REAL D 3D Theatrical System

A Technical Overview

The REAL D 3D theatrical system delivers a high quality 3D movie experience to the viewer. The system is designed to operate on existing digital cinema systems, that include a 3D enabled server and a DLP Cinema™ projector.

The system is classified as a single projector, passive glasses, and circularly polarized. The basic system elements are:
- 3D enabled server and DLP Cinema™ projector
- REAL D Z screen and controller
- Silver screen
- Passive circular eyewear

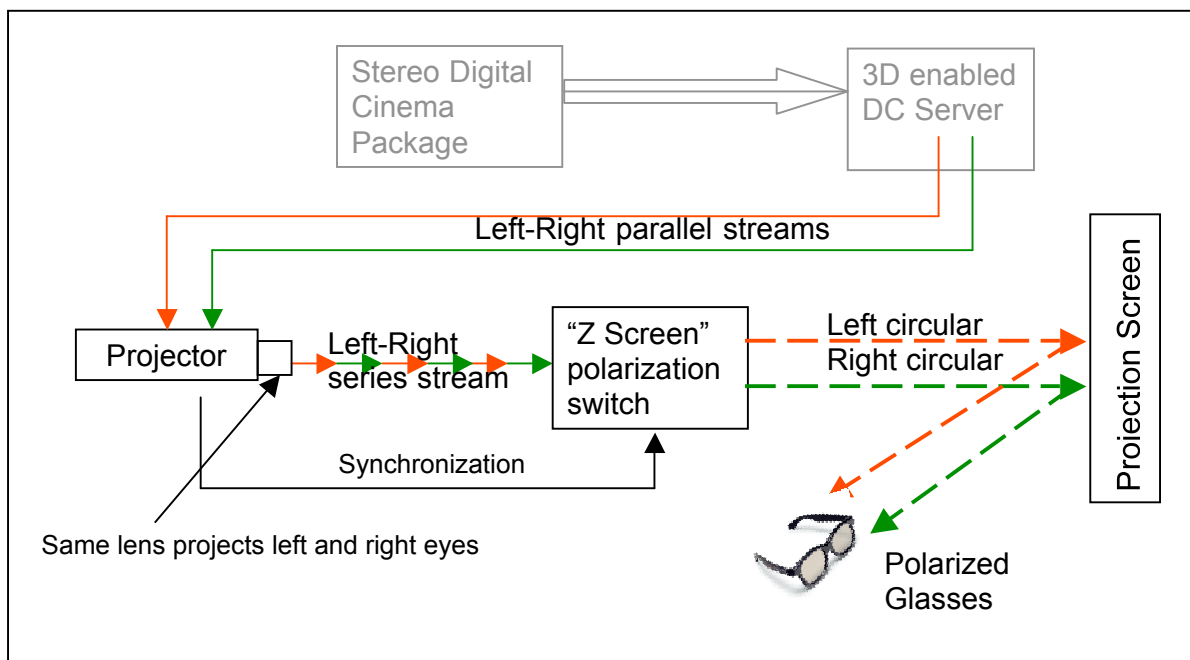The system architecture is outlined in the diagram below.

Figure 1: Block diagram of REAL D 3D system

The 3D enabled server accepts stereo movie content from the stereo digital cinema package. It is decoded and sent to the projector as separate 24 fps left and right streams, over the A and B HDSDI links on the input of the projector. The projector buffers the left and right image and projects them in alternation, at a rate of 144 frames per second, presenting three "flashes" of each frame.

Figure 2: Picture of REAL D Z screen in front of digital cinema projector.

The image is projected through a Z screen (see picture below). The Z screen is a liquid crystal based polarization switch that is synchronized with the projector, and alternates the projected polarization of the image for each eye. It switches at 144 fps, synchronized with the DLP Cinema projector.

The Z screen creates circular polarization. This has the advantage of allowing the viewer to tilt his head without introducing ghosting.

The image is projected onto a silver screen. Silver is required to maintain the polarization of the projected image. The silver screen has a gain of 2.4, referring to the fact that it preferentially reflects the light towards the audience, providing a brighter image than would be available from a matte white screen.

Figure 3: REAL D glasses in action
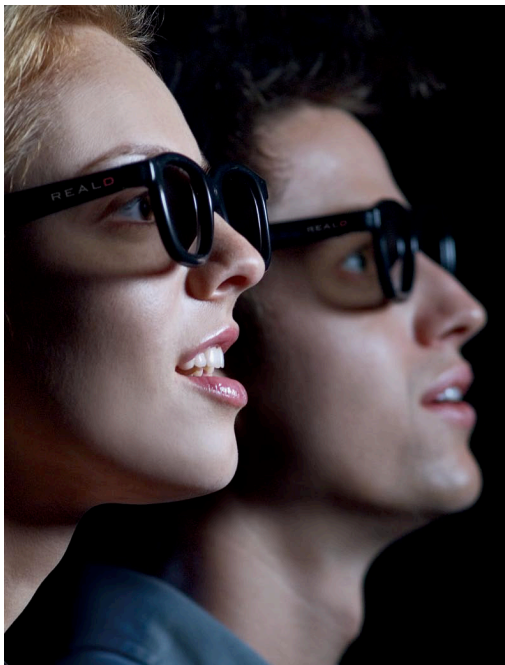
The viewer wears passive circular polarized glasses. These glasses have circular polarizing films that have been designed to exactly match the output of the Z screen, for best performance in colour, transmission, and ghosting. The glasses are designed to be comfortable to wear, even over regular glasses, and are inexpensive. They are intended for single use, ensuring that the viewer gets a pristine pair every time. When the movie is finished, the glasses may be taken home as a souvenir, or to reuse at the next 3D movie. If the viewer doesn't take them home, they may be recycled or refurbished, to minimize the environmental impact.

