Stereoscopic Presentations –
Taking the Difficulty out of 3D

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Abstract

A wide range of technology is now available for the projection of high-quality stereoscopic presentations. This paper reviews the software tools that are currently available for the generation of presentations containing stereoscopic images and the hardware that is available for the projection of those presentations. This paper also discusses the need for more tools to take the difficulty out of preparing and projecting stereoscopic presentations.

Introduction

Modern conference presentations commonly use electronic projection of a computer-generated slide-show and possibly the projection of (NTSC or PAL) video from video tape. A computer-generated slide-show can integrate simple text and graphics, still images and digital video files into a single presentation. All of these items can be presented in stereoscopic 3D. But we need to ask the question: why is it, with so many people working in stereoscopic imaging, that so few presentations are presented stereoscopically? The use of stereopsis can provide a number of improvements to a presentation, such as add visual impact, improved image understanding, etc. However, 3D appears to be rarely used in presentations because of the added difficulty involved in generating the presentation in 3D and organising the necessary equipment. This paper reviews the software and hardware tools that are available and also discusses the need for additional tools to take the difficulty out of preparing and projecting 3D presentations.

It should be noted that there are a multitude of different options and alternatives available for stereoscopic projection and stereoscopic imaging. Unfortunately, it is beyond the scope of this paper to discuss every possible combination of methods, hence this paper will focus on the most feasible and commonly available techniques. This paper also focuses on software solutions for computers running the Microsoft Windows operating system.

The first part of this paper will look at the hardware that is available for stereoscopic projection. The discussion will then move on to look at the tools that are available for the generation of stereoscopic content, before exploring the software that is available for presenting stereoscopic presentations.

Stereoscopic Projection Hardware

The most effective way to project stereoscopic images is to orthogonally polarise the left and right images. Polarised projection allows for the projection of full-colour stereoscopic images to a large audience and the per unit cost of the glasses is relatively low.

Figure 1 shows an example of a polarised projection system. A pair of video projectors are focused at a polarisation preserving screen (e.g. a silvered screen). A pair of orthogonal polarisers (linear or circular) are placed at the output lens of the two projectors. The audience then wear appropriately polarised 3D
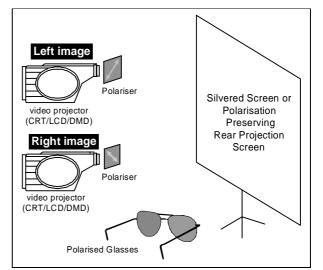

Figure 1: Polarised Projection

glasses. The polarisers in the glasses decode the appropriate view so that the left eye sees images from the left projector and the right eye sees images from the right projector.

Fortunately, high-quality video projectors are now fairly easy to obtain and they are constantly improving in resolution, brightness, size and price. Modern video projectors are commonly compatible with both video (PAL, NTSC) and computer outputs (VGA, SVGA, etc).

The configuration shown in Figure 1 requires the two projectors to be driven with two separate video signals – one video signal for the left image projector and one video signal for the right image projector. Since it is desirable to use only a single video source (e.g. a single 3D video tape or a single computer showing a 3D presentation), appropriate hardware must be used to interface the single source to the two projectors – left images to the left projector and right images to the right projector. The following paragraphs outline approaches for both 3D video and computer 3D.

In the case of 3D video, the most commonly used 3D video format currently used is field-sequential 3D video. This format stores the left and right images on alternate fields of the PAL or NTSC video signal [2]. To drive the two projectors from a single field-sequential 3D video source, a 3D video demultiplexer can be used. This device separates the field-sequential 3D video signal into two separate video streams (one left video signal and one right video signal). These devices are now commonly available from a range of different suppliers.

In the case of computer 3D, two options are feasible to interface a single computer to a projector stereo-pair:
1. Dual-Channel: Use a computer that has two VGA video outputs, either by way of two separate video cards or a single video card with two outputs (for example, the Matrox Millennium G400). Microsoft Windows 98 or higher is required for the support two video outputs. The computer's two video outputs are connected directly to the two projectors.
2. Row-Interleaved and a VGA Demultiplexer: If the computer only has a single video output (like a notebook computer), a device called a VGA demultiplexer could be used to provide left and right video signals. The demultiplexer would take a row-interleaved[1] 3D image and separate alternate lines to the left and right video outputs on the demultiplexer. Unfortunately, the author is currently unaware of the existence of such a device, although it is technically feasible.

