# A STUDY OF A METHOD FOR IMMERSIVE PROJECTION DISPLAY USING ONE PC AND CREATING ANIMATION

*SUMA Noji    TAKASHI Saito    AKIRA Nagata*

Department of Art and Information
Shobi University

655, Shimomatsubara, Kawagoe, japan
E-mail: s-noji@shobi-u.ac.jp

## ABSTRACT

This paper proposes a simple method for realizing a multi-screen immersive display using one PC with dual graphic cards and workflow on which CG creators can create animation movie. This method realizes a multi-screen immersive display without any special hard ware and engineering technology. We implement the non-interactive, non-stereo projection system which projects the integrated movie consisting of front, right, left, and bottom screen. The camera setting technique for each image sequences using multipurpose CG application "maya" is also realized. So creators can easily create animation on this multi-screen immersive display. In this paper, we also discuss the creation of effective animation movies.

**Keywords**: immersive multi-screen display, wide view, computer graphics, animation movie

## 1. INTRODUCTION

In recent years, an animation projection onto the multi-screen display has been accepted. This can offer users visual immersive sense by surrounding them with wide-view display. The multi-screen display such as CAVE developed by Irinoi university, which consists of six square screens surrounding the audience, is very popular.[1] The dome screen type can covers completely audience view. On the other hands CAVE has the advantage of the dome screen type in realization cost. Therefore the CAVE display system has been popular in multi media world today. The various projection technology and contents creation method have been implemented for this system . This is because the CAVE display system can gives to the audience not only the accuracy of the information, but also free, discharged, elevated, sublime, peaceful or delightful, happy emotions.Applying multi‐screen display technology to project the artistic or entertainment content will be very useful for that emotional effects. But most of contents for the CAVE displays have been created for the visualization of the industrial products architecture or check of the quality of industrial products.

The artistic and entertainment contents have not ever been developed enough. This is because for general CG creators creating the animation that requires the special engineering technology and devices such as necessarily for CAVE contents is very difficult. The immersive projection display screens (IPT) are particularly effective owing to their wide angle view and its square figure. The creators must be free from the specialized engineering technology such as frame synchronization and adjusting the images onto screens for seamless animation movies. And also the creators must be free from the trouble in complicated camera parameter setting for proper view angle. In order to realize these tasks , we developed a simple multi-screen projection environment called TERARIUM. In this system images are projected onto four square screens, that consist of ront, right, left, and bottom screens, from four projectors set for each screen . In this environment each animation movie, which is projected onto one screen, is reviewed on just one PC. TERARIUM dose not require any large workstation or PC-cluster and special equipments. Four animation movies that are projected onto each screens are merged into one movie file to show seamless image on TERARIUM. We also developed a efficient method to create animation by almost the same way as in creating an animation for a single screen display. In this method, TERARIUM contents creator can use multipurpose CG application "maya" which is popular in the contents creator for single screen. For this purpose, we developed two creation methods. One is the method that four virtual cameras are set and each camera generates their fov rotate angle, focus, parameters inside of maya interface. Other is the method that each rendered image is mixed into a integrated movie file. By use of these two methods a creating animation workflow are reduced and Multi‐screen projection display is realized

## 2. PREVIOUS WORK

### 2.1 Immersive multi-screen display environment

Usually stereo-view system and the interactive interface devices are used for in the typical CAVE configuration platform like as CABIN[1] or COSMOS[2]. It was well known that the 3D image and interaction could enhance the reality of virtual scenes. But that environment requires high specification computer, specialized equipments and engineering technology. So the animation creation and

movie projection have very complicated problems and high realization cost, as mentioned in section 1. Therefore general CG creators could not have enough chance to create animation for these systems. To solve these problems, TERARIUM was constructed as single-view, non-interactive system. We set our goal that the emotional animation movie is produced easily under the condition of non 3D, non interactive multi-screen display projection
We focused our attention on the emotional sence that is caused by the extremely wide view screen . The reference[3] shows that even if the distance between actual screen and audience view point and screen size are proper, wide-view enable to satisfy the immersive visual senses and influence the emotional stimulus. In the previous work, large-scale immersive multi-screen display projection system have constructed of high performance GWS, super computer or PC-cluster system[4][5]. These equipments have improved the processing speed of simulation and real-time presentation. Instead of this advantage, large-scale environment requires high realization cost and requires special technology as the frame synchronization and adjusting images to multi-screens(to control the mechanical devices). Recently a personal computer(PC) have progressed in its performance and graphical function. So in projection system proposed in this paper only one PC are used to project the animation onto the four screens to simplify the device control. And we implement an environment to present animation easily.