The Details

System Efficiency.

All single projector 3D systems suffer from significant light loss. From a theoretical point of view, single projector systems lose 50% of their light through "duty cycle" operation where the light is split between the left and the right eyes. The light is diminished by polarization, by an additional 50%, leaving a theoretical 25% available for each eye. The theoretical efficiencies are reduced by the practical issues of transmission efficiencies and allowing for switching time of the Z screen. The silver screen with a gain of between 2.2 and 2.4 helps because it makes the image brighter.

At the end of the chain, the viewer sees about 35% of the light that would be seen in a 2D system projecting on a matte white screen.
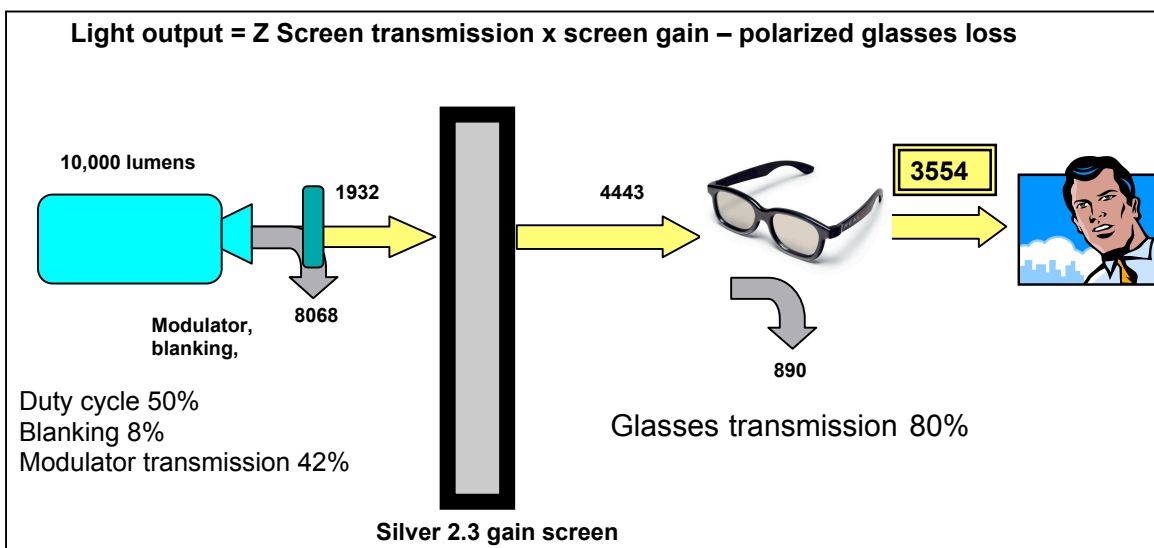

Light output = Z Screen transmission x screen gain – polarized glasses loss

10,000 lumens

1932

4443

3554

8068

Modulator, blanking,

890

Duty cycle 50%
Blanking 8%
Modulator transmission 42%

Glasses transmission 80%

Silver 2.3 gain screen

Figure 4: The viewer sees approximately 35% of the projected light through the system.

Eyewear Management

REAL D's single use eyewear has a significant benefit to the theatre operator and the theatre patron. The theatre does not need to provide manpower to collect, clean, and inspect glasses before giving them to another customer. The single use eyewear is pristine when taken out of the package.

Environmental issues are a concern. REAL D is implementing a system to collect and refurbish eyewear at a central facility which will clean, inspect, and repackage the eyewear for re-use. Any eyewear that isn't suitable for refurbishment will be sent for plastic recycling.

Silver Screens

Silver screens are necessary to maintain polarization of the projected image. Significant research has been done on silver screens and the latest generation of silver screens offers better light distribution and better uniformity than possible in the past.

