Designing a Portable High-Definition Stereoscopic Camera System for Capturing Cultural Content

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Introduction

Part of the Cleveland Museum of Art's expansion includes initiatives to explore virtual reality projects designed to present art, historical, and cultural content as well as multi-site live experiences. One of the challenges is the creation of high quality virtual reality cultural content.

A guiding doctrine of the museum is that its core competency is not the mastery of diverse, complex technologies but the creative use of them. And to that end the high definition camera system would not be engineered, but built from off-the-shelf components and assembled to meet the Museum's needs. One of those needs would be transportability and a battery powered independence. Similarly, the post-production would be accomplished using off-the-shelf software and hardware and if possible off-the-shelf display technologies as well.

The Museum's development of a high-definition stereoscopic camera has been in collaboration with, and is a direct continuation of, the projects and experiments initiated by New Media at Case Western Reserve University.

Initial Tests

Stereoscopic Camcorder Attachment

IEEE 1394 Bumblebee Camera

Several years before the development of the HD stereoscopic camera - early tests in the capture of stereoscopic video included the use of the NuView camcorder attachment and the Bumblebee IEEE1394 stereo camera. However, neither camera offered sufficient manual controls to achieve the project goals.

SD Stereoscopic Video: The Gabrieli Project

Live Stereoscopic Interlaced Camera Setup

For the fall 2003 Internet2 meeting, new-media artists and early-music performers teamed up to provide an immersive virtual experience to demonstrate real-time collaboration across Internet2.

From backstage in Indianapolis, Dr. Darrel Bailey, Dean of the Indiana University Purdue University Indianapolis School of

Informatics, conducted two ensembles of music students from Case Western Reserve University and Indiana University at Bloomington.

Attendees at the Dean & Barbara White Auditorium in the Indiana State Museum in Indianapolis watched the live stereoscopic presentation while wearing polarized 3D glasses and listening to the auditorium's surround sound speaker system.

The live 3D video was broadcast from each location using custom-built stereoscopic camera rigs incorporating CCD security cameras, wide-angle lenses, twin camera bars, and panoramic levelers. The individual 2D video feeds were combined into a field sequential video feed using a 3D Multiplexer.

To achieve a dimensionally accurate split screen, both performance spaces (Cleveland and Bloomington) were calibrated to create one virtual room. This calibration involved locking down the 3D camera settings in Bloomington (building the geometry outward from a corner) and reproducing the settings (in mirror) in Cleveland. The Bloomington musicians were limited to camera right and the Cleveland musicians were limited to camera left. These limits and an additional front 'do not cross' line formed the stereo window. Since the ceiling lights and other details violated the stereo window, a mask was added in the final presentation mix.

The October 15, 2003 performance was the first live multipoint stereoscopic split-screen presentation over a high-speed network.

SD Stereoscopic Video: The French Desk

SD Camera Setup

For the "Gazing into the Future" pavilion at the 2005 Ingenuity Festival: a festival of art and technology The Cleveland Museum of Art showcased and experimented with a variety of innovative technologies. Among the pavilion's many virtual reality exhibits and experiments was a stereoscopic video wall displaying a specially commissioned 3D video "short feature film" of the museum's 18th century French writing desk.

The award winning filmmaker Kasumi was commissioned to direct a 3D film "the French Writing Desk" as an experiment in art object interpretation and representation that transcends the bounds of labels, photographs, and other standard didactics.

Indeed it demonstrated an extraordinary collaboration among artists, technologists, and curators as well as a unique visitor experience. This 7 minute video was shot using twin 3CCD Sony DV Cameras.