## 2.2 Image adjustment and animation creation

The image adjustment mechanisms are required for multi-screen seamless projection display of animation contents. The screen joint must not prevent to project the seamless images onto screens. Koike implemented the real-time image adjustment mechanism by using multi-pass rendering , multi-texturein,  and programmable shaders[7] without any special hardware. Applying this method to PC cluster systemis effective to reduce the workflow for  creating contents. In spite of  this merit, this method can not be applied to our single PC system. The image adjustment technique can not be applied easily to the single PC multi-screen projection platform without any special hardware or algorithms. To overcome this problem we simplified image adjustment mechanism in order to merge four each display image sequences into one oblong movie file as shown in fig 3. We also implemented a method for the image adjusting rendering on the general purpose CG application maya. This implemented program enable seamless rendering for square view area. The animation movie is viewed by QuickTime viewer.

### 3. TERARIUM   HARDWARE

TERARIUM realized the low cost projection system and economy space as below. The images are projected from four projectors onto 2m x 2m screens which are set on front

Tab.1    Hardware specification

| Windows PC | Hp xw4400 |
|---|---|
| CPU | Intel R)Core$^{TM}$ Duo2.4GHz |
| Memory , HD | 4Gb, 500Gb $\times$ 2 |
| Graphics Card | NVIDIA Quadro FX1500 |
| Graphics Expansion Module | Matrox TripleHead2Go |
| Projector $\times$ 4 | NEC   LT280 1024x768 |
| Screen  2m $\times$2m | Front, R, L, Bottom |

right, left and bottom of the system. Four reflection mirrors are set behind three screens and top of the frame.   Except for bottom screen, image is projected behind screens as fig.1 . The projector resolution is 1024pix$\times$786pix VGA, and screen display area take place786pix square. To project the images to four each screens, Graphics expansion module TripleHead is connected into a DVI terminal of one of the dual graphic card on PC. That adapter enhances the display resolution maximum 3076pix$\times$768pix and divide ... y. Fig 2 shows the ... the hardware spec.
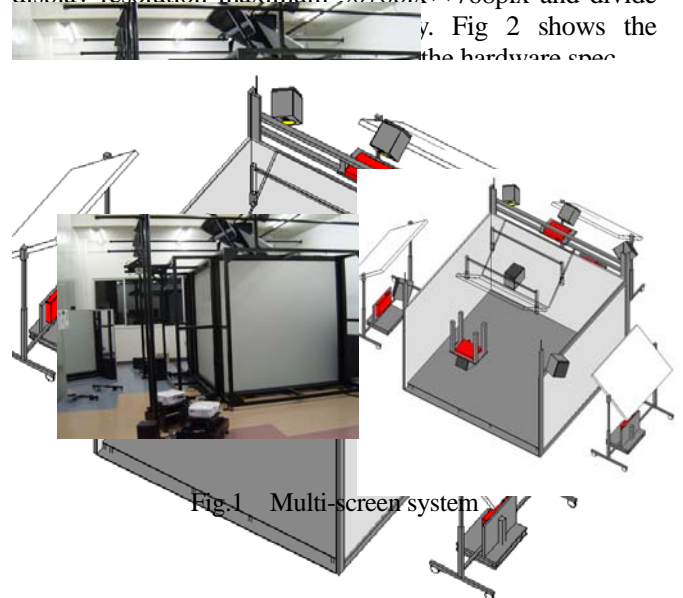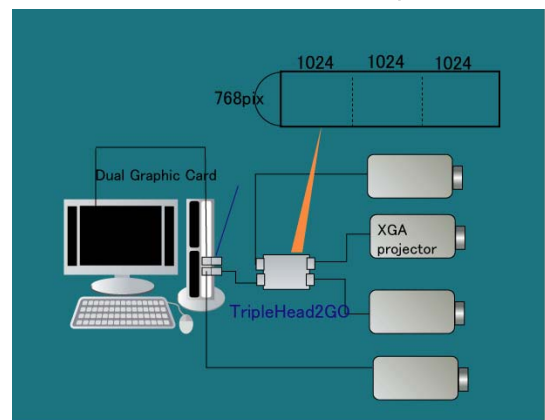


