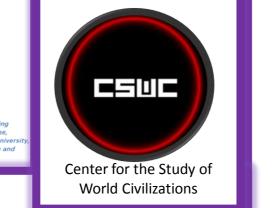# A New "Multiplex Content" Displaying System Compatible with Current 3D Projection Technology

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Multiplex images to the naked eyes

Multiplex images to the glasses and naked eyes

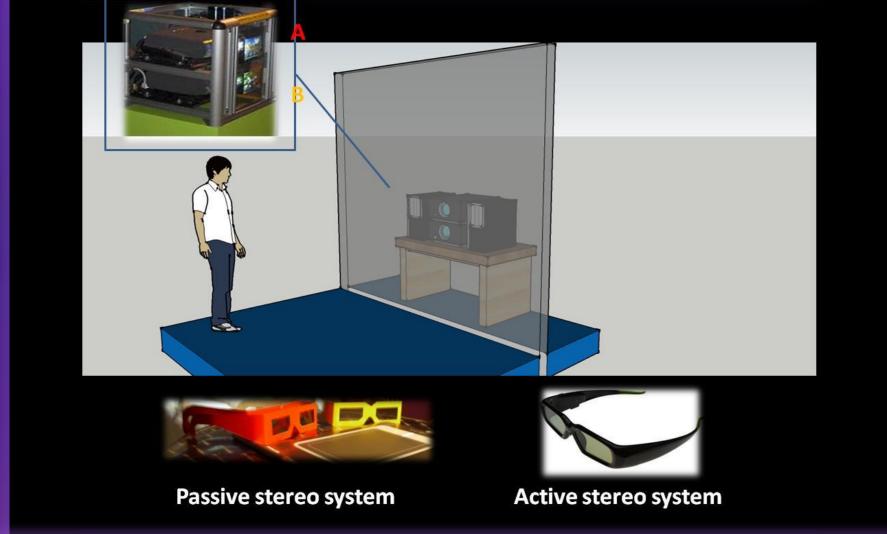Daddy watch TV and kids can play a video game...

We have enabled the superimposition of multiplexed images on the same screen at the same time with tangible and stable equipment. Our multiplex images can be seen by wearing special configured polarized glasses, and the system realized the hiding of a pair of multiplex images: one is invisible to the naked eye, but visible through the glasses and vise versa by processing RGB luminance between the pair.
Also, the image projection method is designed to be based on current 3D stereoscopic technology, which is now prevalent and making rapid progress, thus high compatibility with current contents industries is retained. Therefore our system enables the wide range of applications with new expressions and can easily be put into production.

1 .Motivation: Giving expansive variations for current 3D viewing technology

We suggests a new method for contents creation and broadens horizons of current 3D technologies. Presently, the contents of 3D digital cinemas are rapidly improving as many more theaters start installing 3D digital projectors. These stereo graphics, that are realized with active or passive glasses, enhance the expression of digital content and help prevent illegal copies of cinemas. Consequently, we utilize the infrastructures of 3D graphic projection as a means of contents productions and suggest new contents, "multiplexed contents".
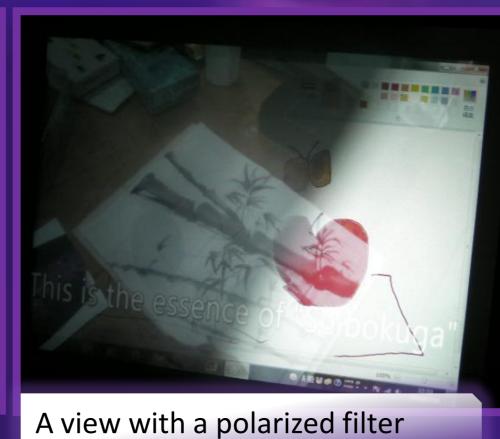
2 .Technology: retained compatibility with current 3D stereo display system

We have realized the multiplex with no special modification to current major stereoscopic projection methods in order to expand new expressions of contents with the compatibility and sustainable growth. In the passive stereo system, we have configured two different image channels by using polarized DMD projectors (Christie DS+300W / ProjectionDesign F22SX+), instead of stereoscopic images of L and R, and two pairs of special configured glasses polarized differently between the pairs, but identical between the right and left eye. The synchronized source channels have been generated by network distributed contents players. Especially in the active stereo system, the glasses are electrically-activated time-division. The system is more complicated but it can realize more channels than that of passive by assigning channels to each viewer.

Passive stereo system   Active stereo system
Systems overview: compatible with current 3D stereo systems.

