-of-the-art field to bring innovation to the program production mechanism. As shown by domestic cases of virtual studios, virtual studios have unlimited values of use for producing programs which can't be materialized with images, such as "History Special" or "Weather Reports." Virtual studio production processes should make image sets with producers using 2D or 3D graphics considering each aspect suggested above and should solve technical problems with engineers operating virtual sets.

It is the most important part in composition for set producers to make programs by making accurate communication[19] so that images of the foreground and background can match well each other.

V. CONCLUSIONS

This paper introduces systems and technical elements necessary for virtual studio production and representative programs which are being produced through domestic present conditions of virtual studios. Techniques of virtual studios are continuously development but the reality is that programs which we

are watching are being used in a limited way. Broadcasting companies currently make various set designs and props to prepare physical sets.

The environment for set production shows that physical time and workers needed for studio setting takes high costs. As virtual studio set production needs a small number of persons and uses computer software, restriction of direction space and time greatly reduces. In addition, direction of virtual studio programs can expected different visual effects from existing studio production because of creative sets. Small broadcasting studios spend high costs to secure the space for studios in reality.

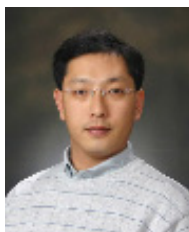
As they have no space to use physical sets, the environment of virtual studio production is desperately needed. Considering such circumstances, the necessity of virtual studios is closely connected with the practical production environment. Since broadcasting companies introduced virtual studios, they have made much efforts to overcome technical assistance or expressional limitation. They, however, haven't made great achievement in terms of utilization of virtual studios.

As far as the production environment of virtual studios which we know is concerned, we can see that we should conduct researches to analyze those studios more minutely to utilize them. If we use advantages of virtual studios, we will be able to make a new access to utilization of creative programs. In this paper, I suggested directions for development of virtual studios through expressional, technical, cultural and economical aspects in virtual studio production processes. Image production experts should try to have a keen interest in virtual studios and researches should be conducted about a new attempt of virtual sets. By producing programs through these aspects, production environments can be diversified and systematic systems will be newly established. Additionally, the outlook of the nation's virtual studios is expected to be brighter.

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