Fig.1    Multi-screen system



Fig. 2    Projection system

# 4. ANIMATION CREATION PROGRAM

Two application programs, MakeCam and SequenceRankaer, have been developed to support animation creating, so that seamless sequencial images in multi-purpose CG application maya have been obtained. Fig.3 shows the proposed workflow. At first, user sets the scene data in maya same as in usual operation. Next, by use of MakeCam four cameras, which target front, left, right and bottom screen respectively, are generated virtually, and their motion parameters such as view angle, rotation angle, position and focus are set in maya script. MakeCame also generates rendering batch file which renders animation sequences for front, left, right, and bottom screen.
Rendered animation is saved as the 768pix $\times$ 768pix image sequences. At last, by use of Sequence Ranker four image sequences are merged into one oblong movie file. Completed movie file is also reviewed by general viewer.
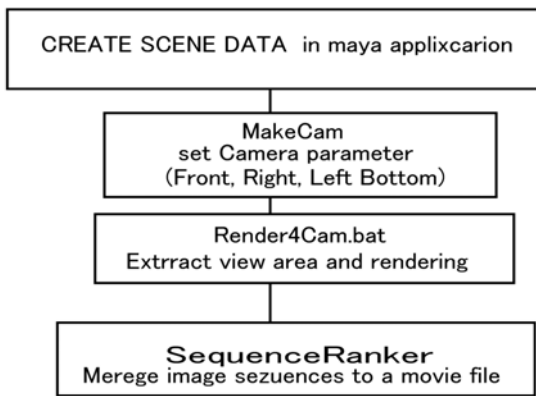
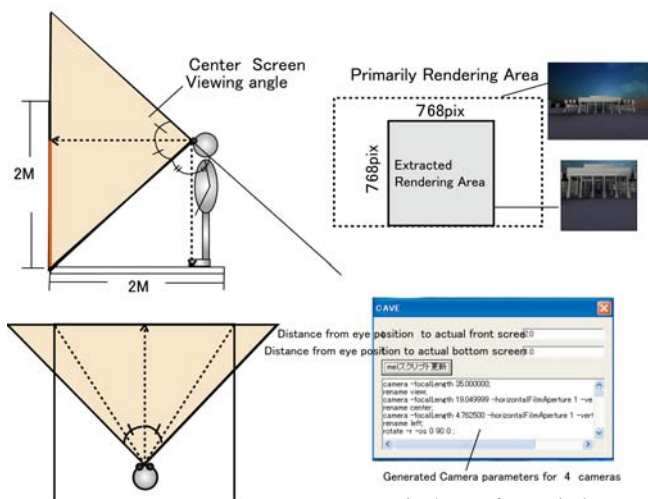
Fig. 3 Proposed Work Flow



Fig. 5 Camera view angle and its rendering


Fig.4 Interface window of MakeCam

① MakeCam
, Fig. 4 shows the interface window of MakeCam. The user sets the distance from audience eye point to actual

front screen, distance from eye point to actual bottom screen and projector resolution. Then MakeCame generates virtual four cameras targetting front, left, right,
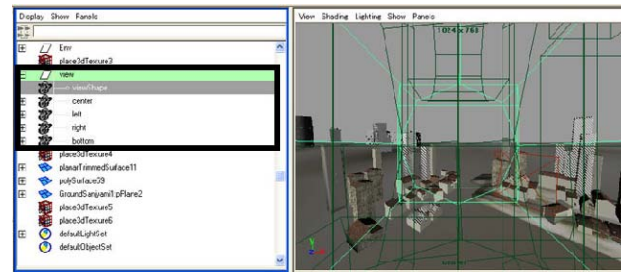

Fig. 6 Modeling window of maya

bottom screen, and sets camera parameters such as view angle, rotate angle, position and focus in maya script data. This script is executed as maya pre-rendering command. Fig. 5 shows a view angle along each screen direction generated by MakeCam. The exact view area is illustrated as the square figure in rendering area. This application calculates extract rendering area which is projected onto each square screen. MakeCam also generates batch rendering file in same time. And extraction of the rendering area is executed by use of maya rendering function. Fig.6 shows the hierarchical four camera nodes in maya scene data ( left side) and look through the front camera view of maya modeling window(right side).
Creator can create camera work animation only by choosing the root node of camera hierarchy, indicated "view" in fig.6 , and setting it in key-flame. Right relative rotation angler can be automatically set for each camera on all flame of the scene . So that the creator can perform animation creation as usual process without any consideration for special screen configuration.