Silver screens provide significant benefits because of their gain. For 3D presentations, they provide a brighter image than would be possible on a matte screen, which makes it possible to illuminate larger screens and project a brighter image for the customer.
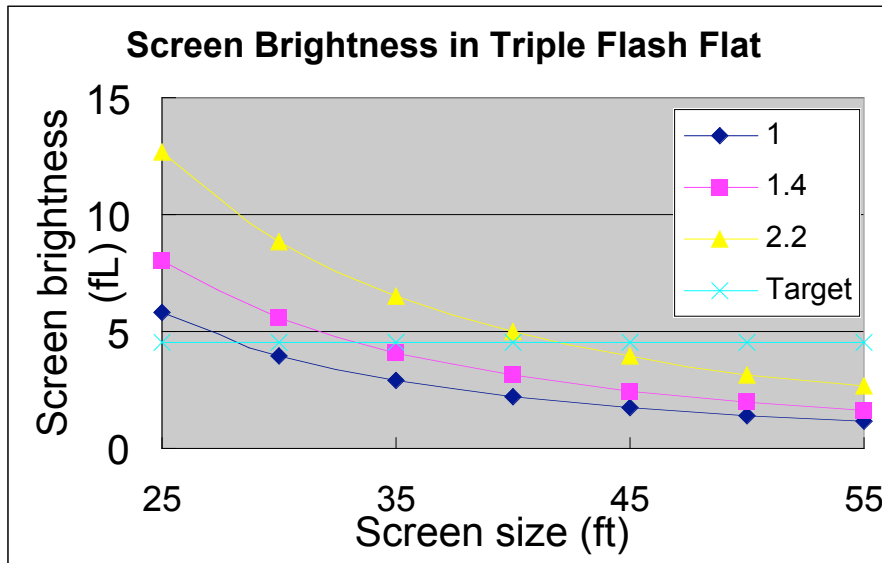

Fig. 4: Plot of screen brightness vs screen size for different screens. from a 20,000 lumen projector, showing the need for high gain screens to illuminate larger screens sizes.

For 2D presentations, the silver screen requires less light to make the same image brightness. In a typical 13 meter screen, this results in annual savings or more than $1300 annually in lamp and electricity costs and the reduced electricity use results in reduction of 3 tonnes of CO_2 production annually.

Ghosting

Ghosting is the leakage of one eye's image into the other eye. Every system has inherent ghosting, and the best 3D images will result from minimizing ghosting. The REAL D system minimizes ghosting by a method of pre-compensation (aka "ghost busting") that analyzes the left and right images and predicts the level of ghosting that will occur in the projected image. The pre-compensation provides an image to the eye that is virtually ghost free.

Color Fidelity
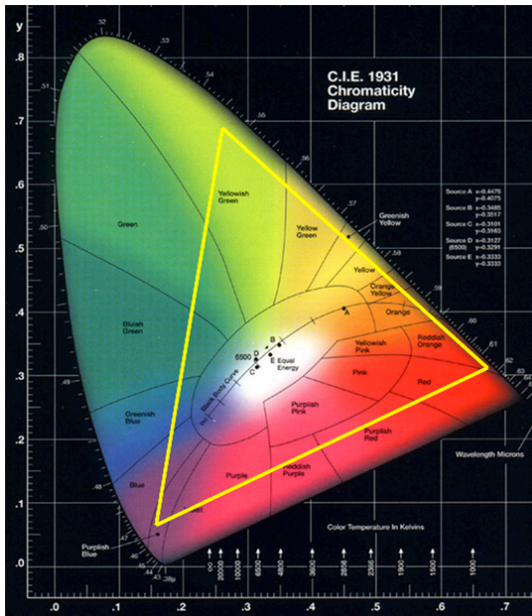
Preservation of correct color is important to 3d systems. The REAL D system is virtually colour neutral and the system will produce the same colour gamut as the DLP projector. The color and spectral characteristics are identival for each eye, assuring comfortable viewing. There is no need to apply additional color management to ensure exact DCI compliant color.

Having exactly the same colour presented to each eye provides a benefit for some color blind viewers, who will have difficulty with images that do not provide the same color spectrum to each eye.

Figure 5: REAL D supports the full DCI colour gamut

System Reliability

REAL D has more than 1000 systems installed worldwide and has accumulated over 700,000 hours of operating time on in the past 2 years. There have been no lost shows as a result of failure of the REAL D Z screen system.

Triple Flash for better motion

The REAL D system uses triple flash to provide the best motion rendition possible. Use of triple flash puts the refresh rate above the normal flicker fusion threshold for humans, providing smoother motion. The triple flash approach also makes the left and right eye images to appear closer in time, giving significantly less motion induced parallax errors and therefore more comfortable motion rendition.

Single Projector Architecture for a better experience

A single projector for projecting 3D has the obvious benefit of not requiring the purchase of a second projector to project a 3d image. Not so obvious is the attribute of "image symmetry". If the left and right eye images don't exactly overlay or don't have the same color or luminance distribution across the screen, the viewer will experience eye strain, headaches, and potentially a bad experience. With the REAL D system, the left and right

images are exactly registered because they are projected from the same imager through the same lens. This ensures that the color and luminance distribution attributes are identical.

Installation and Maintenance

The REAL D system is simple to install on a DLP Cinema projector. A typical installation time, including color calibration is between 1 and 2 hours. The system is reliable, and maintenance is limited to periodic cleaning of the glass surfaces of the Z screen.

For more information

www.reald.com

www.reald-corporate.com/resources_download.asp

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