An image to the naked eyes
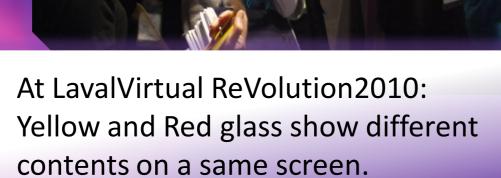

A view with a polarized filter

3 .Evaluation

As the passive stereo prototype that is connected with two PCs by our contents player program, we screened two different contents, "The Naked Maja" with Japanese subtitles and "The Clothed Maja" with French subtitles, and prepared two types of glasses so that visitors can enjoy the double contents by changing the glasses. We could confirm that people from wide range of races and cultures can enjoy the different contents without explanation just by selecting the glasses at Laval Virtual ReVolution 2010.
Other than the evaluation in Laval Virtual 2010, we conducted a questionnaire as the system demonstration in Kanagawa Prefectual Youth Center. We got 26 valid questionnaire results and the investigation shows 20/26 of the attendees want the multiplex contents displaying system in the domestic. Also here are the valuable comments we got:"Family members can watch different channels while sharing the time and space.";
"Children play video games when parents watch the news."; "I was impressed because what a interesting thing is possible despite the just simple equipments."

At LavalVirtual ReVolution2010: Yellow and Red glass show different contents on a same screen.

Public demonstration in Japan: Video game and presentation.
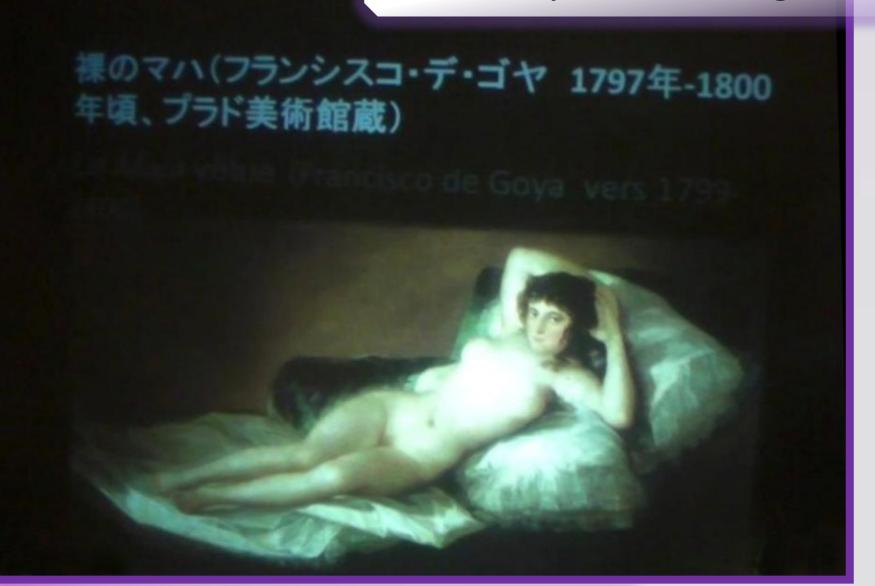
4 .Applications: Tangible Contents Selectors

Already realized applications are as follows:
(1)multi subtitles in cinema; (2)multi cultural commentary for arts in multi subtitles; (3)multi player drawing application. In connection with (2) we enabled not only multi subtitles but also the channels change depending upon user 's age and comprehensive ability. Moreover, we created the magnifier shaped glasses and realized the seamless change of channels. As the specialized feature of this system, we can recognize the value in the idea that users can easily choose information by the glasses, not but by the system.
Also other possible applications resonated with people are as follows:
(4)multiplex of both video game and visual contents on a domestic screen ; (5)sharing messages with video from SNS like Twitter on public screen ; (6)information display on digital signage depending on types of glasses filter and one 's attributes ; (7)educational contents for electronic blackboard and graphic materials particularly suitable for language study ; (8)entertainment contents as video games ; (9)hidden subtitles displaying for the person with hearing difficulties (only visible with the glasses); (10)support systems for the people with hearing difficulties ; (11)display for the medical purposes like CT and MRI ; (12)security usage(embedding of digital watermark and private information).
We hope our system will be applied for content platforms like video games and 3D projectors standards and it will enrich new expressions of digital contents.