Another solution for polarised stereoscopic projection is the µPol (micro-polariser) range of projectors available from VREX [1]. These projectors are generally compatible with both (PAL/NTSC) video and computer video formats and will accept 3D computer video and 3D video directly in the row-interleaved and field-sequential formats (respectively).

Content Generation

In order for there to be a stereoscopic presentation, there must be stereoscopic content to present. Hence this section discusses the tools that are available for the generation of stereoscopic content.

3D Video

The easiest way of generating field-sequential 3D video is with the NuView 3D camcorder attachment (Figure 2) (from I-O Display systems) [4]. The device attaches to most camcorders and allows the direct recording of field-sequential 3D video onto the camcorder's own tape format. The NuView does have its limitations and if these limitations are a problem, a wide range of other equipment is available, ranging from genlocked video cameras (used with a 3D video multiplexer) up to the high-end Ikegami LK-33.
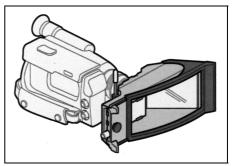
Figure 2: NuView camcorder attachment

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[1] A row-interleaved image consists of left and right image contained in alternate lines of the display. e.g. left image in the odd lines and right image in the even lines. [3]

Computer 3D

As mentioned previously, a computer presentation can contain three main parts: simple text and line graphics, still images such as photographs or computer ray-traced images, and moving images such as digitised video or computer animations. The tools that are available for generating these image forms in 3D are as follows:

Simple text and line graphics are the primary tool used in most electronic presentations. The text is used to outline discussion points or label diagrams. Simple line graphics (such as lines, boxes, circles) are used to group ideas and draw simple diagrams. Microsoft Powerpoint is an example of a program which provides such features in 2D. In 3D, the simple text and line graphics could be placed at different depths to aid the discussion. Unfortunately, to the author's knowledge, no program currently exists for the automated generation of simple text and line graphics in 3D. Manual methods must be used to generate individual left and right views.

Still stereoscopic images can be created by two main techniques:
1. A 3D still camera is used to capture a stereo pair photograph (or two photographs are taken with a single normal camera). These images are then digitised with a flat-bed scanner (or "downloaded" if the camera is a digital still camera). Two different commercially available software packages can then be used to align and store the stereoscopic image in JPS (stereoscopic JPEG) format [6]. The two packages are 3D Stereo Image Factory (from SOFTreat) [5] and Depthcharge Developer Studio (from VREX) [1].[2]
2. Stereoscopic still images can be computer generated using a computer rendering package. Two packages which include a virtual stereoscopic camera are Strata 3D (from C3D) [7] and Lightwave 3D (from NewTek) [8,9]. Stereoscopic camera plug-ins ("DepthCharge Max Stereoscopic Plug-in" (from VREX) [1] and "XidMary" (from Michael Husak) [11]) are also available for 3D Studio Max (from Autodesk) [10]. It is worth noting that Strata 3D is now a free download from the C3D website [7].

Digitised stereoscopic video or computer animations can be generated by two main methods:
1. A computer rendering package (Strata 3D, Lightwave 3D, etc) could be used to generate a sequence of rendered images (an animation) rather than just a single still image.
2. A PAL/NTSC 3D video tape could be captured into the PC using a video capture card. The capturing process must capture both fields of the video signal in order for the 3D information to be retained. It is also sometimes necessary to avoid using image compression and image scaling to avoid corruption of the 3D information. [3,9]

In addition to the process of capturing or generation the stereoscopic sequence, it is also necessary to consider the format in which the stereoscopic video is to be stored, the way the stereoscopic sequence is converted to that format, and what software will be used to play the video file. Michael Husak [11] provides a good review of formats, tools for format conversion, and a program "Win3D Stereoscopic Video Player" [12] for the playback of digitised 3D video files. The video player can accept video files in many different file formats (over-under, row-interleaved, etc) and arbitrarily play them back in different display formats (over-under, row-interleaved, etc). If the 3D video file is in the row-interleaved format, a regular video player can be used to playback the file in 3D as long as the desired output format is row-interleaved and there is no image scaling.