The HD Camera Rig
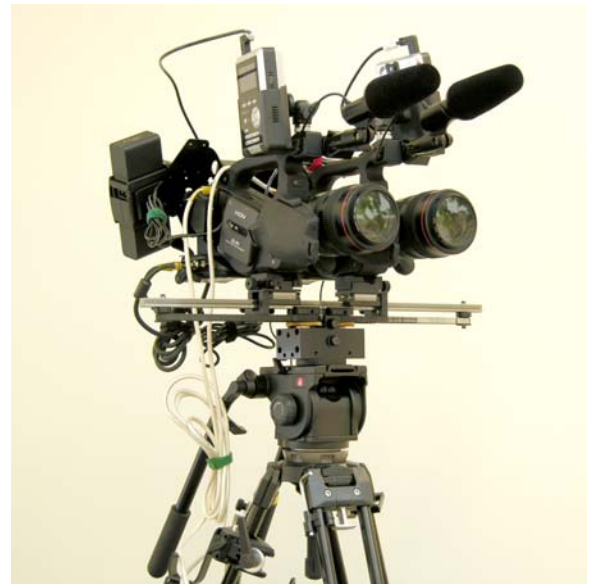
HD Camera
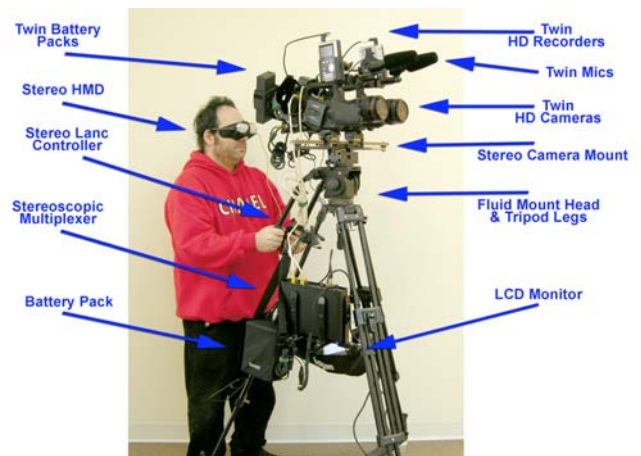
HD Camera Setup Details

At the core of the high definition stereoscopic camera setup are twin Canon XLH1 HD video cameras. They were selected for their quality, the myriad of manual controls, and the JackPack, which allows for synchronization as well as HD-SDI output.

The cameras signals are fed into twin Firestore HD recorders (for tapeless recording), are time-sync and genlocked together, and a Stereo Lanc controller is used to synchronize recording, zoom, and focus.

The cameras are mounted on an Inition ProStereMount, allowing for precision alignment as well as live stereo camera control. Due to the close proximity of the cameras the eye-cups cannot be attached to the cameras and the microphones are mounted directly to the camera body.

SD signals from the HD camera are fed into a stereoscopic multiplexer. Outputs from the multiplexer are fed into an LCD display for menu and alignment and into a stereoscopic head mounted display for live configuration and monitoring.

Building from the lessons learned from previous experiments every detail of the camera setup was scrutinized. Each component was configured with extended life batteries to allow for over 3 hours of tapeless "in the field" continuous recording. In addition cases (and a cart) were purchased to ensure the camera rigs transportability. Lastly the tripod legs were selected to work both on a rolling camera dolly as well as a flex track with a spider dolly.

Video Dolly

Flex Track with Spider Dolly

Editing and Post Production

The raw video feeds are converted from MPG2 streams to more manageable Cineform intermediates and edited on a dual Xeon Boxx workstation with Adobe Premiere Professional. The final video is produced in an "over-under" format and encoded with the Intel Indeo codec.

Stereoscopic Display

The final rendered video is played with 3DTV's Stereoscopic Player. The Stereoscopic Player is a robust player that can feed both interlaced CRTs (with LCD shutter glasses) as well as twin projectors (with polarized lenses and glasses).

Cultural Content

The high-definition stereoscopic camera setup was first tested on June 10, 2006 to record "Parade the Circle" in University Circle, Ohio. "Parade the Circle" is a colorful and festive event held the second Saturday of every June that combines the cultural institutions from the University Circle area with public groups for a fabulously fun, "art-full" parade.

Stereoscopic high-definition highlights from the "Parade the Circle" were demonstrated at the 2006 Ingenuity Festival and the 2007 Research ShowCase in Cleveland, Ohio.

Key Suppliers

3D ImageTek - http://www.3dimagetek.com
3DTV - http://www.3dtv.at/Index_en.aspx
B&H Photo Video - http://www.bhphotovideo.com
Berezin 3D - http://www.berezin.com/3d
BOXX - http://boxxtech.com
Cineform - http://www.cineform.com
CyberWorld - http://www.cwonline.com
Inition - http://www.inition.co.uk
Kaidan - http://www.kaidan.com
NuVision http://www.nuvision3d.com
Point Grey Research - http://www.ptgrey.com
Porta-Jib - http://www.porta-jib.com/flex-trak.htm
Ste-Fra - http://www.digi-dat.de/produkte
Stereo Movie Maker - http://stereo.jpn.org/eng/stvmkr