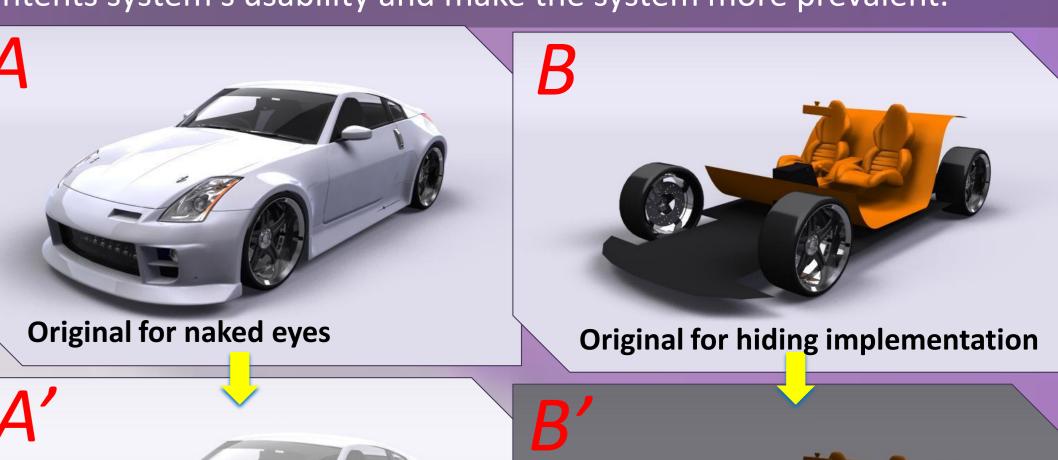A view by the "red" glasses

A view by the "yellow" glasses

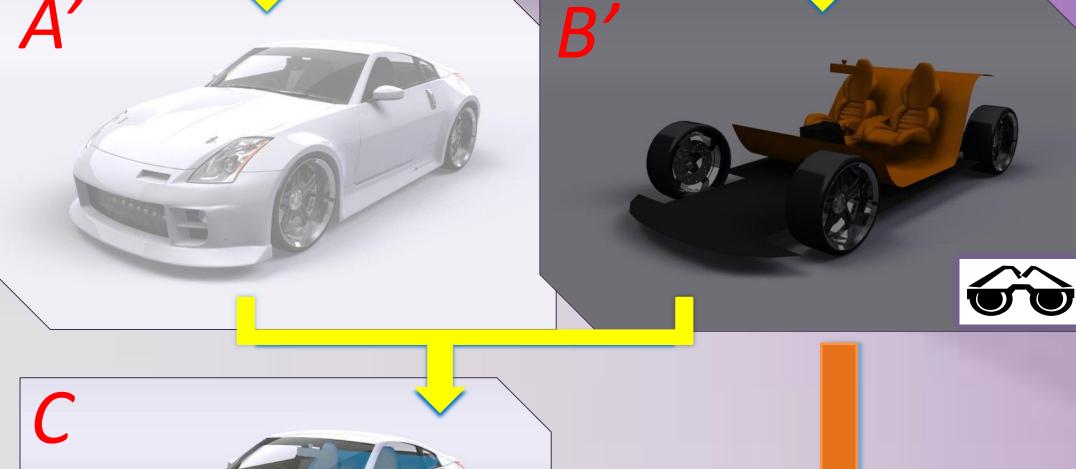## 5 .Additional technology: The image hiding algorithm and result

To realize multiplex contents displaying with minimum stress on users, we generated a hidden image, which is invisible to the naked eye, but visible to the only users who wear the glasses, and enabled the contents change corresponding to take on and off the glasses.
With two arbitrary different images A and B, we process each pixel's RGB parameter in the pair so that the image B can be lower than the image A(A'>B'), and generate the hidden image C with our RGB calculation program: image B' is visible only through the glasses. The image A' only visible to the naked eye is obtained by the superimposition of the image B' and C. The hiding image C calculation program is executed on the equation below;
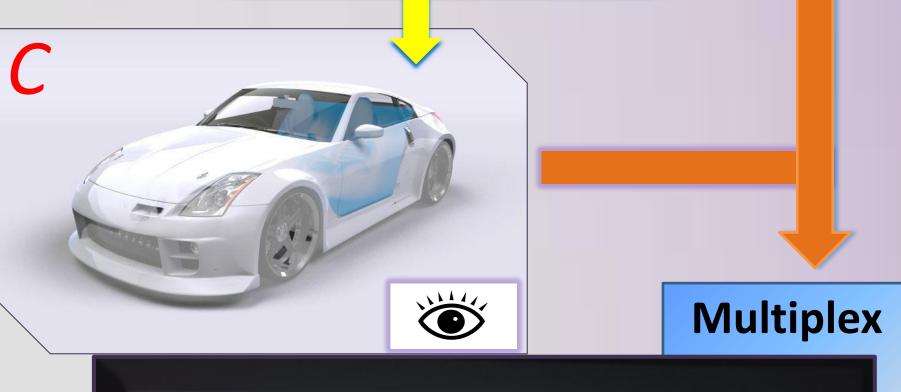
$$C = 255 \times \frac{A'-B'}{256-B'} \quad (128<A'<255 , 0<B'<128)$$

This image hiding algorithm is expected to improve the multiplex contents system's usability and make the system more prevalent.

A Original for naked eyes
B Original for hiding implementation
A'
B'
C
Multiplex Projection

Hiding algorithm

References
SHIRAI, A., ET AL. [information display]. Japan patent application, filed No. 2010-088213 (6th April 2010), (IPC:G06F 21/20).
TAKEO HAMADA, KOKI NAGANO, Takeru UTSUGI, Akihiko SHIRAI, Scritter: A multiplexed image system for a public screen. Proceedings of Virtual Reality International Conference (VRIC) Laval Virtual ReVolution 2010 (April 2010), pp. 321–323.