Fig.7 Integrated images


Fig.8 SequenceRanker Interface

② SequenceRanker
This application program merges rendered animation image sequences of front, left, right and bottom into oblong integrated one image file as fig. 7. Fig.8 shows its

user-interface window. The user chooses four image sequences along screen display order and animation file format as movie file or image sequences. SequenceRanker processes he images into oblong animation file and adjust it onto TERARIUM screen. This application enables to apply any other image file such as photoshop data or live movie and photo pictures.
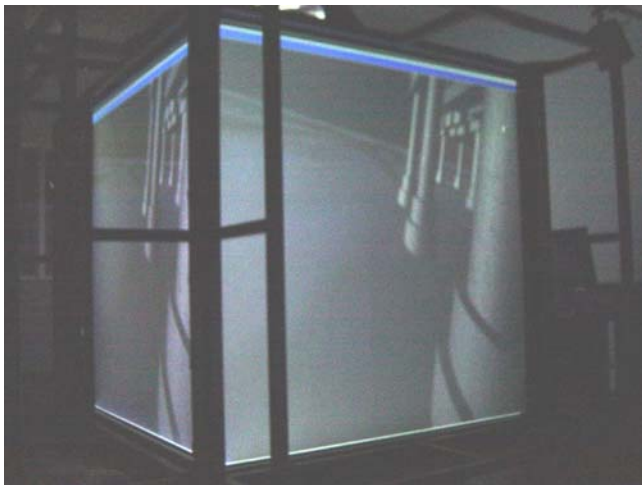


Fig.9 Experimental animation inside Screen



Fig,10 Experimental animation outside Screen

## 5. CONCLUSION

We implemented multi-screen immersive display environment using one PC and simple workflow on which CG creators can create animation movie without any special hard ware and engineering technology. Our proposed method do not require frame-synchronize mechanism or algorithm. And the user does not need give any care with the image adjustment. To support animation creation we developed two applications that set camera parameters and merge image sequences. Fig. 10, 11 show the result from experimental short animation by proposed method. It takes 1'30" long, 50% compressed , 24fps, jpeg format and viewed by QuickTime. Our method enable to create CG animation as usual process using multi-purpose CG application maya. And we simplified the immersive multi-screen projection display structure, reduced hardware cost and engineering resources. Proposed method will contribute to supply artistic and entertainment animation contents which have not been supplied enough for immersive multi-screen projection display. In near future we are going to try to develop original movie viewer instead of QuickTime in order to accomplish stable viewing and high progress speed, so more high resolution and more high quality animation movies will be obtained. We are also going to develop the new animation contents which uses the emotional sense such as free , heel , or elevate. In order to affect these emotion sense, we will analyze human space recognition and psychology based-on KANSEI engineering.

## 6. REFERENCES

[1]Michitaka Hirose、Tetsuro Ogi, ie."Development of immersive multi-screen display CABIN", The Virtual Reality Society of Japan ,Proceeding , No.2, pp137-140,1997

[2]Tetsuro Ogi,"Characteristics of Immersive Projection Displays andtheir Application", The Virtual Reality Society of Japan ,Proceeding ,vol.3,No.4, pp.531-538,1999

[3]Toshio Yamada,Michitaka Hirose, Yoshihiro Iida, "Development of Complete Immersive Display: COSMOS", International Society on Virtual Systemsand MultiMedia, vol.two, pp.522-527, Nov.,1998

[4]NARITA Nagato, KANAZAWA Masaru, Influence of screen size and viewing distance on the psychological parameters of wide visual field images, Tecjmocal report of IEICE.ICD vol99,No.399,pp.29-36,1999

[5]Tomoaki Morozumi, Shoichi Sato, Makoto Sato : "Projection of Wide FOV Image to a Multi Screen Display, Vol.101,No.700,pp.13-18,2001.

[6]Naoki Hashimoto, Takenobu Usuo, Masayuki Nakajima "Toolkit ", IEIEC, Vol.101,No.354,pp5-8,2002.

[7] Takafumi Koike, Kei Utsugi, and Michio Oikawa, "VR Content Platform for Multi-Projection Displays with Realtime Image Adjustment," ICAT2005, Dec. 2005