In addition to the 3D file formats discussed above, which store both the left and right images in the same file, various companies are working on the development of file formats which store only one view and a depth map. This has the advantage of making the video files quite small. On playback, the two views are generated by warping the single view based on the depth map information [13]. This file format is being pursued for streaming of 3D video over the internet because the file size is relatively small. Video players for these formats have been or are in the process of being released by ISee3D [14] and Dynamic Digital Depth [15], however the underlying formats are currently proprietary and tools are not available to the public for the generation of video files in this format.

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[2] JPS images can be manually generated with general-use graphics editing programs such as Paint Shop Pro and Photoshop, however the very important process of aligning the left and right images is not as easy as with a purpose-built program.

Presentation Software - *Bringing it all Together*

Currently, separate programs exist for the display of 3D stills and digital 3D video. For example, Depthcharge (from VREX) [1] for the display of 3D stills[3], and "Win3D stereoscopic video player" (from Michael Husak) [12] for the playback of 3D video files. Depthcharge is quite a powerful program allowing the display of stereoscopic images (JPS, etc) in a range of display formats. Depthcharge can be used to show a slide-show of 3D images however this feature is not yet available to the public. The "Win3D stereoscopic video player" is a very powerful program that can be used to playback digital 3D video files in a range of different input and output formats.

However, the ideal situation is that a single program could be used to prepare and project a stereoscopic presentation containing all three 3D image forms (simple text and graphics, still images, digital video files). The ideal program would also be able to display the stereoscopic images in a range of different stereoscopic display formats - compatible with the stereoscopic display hardware currently being used (row-interleaved, dual output, anaglyph, field-sequential, etc). Unfortunately, to the author's knowledge, such an integrated program does not currently exist.

It is also worth pointing out that dual-output stereo does not appear to be supported by any software yet. This also needs to be addressed.

Other Issues

During the preparation of a stereoscopic presentation, it probably isn't going to be possible to have access to a stereoscopic projection system to preview the presentation. Fortunately, LCS glasses[4] systems are now widely available. These systems allow stereoscopic images to be viewed on the CRT display of the average desktop PC.[5] The most flexible LCS glasses systems are those that support line-blanking.[6] Line-blanking systems do not require the computer's video card to be switched into interlaced mode and hence are compatible with a wider range of computer systems. In addition, hardware dependant software does not need to be installed on the computer.

Another issue is the visual difference between previewing the stereoscopic presentation on a small computer screen versus projection onto a large screen. Enlarging the image also enlarges the parallax values in the image – a stereoscopic image that looks fine on the small screen may be unviewable on the large screen due to extreme parallax values. Some thought therefore needs to go into the size of the screen the presentation will be projected on and the maximum parallax values that should not be. A set of written guidelines would help people choose appropriate parallax limits, however that is beyond the scope of this paper.

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[3] Depthcharge can be used for the playback of digital 3D video files, but it only supports video files in a proprietary row-interleaved format.

[4] 'LCS glasses' stands for Liquid Crystal Shutter glasses. Sometimes the term 'LCD' (Liquid Crystal Display) glasses is used, however the glasses themselves are not a display hence the term 'LCS glasses' (or maybe even 'LC glasses') should be used instead of 'LCD glasses'.

[5] Please note that LCD displays (common to notebook PCs and also sometimes used with desktop PCs) are not compatible with LCS glasses.

[6] Line-blanking is the process of blanking out odd numbered lines of the displayed image and then even numbered lines on the next displayed image, and so-on on alternate refreshes of a progressive scan video signal. It is essentially a manual way of generating a pseudo interlaced scan signal from a progressive scan signal. When a row-interleaved 3D image is line-blanked, alternate images of the video signal will be left and right image – which can then be viewed with LCS glasses.

Summary

Figure 3 summarises the hardware and software available as at July 2000. With regards to 3D video, it can be seen that ample tools already exist for content generation and presentation.

With regards to computer 3D, a good range of tools is already available, however a number of software tools are still needed:
1. A program for the generation of simple text and graphics in stereo (simple stereo-slides),
2. A program which allows stereoscopic text & graphics, stereoscopic still images and stereoscopic digital video to be integrated into a single stereoscopic presentation, and
3. The inclusion of dual-channel stereo support into stereoscopic display programs.

Ideally, all of the above three features would be integrated within a single package, along with the following features that are common to current software:
- Support for various display formats (row-interleaved, dual-channel, etc) to drive a range of different stereoscopic display devices
- Support for various digital 3D video formats, and
- Support for various 3D still image formats.

Any prospective software developers should be aware of two SDKs (software development kits) available for the Windows platform (Winx3D [16] and SSDI [17]). Both SDKs offer support for a wide range of stereoscopic display formats and stereoscopic viewing devices.

With regards to hardware, a VGA demultiplexer device is also needed so that a row-interleaved 3D display can be used to drive a pair of video projectors.
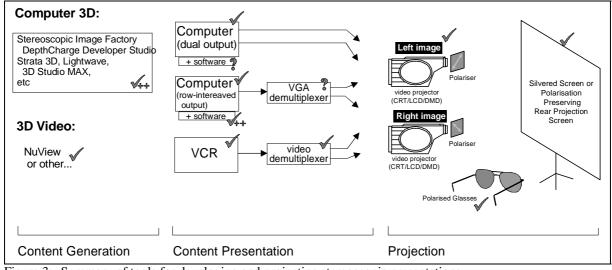
Figure 3: Summary of tools for developing and projecting stereoscopic presentations.
(Where: '✔' = the software or hardware currently exists, '✔++' = some software is available but additional functionality is needed, '?' = as far as the author is aware, that particular tool does not currently exist.)

Conclusion

This paper has summarised the tools and methods available for the generation and projection of stereoscopic presentations. A lot of these software tools are available as shareware or freeware. Additionally, hardware is now available to allow the projection of high quality stereoscopic presentations. However there are a number of notable exceptions that leave a number of holes. As stereoscopic products, both software and hardware, are improving at a fast pace, it should not take long for these holes to be filled and allow for the easy and more common use of stereoscopic presentations at conferences and other events.

References

[1] http://www.vrex.com

[2] Andrew Woods (1999), "Draft Proposed Standard For Field-Sequential 3D Television –The Field Polarity for Storing 3D (Stereoscopic) Left and Right Images in the Even and Odd Fields of the NTSC and PAL Video Standards" [on-line] http://www.stereoscopic.org/standard

[3] Woods, Offszanka, Martin (1999) "A PC-based stereoscopic video walkthrough", Stereoscopic Displays and Virtual Reality Systems VI, Proceedings of the SPIE vol. 3639, San Jose, California.

[4] http://www.i-glasses.com

[5] Jon Siragusa, et al (1997) "General Purpose Stereoscopic Data Descriptor" [on-line] http://www.vrex.com/developer

[6] http://members.aol.com/threedr

[7] http://www.3d.com

[8] http://www.newtek.com

[9] Tony Alderson (1998), "Stereography with Lightwave 3D" [on-line] http://www.aifx.com/3d_lw_a.html

[10] http://www.autodesk.com

[11] Michael Husak (1999), "Guide to making your own digital stereo-video movies in DVD quality for playing on computers" [on-line] http://staff.vscht.cz/~husakm/stereopcvideo.html

[12] Michael Husak (1999), "Win3D Stereoscopic Video Player" [on-line] http://mysak.umbr.cas.cz/~husakm/Public/Win3dVideo/Win3dStereoscopicVideoPlayer.htm

[13] Phil Harman (1999), "Architecture for digital 3D broadcasting" Stereoscopic Displays and Virtual Reality Systems VI, Proceedings of the SPIE 3639, San Jose, California.

[14] http://www.isee3d.com

[15] http://www.ddd.com

[16] http://www.win3d.com

[17] http://www.vrex.com/developer